

ISSN[ONLINE] : 2643-9875

ISSN[PRINT] : 2643-9840

---

# INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH AND ANALYSIS

---

**VOLUME 06 ISSUE 12  
DECEMBER 2023**

**SJIF IMPACT  
FACTOR : 7.022**

**IJMRA ASI  
SCORE : 1.3**

**CROSSREF DOI  
10.47191/IJMRA**

**International Journal of Multidisciplinary Research and  
Analysis is a leading international journal for publication of  
new ideas in Multidisciplinary area.**

Explore your Research to the world.....



## Editorial Team Member

**Dr. V. Mohana Sundaram (Ph.D. (Management))**

Professor, Department of Management Studies, Vivekanandha Institute of Information and Management Studies.

**Dr. Murod Barakaev(Candidate of Pedagogical Sciences(13.00.02 - Methods of teaching mathematics))**

Associate Professor of "Mathematics and Methods of Teaching" TSPU named after Nizami

**Uzbekistan**

**Karimov Nodir Rakhmonqulovich (Pursuing Ph. D.)**

Ph.D. Student, Tashkent State University of Oriental Studies, Tashkent, Uzbekistan

Tashkent, Uzbekistan

**Anshika Bansal (N.E.T,U-SET)**

Asst. Professor Department of Commerce,

Govt P.G. College, Kotdwara, Uttarakhand, **INDIA**

**Dr. Dinh Tran Ngoc Huy (MBA (Finance and Management electives))**

PhD candidate, Banking University, HCM city

**Cach Mang Thang Tam Street, Ward 11, Dist 3, Ho Chi Minh City, Viet Nam**

**Dr. Islam-ul-Haque (MBA (24 project management subjects- AIOU))**

PhD Environmental Engineering and sciences

**House No. 12, Al-Ghani Street, IFCOS, Sector D-17, Islamabad**

**Dr. Alisher Doniyorov (Doctor of Sciences in Historical Sciences)**

Professor-Tashkent State University of Oriental studies,Tashkent, **Uzbekistan**

**Tashkent, Uzbekistan**

**Manish Soni (Ph.D in Computer Science and Application)**

Assistant Professor, Department of Computer Science, Govt. P.G College

**Mandsaur, India**

**Dr Bakhodir K. Mirzaev (Doctor of Philosophy in Technical Sciences)**

Senior Lecturer, Department of "Manufacture of building materials, products and structures" Fergana Polytechnic Institute

**Fergana Region, Kushtepa District**

**Dr Abdulkhamid R. Yusupov (Technical Sciences)**

Associate Professor of the Department of Production of Building Materials, Products and Structures of Fergana Polytechnic Institute

**Fergana City, Behbudi Street**

**Dr Nodira B. Alimova (Doctor of Technical Sciences)**

Associate Professor of the Department of "Mechatronics and Robotics", Tashkent State Technical University

Tashkent City, Mirzo Ulugbek

**Dr Kuysin D. Tukhtaeva (Doctor of Philological Sciences)**

Navoi State Pedagogical Institute, Faculty of Foreign Languages, Associate Professor of English Language and Literature, Candidate of Philological Sciences

**Navoi Region, Navoi City**

**Dr. Umesh Sehgal (Ph.D. (Computer Science))**

Assistant Professor and Department Head (GNA University, Phagwara), Bundelkhand University, Jhansi  
**India**

**Dr. Grebenisan Gavril ( Ph.D. Eng)**

Assoc. Prof. University of Oradea, 1 Universitatii str., 410089, Oradea, **Romania**

**Professor Ibrahim Ormanovich Darvishov (Doctor of Philosophy in Philology, (PhD))**

Acting Associate Professor of Uzbek Language and Literature, Namangan State University  
Namangan Region, Mingbulak District

**Professor Abdulvohid Khabibullevich Abdullazizov**

Acting Head of the Department of Russian Language and Literature, Namangan State University  
Namangan Region, Uychi District

**Dr. Bogdan Constantin Ungurean (PhD Biology)**

Lector, Faculty of Physical Education and Sport of "Al. I. Cuza" University  
Str. Toma Cozma Nr. 3, Iasi 700554, **Romania**

**Dr Kadir Shukurlaev (DCs)**

Head of the Department of Physiology and Pathological Physiology, Urgench branch of the Tashkent Medical Academy  
Republic Of Karakalpakstan, Amudarya District

**Dr Bakhromjon A. Otakulov (Doctor of Philosophy in Technical Sciences)**

Senior Lecturer of the department "Manufacture of building materials, products and structures" Fergana Polytechnic Institute  
Fergana Region, **Fergana District**

**Dr. Abdirashid M. Babadjanov (Candidate of Economic Sciences)**

Associate Professor of the Department "Accounting and audit" of the Tashkent Institute of irrigation and agricultural engineers.  
Tashkent City, Sergeli District

**Professor Karimkhodjaev Nazirjon,**

Associate Professor of the Andijan Machine-Building Institute. Department of "Avtomotive"  
**Uzbekistan**

**Dr. P. Ganesh Kumar (Doctorate(PhD))**

Professor in Networking, K.L.N College of Engineering, Anna University  
Anna University, Chennai, **Tamil Nadu, India, 2009**

**Dr Durdana E. Lutfullayeva (Doctor of Philological Sciences)**

Leading Researcher of the Department of Modern Uzbek Language of the Institute of Uzbek Language, Literature and Folklore of  
the Academy of Sciences  
**Tashkent City, Shayhontohur District**

**Dr. Rano Kh. Davlatova (Doctor of Philological Sciences)**

Head of the Department of Preschool Education, Navoi State Pedagogical Institute  
**Navoi City, Lomonosova Street**

**Dr. Gulmira K. Obidova (Ph.D. in Pedagogical Sciences)**

Assistant of the Department of Languages and Sports, Fergana Branch, Tashkent University of Information Technologies  
**Fergana Region, Fergana City**

**Dr. Md. Amir Hossain (PhD)**

Assistant Professor, Department of English IBAIS University (International Business Administration and Information System)  
**Bangladesh**

**Dr. Parizod Sh. Turopova (Doctor of Philosophy in Philology)**

Senior Lecturer of the department of teaching methods of Uzbek literature of Jizzakh State Pedagogical Institute  
Jizzakh City, Uratpalik Mahalla

**Dr. Nodira I. Soatova (Philological Sciences)**

Associate Professor of the Department of Methods of Teaching Uzbek Literature at Jizzakh State Pedagogical Institute  
**Sh.Rashidov District, Uzbekistan**

**Tahir, Nura Musa (B. Eng. (BUK), M Eng. (UTM, Malaysia).)**

Department of Mechatronics and System Engineering, Faculty of Engineering and Engineering Technology, Abubakar Tafawa Balewa University, Bauchi,  
P.M.B 0248, Bauchi, Bauchi State, Nigeria

**Dr. Saida I. Sadiqova(PhD)**

Associate Professor of the Department of Internal Medicine No. 2 of the Tashkent Medical Academy  
Namangan City, Namangan Region

**Dr. Manoj Kumar Rastogi (Ph.D. (Statistics))**

Assistant Professor Department of Statistics Patna University,  
Department Of Statistics, Patna University, Patna-05, **Bihar**

**Dr. Mourad Hebali (Ph.D. in Electrical Engineering)**

Professor Assistant in University Mustapha STAMBOULI Mascara  
Mascara 29000, **Algeria.**

**Dr. Shaimardan K. Hudjanov (Candidate of Medical Sciences)**

Associate Professor of ENT Diseases, Tashkent Medical Academy  
**Tashkent Region, Zangiota District**

**Dr. Devarani Devi Ningombam (Ph. D.Computer Engineering)**

Post-doctoral fellow, Department of Information strategy, Electronics and Telecommunications Research Institute (ETRI)  
Electronics And Telecommunications Research Institute (ETRI) Dormitory, Gajeong-Dong, Yuseong-Gu, Daejeon 34129, South  
**Korea**

**Dr. Shakhnoza Mukhamedjanovna Jalolova (Doctor of Philosophy in Philology)**

Acting Associate Professor of English Philology, National University of Uzbekistan named after Mirzo Ulugbek  
Tashkent City, Chilanzar District, Kyzyl Sharq District, **Uzbekistan**

**Dr. Suheela Shabir (Doctorate (PhD) in Marketing)**

Asst. Prof. in College of Business and Administration in PRINCESS NOURA BINT ABDUL RAHMAN UNIVERSITY, Riyadh  
**Saudi Arabia**

**Dr. Abdilatip Abdirakhimovich Sarimsokov (Historical Sciences)**

Acting Head of the Department of Archeology, Namangan State University  
Namangan City, Porloq MCM, 3rd Micro-District, 3rd House, 8th Apartment

**Dr. Dharmendra Singh (PhD, CFP, CFA, Associate-life, UGC-NET)**

Assistant Professor, Modern College of Business and Science (MCBS), Sultanate of Oman  
**Oman**

**Dr. Ayman Shehata Mohammed Ahmed Osman Mohammed El-Shazly (Ph.D. (Pure Mathematics- Mathematical Analysis - Complex Analysis))**

Lecturer, Department of Mathematics, Faculty of Science, Assiut University, Assiut 71516,  
**Egypt**

**Dr. Jamila Sharipovna Jumabayeva (Doctor of Philological Sciences)**

Head of the Department of English Philology, Faculty of Foreign Philology, National University of Uzbekistan named after Mirzo  
**Ulugbek Tashkent**

**Dr. Lola S. Ortikova (Doctor of Philosophy in Agricultural Sciences)**

Lecturer of the Department of Biology Teaching Methods, Jizzakh State Pedagogical Institute  
Jizzakh City, Almazar Mahalla,

**Farisa T S(M.Tech (CSE))**

Digital signal processing, Data Mining, Natural Language Processing **INDIA**

**Dr. G.RakeshP.hd(Computer Science & Application)**

Dean of Science JAIRAMS COLLEGE OF ARTS & SCIENCE, KARUR.**INDIA**

**Dr. Shamsiddin A. Allayarov(Ph.D.)(Candidate of Economic Sciences)**

Head of the Department of Management and Marketing, Tashkent Financial Institute  
**Tashkent City, Mirzo Ulugbek District**

**Dr. Rashmi Rai(Ph. D,(Quality of Work-Life and Job Performance))**

Assistant Professor , Management Department , Christ University, **Bangalore,INDIA**

**Dr. Ravshan Khudayberganov(PhD on historical sciences)**

Senior scientific researcher, Al-Beruni Institute of Oriental Studies, Academy of Sciences of the Republic of Uzbekistan, Tashkent,  
**Tashkent, Uzbekistan**

**Dr. Mohammed Nader Shalaby(Ph.D. Degree of Pathobiology and Physiology)**

Associate Prof. of Biological Sciences and Sports Health Department, Faculty of Physical Education, Suez Canal University  
**Egypt, Ismailia**

**Dr.Mona Mostafa Abdo Sakoury(P.hd)**

Associate Professor, Faculty of Applied Studies and Community, Service, Imam Abdulrahman Bin Al- Faisal University.  
**Saudi Arabia**

**Dr. Rita Greengold(Ph. D, Histroy)**

College of William & MaryLyon G. Tyler Department of History.

**Dr. Nargiza Sharopaliyeva Mullaboeva(Doctor of Philosophy in Psychology (PhD))**

Senior Lecturer of Namangan Institute of Engineering and Technology, **Uzbekistan**

**Dr. Shuchi Gupta(PhD (Commerce))**

Associate Professor,University of Hail, KSA  
**Haryana, India**

**Dr. P.Malyadri(Ph.D. (Bank Finance for Rural Development))**

Principal for 11 Years in Government Degree Colleges,Srisailam,Patancheru, Tandur,Chevella,Serilingampally,Kukatpally  
**Hyderabad, INDIA**

**Dr. Makhmud Akhmedovich Shakhodjaev**

Associate Professor of Fergana Polytechnic Institute, Faculty of Energy, "EEE"  
**Fergana Region, Margilan City, M.Khofiz Street**

**Dr. Xaynazarov Baxromjon (Phd In History)**

Faculty of History,National University of Uzbekistan  
**Tashkent, Uzbekistan**

**Dr. Dildora Bakhadirjanovna Agzamova**

Associate Professor of "Translation Theory and Comparative Linguistics" of the National University of Uzbekistan named after  
Mirzo Ulugbek

**Dr. Izzatilla Makhmutalievich Khaydarov**

Associate Professor of "History and Ethnology of the Peoples of Central Asia" Tashkent State University of Oriental Studies

**Dr. Khurshida Erkinovna Yunusova(Doctor of Historical Sciences)**

Professor of the Department of History of Uzbekistan, National University of Uzbekistan named after Mirzo Ulugbek  
**Tashkent City, Chilanazar District , Uzbekistan**

**Dr. Ravshan Berdimurodovich Siddikov(Doctor of Historical Sciences)**

Associate Professor of History of Uzbekistan, National University of Uzbekistan named after Mirzo Ulugbek  
**Tashkent City, Almazar District, Uzbekistan**

**Dr. Ijod Narziqul ugli Akhmedov(Doctor of Philosophy (PhD) in Philosophy)**

Head of the Department of Distance Education in Social Sciences and Humanities Jizzakh State Pedagogical Institute

**Dr. Moise Adrian Cristian (Doctorate(PhD))**

Associate Professor, Spiru Haret University of Bucharest, **Romania**

**Dr. Umidjon Yandashalievich Kuziev**

Acting Head of Department of Uzbek Language and Literature, Namangan State University  
**Namangan Region, Chust District**

**Akpojaro Oghenechuko Owens (Msc, PGD,HND, ND)**

Assistant Lecturer, School of Basic Science Programme(Mathematics Unit), **Nigeria**

**Dr. Prof. Shoeb Ahmad (Ph.D.)**

PROFESSOR, Al Zahra College for Women, (Muscat) Oman  
**(Muscat) Oman**

**Rajibkumar Sanyal (M.Sc., PGDM, Ph.D., D.Sc. (Honoris Causa))**

Associate Professor & Senior Researcher of Economics  
Amity University, Kolkata Action Area II, Major Arterial Road, New Town

**Dr. Askar R. Babaev**

Acting Associate Professor  
Tashkent City, Mirabad District,

**Dr. Thirupathi Dongala(Ph.D, M.Sc. B.Sc. IT)**

Working as Analytical Scientist-I with AUREX LABORATORIES LLC, 10 Lake drive, East Windsor, NJ, 08520 USA

**Dr. Samuel Jacob Bunu (Doctor of Pharmacy)**

Department of Pharmaceutical and Medicinal Chemistry, Faculty of Pharmacy, Niger Delta University, Wilberforce Island, Bayelsa State, **Nigeria.**

**Chibuisi C. Okorieimoh Doctoral Researcher)**

Assistant lecturer School of Multidisciplinary Technologies, Technological University Dublin

**Dr. G.V.P. Samaranayake**

Lecturer (Probationary), Department of Ayurveda Basic Principles, Gampaha Wickramarachchi Ayurveda Institute, University of Kelaniya, **Sri Lanka**

**Khalid Zemam Amer**

Responsible for the Division of Marketing of Scientific Products / Department of Scientific Affairs / Presidency of Mustansiriyah University

**Dr. Wafaa Mohamed Mohamed Moustafa(M.Sc., B.Sc., Ph.D, chemical engineering)**

Head of the Central Laboratory of Environmental Isotope Hydrology, **Egypt**

**Dr. Chandramohan Andavar(Doctorate in Biochemistry. M.Sc., M.Tech)**

Associate Professor and Head in the Department of Biochemistry Annai Violet College of Arts and Science Menambedu, Ambattur, Chennai, **India.**

**Dr. Oyepata Simeon Joseph (Ph. D in Pharmacology and Toxicology)**

Senior Lecturer, Department of Pharmacology, Faculty of Pharmaceutical Sciences, Bingham University, Karu, Nasarawa State, **Nigeria**

**Dr. Janna A. Nazarova(Doctor of Medical Sciences)**

Doctor of Medical Sciences

**Tashkent City, Chilanzar District**

**Dr. Amadou Danlami(Ph. D in Commonwealth Literature and culture)**

University of Dschang, Faculty of Arts, Letters and Social Sciences, Department of Applied Foreign Languages

**Dr.Ramesh Prasad Adhikary(Ph.D)**

Assistant Professor (English) Tribhuvan University, M.M. Campus, Nepalgunj

**Dr Kholida K. Matjanova(Postgraduate, student of the Institute of Bioecology of the Karakalpak branch of the Uzbek Academy of Sciences )**

Associate Professor

Republic Of Karakalpakstan, Amudarya District

**Dr.Ali Adel Dawood(Ph.D,)**

Lecturer, College of Medicine, Mosul, Iraq Course Unit Director, College of Medicine, Uni. of Mosul

**IRAQ**

**Dr Raushana K. Kurbaniyazova(Doctor of Philosophy in Philosophy)**

Senior Lecturer of the Department of Social Sciences, Urgench Branch of the 1st Tashkent State Medical Institute

Republic Of Karakalpakstan, Amudarya District

**Dr. Kamila K. Juraeva ( Ph.D.)**

Associate Professor of Power Supply, Tashkent State Transport University

Tashkent

**Dr. Wan Ainun Binti Mior Othman(Ph.D)**

Associate Professor Institute of Mathematical Sciences, Faculty of Science, University of Malaya, 50603 Kuala Lumpur, **Malaysia.**

**Dr. Dharmendra S. Mistry (Ph.D.)**

Prin. M. C. Shah Commerce College (Navgujarat Campus),( Affiliated toGujarat University)

**Ahmedabad, INDIA**

**Dr. Murodulla A. Juraev(Doctor of Philosophy in Philology)**

Senior Lecturer of the Department of Methods of Teaching Uzbek Literature of Jizzakh State Pedagogical Institute

Jizzakh City, Ittifaq Mahalla

**Dr. Surayyo I. Eshonkulova(Philological Sciences)**

Associate Professor of Teaching Methods of Uzbek Literature, Jizzakh State Pedagogical Institute

**Jizzakh Region, Jizzakh City**

**Dr. Namrata Raviraj Vaishamapayan(MD, PGDHA, BHMS)**

Assistant Professor(Practice of Medicine),MNR Homoeopathic Medical College, Sangareddy, Telangana

**Prof. Dr. Majid Mohammed Mahmood(Ph.D,)**

A University professor of Immunology Mustansiriyyah University – College of Science, **Baghdad**

**Dr. Yelimbet K. Sultanov(Technical Sciences)**

Associate Professor of "Agricultural Mechanization and Investment Activity" Nukus branch of Tashkent State Agrarian University.

**Dr. Durdona A. Akhatova(Pedagogical Sciences)**

Associate Professor of General Pedagogy and Psychology, Navoi State Pedagogical Institute

**Professor Zulkhumor N. Tojjeva**

Professor of Economic and Social Geography

**Tashkent City, Yashnaabad District, Baku 1-Berk Street**

**Dr. Ulughbek M. Ergashev(PhD in Medical Sciences)**

Senior Lecturer of the Department of Otorhinolaryngology and Dentistry, Tashkent Medical Academy

**Tashkent City, Yashnabad District**

**Dr. Jamolbek A. Djuraev(Doctor of Philosophy in Medical Sciences)**

Senior Lecturer, Department of Otolaryngology and Dentistry, Tashkent Medical Academy

**Tashkent City, Almazar District**

**Dr. Lola S. Ortikova** Senior Lecturer of the Department of Otolaryngology and Dentistry, Tashkent Medical Academy

**Tashkent City, Mirabad District, Sadyk Azimov Street**

**Dr Ziyoda G. Mukhamedova(Doctor of Sciences in Technics)**

Doctoral student of the Department of Freight Transport Systems, Tashkent State University of Transport (DSc)

**Tashkent City, Yunusabad District**

**Dr. Shahzada Mudasir Rashid(PhD)**

Assistant Professor (Scientist) Division of Veterinary Biochemistry, Faculty of Veterinary Sciences, SKUAST-K, Shuhama, Alustang, Srinagar.

**Professor Rustam Djumayev**

Professor of the Department of "Oriental Policy and International Relations" of the Tashkent State University of Oriental Studies

**Uzbekistan**

**Dr. Karno Kumar Mondal(Ph.D)**

Teaching Assistantship Undergraduate Lab Department of Physics Khulna University of Engineering & Technology, Khulna-9203

**Dr. Begzodbek Kh. Abdullaev(Doctor of Philosophy in Philology)**

Associate professor , Andijan State Universitys

**Andijan Region, Altynkul District**

**Dr Farida T. Rabbimova(Doctor of Pedagogical Sciences)**

Senior Lecturer of the Department of General Biology and Methods of Teaching ,Jizzakh State Pedagogical Institute

**Dr. Rakhimjon Kh. Muradov(Doctor of Philosophy in Technical Sciences)**

Senior Lecturer, Namangan Institute of Civil Engineering

**Namangan Region, Mingbulak District**

**Dr. Vishal Dubey (Ph.D)**

Director, Department of Pharmaceutical Sciences, Naraina Vidya Peeth Group of Institutions, **INDIA**

**Dr. Venkataraman Mugundan(PhD in Mathematics)**

Math Lecturer in 'INSTITUTE OF APPLIED TECHNOLOGY',(GOVERNMENT OF ABU DHABI), Fujairah, United Arab Emirates, **U.A.E.**

**Dr Muzraf T. Rabbimov(Ph.D)**

Associate Professor at the Department of Primary Education at Jizzakh State Pedagogical Institute

**Dr Otabek Sh. Ochildiev(Doctor of Philosophy in Technical Sciences)**

Head of the Laboratory "Software Management and Mechatronics" of the Research Institute of Agricultural Mechanization

**Tashkent Region, Yangiyul District,**

**Dr Umidbek B. Yusupov(Doctor of Philosophy in Technical Sciences)**

Acting Associate Professor of "Vehicle Engineering" Tashkent State Transport University

**Tashkent City, Sergeli District,**

**Dr Abdirasuli A. Ibragimov(Doctor of Philosophy in Technical Sciences)**

Scientific Secretary of the Research Institute of Agricultural Mechanization and Electrification

**Tashkent Region, Yangiyul District,**



**Dr. Altinoy Masalieva (Associate Professor Candidate of Historical Sciences)**

Uzbek State University of World Languages, Associate Professor of History of Uzbekistan

**Dr. Yusup Kh. Manzarov (Associate Professor Candidate of Historical Sciences)**

Assistant of the Department of Social Sciences at Karshi Engineering and Economics Institute.

**Dr. Durdona A. Mustafoeva (Doctor of Philosophy in Pedagogical Sciences)**

Associate Professor (PhD), Department of "Professional Education and Physical Culture", Tashkent Institute of Irrigation and Agricultural Mechanization Engineers,

**Tashkent Region, Tashkent District,**

**Dr. Mamurzhan A. Mirzazhanov (Candidate of Technical Sciences)**

Associate Professor of Production of Products and Structures, Fergana Polytechnic Institute of Building Materials

**Fergana Region, Oltiariq District**

**Dr. Mahmudjon M. Ergashev (Candidate of Technical Sciences)**

Head of the Department of Production of Building Materials, Products and Structures of Fergana Polytechnic Institute

**Fergana Region, Quvasoy City**

**Dr. Iyanda Kamoru Ahmed (Doctor of Philosophy (Legal and Social History))**

Department of History and International Studies, Federal University Gashua, Yobe State, **Nigeria**

**Dr. J.GAJENDRA NAIDU (Ph.D In Finance)**

Head of the Department, Faculty of Finance Botho university: Gaborone Campus: Botswana

**Dr Nilufar M. Turdieva (Doctor of agricultural science)**

Chairperson of laboratory Scientific research Institute protection of plants

**Uzbekistan**

**Dr. Kutbiddin B. Imomkulov (Doctor of Technical Sciences)**

Trade Specialist for Innovative Projects of Agricultural Research Institute

**Tashkent Region, Yangiyul District**

**Dr. Omer Allagabo Omer Mustafa (PhD. in Economics)**

Assistant professor of Economics, Banking and Finance, Sudan Academy for Banking and Financial Sciences (SABFS-Sudan)

**Sudan, North Africa**

**Dr. Cristobal Millenes Ambayon (Doctor of Education)**

Associate Professor V Sultan Kudarat State University, College of Teacher Education ACCESS, EJC Montilla, Tacurong City

**Tacurong, Philippines**

**Dr. Khamid M. Sodikov (Doctor of Philosophy in Pedagogical Sciences)**

Dean of the Faculty of Physics and Technological Education of Jizzakh State Pedagogical Institute

**Jizzakh District, Navoi SFU**

**Dr. Nazokat G. Juraeva (Doctor of Philological Sciences)**

National Institute of Arts and Design named after K.Bekzod, **Tashkent**

**Dr. Nwodim Obinna (Doctor of Philosophy (Development Studies))**

Department of Political and Administrative Studies, Faculty of Social Sciences, University of Port Harcourt

**Nigeria**

**Dr. Atalla Fahed Al-Serhan (PhD)**

Assistant Professor, Department of Business Administration, Al Albayt University, Mafraq, Jordan

**Dr Nasiba N. Panjjeva (Doctor of Philological Sciences)**

Associate Professor of English Language and Literature, Termez State University

**Surkhandarya Region, Termez City**

**Dr. Shakhlo B. Samanova (Doctor of Philosophy)**

Associate Professor of “Theory of building a democratic society in Uzbekistan.” Urgench State University.

**Khorezm Region, Urgench District**

**Dr. Abderraouf Mtiraoui (Ph.D in Economics)**

Assistant Professor in Economics at the Higher Institute of Finance and Taxation (HIFT)-Sousse- **Tunisia**

**Dr. Muhammad Faizal bin Samat (Doctor of Philosophy (Marketing Communication))**

Senior Lecturer at Malaysian Academy of SME & Entrepreneurship Development, Universiti Teknologi MARA, Shah Alam

**Malaysia**

**Dr. Wulan Rahmadhani (Doctor in Public Health)**

Lecturer, Department of Midwifery, Sekolah Tinggi Ilmu Kesehatan Muhammadiyah Gombong, **Indonesia**

**Dr. Adeboye, N. Olawale (Doctor of Philosophy (PhD))**

Department of Mathematics & Statistics, Federal Polytechnic Ilaro, Nigeria

**Ewa, Moses Apie (Ph.D)**

Lecturer Department of Educational Foundations & Childhood Education, Faculty of Education, Cross River University of Technology (CRUTECH), Calabar, **Nigeria**

**Shaimaa Mohamed Hassanin (Ph.D in English Literature)**

Lecturer of English language and American literature at Horus University

**Damietta, Egypt**

**Dr. Dildora S. Davronova (Doctor of Philosophy in Pedagogical Sciences)**

Associate Professor of “Pedagogy and Psychology” at the Uzbek State University of World Languages

**Chilonzor Region Tashkent, Uzbekistan**

**Dr. Karima J. Tulenova(Doctor of Philosophy)**

Acting Head of the Department of Social Sciences, Tashkent State Pedagogical University named after Nizami

**Tashkent City, Yakkasaray District**

**Yannick Boum (Ph.D in English Language)**

A researcher from the University of Yaounde **Cameroon, Central Africa**

**Dr. Rashmi S (Doctor of Philosophy in Botany)**

Assistant Professor, Post Graduate Department of Botany, JSS College of Arts, Commerce and Science (Autonomous) Ooty Road, Mysore, Karnataka, **India**

**Dr Abdimurot U. Kuziev(Candidate of Technical Sciences)**

Head of the Department of Transport Systems and Structures of Termez State University

**Surkhandarya Region, Termez City**

**Dr. Normakhmat P. Panjiev (Doctor of Philological Sciences)**

Head of the Department of Russian Linguistics, Termez State University

**Surkhandarya Region, Termez City**

**Rawda Bashir Abdulla (Ph.D.)**

Assistant Professor in Teaching English language and Applied Linguistics, Department of English Language Skills Jouf University Kingdom of **Saudi Arabia**

**Dr. Nemat Kh. Kushvaktov( Ph.D Pedagogical Sciences)**

Head of the Department of General Pedagogy of Jizzakh State Pedagogical Institute.

**Jizzakh City, Navruz Mahalla**

**Dr Khurshid A. Sattarov (Ph.D.)**

Head of the Department of Electronics and Radio Engineering, Tashkent University of Information Technologies named after Muhammad al-Khwarizmi, **Tashkent City, Mirabad District**

**Dr. Manoj Kumara.N.V (Ph.D in Finance)**

Associate Professor in Department of Management Sciences, Maharaja Institute of Technology- Mysore.

**Karnataka, India**

**Jupeth Toriano Pentang (Doctor of Philosophy Major in Educational Management)**

Mathematics Educator, Researcher and Extensionist, College of Education, Western Philippines University Puerto Princesa City,

**Philippines**

**Housseine Bachiri (Ph.D)**

Assistant Professor at the Faculty of Sciences and Technologies, Tangier

**Tangier (Morocco)**

**Dr. Sarvarbek Kh. Jumaboev(Doctor of Philosophy in Technical Sciences)**

Acting Associate Professor of Power Supply, Tashkent State Transport University

**Uchtepa District**

**Dr. Gulmira J. Tulenova**

Professor, Tashkent University of Information Technologies named after Muhammad al-Khwarizmi, Tashkent, Uzbekistan

**Uzbekistan**

**Seham Ismail (Doctor Philosophy in Agricultural Sciences)**

Head of Department of Insect Population Toxicology, Central Agricultural Pesticides Laboratory, Agriculture Research Center, Dokki, Giza, Egypt

**Egypt**

**Dr. Veena N (Ph.D. in Educational Psychology)**

Associate Professor, Christ Academy Institute for Advanced Studies (CAIAS), Bangalore

**Bangalore**

**Dr. Djuraev Jamolbek Abdulkakharovich (Ph.D.)**

Senior Lecturer Department of Otolaryngology and Dentistry TMA

**Tashkent**

**Dr. V.KIRUTHIGA (Ph.D)**

Assistant Professor, Department of Management Studies, Faculty of Engineering and Technology, Jawaharlal Nehru Salai, 100 Feet Road, Vadapalani, Chennai-600026

**Chennai**

**Dr. Govind Shinde (Ph.D.)**

Professor, Babasaheb Gawde Institute of Management Studies. (Approved Associate Professor Finance Faculty University of Mumbai)

**Mumbai**

**Prof. Dr. Nagham Mahmood Aljamali (Ph.D.)**

Professor in organic chemistry, Department of Chemistry, Synthetic Organic Field, IRAQ

**Iraq**

**Dr. Tiziana Ciarambino (Ph.D. in Geriatrics Physiopathology)**

Teacher at the University of Campania

**Campania**

**Dr. Kalandarov Palvan Iskandarovich (Doctor of Technical Sciences)**

Professor at the Tashkent Institute of Irrigation and Agricultural Mechanization Engineers in Tashkent

**Tashkent, Uzbekistan**

**Dr. MC Manjunatha (Phd.)**

Assistant Professor, Department of Civil Engineering, Maharaja Institute of Technology, Thandavapura, Mysuru -571 302

**Mysuru**

**Dr. Sourabodhi Bhattacharyya (Ph.D)**

Assistant Professor of Sanskrit (Stage II) Galsi Mahavidyalaya, B.U, Galsi,Purba Bardhaman , W.B-713406  
India

**Dr. Naftaly Gisore Mose (Ph.D in Economics)**

Lecturer (Economics) University of Eldoret

**Kenya**

**Dr. ARTI (Ph.D. in Law)**

Assistant Professor, Desh Bhagat University, Punjab

**INDIA**

**Dr. MOTHUKURI ANJALIAH (Ph.D. In Library Science)**

Assistant Professor (Dept. of Library and Information Science)

**INDIA**

**Dr. Youssif Zaghwan Omar (PhD in English Education)**

General Director of the Institute of Human Resources Development at the Libyan Academy

**Libya**

**Dr. Ndubuisi-Okolo (Ph. D)**

Lecturer, Nnamdi Azikiwe University

**Nigeria**

**Dr. Mourad Romdhani (Ph.D. in English Literature)**

Assistant Professor, the Faculty of Letters and Humanities, University of Sousse, Tunisia

**Tunisia**

**Dr. Utemuratova Gulshirin Najimatdinovna (PHD in Biological Science)**

Karakalpak Scientific Research Institute of Natural Sciences Laboratory of Animal Science, Doctor of Philosophy PHD, Biological Science, Uzbekistan

**Uzbekistan**

**Dr. Tureyev Abat Arisovich, PhD (Doctor of Philosophy (Tourism))**

lecturer of technology of storage and processing of agricultural crops, philosopher of Biological Sciences ,Karakalpakstan Institute of Agriculture and Agrotechnology,

**Uzbekistan**

**Dr. Rico Paulo G. Tolentino (PhD in Development Education)**

School Principal, Department of Education, Schools Division of Bulacan, Philippines

**Philippines**

**Dr. Nik Alif Amri Bin NikHashim (Doctor of Philosophy (Tourism))**

Senior Lecturer (DS51), Faculty of Hospitality, Tourism & Wellness, University **Malaysia Kelantan**

**Australia**

**Shuang Li (Ph.D. in Sociology)**

Sociology Lecturer, Department of Sociology and Social Work University of Wisconsin-Stevens Point  
Wisconsin

**Dr. V.KAVITHA (Ph.D. in English Literature)**

Assistant Professor of English, Nehru Arts and Science College (Autonomous), Coimbatore

**Coimbatore**

**Dr. Samieva Gulnoza Utkurovna**

Doctor of medical sciences (DSC), Samarkand State medical institute, Uzbekistan

**Uzbekistan**

**ANOKE, Amechi Fabian (Ph.D)**

Lecturer, Department of Business Administration, Faculty of Management Sciences; Nnamdi Azikiwe University, Awka, Anambra State **Nigeria**

**Dr..L.Bhuvana (Ph.D)**

Assistant Professor of Chemistry, Shrimati Indira Gandhi College, Tiruchirappalli  
**Tamil Nadu, India**

**Dr. Norjigit T. Nishonov(Candidate of Agricultural Sciences)**

Senior Lecturer, Department of Agrochemistry, Soil Science, Plant Protection and Quarantine, Samarkand Veterinary Medical Institute Samarkand Region

**Dr. Esirgap I. Turapov(Ph.D)**

Associate professor of the Department of "Machine Engineering Technology" at the Almalyk Branch  
Jizzakh Region, Galla-Aral District

**Dr Alisher J. Shokirov(Doctor of Agricultural Sciences)**

Dean of the Faculty of Storage and Processing of Agricultural Products, Tashkent State Agrarian University  
**Tashkent Region, Yunusobod District**

**Dr. Patkhillo Siddikov(Doctor of Technical Sciences)**

Professor of "Technology of textile fabrics" of the Tashkent Institute of Textile and Light Industry  
**Tashkent City, Chilanzar District**

**Suyarova Nargiza Yuldoshevna (Doctor of Philosophy (PhD))**

Senior teacher, Philological Sciences, Karshy State University, Uzbekistan

**International Journal of Multidisciplinary Research and Analysis**  
**ISSN[Online] : 2643-9875 || ISSN[Print] : 2643-9840**

**Table of Contents IJMRA Volume 06 Issue 12 December 2023**

<b>S. no.</b>	<b>Article</b>	<b>Authors</b>	<b>Page no.</b>
1.	Arm Muscle Power, Agility, and Chets Pass Ability in Basketball: Is there a Connection?	M. Taqwal Jumareng, Yustinus Sukarmin	5447- 5450
2.	The Effects of Service Quality and Price on Athlete Satisfaction: A Case Study of Athletes at Badminton Clubs in Bantul District	Amanda Prawesti Nuramanah, Agung Nugroho AM, Tomoliyus, Fauzi, Endang Rini Sukamti, Tri Hadi Karyono	5451- 5457
3.	Meritocracy Disguised as Equity: The Relationship between Teacher Professional Organizations and Teacher Ideology	Hope Kitts	5458- 5465
4.	Framing Analysis of the Suspected Corruption Case of Agriculture Minister Syahrul Yasin Limpo	Tasya Lee Maharani , Nawiroh Vera	5466- 5472
5.	The Influence of Using Idol Kpop Brand Ambassador, Viral Marketing, and Lifestyle on Impulse Buying in Consumers Shopee Marketplace	Ni Putu Ayu Tika Kurniawati , A A I Krisna Gangga Dewi, N. Paramananda	5473- 5476
6.	Cultural Dynamics of Ubud Noble Families in the Age of Globalization	Anak Agung Inten Asmariati, A.A Ayu Rai Wahyuni, A.A Ayu Dewi Girindrawardhani, Abu Bakar Ramadhan Muhamad, Eko Suwargono	5477- 5483
7.	Implementation of Management Strategy in the Development of Dental Health Services for the Indonesian Maritime Community	Nora Lelyana	5484-5494
8.	Effect of Training Using Pullbuoy on Breaststroke Swimming Speed in Club RD Athletes	Ridho Yariansyah, Guntur, Septian Raibowo, Yahya Eko Nopiyanto, Ali Munir	5495-5499
9.	Performance Evaluation of Induction Motor Behaviour on Conventional and PV System Power Sources	Ebenezer Asuquo Williams, Ekom Enefiok Okpo, Imo Edwin Nkan	5500-5511
10.	Strategy for Improving the Local Economy in the Mandalika Area Using Swot Analysis and PIs-Sem Approach	Surya Angga Pranata, M. Firmansyah	5512-5521
11.	Analysis of Regional Government Financial Performance on the Human Development Index in West Nusa Tenggara Province	Dwi Herni Rizkika, M. Firmansyah	5522-5530
12.	Simultaneous Equation: The Case of Inflation & Rupiah Exchange Rate in Indonesia 2001-2022	Rheta Da Lhutfa Salam, Prayitno Basuki	5531-5538
13.	LEARNING MODEL: MAMA (An Alternative to Improve Learning Outcomes English Finite Students of SMP Negeri 11 Palu City)	Jamiluddin, Maf'ulah, Fadhilah Zamzam, Dwi Putri	5539-5546
14.	Childhood Obesity and the Risk of Hypertension in the Caribbean Region: A Narrative Review	Feimatta Immah Sowa, Md, Mph, Pg. Dip.	5547-5555

15.	The Effectiveness of Massage and Stretching Therapy against Neck Pain and Range of Motion (Rom) in Online Game Players	Hafiz Mahesvi , Ali Satia Graha	5556-5561
16.	Development of Badminton “Wheelchair” Disabled Accuracy Test Instruments	Maulana Aditya Pamungkas, Devi Tirtawirya, Wahyu Dwi Yulianto	5562-5565
17.	Project Based Learning and Physical Activity for Cognitive Ability Stimulation in Early Childhood Education: Study Literature	Salmawati, Ika Budi Maryatun, FransFile Manihuruk, Maria Della Strada Dea Meylinda	5566-5572
18.	Nutrition Status and Selected Factors Associated with Malnutrition of Children between 2-5 Years of Age in Medical Officer of Health Area Attanagalla, Sri Lanka	D M J B Dissanayake, G P Nilanthi Pathirana, K R Avanthi Rupasinghe	5573-5577
19.	Evaluation of the Special Sports Class (KKO) Program Using the Illuminative Model at SMP Negeri 3 Samigaluh Kulon Progo	Wulung Reksonegoro, Sumarjo, Zaza Afnindar Fakhurozi	5578-5584
20.	The Relationship between the Level of Knowledge of Students on the School Health Effort Program and the Role of Physical Education, Sports, and Health Teachers in Clean and Healthy Living Behavior of Elementary School Student	Tri Putro Santoso Budi, Sumarjo, Zaza Aazfnindar Fakhurozi	5585-5593
21.	Review on Effects of Organophosphate Pesticides in Human Health and Way to Mitigates its Harmful Impacts	Mr. Subrata Kumar Payra, Ms. Deepa Goswami, Mrs. Sanchita Pan, Mr. Atanu Bera, Ms. Supriya Jana, Mr. Jagmohan Sing6, Mr. Atanu Bhowmik	5594-5599
22.	Effect of Topical Gel Administration of Secretome Hypoxia Mesenchymal Stem Cells (SH-MSCs) on IL-10 and TNF- $\alpha$ Gene Expression (In Vivo Experimental Study in Male Rats of Wistar Strains Model of Fluconazole-Induced Alopecia)	Indah Permata Hati, Agung Putra, Titiek Sumarawati	5600-5610
23.	Effect of Gel Secretome Hypoxia Mesenchymal Stem Cell on Expression of TGF- $\beta$ and IL-6 (In Vivo Experimental Study in Male Rats of Wistar Strains Model Hyperglycemic Wounds)	Yudhi Tities Kusuma, Prasetyowati Subchan, Agung Putra	5611-5623
24.	The Effect of Secretome Hypoxia Mesenchymal Stem Cells on PDGF and IL-1b Gene Expression (Experimental Study on Wistar Rats Hyperglycemic Wound Models)	Nensi Rianti, Agung Putra, Prasetyowati Subchan	5624-5636
25.	Digital Transformation and Smes: A Systematic Literature Review Using Bibliometric Analysis	Dang Khoa Vu	5636-5640
26.	The Knife-Plane Configuration Model of CCP equipment from plasma corona discharge case	Asep Yoyo Wardaya, Zaenul Muhlisin, Isnain Gunadi , Pandji Triadyaksa	5641-5644
27.	Testing the Mediation Effect of Employee Engagement on Internal Branding Practice-Job Satisfaction Relationship of Hospitality Industry Employees	Lohana Juariyah, Syihabudhin, Afwan Hariri Agus Prohimi, I Nyoman Riki Widyastrawan	5645-5653
28.	Employee Performance in Aviation Industry Based on Koopman’s Individual Work Performance Questionnaire (IWPQ)	Lohana Juariyah, Dimas Syah Putra, Syihabudhin	5654-5659

29.	The Influence of Salak Skin Ethanol Extract on the Lipid Profile, IL-6 and MDA Serum (Experimental Study on Male Rats of Wistar Strains Induced by High-Fat Diet)	Hanny Fuzi Lestari, Setyo Trisnadi, Danis Pertiwi, Wahyudi	5660-5672
30.	Simulated Design and Evaluation of Centralized off Grid Street Light Solar Power System with Backup Generator	Ekpa Kenneth Andikan, Joshua Odion, Akpan Nsikak Uduak	5673-5681
31.	The Role of Parents in Improving Early Childhood Literacy Skills	Partijem, Ika Budi Maryatun, Joko Pamungkas	5682-5688
32.	The Influence of Brand Image, Product Quality and Sales Promotion on Shopping Interest in Online Marketplaces	Robi Darmawan, Sekar Dinda Pratiwi, Dyah Ayu Safitri, Lidya Pratama Sari, Nadya Desi Aulia, Renny Sari Dewi, Maryam bte Badrul Munir	5689-5696
33.	Kinds and Levels of Probiotics for Colored Chicken Breed	Mr. John Genesson Omo	5697- 5714
34.	The Effect of Topical Gel Secretome Hypoxic Mesenchymal Stem Cells (SH-MSCs) on IL-6 and TGF- $\beta$ Gene Expression (Experimental Study in Male Wistar Alopecia-Like Rat Models Induced by Fluconazole)	Meri Aldila Rahmanita, Agung Putra, Deddy Hermansyah	5715- 5722
35.	Towards a Healthier Boyolali Community: The Social Return on Investment (SROI) on the Family Care Health Optimization Service Program (Yok Peka)	Fendy Eko Wahyudi, Muhammad Subhan, Muhammad Arief Zuliyani, Betie Febriana	5724- 5739
36.	Risk Factors of Roundhouse Kick Wushu Injury: Systematic Review and Meta-Analysis	Sugiyani Dwi Pangestu, Ali Satia Graha	5740- 5746
37.	Time of Sargassum Tea Application on the Growth and Yield of Garlic	Cherisse May S. Hayohay	5747- 5753
38.	Health Problems and Nutritional Status among Children Under-Five Years in Diocese of Agats: A Cross-Sectional Study	Fransisca B. Batticaca, Eva Sinaga	5754- 5762
39.	Perceptions of Physical Education Teachers Regarding Softball Game Material in Physical Education Subjects Sports and Health in District Public High Schools Purworejo	Yusuf Roikhan Rais, Bernadeta Suhartini, Dima Krisna Wiedarjati, Wahyu Dwi Yulianto	5763- 5767
40.	Media Relation Strategies of the Finance Track Field of G20 Summit Publicity in Indonesia	Rini Tri Utami, Nanang Trenggono, Andy Corry Wardhani, Anna Gustina Zainal	5768- 5774
41.	A Comparative Study of Healthcare User Satisfaction with Health Checkups in Thailand and Worldwide	Poomipat Kongsaksirikul, Thanhathai Sukthai	5775- 5781
42.	The Effect of Cross Country Running Training on Increasing the VO2Max of Alfalah Futsal Players	Hafiz Mahesvi, Ali Satia Graha	5782- 5785
43.	Management of North Jayapura Public Health Center in the Stunting Prevention Program for Children Aged 3-5 Years	Annisa Nadhirani, Sutoro, Ferdinant Martinus Djawa, Dwi Angriyani, Trajanus R. Jembise, Evi Sinaga	5786- 5799
44.	Level of Comprehension of the Material of Big Ball Game in the Online Physical Education Learning for the Fifth Grade Students of Kanisius Kalasan Elementary School	Stefanus Prasetyo Yudi Susanto, Hari Yulianto, Zaza Afnindar Fakhrurozi	5800- 5804
45.	Popularity of Khmer Foods: Possibility for a Successful Marketing Plan	Vandet Mean	5805- 5810



46.	The Influence of Entrepreneurial Knowledge and ICT Self Efficacy on Technopreneurial Intention Mediated Entrepreneurial Motivation	Fannya Turrohmah, Daru Wahyuni	5811- 5818
47.	Development of an Integrated Public Policy Model for Combating Marine Pollution	Pranyoto	5819- 5827
48.	Level of Knowledge about the Effects of Radiation on Pregnant Women among Medical Imaging Techniques Program Students	Suat Çakina, Gülsen Gül	5828- 5832
49.	The Influence of Celebrity Endorsement, Brand Image, Brand Trust and Lifestyle on Purchase Decisions for Geoff Max Brand Shoes (Study on Students in Purwokerto City)	Evan Fauzan Putra, Tri Septin Muji Rahayu, Arini Hidayah, Purnadi	5833- 5841
50.	Effect of Petai Skin Extract Gel Administration on MITF Gene Expression and Melanin Count (in Vivo Experimental Study on Hyperpigmented Wistar Mice Exposed to UVB Exposed Hyperpigmentation)	Maya Rianti Amalia, Prasetyowati Subchan	5842- 5853
51.	Sources and Levels of Natural Growth Promotants for Redbro Chicken	Mark Reagan B Ablog	5854- 5871
52.	Effect of Serum Breadfruit Leaf Extract (Artocarpus Altilis) on TNF- A and Sod Levels (Experimental Study on Guinea Pigs Exposed to UVB Light)	Nani Winarni, Pasid Harlisa, Prasetyowati Subchan	5872- 5878
53.	Tiktok as Rhyming Media in Thematic Learning Platform: Phenomenological Study at SD Negeri 3 Duwet Tumpang Malang	Harun Ahmad, Endang Sumarti, Yunita Anas Sriwulandari	5879- 5885
54.	A Comprehensive Review of FACTS Controllers in Nigeria Power Systems Network for Enhanced Performance on Variable Loads	Joshua Odion, Chukwu F. Nelson, Aniekan B. Inyang, Andikan K. Ekpa, Uduak J. Essien	5886- 5899
55.	Towards the Unification of Inheritance Law in Indonesia: Challenges and Opportunities in the Context of Religious and Cultural Diversity	Rosmanila, Wiwit Pratiwi, Sherly Nelsa Fitri	5900- 5912
56.	Competence of Islamic Religious Education Teachers in the Era of Globalization: Multi Case Studies at State Senior High School in Palu City, Indonesia	Ulfa Wahyuni, Sagaf S. Pettalongi, Hamlan Andi Baso Malla, Nurdin Nurdin	5913- 5919
57.	The Impact of Cooperative Learning Method on Learning Motivation and Academic Achievement of Elementary School Students	Uyu Muawanah	5920-5925
58.	Effectiveness of Circulo Massage on Fatigue Recovery and Sleep Quality of Field Workers	Wildan Wirawan Pinandita, BM. Wara Kushartanti, Enggista Hendriko Delano, Inas Gita Amalia, Sabda Hussain As Shafi, Wahyu Aji Nugroho, Anggun Saraswati, Rulianta Dwi Mundita	5926-5929
59.	Evaluation of Demonstration and Drill Methods for Lower and Upper Passing Skills Volleyball Learning	Panji Pangestu, Ridho Gata Wijaya, Andika Prabowo	5930-5933
60.	Conflict Resolution between Russia and Ukraine Based on an International Law Perspective	Awang Bayu Aji, Dr. Joko Setiyono, S.H., M.Hum	5934-5939

61.	Some Solutions to Improve the Effectiveness of Autonomous Activities at Public Vocational Education Institutions in Hanoi	Ngo Anh Cuong, Nguyen Duc Ngan, Nguyen Thi Diem, Pham Bich Van	5940-5947
62.	Analysis of the Effect of Self-Regulation on Burnout in Athletes at the Samarinda Futsal Club	Muhammad Noor Astama, Djoko Pekik Irianto, Tomoliyus	5948-5952
63.	Description of the Quality of Communication between Athletes and Coaches in the District. Kutai Kartanegara, East Kalimantan	Rahmat, Djoko Pekik Irianto, Faidillah Kurniawan	5953-5958
64.	A Multifaceted Exploration of Loyalty in SSB: Links between Training Environment, Coach Leadership, and Participant Satisfaction	Tri Fandes Purba, Tomoliyus, Faidillah Kurniawan	5959-5964
65.	The Influence of Employee Selection, Job Placement, Work Experience, Job Training, and Reward on Employee Work Productivity in the Trade Office West Nusa Tenggara Province	Isnawati, St. Maryam	5965-5973
66.	Student Perceptions on the Implementation of Practical Subjects Learning Models Post Pandemi Covid- 19	Melly Arfiani, Fatkurahman Arjuna	5974-5980
67.	Prediction Using SVM and DT	Dr T K Ganga, Dr S Selvakani, Mrs K Vasumathi	5981-5991
68.	Correlation between Macronutrient Intakes (Carbohydrate, Protein, Lipid) and Bone Mineral Density in the Elderly	Inria Astari Zahra, Etisa Adi Murbawani, Lusiana Batubara	5992-5996
69.	Project Based Learning, Discovery Learning and Sports Models on Critical Thinking Ability Children Age 5-6 Years: Study Literature	Widya Sri Murti, Nelva Rolina, FransFile Manihuruk, Maria Della Strada Dea Meylinda	5997-6002
70.	Analysis of the Physical Condition of Long-Term Wushu Sanda Athletes PON Athletes of North Sumatra Province in Facing the North Sumatra / Aceh National Sports Week XXI Year 2024	Nadhira Yasmine Ahmad, Sumaryanti	6003-6012
71.	The Role of Exercise Therapy in the Prevention and Treatment of Degenerative Hypertension: Literature Review	Sabda Hussain As Shafi, Enggista Hendriko Delano, Abiyyu Amajida, Wahyu Aji Nugroho	6013-6018
72.	Protection of Bank Customers in Savings Account Hacking Through Illegal Links	Muhamad Shafwan Afif, Yansiska, Theresia Anita Christiani	6019-6026
73.	Bank Indonesia Independence after the Existing of Law Number 4 of 2023	Theresia Anita Christiani, Chryssantus Kastowo	6027-6030
74.	The Scientific Revolution in Europe and its Impact on Chinese Cosmology during the 16th-18th Centuries	Sha Ha	6031-6043
75.	The Effect of Bitter Melon Extract on Cholesterol, IL-6, and Malondialdehyde Serum Levels	Novia Aprilia Rahma, Hadi Sarosa, Joko Wahyu Wibowo	6044-6049
76.	Advocates of the Future: Challenges and Opportunities of Robot Lawyer in Indonesia	Septa Chandra	6050-6058
77.	Navigating the Data Security Landscape: Challenges and Solutions in Financial Markets amid Digitalization and Artificial Intelligence	Mithilesh Gupta, Urvi Naresh Shah	6059-6064
78.	Botanical Leaf Extracts and Mulching Materials in Organic Eggplant (Solanum Melongena L.) Off Season Production	Marites U. Peralta	6065-6099

79.	Food Management Control and Field Bureaucrats Policy Implementation in Kwara State, Nigeria National Agency for Food and Drugs Administration and Control	Dr. Yahuza Danjuma Izom, Ibrahim Salihu Kombo, Mustapha Babarani	6100-6109
80.	Effects of Substance Abuse Consumption and Socio-Economic Development in Kontagora Local Government Area, Niger State	Dr. Yahuza Danjuma Izom, Ibrahim Salihu Kombo, Mustapha Musa Gwadabe	6110-6119
81.	Contribution of Deformation Measurements on the Southern Flank of Nyiragongo Volcano by Incliniometry and Gps in the Monitoring and Prediction of Volcanic Eruptions	Ngangu B. Rugain, Honore M. Ciraba, Kamenyenzi M. Prospère, Migezi M. Rodrigue, Bazibuhe M. Salomon, Kitumaini M Flavien, Maombi Nz Sandra, Kwetu S. Gloire, Seza Bintu D, Bahati R. Marcel, Faustin S. Habari	6120-6126
82.	Preparing Some Nano Composites Decorated with Some Pharmaceutical Compounds and Evaluating their Biological Effectiveness	Athir Ihsan Shakir	6127-6137
83.	Legal Policy on Environmentally Friendly Waste Management	Wahyu Kurniawan Aji, Monica Setyo Kinanthi, Theresia Anita Christiani, Hyronimus Rhiti	6138-6144
84.	Childfree, an Existentialist Feminist Perspective: A Critical Discourse Analysis of Youtube Cretivox Content 'Mending Punya Anak Atau Tidak Punya Anak???'	Nurul Khoiriyah, Diana Anggraeni, Muhamad Rosit, Mashadi Said	6145-6160
85.	The Influence of the Pencak Silat Extracurricular Development Program and Practice Motivation on the Pencak Silat Abilities of Students of Sdit Insan Utama	Ari Marini, Sumarjo, Zaza Afnindar Fakhrurozi	6161-6171

## Arm Muscle Power, Agility, and Chest Pass Ability in Basketball: Is there a Connection?



M. Taqwal Jumareng<sup>1</sup>, Yustinus Sukarmin<sup>2</sup>

<sup>1,2</sup>Department of Sport Science, Faculty of Sport and Health Science, Yogyakarta State University, Indonesia  
St. Colombo No.1, Karangmalang, Yogyakarta, 55281, Yogyakarta, Indonesia

**ABSTRACT:** Basketball is one of the most popular sports in the world. A basketball player needs to have cardiovascular power to run up and down the court from time to time during four-quarters of a game, but players must also be able to perform explosive bursts of speed, explosive jumps, and explosive moves for agility, over time. Arm muscle power is one of the things needed by basketball players to be able to pass well, because basketball players rely on attributes related to strength to perform basic techniques. The purpose of this study was to determine the relationship between arm muscle power and agility to basketball chest pass ability. The method used in this study was correlational, the sample in this study was 33 male students Haluoleo University Physical Education study program. Instruments used to measure arm muscle power with two-hand medicine ball put, instruments to measure agility with shuttle run tests, and chest pass ability test instruments using chest pass ability tests. The data analysis technique used in this study used product moment correlation analysis and multiple regression analysis using SPSS 26. The results of this study are known to have a positive relationship between arm muscle power and chest pass ability in students of 0.414 with a significance value of 0.016. As for the agility variable, it has no relationship with chest pass ability of 0.054 with a significance value of 0.766. The relationship of Arm Muscle Power and Agility to Chest Pass Ability has a correlation value of 0.417 with a significance value of 0.057. This means that there is a relationship between Arm Muscle Power and Agility to Chest Pass Ability, but it is not significant. The two independent variables together affect the dependent variable by 17.4%. The conclusion of this study is that it can be concluded that there is a positive and significant relationship between arm muscle power and students' chest pass ability. The success of doing a chest pass is to use the strength of the arm muscles so that the ball moves. This means that the better the strength of the player's arm muscles, the faster the ball will move. The strength needed to perform this chest pass movement is obtained from the strength of the muscles in the arm. If done well and systematically, it will affect the ability of chest passes in basketball. While there is no relationship between agility and chest pass ability, speed remains an important component of basketball. Based on this, a good exercise program is needed to increase arm muscle power so that chest pass ability can increase, besides that it is also necessary to include an agility training program to support all aspects of the basketball game.

**KEYWORDS:** Arm Muscle Power, Agility, Chest Pass, Basketball

### INTRODUCTION

Basketball is one of the most popular sports in the world [1]. Basketball is one of the fastest team sports with maneuverability, this describes athletic ability i.e., speed and strength [2]. In the game of basketball, it is not only relying on technique, tactics, psychology, and anthropometry, but it is also necessary to rely on physical conditions such as jumping strength, cyclic and acyclic speed, and agility [3]. In addition, the physiological requirements of basketball include aerobic and anaerobic performance as well as physical characteristics including muscle strength, strength, endurance, flexibility, speed, agility and sport-specific abilities [4]. Basketball, a game played with a continuous flow of activity, has always been considered a game of precision, timing, accuracy and agility [2]. To be able to play at the highest level, an athlete needs to improve agility, aerobics, and anaerobic external muscles [5]. A basketball player needs to have the cardiovascular power to run up and down the court from time to time during four-quarters of a game, but the player must also be able to perform explosive speed bursts, explosive jumps, and explosive moves for agility, over time [2].

The game of basketball is a team game in which five players combine basic techniques to move the ball effectively [6]. In the game of basketball, when one touches the ball he has three important Action options namely, dribble, pass the ball to a

## Arm Muscle Power, Agility, and Chets Pass Ability in Basketball: Is there a Connection?

teammate, and make a shot to the hoop [7]. A style of play with passing dominance and acceptance of passes over dribbling is recommended to break the rhythm of the game, generate imbalances in defense, and increase shot attempts [7]. Passing moves that are often used in a match are useful for managing attacks [6].

Arm muscle power is one of the things needed by basketball players to be able to pass well, because basketball players rely on attributes related to strength to perform their basic techniques [8]. One technique in the game of basketball is a chest-high throw or chest pass. In addition, the thing that is no less important and needs to be owned by a basketball player is agility. Agility is a direct quality of work and contributes to success in sports [9]. In team sports such as, football, handball, and basketball, agility allows an athlete to outperform his opponent in situations where he or she is in a position to determine movement patterns [10]. Based on the explanation above, the purpose of this study was to determine the relationship between arm muscle strength and agility with chest pass ability in basketball games.

### METHODS

This research is correlational which means a study that involves data collection actions to determine whether there is a relationship and the level of relationship between two or more variables. The sample in this study was 33 male students Haluoleo University Physical Education study program. Instruments used to measure arm muscle power with two-hand medicine ball put, instruments to measure agility with shuttle run tests, and chest pass ability test instruments using chest pass ability tests. The data analysis technique used in this study used product moment correlation analysis and multiple regression analysis using SPSS 26.

### RESULTS

Aware of the results of the research carried out can be explained in the table as follows.

**Table 1. Descriptive Statistic**

Variabel (n=33)	Minimum	Maximum	Mean	Std. Deviation
Arm Muscle Power	2.88	3.80	3.2427	.25494
Agility	14.96	16.23	15.5145	.41035
Chest Pass Ability	5.00	15.00	8.5455	2.47602

Based on the descriptive statistical data above, it can be seen that the average value of student arm muscle power is 3.2427, agility is 15.5145, and chest pass ability is 8.5455. In the arm muscle power variable is known to have a minimum value of 2.88 and a maximum value of 3.80, while in the agility variable it has a minimum value of 14.96 and a maximum value of 16.23, in the chest pass ability variable it has a minimum value of 5.00 and a maximum value of 15.00.

**Table 2. The Relationship of Arm Muscle Power and Agility to Chest Pass Ability**

	N=33	Agility	Arm Muscle Power	Chest Pass Ability
Agility	Person Correlation		0.012	0.054
	Sig. (2-tailed)		0.948	0.766
Arm Muscle Power	Person Correlation	0.012		0.414*
	Sig. (2-tailed)	0.948		0.016
Chest Pass Ability	Person Correlation	0.054	0.414*	

Based on the data above, namely, the relationship between arm muscle power and agility to chest pass ability is known to have a positive relationship between arm muscle power and chest pass ability in students of 0.414 with a significance value of 0.016. As for the agility variable, it has no relationship with chest pass ability of 0.054 with a significance value of 0.766.

**Table 3. The Relationship of Arm Muscle Power and Agility to Chest Pass Ability**

R	R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. Change
0.417	0.174	2.32395	.174	3.162	2	30	0.057

Based on the data above, the relationship between Arm Muscle Power and Agility to Chest Pass Ability has a correlation value of 0.417 with a significance value of 0.057. This means that there is a relationship between Arm Muscle Power and Agility to Chest

## Arm Muscle Power, Agility, and Chets Pass Ability in Basketball: Is there a Connection?

Pass Ability, but it is not significant. The two independent variables together affect the dependent variable by 17.4%.

### DISCUSSION

Based on the results above, it is known that the relationship between arm muscle power and agility on chest pass ability is known to have a relationship between arm muscle power and chest pass ability in students of 0.414 with a significance value of 0.016. As for the agility variable, it has no relationship with chest pass ability of 0.054 with a significance value of 0.766. It can be concluded that there is a significant relationship between arm muscle power and chest pass ability in male college students. This is in line with previous research that explains that there is a significant relationship between physical fitness variables and basketball passing accuracy, namely, hand strength, foot strength, agility, balance, and speed [11]. According to Endris & Kumar, 2018 explains that speed, explosive power, grip strength have an important role in the game of basketball.

The game of basketball consists of five players, and passing is one of the techniques that players need to master [11]. When a person performs a chest pass the movement of the ball is influenced by force, the stronger the force or impulse exerted, the stronger the motion of the object given the force [6]. A chest pass is a pass toward the chest or between the waist and shoulders of a teammate who receives it. This pass is useful for short-range passes, so it requires speed and accuracy in passing the ball [12]. According to Putra, 2020 success in doing chest passes is using arm muscle strength so that the ball moves. This means that the better the strength of the player's arm muscles, the faster the ball will move [6].

According to Nurliani & Hasyim, 2023 arm muscle strength in question is the ability of strong and fast arm muscles to reach the maximum in a short time when performing chest pass movements. To produce a hard pass, the thrust must be strong and fast, so a large enough explosive power is required to hit the target. The strength needed to perform this chest pass movement is obtained from the strength of the muscles in the arm. If done well and systematically, it will affect the ability of chest passes in basketball [12]. Another study explains that, shoulder strength has a significant relationship to basketball game performance [13]. Arm muscle strength is the ability of one's arm muscles to make maximum movement, Increasing arm muscle strength is highly recommended in basketball games, if one has good muscle strength then it will be more efficient in playing basketball [6].

Meanwhile, based on the results of this study, the agility variable has no relationship with chest pass ability of 0.054 with a significance value of 0.766. In the game of basketball speed and agility are important components for achieving success, high-intensity movements such as, jumping (for rebounds, blocks and shots), turns, dribbles, sprints, and low-intensity activities such as walking, stopping, and jogging are required during basketball games [14] A study explains that, there is a relationship between postural stability, muscular endurance, and agility in the game of basketball. It is also explained that agility can make athletes more controllable [15]. Therefore, it is important to implement an exercise program that improves postural stability and increases core muscular endurance to improve the success of the game of basketball. Design an exercise program that enhances endurance and then balance as an integrated part of optimal athlete performance [15].

### CONCLUSIONS

Based on the discussion above, it can be concluded that there is a positive and significant relationship between arm muscle power and student chest pass ability. The success of doing a chest pass is to use the strength of the arm muscles so that the ball moves. This means that the better the strength of the player's arm muscles, the faster the ball will move. The strength needed to perform this chest pass movement is obtained from the strength of the muscles in the arm. If done well and systematically, it will affect the ability of chest passes in basketball. While there is no relationship between agility and chest pass ability, speed remains an important component of basketball. Based on this, a good exercise program is needed to increase arm muscle power so that chest pass ability can increase, besides that it is also necessary to include an agility training program to support all aspects of the basketball game.

### ACKNOWLEDGMENT

Thank you to all parties who helped in this research, until finally I was able to make scientific papers in the form of article writing

### REFERENCES

- 1) Garcia-Gil M, Torres-Unda J, Esain I, Duñabeitia I, Gil SM, Gil J, et al. Anthropometric parameters, age, and agility as performance predictors in elite female basketball players. *J Strength Cond Res.* 2018;32(6):1723–30.
- 2) Parimalam S., Pushparajan A. Effect of basketball specific training and traditional method of training on agility, explosive power and passing ability of inter collegiate women basketball players. *Int J Innov Res Dev.* 2014;3(3)(March, 2014):15–21.
- 3) Erčulj F, Blas M, Čoh M, Bračić M. Differences in Motor Abilities of Various Types of. *Kinesiology.* 2009;41(December

## Arm Muscle Power, Agility, and Chets Pass Ability in Basketball: Is there a Connection?

2009):203–11.

- 4) Drinkwater EJ, Pyne DB, Mckenna MJ. Review med mycket fakta. Sport Med. 2008;38(7):565–78.
- 5) Pojskić H, Šeparović V, Užičanin E, Muratović M, Mačković S. Positional role differences in the aerobic and anaerobic power of elite basketball players. J Hum Kinet. 2015;49(1):219–27.
- 6) Putra AL. The Contribution of Arm Muscle Strength and Coordination of Hand Eye Towards Chest Pass Skills in Self Development Activities of Basketball. Atl Press. 2020;464(Psshers 2019):427–30.
- 7) Lopez MIP. Effect of Rule Modifications on Some of the Variables that Determine the Formative Process of Mini- Basketball Players (9- 11 Year Olds. University of Granada; 2005.
- 8) Wen N, Dalbo V, Pyne BiBB, Scanlan A. Power Testing in Basketball: Current Practice and Future Recommendations. J Strength Cond Res. 2018;32(9):2677–91.
- 9) Sekulic D, Pehar M, Krolo A, Spasic M, Uljevic O, Calleja-González J, et al. Evaluation of Basketball-Specific Agility. J Strength Cond Res. 2017;31(8):2278–88.
- 10) Lacono A Dello, Eliakim A, Meckel Y. Improving Fitness of Elite Handball Players: Small-Sided Games Vs High Intensity Intermittent Training. J Strength Coditioning Res. 2015;29(3):835–43.
- 11) Endris M, Kumar H. A study on relationship between physical fitness variables with basketball passing accuracy among in Amhara region basketball player. Int J Adv Educ Res. 2018;512–4.
- 12) Nurliani, Hasyim. Analysis of Arm Muscle Strength on Chestpass Ability in Basketball Games for. J Olahraga. 2023;
- 13) Meena R, Singh DP. Relationship of Selected Anthropometric and Physical Fitness Variables to Basketball Performance. Int J Sci Res. 2012;2(5):531–2.
- 14) Asadi A. Relationship Between Jumping Ability, Agility and Sprint Performance of Elite Young Basketball Players: A Field-Test Approach. Rev Bras Cineantropometria e Desempenho Hum. 2016;18(2):177–86.
- 15) Cengizhan P, Cobanoglu G, Gokdogan C, Zorlular A, Akaras E, Orer G, et al. The relationship between postural stability, core muscles endurance and agility in professional basketball players. Ann Med Res. 2019;26(10):2181.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## The Effects of Service Quality and Price on Athlete Satisfaction: A Case Study of Athletes at Badminton Clubs in Bantul District



Amanda Prawesti Nuramanah<sup>1</sup>, Agung Nugroho AM<sup>2</sup>, Tomoliyus<sup>3</sup>, Fauzi<sup>4</sup>, Endang Rini Sukanti<sup>5</sup>, Tri Hadi Karyono<sup>6</sup>

<sup>1,2,3,4,5,6</sup>Department of Sport Science, Yogyakarta State University, Yogyakarta Indonesia

**ABSTRACT:** This study aims to analyse: (1) the effect of service quality on the satisfaction of badminton athletes in Bantul Regency. (2) The effect of price on the satisfaction of badminton athletes in Bantul Regency. (3) The effect between service quality and price on the satisfaction of badminton athletes in Bantul Regency. This type of research is quantitative with an ex post facto approach. The population in this study were badminton athletes in Bantul Regency. The sampling technique based on purposive sampling totalled 169 athletes from 7 badminton clubs. The instrument used was a questionnaire. Analysis was carried out using Social Sciences (SPSS) software, specifically version 21, p-value <0.05. The results showed that (1) There is a significant influence between service quality on the satisfaction of badminton athletes in Bantul Regency, with a p-value of 0.000 <0.05. (2) There is a significant influence between price on the satisfaction of badminton athletes in Bantul Regency, with a p-value of 0.000 <0.05. (3) There is a significant influence between service quality and price on the satisfaction of badminton athletes in Bantul Regency, with a p-value of 0.000 <0.05.

**KEYWORDS:** service quality, price, athlete satisfaction

### INTRODUCTION

Badminton is a game that can be played both on and off the court, where the court consists of lines demarcated in a certain length and width (Malwanage et al., 2022). The badminton game uses a racket as a bat and a shuttlecock as the object being hit. The playing field is rectangular and limited by a net to distinguish the opponent's playing area and their own playing area (Hikmad et al., 2022). Badminton has long been one of the most popular sports in many parts of the world. With indoor and outdoor badminton courts in almost every region, this sport has become popular. Especially in Indonesia itself that badminton is one of the sports that is favoured by the Indonesian people (Anwar et al., 2020). It can be seen in every place, people are playing badminton everywhere both indoors and in the open field.

Nowadays badminton in Indonesia is an achievement sport, not merely a recreational sport. Ideally in this increasingly competitive era, everyone is increasingly aware of the importance of the development aspect of achievement, especially in badminton. To score achievements, meeting athletes' expectations and satisfying athletes' needs are important elements in an organisation's efforts to retain its athletes and gain a competitive advantage over competitors. In this case, the availability of an adequate badminton club forum is one of the important keys in fostering the achievements of badminton athletes. (Yildiz et al., 2018) stated that the most desirable aspects are modern facility services, staff attitudes and skills, membership offers and price packages, programmes, hours of operation, security of personal belongings and consistent service conditions, these are important aspects needed for every badminton club. The most important thing in the business world, one of which is a sports club, is the concept of satisfaction used to attract consumers.

Customer satisfaction is the level of feeling where someone states the results of a comparison of the performance of the product or service received and expected when someone feels happy and satisfied in buying goods or services (Subaebasni et al., 2019). It is imperative that the club creates the best quality of service and pricing so that it can survive and remain the trust of customers. The creation of customer satisfaction can provide benefits including the relationship between the company and the customer being harmonious.

Service quality is an important aspect in service companies in shaping customer satisfaction and loyalty who use company services, including in the field of sports. Amplified (Šíma & Ruda, 2019) stated that service quality, customer satisfaction, and



## The Effects of Service Quality and Price on Athlete Satisfaction: A Case Study of Athletes at Badminton Clubs in Bantul District

customer loyalty, are important questions in most service sectors including sports. The dimensions of service quality which include tangibility, reliability, responsiveness, assurance and empathy have an effect on overall satisfaction (Barshan et al., 2017). Some of the components of assurance are: communication, credibility of the trainer, assurance of safety and comfort of the exercise, competence of the trainer, and friendliness, courtesy. Service quality has been recognised as one of the key factors that influence customers and lead to organisational profitability in the long term (Yusof et al., 2018). Service quality as a measure of the difference between customer expectations or desires. In a study that the implementation of training there is a strong and positive relationship between the quality of service facilities and motivation as well as the quality of service facilities in coaching affects athlete satisfaction (Napitupulu et al., 2018). Service quality has a significant effect on satisfaction, and the effect of service quality on loyalty indirectly (Ndayisenga & Tomoliyus, 2019). So in choosing a badminton club, you must know how the quality of service is at the club. Service quality refers to the extent to which the club is able to provide positive experiences to athletes in terms of services and support provided. Athletes and parents who are satisfied with a club's services tend to have a strong intention to re-train, and recommend services to other athletes (Rashid & Rokade, 2019).

The next factor is price. Price is translated as the cost charged from producers to consumers. Price also refers to what consumers have to give to buy a good or service which usually uses monetary value (Cosguner et al., 2018). Price is an aspect that needs to be considered by sellers in an effort to market their products, and in terms of buyers, price is one aspect that helps determine whether to buy or not. Regarding pricing policies that are not transparent, often charging unexpected additional fees can make athletes feel dissatisfied. Athletes want to know clearly what they are paying and what they are getting in return. This can lead to club management conflicts, including disagreements about policies or feelings of disrespect. The registration price, private price, regular price or monthly dues payment system in each club is different. Some clubs require high membership fees or training fees, while others may offer needs-based programmes.

Pricing is not only at the discretion of the club, but also takes many things into consideration. Whether a price is cheap or expensive is very relative. Price is often used by consumers as an indicator of value between the perceived benefits and the price of a good or service. If the price set by the company does not match the benefits of the product, the level of customer satisfaction may decrease, and vice versa. If the value perceived by consumers is higher, it will create customer satisfaction. Research conducted by (Zhao et al., 2020) the results showed that price perception has a positive influence on customer satisfaction.

The above presentation is certainly interesting to study and research deeper, therefore, researchers are very interested in conducting research. This study aims to analyse (1) the effect of service quality on athlete satisfaction. (2) the effect of price on athlete satisfaction. (3) the effect of service quality and price on athlete satisfaction.

### METHODS

This type of research is descriptive quantitative with an ex post facto approach. Ex post facto is research that aims to find possible causes of changes in behaviour, symptoms or phenomena caused by an event, behaviour or things that cause changes in the independent variable that have already occurred. The population in this study were badminton athletes in Bantul Regency. The sampling technique based on purposive sampling totalled 169 athletes from 7 badminton clubs. The instrument used is a questionnaire. The statements compiled consist of two item components, namely favourable (positive statements) and unfavourable. The lattice of research instruments in table 1.

**Table 1. Instrument Grid**

Variable	Indicator	Item Numbers	
		Favorable	Unfavorable
Service Quality	Tangibility	1,3	2,4
	Empathy	6,8	5,7
	Reliability	10, 11,	9,
	Responsive	12, 13, 14	-
	Assurance	15, 16	-
Price	Pricing match to service quality	17,18,	
	Price	19, 20	
	Discounts	21, 22	
Athlete satisfaction Variable	Complaints and suggestions	-	35, 36
	Customer Satisfaction Survey	37, 38, 40	39,
	Customer loss rate analysis	-	41, 42, 43, 44

## The Effects of Service Quality and Price on Athlete Satisfaction: A Case Study of Athletes at Badminton Clubs in Bantul District

The data analysis technique used is a prerequisite test consisting of normality test, linearity test, multicollinearity test, while the hypothesis test uses partial and simultaneous tests. The analysis was carried out using Social Sciences (SPSS) software, specifically version 21,  $p$ -value  $<0.05$ .

### RESULTS

The results of descriptive analysis of the variables of service quality, price, and athlete satisfaction based on the results of filling out the questionnaire. Descriptive statistical results based on mean and standard deviation are in Table 2.

**Table 2. Descriptive Statistics**

No	Variable	N	Statistik (Mean $\pm$ Std. Deviation)
1	Service Quality	169	39.65 $\pm$ 4.82
2	Price	169	15.53 $\pm$ 2.16
3	Athlete Satisfaction	169	24.65 $\pm$ 2.64

Uji normalitas data dalam penelitian ini digunakan metode Kolmogorov-Smirnov. Hasil uji normalitas data yang dilakukan pada tiap kelompok analisis dilakukan dengan program software SPSS version 20.0 for windows dengan taraf signifikansi 5% atau 0.05. Rangkuman data disajikan pada Tabel 3.

**Tabel 3. Hasil Uji Normalitas**

No	Variable	$p$ -value	Sig	Description
1	Service Quality	0.186	0.05	Normal
2	Price	0.211	0.05	Normal
3	Athlete Satisfaction	0.206	0.05	Normal

Based on the statistical analysis of the normality test that has been carried out using the Kolmogorov-Smirnov test in Table 6, the service quality variable ( $p$ -value  $0.186 > 0.05$ ), price ( $p$ -value  $0.211 > 0.05$ ), and athlete satisfaction ( $p$ -value  $0.206 > 0.05$ ), which means the data is normally distributed.

Testing the linearity of the relationship is done through the F test. The relationship between the independent variable (X) and the dependent variable (Y) is declared linear if the sig value  $> 0.05$ . The results of the linearity test can be seen in Table 4.

**Table 4. Linearity Test Results**

No	Functional Relationship	$p$	Sig.	Descripton
1	Service quality * Athlete satisfaction	0.360	0.05	Linier
2	Price * Athlete satisfaction	0.200	0.05	Linier

Based on the analysis results in Table 4 above, it can be seen that the relationship between service quality and athlete satisfaction ( $p$ -value  $0.360 > 0.05$ ) and the relationship between price and athlete satisfaction ( $p$ -value  $0.200 > 0.05$ ), so it is declared linear.

The multicollinearity test uses the Variance Inflation Factor (VIF) value in the regression model, if  $(VIF) < 10$ , then that variable has no problems with other independent variables. The multicollinearity test results can be seen in Table 5.

**Table 5. Multicollinearity Test Results**

No	Variabel	Tolerance	VIF
1	Service quality	0.572	1.748
2	Price	0.572	1.748

Based on Table 5 above, the variance inflation factor (VIF) value is obtained, the variable Service quality ( $X_1$ ) =  $1,748 < 10$  and Price ( $X_2$ ) =  $1,748 < 10$ . Both independent variables have VIF values smaller than 10, so it can be concluded that there is no multicollinearity between the independent variables.

Furthermore, hypothesis analysis is carried out, namely partial tests and simultaneous tests. The t test (partial) was conducted to determine the effect of each independent variable, namely service quality and price on the satisfaction of badminton athletes in Bantul Regency. The results of the t test (partial) analysis are presented in Table 6.

# The Effects of Service Quality and Price on Athlete Satisfaction: A Case Study of Athletes at Badminton Clubs in Bantul District

**Table 6. Partial Test Analysis Results (t test)**

Coefficients <sup>a</sup>						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	6.150	.999		6.157	.000
	Service quality	.261	.032	.478	8.230	.000
	Price	.523	.071	.428	7.379	.000

a. Dependent Variable: Athlete Satisfaction

The service quality variable obtained a p-value of 0.000. Because the p-value of 0.000 < 0.05, then H0 is rejected, meaning that H1 "There is a significant influence between service quality on the satisfaction of badminton athletes in Bantul Regency" is accepted. The coefficient value is positive, meaning that if the service quality is getting better, the athlete's satisfaction will also be higher.

The price variable obtained a p-value of 0.000. Because the p-value of 0.000 < 0.05, then H0 is rejected, meaning that H2 "There is a significant effect between price and the satisfaction of badminton athletes in Bantul Regency" is accepted. The coefficient value is positive, meaning that if the price is getting better, the athlete's satisfaction will also be higher.

The F test is used to test the hypothesis whether the independent variables together (simultaneously) have an effect on the dependent variable. H3 reads "There is a significant influence between service quality and price on the satisfaction of badminton athletes in Bantul Regency". The analysis results are in Table 7.

**Table 7. F Test Analysis Results (Simultaneous)**

ANOVA <sup>b</sup>						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	793.252	2	396.626	176.303	.000 <sup>a</sup>
	Residual	373.446	166	2.250		
	Total	1166.698	168			

a. Predictors: (Constant), Price, Service quality  
b. Dependent Variable: Athlete satisfaction

Based on Table 7 above, the F-value coefficient is 176,303 and the p-value is 0.000 < 0.05, then Ho is rejected, meaning that H3 "There is a significant influence between service quality and price on the satisfaction of badminton athletes in Bantul Regency", is accepted. It can be concluded that the regression model chosen is suitable for testing data and the regression model can be used to predict that service quality and price simultaneously affect the satisfaction of badminton athletes in Bantul Regency.

The Coefficient of Determination is essentially used to measure how far the ability of the regression model to explain variations in the dependent variable. The analysis results are in Table 8.

**Table 8. Coefficient of Determination Analysis Results**

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.825 <sup>a</sup>	.680	.676	1.49989

Predictors: (Constant), Price, Service quality

The Adjusted R Square coefficient of determination or service quality and price in explaining or predicting the athlete satisfaction variable is 0.676 or 67.60%. This means that the variables of service quality and price have an influence on the satisfaction of badminton athletes in Bantul Regency by 67.60%, while the remaining 32.40% is influenced by other factors outside this study.

## DISCUSSION

### The effect of service quality on athlete satisfaction

Based on the results of the study, it shows that there is a significant influence between service quality on the satisfaction of badminton athletes in Bantul Regency, with a p-value of 0.000 < 0.05. These results are in line with research (Agung Nugroho & Sumaryanto, 2021) that service quality affects athlete satisfaction. Furthermore, research (Ndayisenga & Tomoliyus, 2019) the

## **The Effects of Service Quality and Price on Athlete Satisfaction: A Case Study of Athletes at Badminton Clubs in Bantul District**

results showed that service quality had a significant effect on satisfaction. Satisfied athletes tend to use the service more often, have a strong intention to train again, and recommend the service to other athletes (Rashid & Rokade, 2019). Furthermore, greater athlete satisfaction increases and results in a better reputation for the club. The recognition of a positive relationship between satisfaction, and athletes' intention to return to training emphasises the importance of identifying and explaining the conditions under which satisfaction is developed.

(Vieira & Ferreira, 2018) stated that measuring service quality using tangibility, reliability, responsiveness, assurance, and empathy factors. The most desirable aspects of service are: modern facilities, employee attitudes and skills, membership offers and price packages, programmes, hours of operation, security of personal belongings and consistent terms of service (Yildiz et al., 2018). The physical environment is the service quality dimension with the highest impact on satisfaction. The strong relationship between physical environment quality and satisfaction is explained by the high expectations that athletes have of service elements, as well as the importance for him or her to rely on scientific knowledge of their coaches, as their behaviour and attitude largely determine the customer experience.

Assessment of customer loyalty is reviewed from the quality of service to a product or service. In addition, the occurrence of athletes is often not loyal due to poor service quality or service quality that is decreasing from what athletes expect. The goal of providing high quality service so that customers are loyal to a particular club which has the impact of obtaining maximum profit. Unsatisfactory service will cause fewer customers or even disappear because customers move to other services. The existence of this kind of emotional bond allows the company to carefully understand the specific expectations and needs of customers where the company maximises pleasant customer experiences and minimises or eliminates experiences from customers that may be less pleasant.

### **The effect of price on athlete satisfaction**

Based on the results of the study, it shows that there is a significant influence between price on the satisfaction of badminton athletes in Bantul Regency, with a p-value of  $0.000 < 0.05$ . In line with research (Zhao et al., 2020) the results showed that price perception has a positive influence on customer satisfaction. The role of price in running a business, especially badminton sports clubs, is very important, because price is the key to creating and attracting consumer interest here athletes. Prices not only depend on club policy, but also by considering various things. Cheap or expensive prices are very relative in nature. Pricing that is too expensive will cause the results of enthusiasts to decrease, but if the pricing is too cheap it will reduce the profit earned by business actors, namely badminton clubs. In general, athletes will assume that if the price is high, then most likely the product will be of high quality, and vice versa if the price offered is low, then the product is likely to be of low quality.

Price perception is very closely related to athlete satisfaction because it can affect the results of product sales offered by the club because price is a factor determining market demand and price determines the level of customer satisfaction. Products or services that have low prices with good quality will provide a high level of satisfaction to their customers. The company should set the appropriate price, because what customers are looking for, apart from having good quality, are also looking for products that are cheap. Price represents the value contained in a product / service and the price itself and the customer must accept to get the product / service. This can lead to satisfaction and use of services for customer intentions to use services repeatedly (loyalty). Price information can also affect price adjustments to a product (service) with good facilities, of course, it will spoil customers. (Kim, 2019) stated that price has an important role to play in attracting new customers and retaining existing customers.

### **The effect of service quality and price on athlete satisfaction**

Based on the results of the study, it shows that there is a significant influence between service quality and price on the satisfaction of badminton athletes in Bantul Regency, with a p-value of  $0.000 < 0.05$ . Customer satisfaction results from measuring products and services according to previous customer experience as well as an overall evaluation of the consumer experience. Companies to fulfil customer satisfaction are required to carefully understand the ever-changing needs and desires of consumers. Customer satisfaction is an evaluation of the buyer, where the alternatives chosen are at least equal to or exceed customer expectations, so it can be said that the management control system can be used as an additional alternative to evaluate customer satisfaction.

Measuring customer satisfaction is an important factor in providing better, more efficient and more effective services. The company will take wise action by assessing customer satisfaction periodically, because one of the keys to retaining customers is customer satisfaction. Highly satisfied customers are usually loyal for a longer period of time. Therefore, the key to the company's success actually depends on the company's success in meeting customer needs.

## The Effects of Service Quality and Price on Athlete Satisfaction: A Case Study of Athletes at Badminton Clubs in Bantul District

Service quality can be an important factor in determining consumer satisfaction, especially athletes. Because service quality is an effort made to fulfil what consumers need and want and how to deliver it appropriately to consumers. It can be said that service quality is an important part of maintaining athlete satisfaction when coming to the club for training. Service quality is an invisible activity that occurs due to interactions between athletes and coaches, or things provided by the club in providing services. That the image of good quality is not seen from the perception of the club, but based on the perception of the athletes.

Price is often used as an indicator of value when the price is related to the perceived benefits of a good or service. Thus, at a certain price level, if the benefits perceived by consumers increase, the value will also increase, so that satisfaction will arise in athletes. At a certain price level that has been spent, athletes can feel the benefits of the product they have bought and athletes will feel satisfied if the benefits they get are comparable or even higher than the nominal money they spend.

### CONCLUSIONS

Based on the results of data analysis, description, testing of research results, and discussion, it can be concluded that: (1) There is a significant influence between service quality on the satisfaction of badminton athletes in Bantul Regency, with a p-value of  $0.000 < 0.05$ . (2) There is a significant influence between price on the satisfaction of badminton athletes in Bantul Regency, with a p-value of  $0.000 < 0.05$ . (3) There is a significant influence between service quality and price on the satisfaction of badminton athletes in Bantul Regency, with a p-value of  $0.000 < 0.05$ .

Club owners must improve and improve service quality continuously to attract athletes to feel comfortable and happy in training. Club owners also need to consider pricing policies to be adjusted to other competitors, especially oriented towards the benefits felt by athletes, in order to create athlete satisfaction. This study only analyses the effect of service quality and price on athlete satisfaction. There are still many other factors that can affect athlete satisfaction, for example product factors, promotions, location and others, so future researchers are expected to develop this research, add the number of respondents, and examine other factors not examined in this study.

### REFERENCES

- 1) Agung Nugroho, T., & Sumaryanto, I. (2021). Effects of service quality, social environment and financial on motivation, satisfaction, and performance for athletes at training center PON XX in DIY. *Journal of Human Movement and Sports Sciences*, 9(5), 1067–1079.
- 2) Anwar, N., HendroAsali, E., Budiyanto, T., Hendyan, W., & Warnars, H. L. H. S. (2020). Smartphone Application for Badminton sports community. *Journal of Physics: Conference Series*, 1477(2), 22036.
- 3) Barshan, G., Elahi, A., & Aghaei, N. (2017). Impact of service quality on satisfaction, loyalty and intention to revisit of sport customers: The case study of swimming pools in Alborz Province. *International Review of Management and Marketing*, 7(2), 334–339.
- 4) Cosguner, K., Chan, T. Y., & Seetharaman, P. B. (2018). Dynamic pricing in a distribution channel in the presence of switching costs. *Management Science*, 64(3), 1212–1229.
- 5) Hikmad, H., Sahabuddin, S., Herman, H., Amahoru, N. M., & Fadillah, A. (2022). The Correlation Between Wrist Flexibility and Hand Reaction Speed with Short Serve Ability in Badminton Game. *Nusantara Journal of Sports Science (NJSS)*, 1(2), 54–63.
- 6) Kim, J. (2019). The impact of different price promotions on customer retention. *Journal of Retailing and Consumer Services*, 46, 95–102.
- 7) Malwanage, K. T., Senadheera, V. V., & Dassanayake, T. L. (2022). Effect of balance training on footwork performance in badminton: An interventional study. *PLoS One*, 17(11), e0277775.
- 8) Napitupulu, D., Rahim, R., Abdullah, D., Setiawan, M. I., Abdillah, L. A., Ahmar, A. S., Simarmata, J., Hidayat, R., Nurdiyanto, H., & Pranolo, A. (2018). Analysis of student satisfaction toward quality of service facility. *Journal of Physics: Conference Series*, 954(1), 12019.
- 9) Ndayisenga, J., & Tomoliyus, T. (2019). Effect of service quality and rates on satisfaction and loyalty of customer behavior at fitness. *International Journal of Human Movement and Sports Sciences*, 7(2), 25–32.
- 10) Rashid, A., & Rokade, V. (2019). Service quality influence customer satisfaction and loyalty. *UKH Journal of Social Sciences*, 3(1), 50–61.
- 11) Šíma, J., & Ruda, T. (2019). Using the SERVQUAL model in prediction of customer satisfaction in Czech fitness centres. *Management*, 7(1), 42–49.
- 12) Subaebasni, S., Risnawaty, H., & Wicaksono, A. R. A. (2019). Effect of brand image, the quality and price on customer satisfaction and implications for customer loyalty PT Strait Liner Express in Jakarta. *International Review of*

## The Effects of Service Quality and Price on Athlete Satisfaction: A Case Study of Athletes at Badminton Clubs in Bantul District

*Management and Marketing*, 9(1), 90.

- 13) Vieira, E. R. M., & Ferreira, J. J. (2018). Strategic framework of fitness clubs based on quality dimensions: the blue ocean strategy approach. *Total Quality Management & Business Excellence*, 29(13–14), 1648–1667.
- 14) Yildiz, K., Polat, E., & Güzel, P. (2018). A Study Investigating the Perceived Service Quality Levels of Sport Center Members: A Kano Model Perspective. *Journal of Education and Training Studies*, 6(4), 177–188.
- 15) Yusof, A., Popa, A., & Geok, S. K. (2018). Relationship between perceptions of fitness facility service quality and future intentions of fitness Center users in Thailand. *International Journal of Academic Research in Business and Social Sciences*, 8(7), 863–871.
- 16) Zhao, G., Jahangir, J., Faisal, M. N., Hafeez, M., & Abbas, K. (2020). Service quality and customers' satisfaction nexus in the light of price perception moderation. *Revista Argentina de Clínica Psicológica*, 29(5), 611.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Meritocracy Disguised as Equity: The Relationship between Teacher Professional Organizations and Teacher Ideology



Hope Kitts

University of Minnesota-Duluth Orcid ID: 0000-0003-1789-8980

**ABSTRACT:** The institution of public schooling in the United States exists in the popular imagination as a primary means of achieving social mobility. It is believed that schools provide students with unbiased opportunities to earn credentials that translate into real, economic benefits. This myth of equality of opportunity in the contexts of schooling, while idyllic, does more harm than good when it comes to addressing historical inequities and serving as a means for the realization of social justice. Through a window into a larger qualitative study with practicing secondary school teachers at a large, district high school in the southwest United States, I show how discourses of meritocracy at a micro level are reflected in the language of influential teacher professional organizations. I call on these organizations to examine how their use of language promotes meritocratic myths that homogenize diverse student populations and eclipse historical,

Generational inequities that persist to this day.

Mass, compulsory public schooling, more than any other institution in the United States, has significant potential to foster societal change or social conformity, depending on multiple factors related to policy, resource distribution, teaching and social context (Bourdieu & Passeron, 1977; Feinberg & Soltis, 2009). For this reason, it is one of the most hotly contested public domains, historically and to the present day. School policy, curriculum, structure and purpose have been the subject of debate since the inception of the common school movement in the early 19<sup>th</sup> century (Kaestle, 1983; Spring, 2018). Today, political battles on the subject of schooling are waged around issues of testing, curriculum, funding, governance structure and equity, to name a few. This is because schools and the experiences they offer, outside of familial influences, prove to be formative for people from the ages of five to 18, the legal age of majority at the boundary of adulthood in the United States context. The extent to which schools shape the attitudes, values, dispositions, knowledge and skills of the people who pass through them affects how society itself is formed and transformed.

From this perspective, teaching within the contexts of schooling is an important site for examining how dominant ideas circulate or are stifled. Teaching (as one aspect of schooling) is enacted at the interstices of institutional obligation and interpersonal relation. As described in this study, teachers-participants often felt pulled between their institutional roles and their relationships with students. For this reason, the teaching context contains enormous potential for the perpetuation or challenge of social norms and political relationships; and considering disparate educational outcomes, this challenge is requisite to social progress.

According to the National Center for Education Statistics (2017), in the United States, only 37 percent of fourth grade students scored at the “proficient or above” level in reading. The scores were even more dire for children of color, when in 2017 only 20 percent of AfricanAmerican/Black students and 23 percent of Hispanic students scored at “proficient or above” in reading, compared with 47 percent for White students (National Assessment of Educational Progress, 2017). These statistics indicate the unequal reality of schools, not the unequal distribution of ability. Questionable validity aside (Grodsky, Warren & Felts, 2008), these scores have real consequences for individuals and communities in terms of credentialing, funding, retention and promotion. While these tests are by no means objective measures of students’ abilities, assets, and understandings, the sheer discrepancy of scores—like the discrepancy of wealth between demographics—raises suspicion about the myths of equality of opportunity in the contexts of schooling.

While schools as vast social institutions dis/function at multiple, intersecting levels this study examines the extent to which power (social, political and interpersonal) may be interrogated at the level of teachers’ consciousness, as expressed through language. Scholarly work on how teachers contribute to social and cultural reproduction through unexamined practices such as labeling and ability-grouping are well-documented (Ireson & Hallam, 2009; Lleras & Rangel, 2009; Loveless, 1999; Rist, 2016), yet

## Meritocracy Disguised as Equity: The Relationship between Teacher Professional Organizations and Teacher Ideology

work on how practicing teachers understand, interpret, and relate to a critical pedagogy which challenges this reproduction remains inchoate.

To address this gap, I investigated how teacher study groups with critical text facilitated a confrontation of ideologies. As I show, White teachers distanced their practice from Freire's

*Pedagogy of the Oppressed* on the basis of meritocratic ideology informing so-called commonsense. I viewed the role of ideology in critical interpretation as one aspect of the broader issue of functionalist schooling in the United States, that is, schooling that functions to reproduce the dominant social structure, as opposed to challenge it (Feinberg & Soltis, 2009). Understanding how White teachers responded to critical pedagogical concepts has implications for the realization of schools as spaces of social change.

Furthermore, I assume that all positions are ideologically informed (including my own), whether consciously or not; and that uncovering ideological interests can illuminate hidden politics within a position, insofar as ideology and political positioning are interwoven. I also assume that the process of coming to ideological clarity is a means toward more conscious and informed decision-making as political actors engaged in daily life (Bartolome, 2007; Giroux, 2001; King, 1991). We all need to undertake ideological work constantly, because the nature of dominant ideology is to pass itself off as common knowledge, to try to be unseen, natural and assumed. As I show, in response to this study some teachers reproduced tropes of equality of opportunity, tropes major teacher professional organizations produce and circulate, to the detriment of social justice equity work. The study described here was approved by a university Institutional Review Board (IRB). There are no funding sources or conflicts of interest to declare.

### THEORETICAL FRAMEWORK

For this study I utilized a Critical Discourse Study (CDS) framework—also referred to as Critical Discourse Analysis (CDA)—to focus on issues of power and ideology (conscious and unconscious) embedded in language (Kress, 2011, van Dijk, 2001; Wodak, 2001). Scholars taking the CDS approach examine how power manifests at the level of language (Fairclough, 2010; Rogers, 2011; van Dijk, 1987), which makes it a suitable approach for this research insofar as I show how relations of power manifested ideologically through teachers' verbal interactions and written responses. As Fairclough (2001) writes:

Ideologies are closely linked to language, because using language is the commonest form of social behavior, and the form of social behavior where we rely most on commonsense assumptions...Ideology is pervasively present in language (p. 2).

We shroud ideological commitments in language to the point that we are often not consciously aware of them (Althusser, 2014). Studying language in use (in this case speech) reveals relationships of power and dominance at multiple levels—from the smallest interaction at a micro level to macro levels related to institutional and government entities. Again, Fairclough (2010) writes, "For critical discourse analysis...the question of how discourse cumulatively contributes to the reproduction of macro structures is at the heart of the explanatory endeavor" (45). Halliday (1977) proposes that "by their everyday acts of meaning, people act out the social structure, affirming their own statuses and roles, and establishing and transmitting the shared systems of value and of knowledge" (p. 2). Illuminating social relations of power as revealed through critical analysis of language works to understand how entities shape individuals, but also how individuals shape institutional entities. Language, from this perspective, shapes and is shaped by individuals and abstracted institutional formations in relationship. To put it succinctly: "Discourse makes people, as well as people make discourse" (Fairclough, 2010, p. 41). This view of language, which I share, sees "language as social, as meaningful, and as always embedded in a social context and history. Language is not an isolated phenomenon; language is deeply social, intertwined with social processes and interaction" (Wodak, 1999, p.

186). CDS does not aim to uncover a truth apart from individuals or entities, however, but to illuminate social relations between individuals and entities. As Wodak (1999) found: Each communicative event allows numerous interpretations, linked to the positions of the readers', listeners', or viewers' respective contexts and levels of information. Interpretations that the researchers put forward also are laden with certain beliefs and knowledge. A "right" interpretation does not exist and a hermeneutic approach is necessary. Interpretations can be more or less plausible or adequate, but they cannot be "true." (p. 187)

CDS is guided primarily by critical social theory and questions (Fairclough, 2010), rather than a strict set of methods. There is no consistent CDS methodology, but rather a diverse and multidisciplinary field of inquiry guided by principles of humanization (Jäger, 2001), or as van Dijk (2001) would say, "discourse analysis with an attitude...biased and proud" (van Dijk, 2001, p. 96).

### METHODS

To understand how ideology functioned in teachers' responses to critical pedagogy, I conducted teacher study groups on the whole of Paulo Freire's text: *Pedagogy of the Oppressed*.



## Meritocracy Disguised as Equity: The Relationship between Teacher Professional Organizations and Teacher Ideology

I supplemented study groups with individual interviews and reflective journaling. Guided by Thompson's (1990) critical hermeneutical framework for ideological critique I located ideological symbolic constructions in teachers' discourse, which I then analyzed through examination of facework and the unsaid (Fairclough, 2010; Gee, 2011; Goffman, 1959)

To further understand the production of social inequities (social reproduction) at the intersections of schooling and consciousness, I designed this study to go beyond a descriptive representation of teachers' views of Freire's critical pedagogy. Specifically, as a discourse analysis, I analyzed the ideological dimension of teachers' interpretations as they encountered

Freire's critical pedagogy through a primary source text. As I discuss more fully, I paid particular attention to how teachers' statements functioned to create them as "kinds of persons" (Gee, 2011), which involved examining ideology embedded in the assumptions they left unsaid and how they used language to make comparisons and present their institutional teacher selves. Humans shape and transform language, and language has real effects on how we as people understand ourselves and others. Language is more than mere symbols; it is social action. Understanding how language can be damaging for students and detrimental to teaching for social progress drive the purpose of this study.

The data collection methods I employed included study groups utilizing a focus group approach, interviews and participant reflective writing at a single school site. Subsequently, in order to understand the ideological underpinnings of these teachers' views, I analyzed these data according to the tradition of ideological critique within the broader field of Critical Discourse Studies (CDS) (Blommaert & Verschueren, 2014; Bloome et al., 2008; Bloor & Bloor, 2018; Fairclough, 2010; Gee, 2011; Jäger, 2001; Ng, 2018; Thompson, 1990; van Dijk, 2001).

### RESULTS

In the following I present a small dialogic exchange between Roxanne and Pam. Their views on opportunity are illustrative of meritocratic ideology more broadly, and raise the question: What larger social structure(s) relevant to teachers' work perpetuate meritocratic ideology? My final question to the group and their responses unfolded as follows: **Hope:** I want to ask you to respond to a portion of Freire's text. It starts on the second paragraph of page 139. It's right in the middle of the second paragraph. And I'm going to read to the end of the page. So we're all together, it starts with "in order." (reads aloud) "In order to present for the consideration of the oppressed and subjugated a world of deceit designed to increase their alienation and passivity the oppressors develop a series of methods...It is accomplished by the oppressors, depositing myths indispensable to the preservation of the status quo, for example, the myth that the oppressive order is a free society." So I'm going to ask you, what do you think of these myths? (reads aloud) "The myth that all persons are free to work where they wish. If they don't like their boss, they can leave him and look for another job. The myth that this order respects human rights and is therefore worthy of esteem. The myth that anyone is who is industrious can become an entrepreneur. Worse yet, the myth that the street vendor is as much an entrepreneur as the owner of a large factory. The myth of the universal right of education when all of the Brazilian children who went to primary schools only a tiny fraction ever reach the university. The myth of the equality of all individuals when the question 'Do you know who you're talking to?' is still current among us." I'm going to stop there. So in terms of when you're communicating with your students, do these myths ever come into your conversation with them, or do you think these are myths? Or just what are your thoughts on this passage? (Freire, 1970, p. 139).

**Roxanne<sup>1</sup>:** Well, I actually noted that myself that I don't really agree with what he's saying on this, because you can—if you don't like the job where you're at, you can quit. You may not have any income, but you can quit and find another job. I was thinking of well, in the United States here, you can become an entrepreneur. I mean, you know, and of course, I mean, the little hot dog guy with the hot dog or the little cart, you know, selling the popsicles he's still just as much as an entrepreneur as the guy who is the big boss, Jeff Bezos, you know... And we do talk about students' ability to better themselves, you know, so I don't know. I didn't like his myth stuff.

**Pam:** But the myths, the myths take away hope. I'm sorry they take away your hope and those myths are draining on hope. And no, I can't go to Brazil and help all those kids. But where I am now, I can show my kids how to access opportunities regardless of poverty, regardless of the structure of their family. That's all I can do is show them how to take advantage of opportunities and how to access those opportunities. That way, when they become a career person, if they're going to do the pushcart, then it's a choice they made. But I can't change every single thing. Right? I mean, that's kind of my frustration with this. It's like, you know, people—myths were true at one point and some of that stuff. I feel like it's because they have some crappy teachers or those

---

<sup>1</sup> All names of participants and sites are pseudonyms.

## Meritocracy Disguised as Equity: The Relationship between Teacher Professional Organizations and Teacher Ideology

people had some crappy teachers, right, that didn't give them access to, "Hey, this is really something you can do." But maybe it's because I do believe that every kid should go to college and that we shouldn't say, "Oh, this is career and college high school, career and college." What's my purpose of being a high school teacher if it's not to further them and then more education after school? You know, I don't understand the whole career. I think that's the myth. But I feel like you have to give them the opportunities and show them what lifelong learning can do for them. And is the hot dog vendor happy? And who are we to judge people, if that's the choice? And, you know, I feel like if you're comfortable where you are, you don't need to go outside of your boundaries and do things. Why am I going to be judging other people? Because I'm my own harshest critic. I assume everybody else is their own harshest critic, too, but that's my cultural bias, too

### DISCUSSION

Roxanne stated that she didn't agree with Freire characterizing meritocracy, a core tenet of political ideology in the United States, as a myth (19-20). After stating her disagreement, she went on to illustrate her point anecdotally through the second-person pronoun "you," which she used seven times in the course of three lines (20-23). The effect of this usage created a fictional person who was effectively someone and everyone: "If you don't like the job where you're at, you can quit" (20). As Nakayama and Krizek (1995) show, whiteness is often discursively constructed through universals in place of particulars, reflecting the tendency of White supremacist ideology to remain invisible and unmarked (Frankenberg, 2020). In contrast, when clarifying her statement later, Roxanne shifted her pronoun usage to the first person "I" (which she also used seven times), as in "If I was a guy out there pushing a cart." Though she shifted her pronoun usage from "you" to "I" Roxanne still employed the particular as the universal insofar as the scenario where she is pushing the cart was how she would feel about the situation in a different body ("a guy"). Roxanne, in stating that she would feel pride if she were a guy pushing a cart created the impression that anyone (regardless of social position or embodiment) could feel pride in this scenario. The question remained without being asked: Would Roxanne as Roxanne (as White, middle-class, female, professional) feel pride were her vocation pushcart vendor? In both cases (with the use of the pronoun *you* and with the pronoun *I*) Roxanne takes a position not based on her own embodiment or identity, but on a projected identity as generalized, unraced, universal. Discursively, Roxanne's position is disembodied, reminiscent of the "view from nowhere" (Nagel, 1989), a positionless position. Scholars examining whiteness have explicated how White people describe themselves in unraced, general, universal terms (Frankenberg, 2020; Wise, 2011), a pattern belonging to the broader discursive moves Yoon (2012) calls "whiteness at work" (p. 587). Roxanne is not alone in this construction, as can be seen when examining the presentation of self that teacher professional organizations construct.

Three major teacher professional organizations—the National Council of Teachers of English (NCTE), the National Council of Teachers of Mathematics (NCTM), and the National Council for the Social Studies (NCSS)—all use generalized, unraced language, ironically when referring to students of color. This reflects the unification strategy Thomson (1990) identifies as ideological symbolic construction. All of these organizations take public stances opposing racism, yet not one names the oppressor or oppressed specifically. In its vision statement, for example, NCTE uses the language of "all students," "all learners," "diverse learners," and "every students' consciousness" (<https://ncte.org/about/>). NCSS similarly refers to ameliorating the legacy of White supremacy by envisioning "A world in which all students are educated and inspired for lifelong inquiry and informed civic action" (<https://www.socialstudies.org/about>). Not unlike the previous two, NCTM's all-inclusive phrasing includes "each and every" student three times in its short summary (<https://www.nctm.org/About/>). Oblique wording such as this, while seemingly addressing historical injustice, fails to name the disparity that exists today, where educational outcomes are still largely determined by zip code, which itself has been structured for generations by White supremacy (Haney-López, 2006; Massey & Denton, 1993). The meaning of Roxanne's statement "If you don't like the job where you're at, you can quit" (20) echoed the concept of free wage labor inherent to capitalist ideology, where labor power is an individual commodity that can be bought and sold (Dubofsky & McCartin, 2017). Although free wage labor conveys a sense of freedom on the part of the proletariat (worker), ignored is the fact that regardless of where a worker sells their labor, selling labor is the only commodity a worker possesses, which means workers do not have the option to not work. Additionally all labor is not valued equally. It is not as if a pushcart vendor can quit and sell their labor as an engineer. Although meritocratic ideology purports to ignore wealth and social class in favor of intelligence and effort, social stratification on the basis of wealth and class predominates in the earliest years of life, limiting the extent to which those at the bottom of the social hierarchy can move up. The effect of meritocratic ideology is the illusion of options. Roxanne indicated this when she said, "You may not have any income, but you can quit and find another job" (20-21). In a society where not having an income means not having necessities such as food, healthcare, transportation or housing, not having an income is not truly an option. In shifting topics from wage labor to entrepreneurship (22), Roxanne seemed to

## Meritocracy Disguised as Equity: The Relationship between Teacher Professional Organizations and Teacher Ideology

implicitly acknowledge the vicious cycle of wage labor, the implication of which was to convey that even if a worker cannot find another job (or move up from a low-paying job), in the context of the United States, they could still become a business owner. The conflation of wage labor with capital created a world where there are no limits, as well as no excuses for not attaining wealth and status.

Roxanne's statement "in the United States here" (21-22) positioned the U.S. as the center of business and capitalist values of hard-work and productivity. The implication was that other countries are not as supportive of business or entrepreneurship, and therefore also not as hardworking or efficient. The implication of identifying the U.S. with entrepreneurial spirit lauded the effort of primarily White individuals to attain the status of capitalist, and masked advantages gained through inherited wealth, elite education and social networks facilitated by residential and school segregation. The \$200,000 loan given to Jeff Bezos by his adopted father and former Exxon engineer to invest in Amazon and the conditions for this possibility are not credited as factors made possible through the oppression of the world's majority (Exxon's role in climate change, extreme wealth inequality and racial stratification). Bezos's position in life, like that of the hot dog vendor, is ascribed to his "ability to better himself" (25).

Roxanne equated the "little guy" with the "big boss" (40-42), as "just as much an entrepreneur" (41), where to be an entrepreneur is a good thing because it implies inner character defined by traits of determination, creativity, and intelligence. With "just as much" Roxanne implied a moral equivalence (41), meaning she saw them both as equally deserving of the title *entrepreneur*, as equally respectable. She also elevated the moral quality of the fictional hot-dog vendor when she spoke of having pride in that role (92-93). Like Roxanne's moral equivalence, Pam also expressed extreme aversion to being labelled as judgmental of those who "make the choice" to sell popsicles from a pushcart.

Teacher Discourse on the subject of poverty in these cases expressed an anxiety around the relationship between poverty and character. This anxiety revealed a contradiction inherent to meritocratic ideology: If everyone has the equal opportunity to pursue wealth, not attaining wealth at whatever level is attributed to a person's inherent character, intelligence and or ability. Roxanne and Pam expressed an uneasiness with the inherent moral judgement of innate ability that defines meritocratic ideology, and made discursive moves to distance themselves from this moral aspect. Roxanne did so by equating the hot dog vendor with Jeff Bezos (24). In Pam's case she distanced herself from the moral aspect of meritocracy with the use of the word "judge" (40). With this word Pam portrayed herself as non-judgmental while simultaneously implicitly positioning activists as the opposite, judgmental. Pam's reasoning resulted in justifying her nonintervention in issues of oppression on the basis that taking a stance would be patronizing. Pam furthered this logic when she offered the possibility that people "want to be oppressed," or "they're not really sure if they're happy" (Interview 2, December 16<sup>th</sup> 2020). Pam's defense for neutrality on oppression romanticized poverty, and ironically patronized the working class as potentially content in the face of extreme inequality.

Beyond Pam's articulation, this kind of thinking favorable to meritocratic ideology permeates discourse at the level of professional organizations such as the National Council of Teachers of English (NCTE) that define "access" as the first component of the organization's vision, and mention "access" four times in all (<https://ncte.org/about/>). Their impact, as stated on their website, includes the effort to "widen possibilities for all students' access, power, agency, affiliation, and impact, across a lifetime" (<https://ncte.org/about/>). The language of access is not limited to NCTE, but extends to other influential professional organizations like the National School Board Association (NSBA), which works to "ensure each student everywhere has access" and defines equity as:

The promise of public education is for every child to succeed in school and life. To realize this promise, every child must be given resources, supports, and interventions based on his or her needs. The nation's school boards are uniquely positioned to fulfill this promise to all students, which is why NSBA is committed to educational equity for all children in public schools" (<https://www.nsba.org/About>).

The words "every" or "all" are used four times in this short excerpt, which asserts that public education functions as a social equalizer. How is saying "equity for all children" different from simply "equity for children?" Why is the word "all" necessary? The unsaid of this discourse is to negate exclusion, to imply that students of color and students not considered of color are alike represented. It functions to deny disenfranchisement (which has been endemic and historical) all the while never revealing who benefits and who suffers from educational inequity (Edbuild, 2019).

Likewise the Council of the Great City Schools (CGCS) (in which the local department of education specific to this study participates) maintains:

Diversity propels the coalition forward to see that *all* citizens receive an education that will equip them with the skills and knowledge to compete successfully in the world marketplace and to enhance the quality of their lives in a society changing with phenomenal speed. (<https://www.cgcs.org/domain/16>)

## Meritocracy Disguised as Equity: The Relationship between Teacher Professional Organizations and Teacher Ideology

The word “equip” echoes the language of “access,” the unsaid of which is that upward mobility is a problem of knowledge rather than materiality. A CGCS (2021) report examines the extent to which schools can “do a better job to overcome the effects of poverty,” the assumption of which is that students, teachers and administrators can and should bear the responsibility for thriving in spite of poverty (p. 8). This logic negates schools as places to challenge the conditions that make poverty possible, and instead positions them as successful to the extent that they produce results in the context of extreme inequality. The implication reflects the bootstraps mentality that since some schools are producing results in the context of poverty, all other schools can and should be able to do the same. Their failure to do so, consequently, rests on their own shortcomings, their lack of “torque” as CGCS puts it (p. 8).

Pam’s comment implied not only that students’ families constituted a barrier (28-29), but that opportunity is equally accessible to everyone and simply knowing how to access opportunity will mitigate any and all barriers to its realization. By this logic, failure to realize opportunity can be attributed to an individual deficit and a problem of knowledge, in which case those who lack the knowledge of accessing opportunity are ignorant and uneducated. Pam concluded that she was limited to presenting the means of accessing opportunities, after which students’ educational and life outcomes were the result of their personal choices (31). Logically, those who work in low-wage jobs, such as her example of vendors selling from a pushcart, have chosen this vocation (31). In this view, poverty stems solely from personal choice, not from systemic and generational barriers in education, law, healthcare, housing, the courts or any other institutional entity. Ideologically, this form of unification ignores the very real obstacles faced by people without the means or privilege to advance economically and in effect preserved the status quo where success is based on individual merit, i.e., those who are wealthy are deserving and those who are not equally undeserving. To check my interpretation of Pam’s view of opportunity I asked her: “In your view, do your students all have opportunities equal to other students their age?” Pam responded:

All students have the same opportunities, but they have different ways of fitting their puzzle together to turn the opportunity to reality. The opportunity is always there even though some people will need to work harder and put in more effort to open that door because people are not all born the same. (personal correspondence, April 12, 2021) Pam’s statement that all students have the same opportunities denied the structural and systemic barriers that impact opportunity, and placed the onus of so-called success on the individual who must “work harder and put in more effort” (47). McIntyre’s (1995) observation is relevant here, that: What becomes increasingly difficult [for White teachers] is understanding the chasm that exists between their antiracist ideals and their tendency to appropriate longstanding strategies for teaching that benefit the dominant group (e.g., treating all students equally, individualism, hard work, “loving” students. (p. 132)

Pam reinforced meritocratic ideology when she elaborated saying that individuals have to work harder because of their innate qualities, or not being “born the same” (48). Consider how the phrase “not born the same” is different from the phrase “not born in the same circumstances.” The latter recognizes that individuals face various inequities in life, but in this statement those inequities are the result of the environment, history and culture, as opposed to deficiencies of their innate intellectual and moral nature. In this meritocratic view, as stated above, individual ability and effort determine opportunity, and are unrelated to structural factors such as racism, White supremacy, colorism, classism or sexism.

This ideology is reflected and reproduced through powerful institutional entities like the College Board, which evolved out of the standardized testing used to sort military recruits during World War 1 (Fuess, 1967; Hampel, 2001). The College Board today upholds the ideology of meritocracy, to which for the most part schools at all levels still subscribe (Lemann, 2000). Of the College Board, Riccards (2010) says it is an “institution born in unashamed Eastern elitism and nourished on the dreams of creating a meritocracy” (p. 108). The belief that College Board tests, most notably the SAT, represent a true measurement of intelligence and ability have been critiqued for decades (Garrison, 2009; Sacks, 2000; Sadler, Sonnert, Tai, & Klopfenstein, 2010; Schudson, 1972), with some colleges and universities opting recently to scrap their requirement on admissions applications (Anderson, 2021). Beyond holding the keys to the gates, the College Board has had a complex relationship of involvement with the creation of learning standards— the paths to the gates—in the United States, beginning in 1900. This relationship was illustrated in the 2012 appointment of David Coleman, as President of the College Board, and former architect of the Common Core learning standards, the closest thing to a set of federal standards in literacy and numeracy (Caldwell, 2012). As of 2022 David Coleman was Chief Executive Officer at the College Board.

Ideologies of meritocracy are evident in Roxanne and Pam’s discourse, and reflected more broadly in teacher professional organizations at the institutional level. These meritocratic discourses, promulgated by professional organizations and repeated by practicing teachers, obscure structural inequities, ironically all in the name of whitewashed diversity efforts. Rather than confronting history and present-day inequities, meritocratic language becomes performative.

# Meritocracy Disguised as Equity: The Relationship between Teacher Professional Organizations and Teacher Ideology

## CONCLUSION

When asked to respond to the way Freire characterizes meritocratic principles as myths, Roxanne and Pam spoke to the primacy of choice in determining a person's life outcomes. Lauding choice in a vacuum, without consideration for context, history and inequity does not spring from these individual teachers alone, but rather is found reflected in broader educational discourses at the institutional level, such as the College Board, Council of the Great City Schools, the National Council of Teachers of English (NCTE), the National School Board Association (NSBA), the National Council of Teachers of Mathematics (NCTM), and the National Council for the Social Studies (NCSS). The failure of these organizations to name historically disenfranchised groups, and instead hide behind generalities, represents performative social justice and reinforces teachers' tendencies toward colorblindness and generalizations of students as a whole.

## REFERENCES

- 1) Althusser, L. (2014). The subjectivity effect of discourse. In J. Angermuller, D. Maingueneau, & R. Wodak (Eds.), *The discourse studies reader* (pp. 83-88). Benjamins.
- 2) Anderson, N. (2021, December 16). Harvard won't require SAT or ACT through 2026 as test optional push grows. *The Washington Post*. Retrieved from: <https://www.washingtonpost.com/education/2021/12/16/harvard-test-optional-collegeadmissions/>
- 3) Bartolome, L. I. (2007). Critical pedagogy and teacher education: Radicalizing prospective teachers. In P. McLaren & J. Kincheloe (Eds.), *Critical pedagogy: Where are we now?* (pp. 263-286). Peter Lang.
- 4) Blommaert, J., & Verschueren, J. (2014). Debating diversity: Analysing the discourse of tolerance. In J. Angermuller, D. Maingueneau & R. Wodak (Eds.), *The discourse studies reader: Main currents in theory and analysis* (pp. 370-377). Benjamins.
- 5) Bloome, D., Carter, S. P., Christian, B. M., Madrid, S., Otto, S., Shuart-Faris, N., & Smith, M. (2008). *Discourse analysis in classrooms: Approaches to language and literacy research*. Teacher's College Press.
- 6) Bloor, M., & Bloor, T. (2007). *The practice of Critical Discourse Analysis: An introduction*. Hodder Education.
- 7) Bourdieu, P. & Passeron, J. C. (1977). *Reproduction in education, society and culture*. Sage.
- 8) Caldwell, T. (2012, May 16). College Board selects backer of Common Core school curriculum as new president. *The New York Times*. Retrieved from <http://thechoice.blogs.nytimes.com/2012/05/16/college-board-selects-backer-of-common-core-school-curriculum-as-new-president/?pagewanted=print>
- 9) Dubofsky, M. & McCartin, J.A. (2017). *Labor in America: A history*. John Wiley & Sons.
- 10) Edbuild. (2019). 23 billion. <https://edbuild.org/content/23-billion/full-report.pdf>
- 11) Fairclough, N. (2001). Critical discourse analysis as a method in social scientific research. In R. Wodak & M. Meyer (Eds.), *Methods of Critical Discourse Analysis* (pp. 121-138). Sage.
- 12) Fairclough, N. (2010). *Critical discourse analysis: The critical study of language* (2<sup>nd</sup> ed.). Routledge, Taylor and Francis Group.
- 13) Feinberg, W., & Soltis, J. F. (2009). *School and society* (5th ed.). Teachers College Press.
- 14) Frankenberg, R. (2020). The mirage of an unmarked whiteness. In S. Seidman & J. C. Alexander (Eds.), *The new social theory reader* (pp. 416-421). Routledge.
- 15) Freire, P. (2018). *Pedagogy of the oppressed (50<sup>th</sup> anniversary edition)*. Bloomsbury.
- 16) Fuess, C. M. (1967). *The College Board: Its first fifty years*. College Board.
- 17) Garrison, M. J. (2009). *A measure of failure: The political origins of standardized testing*. State University of New York Press.
- 18) Gee, J. P. (2011). Discourse analysis: What makes it critical? In R. Rogers (Ed.). *An introduction to critical discourse analysis in education* (3<sup>rd</sup> ed., pp. 23-45). Routledge
- 19) Giroux, H. A. (2001). *Theory and resistance in education: Towards a pedagogy for the opposition*. Bergin & Garvey.
- 20) Goffman, E. (1959). *The presentation of self in everyday life*. Anchor Books
- 21) Grodsky, E., Warren, J. R. & Felts, E. (2008). Testing and social stratification in American education. *Annual Review of Sociology*, 34(1), 385-404.
- 22) Halliday, M. A. K. (1978). *Language as social semiotic*. Edward Arnold.
- 23) Hampel, R. L. (2001). The origins of the Educational Testing Service. In Johaneck, M. C. (Ed.), *A faithful mirror: Reflection on the College Board and education in America* (pp. 247-270). College Entrance Examination Board.

## Meritocracy Disguised as Equity: The Relationship between Teacher Professional Organizations and Teacher Ideology

- 24) Haney López, I. (2006). *White by law: The legal construction of race*. NYU Press.
- 25) Ireson, J., & Hallam, S. (2009). Academic self-concepts in adolescence: Relations with achievement and ability grouping in schools. *Learning and Instruction, 19*(3), 201-213. <https://doi.org/10.1016/j.learninstruc.2008.04.001>
- 26) Jäger, S. (2001). Discourse and knowledge: Theoretical and methodological aspects of a critical discourse and dispositive analysis. In R. Wodak & M. Meyer (Eds.), *Methods of critical discourse analysis* (pp. 32-62). Sage.
- 27) Kaestle, C. (1983). *Pillars of the republic: Common schools and American society, 1780-1860*. Hill and Wang.
- 28) King, J. E. (1991). Dysconscious racism: Ideology, identity and the miseducation of teachers. *Journal of Negro Education, 60*(2), 133-146.
- 29) Kress, G. (2011). Discourse analysis and education: A multimodal social semiotic approach. In R. Rogers (Ed.), *An introduction to Critical Discourse Analysis in education* (3<sup>rd</sup> ed., pp. 205-226). Routledge.
- 30) Lemann, N. (2000). *The big test: The secret history of the American meritocracy*. Farrar, Straus and Giroux.
- 31) Lleras, C., & Rangel, C. (2009). Ability grouping practices in elementary schools and African/American/Hispanic achievement. *American Journal of Education, 115*(2), 279-304.
- 32) Loveless, T. (1999). *The tracking wars: State reform meets school policy*. Brookings Institution Press.
- 33) Massey, D., & Denton, N. (1993). *American apartheid*. Harvard University Press.
- 34) McIntyre, A. (1995). *Making meaning of whiteness*. State University of New York Press.
- 35) Nagel, T. (1989). *A view from nowhere*. Oxford University Press.
- 36) Nakayama, T. K. & Krizek, R. L. (1995). Whiteness: A strategic rhetoric. *Quarterly Journal of Speech, 8*, 291-309.
- 37) National Assessment of Educational Progress. (2018, August 27). Retrieved from [https://www.nationsreportcard.gov/reading\\_2017/#/nation/achievement?grade=4](https://www.nationsreportcard.gov/reading_2017/#/nation/achievement?grade=4)
- 38) Ng, C. J. W. (2018). Metaphor. In J. Flowerdew & J. E. Richardson (Eds.), *The Routledge handbook of Critical Discourse Studies* (pp. 215-227). Routledge.
- 39) Riccards, M. P. (2010). *The College Board and American higher education*. Fairleigh Dickinson University Press.
- 40) Rist, R. C. (2016). On understanding the processes of schooling: The contributions of labeling theory. In A. Sadovnik, & R. W. Coughlan (Eds.), *Sociology of education: A critical reader* (3<sup>rd</sup> ed., pp. 71-82). Routledge.
- 41) Rogers, R. (2011). Critical approaches to discourse analysis in educational research. In R. Rogers (Ed.), *An introduction to critical discourse analysis in education* (3<sup>rd</sup> ed., pp. 120). Routledge.
- 42) Sacks, P. (2000). *Standardized minds: The high price of America's testing culture and what we can do to change it*. Perseus Publishing.
- 43) Sadler, P. M., Sonnert, G., Tai, R. H., & Klopfenstein, K. (Eds.) (2010). *AP: A critical examination of the Advanced Placement Program*. Harvard Education Press.
- 44) Schudson, M. S. (1972). Organizing the meritocracy: A history of the College Entrance Examination Board. *Harvard Educational Review, 42*(1), 34-69.
- 45) Spring, J. (2018). *American education* (18<sup>th</sup> ed.). Routledge. Thompson, J. B. (1990). *Ideology and modern culture*. Polity Press.
- 46) van Dijk, T. (1987). *Communicating racism: Ethnic prejudice in thought and talk*. Sage. van Dijk, T. (2001). Multidisciplinary CDA: A plea for diversity. In R. Wodak & M. Meyer (Eds.), *Methods of critical discourse analysis* (pp. 95-120). Sage.
- 47) Wise, T. (2011). *White like me: Reflections on race from a privileged son*. Catapult.
- 48) Wodak, R. (1999). Critical discourse analysis at the end of the 20th century. *Research on Language & Social Interaction, 32*(1-2), 185-193.
- 49) Wodak, R. (2001). What CDA is about—a summary of its history, important concepts and its developments. In R. Wodak & M. Meyer (Eds.), *Methods of critical discourse analysis* (pp. 1-13). London.
- 50) Yoon, I. H. (2012). The paradoxical nature of whiteness-at-work in the daily life of schools and teacher communities. *Race Ethnicity and Education, 15*(5), 587-613.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Framing Analysis of the Suspected Corruption Case of Agriculture Minister Syahrul Yasin Limpo



Tasya Lee Maharani<sup>1</sup>, Nawiroh Vera<sup>2</sup>

<sup>1,2</sup>Faculty of Communication and Creative Design, Universitas Budi luhur Jl. Ciledug Raya, Petukangan Utara, Jakarta Selatan, Daerah Khusus Ibukota Jakarta 12260, Indonesia.

**ABSTRACT:** Corruption is one of the deep-rooted problems in this country. One of the corruption cases that caught the public's attention and also received media attention was the corruption case of Minister of Agriculture Syahrul Yasin Limpo or commonly known as SYL. SYL's corruption case was widely reported in various mass media, one of which was Detik.com. News is the result of media construction. The content of each news is determined by several factors such as media ideology, ownership factors, and individual factors from the news journalist. One method of analysis to see how the media constructs a news narrative can use news framing analysis. This research is descriptive qualitative research with a constructivist paradigm perspective. This study aims to analyze how Detik.com framed the news of SYL's suspected corruption case. The news used are 3 news articles that were posted at the time of SYL's alleged arrest (October 12-13, 2023). The framing analysis used is Robert N. Entman's framing model which has 4 main elements: 1. Problem identification, what the problem is framed as; 2. Diagnoses causes, causal logic related to the problem; 3. Make moral judgment, what moral values are highlighted by the media; and 4. Solution, what solutions are highlighted in the news frame. The results showed that Detik.com reported on SYL's corruption case which showed the firm action taken by the KPK for corruption cases in the Ministry of Agriculture. The total amount of corruption money of SYL and 2 other perpetrators KS and MH was reported 1 day after the day of being arrested and questioned. With this news, hopefully there will be no more corruption cases in the Ministry, or in other institutions.

**KEYWORDS:** Corruption case, news framing, Syahrul Yasin Limpo, Minister of Agriculture, Nasdem

### I. INTRODUCTION

Corruption is the latin word which means rotten, damaged, deranged, twisted, or bribed. In the Oxford dictionary, corruption is an illegal or dishonest behavior, especially committed by people in power. In the Indonesian Dictionary, corruption means misappropriation or abuse of money from the state, companies, and other people for personal gain (Badjuri, 2011).

Putri (2021) describes the meaning of corruption in Indonesian law. Based on Indonesian Law Number 31 of 1999 and Indonesian Law Number 20 of 2001, corruption is an unlawful act with the intention of enriching oneself / others, both individuals and corporations, which can harm state finances / the state economy. There are 7 types of corruption, which are state financial losses, bribery, extortion, embezzlement in office, fraud, conflict of interest in the procurement of goods and services, and gratuities.

Corruption is one of the deep-rooted problems in this country. In Indonesia, corruption is like a disease that is difficult to eliminate. The rise of corruption cases in Indonesia has a huge impact on society. Based on data from Indonesia Corruption Watch (ICW) in 2022, there were 579 corruption cases that have been investigated in Indonesia throughout 2022. The number increased by 8.63% compared to the previous year which amounted to 533 cases (Figure 1).

## Framing Analysis of the Suspected Corruption Case of Agriculture Minister Syahrul Yasin Limpo

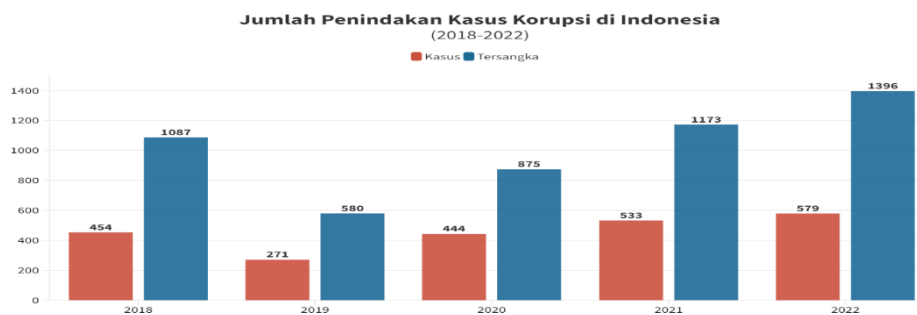


Figure 1. The number of corruption cases prosecuted in Indonesia (2018-2022)

Source: Indonesia Corruption Watch (2022)

On June 2023, KPK received 2,707 reports of suspected corruption (Muhammad, 2023). The amount of reports for 6 months in 2023 is more than the amount of reports of alleged corruption in 2022 for 1 full year. One of the corruption cases that caught the public's attention and also received media attention was the corruption case of agriculture minister Syahrul Yasin Limpo, commonly known as SYL. SYL is a politician from the National Democratic Party (Nasdem), within a few months, two Nasdem party cadres, such as Johnny G Plate, Minister of Communication and Information, were first arrested by the KPK, and then SYL who also had a corruption case and was confirmed as a suspect by the KPK. This is a question mark for many parties, whether it is intentional or just a coincidence that both are from Nasdem. This suspicion has arisen because Nasdem, led by Surya Paloh, has nominated Anies Baswedan as a presidential candidate, and assumptions have surfaced connecting this to the suspensions of the two Nasdem politicians. The media was busy reporting on this issue. From print media, electronic media to online media, all of them have taken up this hot topic. News value is the main basis for the media to spread information to the public. SYL's corruption case has news value, including: 1) Magnitude: Detik.com reported the SYL corruption case, as the Minister of Agriculture whose policies affect many people, especially farmers and breeders; 2) Significance: Detik.com reported SYL's corruption case, where corruption cases are always an important event for the public, as an assessment of the performance of government institutions; 3) Actuality/Timeliness: Detik.com always reported the latest updates on SYL's corruption case, from the initial report received by the KPK to the announcement of SYL as a suspect; 4) Proximity: News about SYL's corruption case as Minister of Agriculture is interesting for the political world and people who care about corruption cases in Indonesia; 5) Prominence; SYL's corruption case is big because SYL is one of the political figures in Indonesia and serves as Minister of Agriculture. The mass media acts as a medium of communication between the public and the government. Communication that takes place through mass media is called mass communication. Leliana et al. (2018) said that mass media is one of the communication media or communication tools used to convey information to a wide audience. The term "mass" in mass media refers to the total number of people the media can reach. Mass media includes various forms such as print media, electronic media, and online media. One of the online media that has been aggressively reporting on SYL's corruption case is Detik.com. The reason the author chose detik.com is because it is number 1 in terms of online news portal media and the most widely read media publisher in Indonesia.



Figure 2. Ranking website news and media publisher in Indonesia

Accessed October 12-13, 2023



## Framing Analysis of the Suspected Corruption Case of Agriculture Minister Syahrul Yasin Limpo

The impact of mass media is very strong, especially in political communication in a country. According to Sobur (2013: 30), the media is a social arena between competing ideologies. In interpreting a case reported in the mass media, it has different perceptions and meanings. So that the perspective in writing news, starting from the news angle, the meaning of a case, different news writing styles, categorization, and there are separate elements contained in news writing according to the issues that will be raised.

News is the result of media construction. News content has been written in such a way and of course it is influenced by several factors such as media ideology, ownership factors, and individual factors of the news journalist. The choice of language contained in the news is a form of representation of reality and can also affect the relief that will be created from the language. That way the mass media has a huge opportunity in shaping public opinion.

Ibnu Hamad in his book "Construction of Political Reality in the Mass Media" argues that every effort to 'tell' (conceptualize) an event, situation, or object is an attempt to construct reality. The nature and fact of mass media work is to tell events, so the main activity of the mass media is to construct various realities that will be broadcast (Hamad, 2004: 11).

The massive news coverage of this case made researchers interested in knowing how detik.com framed the news of SYL's corruption case through Robert M. Entman's framing analysis model. Researchers chose 3 news samples to analyze how Detik.com journalists framed the news of SYL's corruption case on October 12 and 13, 2023. because on that date, SYL as a corruption suspect was caught and investigated by a team of KPK investigators, so on that date news related to SYL's corruption case was more widely reported. News framing uses Robert N Entman's theory with 4 news schemes; define problems, diagnose causes, make moral judgments, and treatment recommendations.

## II. RESEARCH METHODS

This research is a qualitative research with a constructivist paradigm perspective. The constructionist view of news is like a drama. It is not a description of reality, but a portrait of the battleground between various related parties (Eriyanto, 2007: 25). Because many factors influence media content, at the institutional level it is strongly influenced by ideological factors and the political direction of media owners. Like a drama, there are those who are defined as heroes, but there are also those who are defined as enemies and losers. The construction of reality by the media is not only based on the way the editorial team views reality, but also includes the political life where the media is located. The political system implemented by a country determines the working mechanism of the mass media and influences the way the mass media constructs reality.

The analysis method used in this research is framing analysis. Eriyanto (2012:12) argues, "framing analysis is a content analysis method that is influenced by sociology and psychology theories". Framing can be studied as a strategy for processing and constructing news descriptions or as a characteristic of the content itself. The framing process is closely related to the routines and professional conventions of journalism. The framing process cannot be separated from the strategy of processing and presenting information in media presentations (Simatupang, 2021).The framing model that researchers believe is suitable for analyzing the case that is the object of research is the framing analysis model of Robert N. Entman by describing the four elements in each news which is the object of research, in order to be able to know the frame of mind of online media, especially detik.com on the news of the suspected corruption case of Minister of Agriculture SYL. Then observe how aspects and realities are framed by the media for the process of forming reality construction by the media into the formation and construction of a reality. Robert N. Entman's framing model has four main elements as shown in the following table.

**Table 1. Robert N. Entman's framing element set**

Element of framing	The discovery
Problem identification	What the problem is framed as
Diagnoses causes	Causal logic related to the problem
Make moral judgement	What moral values are highlighted
Solution	What solutions are highlighted in news frame

### A. Study Subjects and Objects

The subject of this research is the online media detik.com. The objects of research are three news published by detik.com on October 12-13, 2023.

## Framing Analysis of the Suspected Corruption Case of Agriculture Minister Syahrul Yasin Limpo

**Table 2. Detik.com news subjects analyzed**

NO	NEWS HEADLINE	PUBLICATION TIME
1	. KPK Langsung Periksa Syahrul Yasin Limpo Usai Ditangkap	October 12, 2023 at 20.26 WIB
2	SYL Ditangkap Malam Ini Padahal Siap Hadir Besok, Ini Alasan KPK	October 12, 2023 at 20.28 WIB
3	SYL Diduga Pakai Miliaran Duit Korupsi Beli Tiket – Perawatan Wajah Keluarga	October 13, 2023 at 19.22 WIB

Source: processed by researchers 2023

### III. RESEARCH RESULTS AND ANALYSIS

Framing analysis of SYL's corruption case on Detik.com using Robert N Entman's analysis theory.

#### A. News Analysis 1

Headline: KPK Langsung Periksa Syahrul Yasin Limpo Usai Ditangkap

Publication time: October 12, 2023 at 20.26 WIB

KPK has arrested former Minister of Agriculture Syahrul Yasin Limpo in connection with an alleged corruption case. Syahrul Yasin Limpo was caught in an apartment in Kebayoran Baru, South Jakarta. Syahrul Yasin Limpo was arrested 1 day before his scheduled interrogation. KPK immediately investigated Syahrul Yasin Limpo shortly after arriving at the KPK Red and White House. The framing analysis of detik.com news with Robert N Entman's framing scheme is listed in Table 3.

**Table 3. News analysis 1**

Schematics	The discovery
<i>Problem identification</i>	Syahrul Yasin Limpo, commonly known as SYL, was investigated by a team of KPK investigators after being arrested at an apartment in Kebayoran Baru, South Jakarta. SYL was arrested in an allegations of corruption.
<i>Diagnose causes</i>	The source of the problem in this news is that the KPK arrested SYL 1 day before the scheduled investigation. SYL was sent a summons on Friday (tomorrow), but the KPK decided to arrest SYL at his apartment on Thursday (when the news was released).
<i>Make moral judgement</i>	The KPK's arrest and investigation of SYL, which took place one day before the scheduled investigation, showed that the KPK investigators were taking the case seriously. The KPK did not want the suspect to run away or lose any evidence before the scheduled investigation.
<i>Solution</i>	KPK arrested YSL on Thursday (12/10/2023), 1 day before the scheduled investigation on Friday (13/10/2023). The KPK investigating team immediately investigated YSL after his arrival at the KPK's Red and White Building. Firm action by the KPK indicates the seriousness of the KPK in handling corruption cases. With news like this, hopefully corruption cases (especially in the line of ministries) will not happen again.

After analyzing the news above, based on the results of the 4 elements of news framing using Robert N Entman's theory, it can be concluded that the first news constructs the reality of the arrest of SYL as the former Minister of Agriculture related to corruption in the Ministry of Agriculture. The moral value displayed in the news is the firmness of the KPK in eliminating corruptors and disciplining corruption, even within the government. In this news, detik.com highlighted the KPK's attitude to arrest and investigate directly, rather than SYL's lawyer's protest regarding SYL's investigation schedule which should have been held 1 day after the arrest. Detik.com framed the story through the KPK's efforts to investigate corruption.

#### B. News Analysis 2

Headline: SYL Ditangkap Malam Ini Padahal Siap Hadir Besok, Ini Alasan KPK

Publication time: October 12, 2023 at 20.28 WIB

KPK forcefully arrested Syahrul Yasin Limpo (SYL), the former Minister of Agriculture who is a suspect in a corruption case at the Ministry of Agriculture. SYL was scheduled to be investigated by the KPK on Friday (13/10/2023). However, the KPK arrested SYL at his apartment this evening, Thursday (12/10/2023). The following is an analysis of the news framing using Robert N Entman's scheme (Table 4):

## Framing Analysis of the Suspected Corruption Case of Agriculture Minister Syahrul Yasin Limpo

Table 4. News of analysis 2

Schematics	The discovery
<i>Problem identification</i>	The KPK forcefully arrested SYL, a suspect in the Ministry of Agriculture corruption case, one day before the scheduled summons, based on strong legal reasons.
<i>Diagnose causes</i>	The source of the problem in this news is that the KPK arrested SYL 1 day before the scheduled examination set in the summons on the basis of concerns that SYL would escape and SYL would disappear evidence. Head of KPK News, Ali Fikri said, "When arresting a suspect, there are reasons in the criminal procedure law, such as the fear of running away, the fear of disappearing evidence, that is the basis for the KPK investigating team to make an arrest and bring him to the KPK Red and White Building." In addition, the KPK has given SYL space to fulfill the call, but the previous call was not attended.
<i>Make moral judgement</i>	SYL's arrest at his apartment one day before his scheduled interrogation by the KPK was an accurate and firm action taken by the KPK. SYL's arrest was made after the KPK knew that SYL was already in Jakarta but had not come to the KPK to fulfill the first call that SYL had avoided.
<i>Solution</i>	The solution offered in this news is that the government (through the KPK) will take firm action against corruption criminals. The KPK does not give the criminals a chance to escape and prevents the criminals from disappearing evidence.

The results of the news analysis based on the results of the analysis on the 4 elements of news framing using Robert N Entman's theory, it can be concluded that in the second news, detik.com constructed the reality of SYL's forced arrest in his apartment as a result of SYL's actions that did not fulfill the KPK's first call.

The moral value displayed in the news is the correct and right action taken by the KPK in investigating the Ministry of Agriculture corruption case committed by SYL. The KPK confirmed that there was a strong legal basis for the KPK investigation team to arrest SYL before the scheduled summons. SYL's arrest was to prevent SYL as a suspect from running away and disappearing evidence, and direct investigation by the KPK. In this news, detik.com did the framing through strong reasons from the KPK for the action of arresting SYL.

### C. News Analysis 3

Headline: SYL Diduga Pakai Miliaran Duit Korupsi Beli Tiket – Perawatan Wajah Keluarga

Publication time: October 13, 2023 at 19.22 WIB



Figure 3. Syahrul Yasin Limpo during his investigation

Source: Detik.com accessed October 13, 2023

KPK has charged former Minister of Agriculture Syahrul Yasin Limpo (SYL) along with Secretary General of the Ministry of Agriculture Kasdi Subagyo and Director of Alsintan Ministry of Agriculture Muhammad Hatta as suspects in a case of misusing power and receiving gratification. The money from this corruption was reportedly used by SYL to buy airplane tickets for his family and facial treatments. The following news framing analysis with Robert N Entman's scheme is listed in Table 5.

## Framing Analysis of the Suspected Corruption Case of Agriculture Minister Syahrul Yasin Limpo

Table 5. News analysis 3

Schematics	The discovery
<i>Problem identification</i>	Syahrul Yasin Limpo or SYL as the former Minister of Agriculture was confirmed as a suspect in a case of abuse of power and acceptance of gratuities at the Ministry of Agriculture, allegedly using the money from the corruption to buy family plane tickets and facial treatments. Syahrul Yasin Limpo or SYL as the former Minister of Agriculture was not the only suspect in the corruption case at the Ministry of Agriculture who misused his power and received gratification, but there were also 2 suspects, the Secretary General of the Ministry of Agriculture, Kasdi Subagyono, and the Director of Alsintan Ministry of Agriculture, Muhammad Hata.
<i>Diagnose causes</i>	The source of the problem in this news is that SYL together with KS and MH enjoyed the money of the corruption proceeds of around 13.9 million. The money was allegedly used to pay credit card installments, installments for the purchase of SYL's Alphard car, private home improvements, airplane tickets for the family to medical treatment and facials for the family, and to go Umrah together.
<i>Make moral judgement</i>	With corruption cases in the amount of billions conducted by SYL, KS, and MH, it has become a huge obstacle in running programs in the Ministry of Agriculture. It also makes the performance of the Ministry of Agriculture questionable.
<i>Solution</i>	The KPK has confirmed SYL as a suspect and has been investigating the amount of money SYL, KS and MH corrupted. All three will continue to be investigated until punishment. With this news, hopefully there will be no more cases of corruption in the Ministry, or in other institutions.

Based on the analysis of observations on 4 elements of news framing using Robert N Entman's theory, it can be concluded that in the third news, detik.com constructs the reality of corruption cases within the Ministry of Agriculture committed by Minister of Agriculture Syahrul Yasin Limpo, Secretary General of the Ministry of Agriculture Kasdi Subagyono, and Director of Alsintan Ministry of Agriculture Muhammad Hata and the corruption proceeds and the use of the corruption money.

In this news, detik.com highlighted the suspects in the corruption case at the Ministry of Agriculture, totaling 3 people (SYL, KS, and MH) and the corruption proceeds and the use of corruption proceeds. The use of the corruption monies allegedly used to pay credit card installments, installments for the purchase of SYL's Alphard car, private home repairs, airplane tickets for the family to medical treatment and facials for the family, and going on Umrah together was highlighted to show that the amount of money corrupted in the Ministry of Agriculture was very large. The large amount of funds certainly disrupted the operations of the Ministry of Agriculture.

#### IV. CONCLUSION

Three news published on October 12 & October 13, 2023 on the Detik.com reported the arrest of Minister of Agriculture Syahrul Yasin Limpo for suspected corruption along with the secretary general of the Ministry of Agriculture Kasdi Subagyono and the Director of Alsintan Ministry of Agriculture Muhammad Hatta and the total amount of money from corruption and the use of the money.

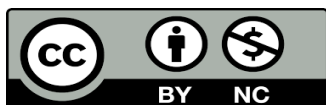
Based on the results of the framing analysis using Robert N Entman's framing model, Detik.com framed the news of former Agriculture Minister Syahrul Yasin Limpo's corruption case as follows: 1) Problem identification, in the first and second news, Detik.com defines the problem in the news of how the KPK made the decision to forcibly arrest Syahrul Yasin Limpo 1 day before the summons schedule. In the third news, Detik.com defines the problem in the news related to the use of money from Syahrul Yasin Limpo's corruption; 2) Diagnose causes, in the first and second news, Detik.com shows that Syahrul Yasin Limpo's arrest by the KPK has strong legal reasons, including to prevent Syahrul Yasin Limpo from running away and disappearing evidence, in the third news Detik.com highlights the details of the use of money from Syahrul Yasin Limpo's corruption, which is for personal and family needs; 3) Make moral judgment, in the first and second news, Detik.com focuses more on how the firm and correct attitude taken by the KPK for the forced arrest of Syahrul Yasin Limpo 1 day before the summons schedule, this action is considered very

## Framing Analysis of the Suspected Corruption Case of Agriculture Minister Syahrul Yasin Limpo

appropriate to prevent the suspect from missing the investigation, while in the third news Detik.com shows how the Ministry of Agriculture has lost money due to the corruption case committed by Syahrul Yasin Limpo; 4) Solution, Detik.com shows how the KPK will take firm action against perpetrators of corruption.

### REFERENCES

- 1) Badjuri, Ahmad. (2011). Peranan komisi pemberantasan korupsi (KPK) sebagai lembaga anti korupsi di Indonesia. *Jurnal Bisnis dan Ekonomi*, 18(1): 84-96.
- 2) Eriyanto. (2007). *Analisis Framing: Konstruksi, Ideologi dan Politik Media*, Yogyakarta, LKIS.
- 3) Eriyanto. (2012). *Analisis Framing: Konstruksi, Ideologi dan Politik Media*, Yogyakarta, LKIS.
- 4) Hamad, Ibnu. (2004). *Konstruksi Realitas Politik Dalam Media Massa; Sebuah Studi Critical Discourse Analysis Terhadap Berita-Berita Politik*. Jakarta: Granit.
- 5) Indonesia Corruption Watch (ICW). (2022). Jumlah Penindakan Kasus Korupsi di Indonesia 2018-2022. <https://www.antikorupsi.org/id> diakses 30 Oktober 2023 pukul 10.00 WIB.
- 6) Leliana, I., Herry., Suratriadi, P., & Enrieco, E. (2018). Analisis framing model Robert N Entman tentang pemberitaan kasus korupsi bansos Juliari Batubara di Kompas.com dan BBCIndonesia.com. *Cakrawala: Jurnal Humanioran dan Sosial*, 21(1): 60-67.
- 7) Muhammad, Nabila. (2023). 5 Provinsi dengan Jumlah Laporan Kasus Dugaan Korupsi Terbanyak yang Diterima KPK (Januari-Juni 2023). <https://databoks.katadata.co.id> diakses 30 Oktober 2023 pukul 10.25 WIB.
- 8) Putri, Dwina. (2021). Korupsi dan perilaku koruptif. *Tarbiyatul Bukhary, Jurnal Pendidikan, Agama dan Sains*, 5(2): 47-54.
- 9) Simatupang, Rosida. (2021). Analisis framing pemberitaan Kompas.com tentang Covid-19 di DKI Jakarta. *Jurnal Pustaka Komunikasi*, 4(1): 39-52.
- 10) Sobur, Alex. (2013). *Analisis Teks Media: Suatu Pengantar Untuk Analisis Wacana, Analisis Semiotika dan Analisis Framing*. Bandung: PT. Remaja Rosdakarya.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## The Influence of Using Idol Kpop Brand Ambassador, Viral Marketing, and Lifestyle on Impulse Buying in Consumers Shopee Marketplace



Ni Putu Ayu Tika Kurniawati<sup>1</sup>, A A I Krisna Gangga Dewi<sup>2</sup>, N. Paramananda<sup>3</sup>

<sup>1,2,3</sup> Faculty Of Economic and Business, Warmadewa University, Bali

**ABSTRACT:** This study aims to analyze the effect of using kpop idol brand ambassadors, viral marketing, and lifestyle on impulse buying on shopee marketplace consumers in Badung Regency, This research uses quantitative research methods, with purposive sampling techniques. The sample calculation used the Slovin formula technique which in this study amounted to 100 respondents. The results of this study explain that the variables of using kpop idol brand ambassadors, viral marketing, and lifestyle simultaneously have a significant positive effect on impulse buying. The use of kpop idol brand ambassadors partially has a positive and significant effect on impulse buying. viral marketing partially has a positive and significant effect on impulse buying. Lifestyle partially has a positive and significant effect on impulse buying.

**KEYWORDS:** kpop idol brand ambassador, viral marketing, Lifestyle and Impulse buying

### I. INTRODUCTION

Most people have moved online and integrated digital services, such as e-commerce, into their lifestyle. Quoted from Suara.com (2023) Consumers in Indonesia have become accustomed to digital devices and spend more time on online platforms. The various conveniences and technological advances offered have an influence, especially in the tendency of people's online shopping behavior. According to SimilarWeb data (2023), the 5 e-commerce sites in the marketplace category with the most visitors in Indonesia in the second quarter of 2023 were Shopee, Tokopedia, Lazada, Blibli, and Bukalapak. As for the 5 sites, only Shopee and Blibli achieved growth in visits. During the second quarter of 2023, Shopee's website received an average of 166.9 million visits per month, up 5.7% compared to the previous quarter (quarter-on-quarter/qqq). To increase visitors to the Shopee website, shopee always strives for various digital marketing in increasing visitors, one of which is by using KPOP Idol Brand Ambassadors. Quoted from Indriningtiyas (2022) many people like to use Korean artists as brand ambassadors because young people are interested in K-pop and South Korean culture and things. Apart from using brand ambassadors, shopee also uses viral marketing in its marketing. Viral marketing used by shopee According to Hindayani (2018) Viral marketing starts from the habits of everyday life. If we feel something positive or negative, we will pass it on (tell stories) to others. In addition to brand ambassadors and viral marketing in shopping online through shopee, there are internal factors that stimulate consumers to make impulse purchases, namely lifestyle factors. According to Wulan et al., in Angela (2020) said that currently shopping habits have become a lifestyle to satisfy emotions and no longer to meet needs, thus causing changes in behavior from what people used to shop with a plan to shopping unplanned and even spontaneously.

### II. LITERATURE REVIEW AND RESEARCH DEVELOPMENT

#### Impulse Buying

Utami (2010) Impulse buying is a purchase that occurs suddenly after consumers see items on display at a shopping place, so that consumers are interested in having them. This interest occurs because of the stimulation of the shopping place. Mowen and Minor explain that impulse buying is a buying behavior where consumers do not consider buying or consider buying but have not decided what product to buy, or can be defined as a buying action without having prior problems or buying intentions / intentions formed before entering the store. Or it can also be said to be a sudden, strong, persistent and unplanned urge to buy something directly, without much thought about the consequences (Utami, 2010).

#### Brand Ambassador

# The Influence of Using Idol Kpop Brand Ambassador, Viral Marketing, and Lifestyle on Impulse Buying in Consumers Shopee Marketplace

The use of brand ambassadors is not only more cost-effective, but also more effective than other marketing tools such as advertising (Andersson and Ekman, 2009). Brand Ambassadors, also known as opinion leaders, can start using a new product or idea and create a special place for the brand (Rehmet and Dinnie, 2013). Brand ambassadors are mediators between internal and external brand management and can have a significant impact on customer perceptions of brands and organizations; and in general, brand ambassadors are brand representatives who confirm the brand with their reputation (Goutam, 2013; Harris and De Chernatony, 2001). Recent studies have been conducted on brand ambassadors, for example, research examined how employees can be effective and recognized as brand ambassadors (Gilani et al., 2016) and other research explored the effects of football players as brand ambassadors on beverage brand management (Fairchild et al., 2017), and other research investigated the positive and negative impacts of celebrities such as actors and athletes on brand awareness and image (Boeuf, 2017) and other research investigated the positive effects of celebrities on brand awareness (Rahman, 2017).

## Viral Marketing

To measure the success of viral marketing, Kotler and Keller (2014) argue that in measuring the viral success of the jackrabbit.intuit.com website, blogs are classified based on speed (how long it takes for a blog to go viral), Vote share (How many conversations are happening on the Arena blog), the quality of the voice (what is being said and how positive or negative it is), and the sentiment. (How meaningful the comment is). Viral marketing is a type of marketing that broadcasts itself and encourages others to voluntarily share the message with others. As one of the modern tools, viral marketing can advertise and promote companies with interactive media, which utilizes social networks to increase brand awareness. In this era, many consumers use this method when making purchasing decisions (S.L. Wei, 2014). Based on the research result of Widyadhari and Wiyadi (2023) viral marketing having a positive effect on purchasing decisions.

## Lifestyle

Lifestyle according to Assael (2019) is a pattern of life in the world expressed by a person's activities, interests, and opinions. Consumers with a hedonic lifestyle in satisfying their needs, often use emotional criteria rather than logic in making purchasing decisions (Assael, 2019). According to (Reni 2019) Lifestyle is an individual's way of life in which they manage their psychosomatic, social and physical economic environment based on daily habits. According to Kotler & Keller (2016), lifestyle is a person's life as shown through activities, interests, and opinions. It can be concluded that lifestyle is a person's style of living the life cycle. Based on the research result of Nuri (2022) lifestyle having a positive and significant to impulse buying.

### III. RESEARCH METHOD

This study is a quantitative research. The population in this research consists of teenagers in Badung, Bali. The sampling method used is non-probability sampling, with a sample size of 100 respondents selected through purposive sampling. Data collection is done using a Google Form distributed to respondents who meet the criteria, which are teenagers aged 15-24 years, residing in Badung, Bali, and have made purchases on Shopee. The collected data is analyzed using multiple linear regression

### IV. RESULT AND DISCUSSION

Respondents this research are 100 consumers of Shopee in Badung Regency. These respondent are 25% or 25 person with the age 15-19 years old, 25% or 25 person 20-24 years old and 25% or 25 person with the age 25-29, years old, 25% or 25 person 30-34 years old. "The age of the respondents indicates their ability to make impulse buying by considering brand ambassadors kpop idol, viral marketing and lifestyle.

#### Result of validity and Reliability test

Test the validity of the questionnaire statements distributed to 100 respondents who have made purchases at Shopee. All items used valid because Person Correlation value all items more than 0,01. "This study tested reliability using the Conbrach's Alpha test, and the reliability test results for all items yielded a Conbrach's Alpha value higher than 0,5.

**Table 1. Validity and Reliability Test**

Variable	Item	Valid	Reliabel
Brand Ambassador Kpop Idol (X1)	Shop at every event held by shopee (X1.1)	0,879	
	Interested in shopping at shopee because it suits their needs (X1.2)	0,893	
	Kpop idols can be trusted when conveying about the shopee application (X1.3)	0,867	0,903

## The Influence of Using Idol Kpop Brand Ambassador, Viral Marketing, and Lifestyle on Impulse Buying in Consumers Shopee Marketplace

	Kpop idols have an attraction due to their popularity which is known to people from various circles (X1.4)	0,887	
	Kpop idols as brand ambassadors have the ability to influence consumer perceptions about shopee (X1.5)	0,881	
Viral Marketing (X2)	How long does it take for shopee to go viral on social media (X2.1)	0,620	
	Suggesting others to shop at shopee (X2.2)	0,704	
	Spread information about shopping at the shopee marketplace through social media (X2.3)	0,752	0,754
	Interested in shopping at shopee because I saw the information on social media (X2.4)	0,702	
Lifestyale (X3)	Shop at every shopee event (X3.1)	0,679	
	Interested in shopping at shopee marketplace because shopee follows korean wave (X3.2)	0,895	0,688
	Interested in shopping at the shopee marketplace because it can increase self-confidence (X3.3)	0,661	
Impulse Buying (Y)	Shopped at shopee because they saw advertisements on various websites (Y1)	0,720	
	Buying items without planning when seeing discounts (Y2)	0,693	0.777
	Buying products or services that promise a pleasant experience even without planning (Y3)	0,783	
	Like to enjoy the moment now and bear the consequences later rather than carefully planning every purchase (Y4)	0,708	

"The multiple linear regression analysis results are free from classic assumption tests. The One-Sample Kolmogorov-Smirnov Test for normality yielded an asymptotic significance value of 0.200, which is higher than 0.05, indicating that the data is normally distributed. The regression model is free from multicollinearity as the Variance Inflation Factor (VIF) is less than 10, and the tolerance values are more than 0.1. The heteroskedasticity test using the Gletjer test indicates that it is free from heteroskedasticity because the significance value is higher than 0.05

### Multiple Regression Analysis

**Table 2 multiple regression analysis**

Dependent Variable	Independent Variable	Coefisien Regression	t Value	Level of Sig
Y	Constant	0.866	0.911	0.365
	Brand Ambassador Kpop Idols	0.050	5.357	0.000
Impulse Buying	Viral Marketing	0.066	5.342	0.000
	Lifestyle	0.081	4.743	0.000
	F Value		79.301	0.000
	Adjusted R Square		0.704	

Based on the regression model's F-test, it is considered suitable because the F-value has a significance level of less than 0.05 (alpha). An adjusted R Square value of 0.704 means that 70.4 % of consumer impulse buying are determined by variations in on brand ambassadors kpop idols, viral marketing, and lifestyle. Meanwhile, 29.6 % is determined by other variables that are not included in the model. This study has three hypotheses, H1 : There is a significant influence between the use of Kpop Idol Brand Ambassadors on Impulse Buying in Shopee Marketplace Consumers, H2 : A significant influence between Viral Marketing on Impulse Buying in Shopee Marketplace Consumers and H3 : A significant influence between Lifestyle on Impulse Buying in Shopee Marketplace Consumers.

## V. DISCUSSION

H1 states that Brand ambassador kpop idol reviews have an effect on customer impulse buying. Brand ambassador kpop idol can enhance customer impulse buying. The emergence of the Korean wave caused local brands to use Korean artists and idols as



## The Influence of Using Idol Kpop Brand Ambassador, Viral Marketing, and Lifestyle on Impulse Buying in Consumers Shopee Marketplace

brand ambassadors for their products. Shopee uses the Kpop idol "Blackpink" as their brand ambassador to attract the attention of Kpop fans to visit the Shopee site. This research is supported by studies conducted by Putri (2023), Salsabila (2023), Zulianto (2022), all of which found a positive and significant impact on impulse buying. H2 state that Viral marketing have an effect on customer impulse buying. Viral marketing can enhance customer impulse buying. Viral marketing is word of mouth marketing that uses the internet as an intermediary by creating electronic messages or other marketing events that are very contagious so that consumers are willing to spread and recommend products or services to friends or relatives, because consumers convey messages or promotions to other consumers, then using viral marketing does not cost a lot of money. This means that viral marketing also affects customer impulse buying. This research is supported by studies conducted by Widyadhari, Wiyadi (2023) which found a positive and significant impact on impulse buying. H3 states that lifestyle reviews have an effect on customer impulse buying. Lifestyle that changes people from planned to unplanned shopping habits. This is very influential on costumer impulse buying. This research is supported by Nuri (2022), which found a posive and significant impact on customer impulse buying.

### VI. CONCLUSION

Brand ambassadors Kpop idols, viral marketing and lifestyle have the same positive and significant effect on impulse buying. This research has theoretical and practical implications. The theoretical implications involve the development of consumer behavior theory in impulse buying. Practically, for sellers on Shopee, it is recommended to continue to increase viral marketing by spreading it on social media. For consumers, Before making a purchase, you must first find out whether the item is purchased based on needs or just a lifestyle. For further research, it is recommended to increase the number of samples with wider coverage. Apart from that, we add variables that have not been studied in this research, such as trust, quality of information, motivation and so on.

### REFERENCES

- 1) Christina Whidya Utami, Retail Management: Strategy and Implementation (Business Operations Morden in Indonesia), (Jakarta: Salemba Empat. 2010), 51.
- 2) Harwandi, RI (2018). The relationship between parental social support and procrastination in writing a thesis for students (Thesis). Faculty of Psychology and Social and Cultural Sciences, Indonesian Islamic University, Yogyakarta. Taken from <https://dspace.uui.ac.id/handle/123456789/9762>
- 3) KI Zernigah and K. Sohail, Consumers' Attitude Towards Viral Marketing in Pakistan. Management & Marketing Challenges for the Knowledge Society, vol. 7, no. 4, pp. 645-662, 2015.
- 4) Michel R. Solomon, Consumer Behavior Buying, Having, and Being 10th Edition (New Jersey: Prentice Hall, 2013), 351
- 5) Putri, CM (2023). The Influence of *Brand Ambassadors on Impulsive Buying with Brand Image as a Moderating Variable in the Lemonilo*
- 6) Salsabillah, TA (2023). *THE INFLUENCE OF KPOP IDOL BRAND AMBASSADOR PERCEPTIONS ON IMPULSIVE BUYING AMONG KPOP FANS USING SHOPEE* (Doctoral dissertation, Yogyakarta Technological University)
- 7) SL Wei, The Attitudes of Consumers towards Viral Marketing in Malaysia. (Doctoral Dissertation) (Available in Tunku Abdul Rahman University Database), 2014.
- 8) SL Wei, The Attitudes of Consumers towards Viral Marketing in Malaysia. (Doctoral Dissertation) (Available in Tunku Abdul Rahman University Database), 2014.
- 9) Sugiyono (2015). Combination Research Methods (Mix Methods). Bandung: Alfabet.
- 10) Wideasworo Erwin. (2017). Strategies and Methods for Teaching Students Outside the Classroom. Yogyakarta: Ar-ruzz Media
- 11) Wijaya, KA, & Tjiptodjojo, KI (2023). Impulse Buying Behavior of Shopee Users During the Covid-19 Pandemic. *Economics, Finance, Investment and Sharia (EQUITY)* , 4 (4), 1104-1112.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Cultural Dynamics of Ubud Noble Families in the Age of Globalization



Anak Agung Inten Asmariati<sup>1</sup>, A.A Ayu Rai Wahyuni<sup>2</sup>, A.A Ayu Dewi Girindrawardhani<sup>3</sup>, Abu Bakar Ramadhan Muhamad<sup>4</sup>, Eko Suwargono<sup>5</sup>

<sup>1,2,3</sup> History Study Program, Faculty of Cultural Sciences, Udayana University

<sup>4,5</sup> Faculty of Humanities, Universitas Jember

**ABSTRACT:** This paper presented about the dynamics of culture and traditions of the Ubud aristocratic family that took place in the era of Globalization, Ubud Palace is one of the tourism powerhouses in Bali. Cultural results have developed in the era of globalisation and culture in Ubud Castle—the introduction of the Puri Family to Europeans in 1927. Further development in 1930, the Ubud area began to be introduced by Walter Spies through his paintings so that Ubud was known to foreign countries, and also packaged cultural products as part of tourist attraction. Furthermore, this paper focuses on cultural dynamics that contain customs and traditions by asking two questions: First, How are the cultural dynamics of Ubud aristocratic families in the era of globalisation? The second tries to trace the forms of cultural dynamics and their implications. Both questions above are answered by elaborating the concepts of dynamics, nobility, tourism and globalisation. The concept is wrapped through theory. Two theories are used in this paper, namely the theory of dynamics and psychological theory, with the methodology of the history of mentality. The results of this paper show an interesting phenomenon: the cultural dynamics experienced by the Ubud nobility cannot be separated from changes in the government system from the kingdom in the form of government. Like The entry of foreign culture with the introduction of a painter from France, Walter Spies and the entry of tourism, there was a cultural dynamic in the life of the noble family of Ubud Royal Palace.

**KEYWORDS:** nobility, cultural dynamics, globalisation, tourism, Ubud Royal Palace

### INTRODUCTION

Balinese culture in its development cannot be separated from the existence of the castle, which its leaders built since ancient times. Puri's existence was not only a residence for nobles but also automatically a centre of power and culture in its time. Now, Puri is also being developed into a high-value cultural tourist attraction, starting from the architecture of the building to the cultural activities, customs and traditions of the Puri family. Moreover, castles in Bali are not just residences for kings or nobles but are also built considering specific rules or local wisdom that have been in effect for generations, such as the concepts of Asta Kosala Kosali and Sanga mandala. Applying this local wisdom creates a beautiful castle, complete with authority for its residents and, at the same time, full of Balinese cultural values.

The king and his castle were formal and informal centres or leaders in the pre-independence era. However, as time passed, the form of government changed from the Kingdom to the Unitary State of the Republic of Indonesia. This causes the function of the Puri in Bali to change, not only as a residence for Kings or nobles but also as a tourist attraction that has a high appeal for tourists, so this will influence the activities of the Puri family and the Puri family still carries it out as a form of heritage. culture acquired from generation to generation is called tradition by following the times.

The castles in Bali correspond to the number of districts in Bali. Still, the municipality has three large castles, namely Puri Agung Pemecutan, Puri Denpasar, now known as Puri Agung Satria and Puri Agung Kesiman. For other areas, Puri Agung Karangasem, Puri Agung Singaraja, Puri Agung Gianyar, Puri Agung Bangli, Puri Agung Klungkung and for Puri Ubud itself during the Kingdom era were the residences of the retainers of the Kingdom of Gianyar. Geographically, Ubud Village is at an altitude of 250 meters above sea level. As a tropical area, Ubud Village has cool air temperatures between 26 and 28 degrees Celsius. Ubud is located about 26 km northeast of the centre of the capital of Bali Province. Administratively, Ubud Village is included in the Ubud sub-district, Gianyar Regency. This location can be reached from all directions due to the rotation of village areas and the availability of smooth connecting infrastructure. The road that passes in the East-West direction of the village connects

## Cultural Dynamics of Ubud Noble Families in the Age of Globalization

Ubud Village with the district capital and the provincial capital of Bali. Meanwhile, in the North-South direction, it connects Ubud Village with tourist attractions in the north Petulu (Tegalalang, Kintamani) and tourist attractions in the south, including the Wenara Wana tourist attraction, the Arma Museum (Oka Sukawati, 2004:49).

Puri Agung Ubud is the seat of the ruler of the Ubud area, who is a descendant of the Sukawati royal family. The Sukawati region once emerged as its kingdom in the 18th century AD but did not develop for long. The kingdom then collapsed due to conflict and the expansion of neighbouring kingdoms, including Gianyar and Mengwi. Before 1965, most of the Puri in Bali could still be said to have power during community life, where there had not been a reduction in rice field ownership carried out by Government policy. With the Land Reform in 1965, the government restricted the rice fields belonging to Puri, so the people no longer sent all their rice fields to Puri.

After Indonesia became independent, Land Reform was implemented, ending the form of kingdoms in Indonesia, including Bali. The position of the Kings and their families became the same in society. This also applies to the Puri Agung Ubud family. The descendants of the Puri Agung Ubud family still have the title Tjokorda and belong to the nobility group. The privileges gained when the King of Ubud became King and mingled with ordinary society. However, things changed from the order when he became king and mingled with ordinary society. During the kingdom period, people came to Puri when there were administrative matters. Still, nowadays, people go to Puri with the aim of ngayah when there are religious activities or traditional ceremonies at Puri. The Puri family must also blend into society and live like ordinary people.

The influence of globalisation, accompanied by the influx of tourism customs/traditional activities passed down from generation to generation by the Puri Agung Ubud family, continues. Still, as time goes by, there has been a dynamic in Puri culture. Departing from the problems above, several things want to be studied, including: (1) What are the Cultural Dynamics of the Ubud Aristocratic Family in the Era of Globalization? (2) Forms of Cultural Dynamics of the Ubud Aristocratic Families and the Implications They Have 2—Theoretical Framework.

A theoretical framework is a framework of thinking that originates from a theory needed to solve various research problems. In addition, the theoretical framework functions as a frame of reference that can direct research. In studying this topic, the author will use social psychology theory to answer changes in the lifestyle of the Ubud noble family after the Royal form was no longer implemented. With the help of psychology, it discusses the emotional events that occurred in the Puri family after the change from kingdom to form of government and the influence of tourism, resulting in cultural acculturation. The development of science and technology has given rise to human innovation and creativity, as well as the culture of the Puri family. The Puri nobility started to follow the trends of their time, from clothing styles, social interactions in society, and lifestyle, and they even paid great attention to education.

### RESEARCH METHODS

Good research always considers the compatibility between the techniques and the general flow of thought and theoretical ideas. Therefore, it is necessary to pay attention to the type of research and an appropriate method for conducting the research. This type of research is qualitative, a procedure that produces descriptive data in written or spoken words from people and observed behaviour. Research that uses qualitative research aims to understand the object being studied in depth and to develop the concept of sensitivity to the problems faced by explaining the reality related to theoretical exploration and understanding one or more of the phenomena faced (Imam Gunawan, 2022: 24). Regarding the article "Cultural Dynamics, Customs/Family Traditions of Puri Agung Ubud in the Era of Globalization", we will use Mentality History. The history of mentality is the result of combining sociology, psychology and history or social psychology and history. Mental history is the psychological history of a social group. The history of mentality discusses circumstances, behaviour and the collective subconscious (Kuntowijoyo, 2016: 11)

### DISCUSSION

According to Kuntowijoyo (2016), history can be written about contemporary culture. The greatest challenge for historians is precisely in writing contemporary history because we can see our present by writing it. Our present still belongs to many people, but historians can do the work that has the most advantageous position because historians can carry out critical reflection across time: past, present and future. Culture is dynamic, meaning it is continually undergoing continuous change. Cultural change occurs due to acculturation, a process of cultural dynamics in a society due to the influence of foreign cultures. In the acculturation process, the arrival of foreign cultural influences does not necessarily eliminate the old culture. The two cultures mix together to produce a new culture without losing their respective cultural identities. Innovation is also part of cultural dynamics, namely results that are not influenced by foreign cultures but by updates carried out by humans. The two things above influence the cultural dynamics of the Puri Agung Ubud family amidst the influence of globalisation.

## Cultural Dynamics of Ubud Noble Families in the Age of Globalization

### Cultural Dynamics of the Ubud Aristocratic Family in the Current Globalization

The changes in the Puri Agung Ubud family in terms of culture could have been felt earlier than in other kingdoms. This was caused by Tjokorda Raka Sukawati's controversial thoughts at that time, which began with his introduction to Walter Spies, a painter from France. Tjokorda Raka Sukawati was the son of the last King of Puri Agung Ubud. Throughout history, his name was unpleasant due to his closeness to the Dutch government. In 1946, the federal government was formed in Indonesia for the Dutch to continue to exert influence in Indonesia. One form of a federal state is the State of Eastern Indonesia (NIT). This country's president is Tjokorda Gde Raka Sukawati, accompanied by the prime minister, Mr. A. A. Gde Agung from Puri Agung Gianyar (Picard, 2006: 121-122).

There was a global approach taken by Tjokorda Gde Raka Sukawati, cultural innovations such as bringing foreign artists to Bali in 1927 and sending dancers and musicians to Europe in 1931. Tjokorda Gde Raka Sukawati's role was so significant that his family at Puri Agung Ubud supported him in making the Puri a tourist facility. Then, his footsteps were followed by other Puri in Bali. The influx of tourism to Puri Agung Ubud has indirectly influenced the lifestyle of the Puri family. There has been cultural acculturation between the Puri family and European friends from Tjokorda Gde Raka Sukawati. There was a suggestion from Walter Spies to open Puri as a place to stay for foreign tourists visiting Bali around the 1930s. The castle was used as a place to stay only for foreign guests or state guests related to Tjokorde Raka Sukawati or friends of Walter Spies. With increasing tourist visits in the 1970s, some Puri families seized this opportunity and adapted to tourism developments in Ubud and Bali. This ultimately influenced the lifestyle of the noble families at the Agung Ubud palace. It can be seen from how they dress, manners, language, knowledge and the influence of technological developments.

The role of Tjokorde Gde Raka Sukawati in developing Ubud as a Tourist Destination Area (DTW) is beyond doubt. Tjokorde Gde Raka Sukawati is a diplomat, great statesman, and noble nobleman. He played a role in Indonesian history during the Modern National Movement period and the Indonesian Revolution period, struggling through diplomacy in the political and cultural fields, giving birth to the concept of cultural diplomacy between countries at the world level (Arya Suharja et al. 2022). Tjokorde Gde Raka Sukawati was the son of Tjokorde Gde Sukawati, a Punggawa Agung Ubud warlord from the Kingdom of Gianyar (Keraton Gianyar). He is the second son of the Ubud Punggawa, who was instrumental in restoring Gianyar's sovereignty.

The family environment, the nature of Ubud and the strong cultural-religious activities in Ubud are some of the atmospheres that influenced the formation of a Tjokorde Gde Raka Sukawati, by receiving an education at Volkschool or village school in Gianyar. Then he continued to MULO. Tjokorde Gde Raka Soekawati's intention to improve his education was very high and with his father's permission, he continued his studies at the Opleidings School for Inlandsche Ambatenaren (OSVIA). After graduating from school at OSVIA, around 1918, Tjokorde Gde Raka Soekawati was immediately assigned as a police orderly in Denpasar (Arya Suharja. 2022:74-76).

A good relationship existed between the Puri Ubud family and the Javanese Palace, bringing Tjokorde Gde Raka Sukawati together with the German painter and musician Walter Spies. Spies' role is enormous in guiding his fellow artists to understand Bali. Spies is known for sharing knowledge about Bali and is involved in the artistic renewal movement that developed throughout the 1930s. Spies and his friends have influenced the rebuilding of the artistic desires of the Balinese people to produce new creations. Spies' admiration for classical art performances in Ubud and the Ubud area's beauty made Spies want to live in Ubud. The Puri Ubud family gave him the Campuhan area for Spies to live in. Spies' arrival in Ubud was followed by fellow artist Rudolf Bonnet and in 1929, Bonnet chose to settle in Ubud. Together with Bonnet, Spies made reforms in the arts, dance and painting, especially introducing new techniques in the fine arts. Likewise, on January 29 1936, the official founding of Pitamaha was based on the initiative of Tjokorde Gde Raka Soekawati, Tjokorde Gde Agung Sukawati, Walter Spies, Rudolf Bonnet and Gusti Nyoman Lempad. Because his interest in the arts was quite considerable, at the Second Youth Congress, Tjokorde Gde Rake Soekawati was trusted to lead an arts agenda outside Bali. In 1929, he led a vital artistic mission to elevate Indonesian culture, especially Balinese, at the local, national and international levels. Tjokorde Gde Rake Soekawati prepared an art tour at the Gambier festival held in Batavia. In the following period, he was again given assignments on arts missions, including cultural missions to the Paris Expo 1931, and the Expo of Colonial Countries throughout the World in Paris (Arya Suharja. 2022:95-103).

Through this mission activity, Bali's natural beauty and culture began to be introduced internationally. This influenced the diffusion of Balinese culture and impacted the culture of noble families in Bali, including the Ubud area. Cultural dynamics is a process related to social phenomena in the past and future, as well as changes that occur due to changes in human life patterns in society. The form of power in Bali was initially a Kingdom with privileges given to the King and his family in society. Still, after changes, the form of government was changed to the formation of the unitary state of the Republic of Indonesia. King's position and the family had the same position in society, so this change also influenced changes in the culture of the royal

## **Cultural Dynamics of Ubud Noble Families in the Age of Globalization**

family, which is also called the noble family. The culture in the palace is inherited from generation to generation, and gradually this culture can be used by society in general.

The influence of tourism gives rise to phenomena in society, including creativity and cultural innovation, including renewal in all fields, one of which is the arts. The arrival of artist Walter Spies in Ubud, who was amazed by what he found in Bali, made Spies admire Balinese culture. With his reputation as an artist, he made him an intermediary for honoured guests who came to Indonesia. Walter Spies is a phenomenal figure in the history of fine art in Indonesia and Bali in particular, his presence in various places in Java and Bali is always accompanied by the creation of mutualistic interactions with local artists until it develops into joint practice and artistic collaboration and not infrequently this practice gives birth to artistic creation.

Next, cultural acculturation also occurred, not only in the arts but also in the lifestyle of the nobles in Bali, including the Ubud nobles. The influx of foreign culture, especially European culture, as shown by Tjokorde Gde Rake Soekawati's introduction to Walter Spies, as well as education on the island of Bali, gave a new influence to Tjokorde Gde Rake Soekawati as the son of an Ubud Punggawa. It can be seen from how they dress, birthday celebrations by holding parties accompanied by drinking and dancing have entered the life of the Puri family. The thoughts of Tjokorde Gde Rake Soekawati's father were liberal. Still, they remained in the corridor of Puri cultural values, seen in the freedom given to Tjokorde Gde Rake Soekawati to remarry a Dutch woman as his 5th wife and 7th French wife.

Cultural revitalisation is one of the dynamics of culture, cultural revitalisation occurs as a form of effort to preserve the culture that a society has. The same thing happens to the Puri family, the cultural heritage obtained from generation to generation, known as Puri family customs or traditions, is still carried out, such as cremation ceremonies, weddings or other religious activities and still uses Puri standards.

### **Dynamic Forms of Aristocratic Culture and Their Implications**

The king and the royal family placed great importance on cultural symbols to show the hierarchy/power that Puri possessed. These symbols are seen in the structure of the Puri building, respect for the Puri family, and the way of clothing that is only used by the royal family, which is known as the noble group. After the change in the form of government, these symbols can still be found in Puri and some symbols blend into society.

#### **1. Authority**

The position of Tjokorde Gde Rake Soekawati's father was as an Ubud Manca, a patron and village head who carried out traditional village administration and promoted the culture of the Ubud area and its surroundings. Being in the Puri environment with his father as a Punggawa in Ubud gave the Ubud family power. There was a transition in the government system from district to village, so the Ubud area was then led by a prebeker at the level of the village head. The leader of this village is not necessarily from the Puri family, so this transition is an effort by the Puri family to adapt to a new atmosphere of life where they must blend in with society.

#### **2. Respect**

With the position of Tjokorde Gde Rake Soekawati's father as Punggawa, a burial procession was held so he was permitted to use the Naga Banda when he died. Naga Banda is a means of the Pengabenan (cremation) ceremony used by kings in Bali. Using adventure in different forms is inseparable from Balinese Hindu beliefs, history and mythology. The use of Naga Banda for the main cremation category. Naga Banda has its philosophical values. Judging from the stories that people believe, the story of naga banda begins with Raja Dalem Waturenggong, who tested Ida Dang Hyang Astapaka's supernatural powers. When Ida Dalem Waturenggong wanted Nyuciang Raga "Diksa" (self-purification), he asked the King of Majapahit to send the Buddhist Shiva Priest to be his nabe (principal spiritual teacher). The one who came was Dang Hyang Nirartha, the Shiva Priest but Ida Dalem Waturenggong was not yet pleased to have a ceremony with Dang Hyang Nirartha. Dang Hyang Angsoka, the older brother of Dang Hyang Nirartha, is a Buddhist priest, but due to his old age, he could not come to Bali and sent his son, Dang Hyang Astapaka.

Due to Dang Hyang Astapaka's young age, Ida Dalem Waturenggong wanted to prove his supernatural powers by making a bambang (hole) where the hole contained geese. Dang Hyang Astapaka came and was asked to guess what was in the hole, even though the sound "guk guk" indicated the animal was a swan, Dang Hyan Astapaka said it was a dragon. Hearing this, the people there laughed, including Ida Dalem Waturenggong. Then the hole was dug, and it turned out that a dragon emerged. This dragon was then conquered by Dang Hyang Astapaka and handed over to Ide Dalem Waturenggong, who advised that this animal would send his spirit to Swargaloka. Since hearing that message, when Ida Dalem Waturenggong died (died, the Balinese term used when a king dies), the Naga Banda Ngaben ceremony was used, which continues to this day. Besides using

## Cultural Dynamics of Ubud Noble Families in the Age of Globalization

Naga Banda, Ox is used during the burning process and uses Bade. In the use of oxen and Bade, people are now accustomed to using them according to economic capabilities.

### 3. Use of Clothing

There are clothing rules that must be worn by the king, family, courtiers and ordinary people. The king is the pinnacle of beauty, luxury and all that is expensive. Kuntowijoyo's writing "King, Priyayi and Kawula" was delivered by Pagelaran at the ceremony of giving fifteen types of Srinugraha umbrellas, starting from the top in the form of a kanigara crown to black velvet shoes with blue socks. Then the clothing of the courtiers is also included in the audience every Thursday (the king's birthday, the king's coronation day), both civil and military as a sign of the courtiers who are called priyantun. A similar thing also happened at Ubud Palace, how a retainer of the King, a commander who protected his country, was dressed. In every Ubud courtier's clothing, there are symbols with their meaning. For courtiers, men are called parakan and women are called pemuranaan. They are from among the ordinary people, the clothes used by men are cloth accompanied by bare-chested shirts with the task of covering the Punggawa Ubud. Women wear cloth and their top clothes are wrapped in a shawl to clean the king's residence and cook. The courtiers who were assigned as note-takers wore nicer clothes. These strict regulations were deliberately created to glorify the Ubud Punggawa. Ordinary people who entered the castle had to remove their clothes and put the things they brought on their heads with their heads down so as not to see my lord Punggawa.

As time goes by, there has been a shift in the way nobles dress. With the influx of tourism, there has been cultural acculturation which has also impacted how kings, courtiers and Santana kings (nobles) dress in a modern direction. The clothes worn by the kings in Bali are now commonly used by ordinary people in ceremonial activities between weddings, and the kings also have a modern dress style.

### 4. Lifestyle/Hedonism

During the kingdom's era of gratitude, if there was a success in an activity, the Ubud retainer and his sentana expressed their gratitude by praying with their family and eating together. The dish served is a type of vegetable called lawar, accompanied by a drink called palm wine. Introducing foreign culture through Tjokorde Gde Rake Soekawati to Europeans has begun to make European-style parties known, as well as marriages occurring in the royal family with more than one wife.

### 5 Traditional Activities

The Puri family traditions remain alive today, including human yadnya activities (ceremonies at seven months of pregnancy, ceremonies from birth to adulthood), Dewa Yadnya, and Pitra Yadnya. The Pitra Yadnya is carried out by the symbols of the King and the King's sentana. This can be seen in the use of Naga Banda, Bade, oxen and other ceremonial facilities.

Without realising it, the traditional activities have become a tourist attraction. However, of the many traditional activities carried out, several traditions can only be attended by noble families, one of which is the Teeth Cutting Ceremony

## Implications of cultural dynamics for Puri families and society

### 1. Cultural Preservation

Interestingly, the traditional activities, traditions and culture of the nobles in Bali, especially Ubud, attract tourists to learn more about the culture of noble families. Being in the modern era, and the strong current of globalisation, Ubud nobles do not simply abandon and forget the culture that has been inherent to them since birth. Balinese people have become modern but still preserve their culture (Picard, 2006: 173). By maintaining and preserving traditional cultures, Balinese cultural identity can be strengthened. Puri is a centre for developing arts and culture as a forum for cultural preservation. This is proven by the area in front of the Puri (ancak serving) being used as a place for practising dancing, megambel, carving and practising kekawin and kekidung (literary arts).

Without realising it, this activity has become an attraction for tourists to learn more about Balinese culture. The activities in Puri provide a positive meaning to the development and preservation of Balinese culture. This can be proven by the loyal attitude of the local community towards the Puri, this is especially visible when the Puri has events/ceremonies such as during cremation ceremonies.

### 2 Economy

According to Smith, effective allocation of human resources is the starter of economic growth. After the economy grows, capital accumulation (physical) is just starting to be needed to keep the economy growing. In other words, the effective allocation of human resources is a necessary condition for economic growth. As Ubud moves into the tourism area, the people of Ubud will not forget the role of Tjokorde Gde Rake Soekawati and Walter Spies has introduced Ubud to foreign countries through paintings by Spies. One of the changes occurring in the Ubud area is using residents' yards as shops for business.

From the results of an interview with Tjokorda Putra Sukawati (interview, January 2023), namely:

## Cultural Dynamics of Ubud Noble Families in the Age of Globalization

"When Ubud was still a traditional village, the yard structure was divided into three parts, namely the north or east as a sacred place, the centre as a residential area, and the south or west as a place to raise livestock and plant various kinds of plants, which was called the Teba area. However, the yard structure changed after Ubud became a tourist village, and the Teba area became a business place. "This change occurred because of the openness of the Ubud community to accept elements or influences that come from outside as long as they are seen from an economic perspective and are beneficial, and from a social and cultural perspective, they do not have a negative impact."

The expression above illustrates that the entry of Ubud as a tourism area has changed the layout of people's homes, but it has not changed the nature of Ubud people to forget its culture. This is what Tjokorde Gde rake Soekawati instilled when introducing Ubud to tourists. The influx of tourism should not diminish the cultural values which constitute the ancestral heritage, and this cultural heritage must be maintained and preserved.

### CONCLUSION

The changes or dynamics in the lives of noble families in Ubud went through a long process. This is due to the development of science and the influx of tourism to Bali. The flow of change cannot be stemmed by the Ubud noble family. The changes in the government system that took place in Indonesia and the issuance of the Land Reform policy (1965) had a big influence on the lifestyle of the Ubud noble family in Bali. Restrictions on land ownership, and the no more extended implementation of the Kingdom form, positioned the Ubud noble family on the same footing as the ordinary people. This social change became increasingly widespread until it entered the lifestyle of the Ubud and other Balinese nobles.

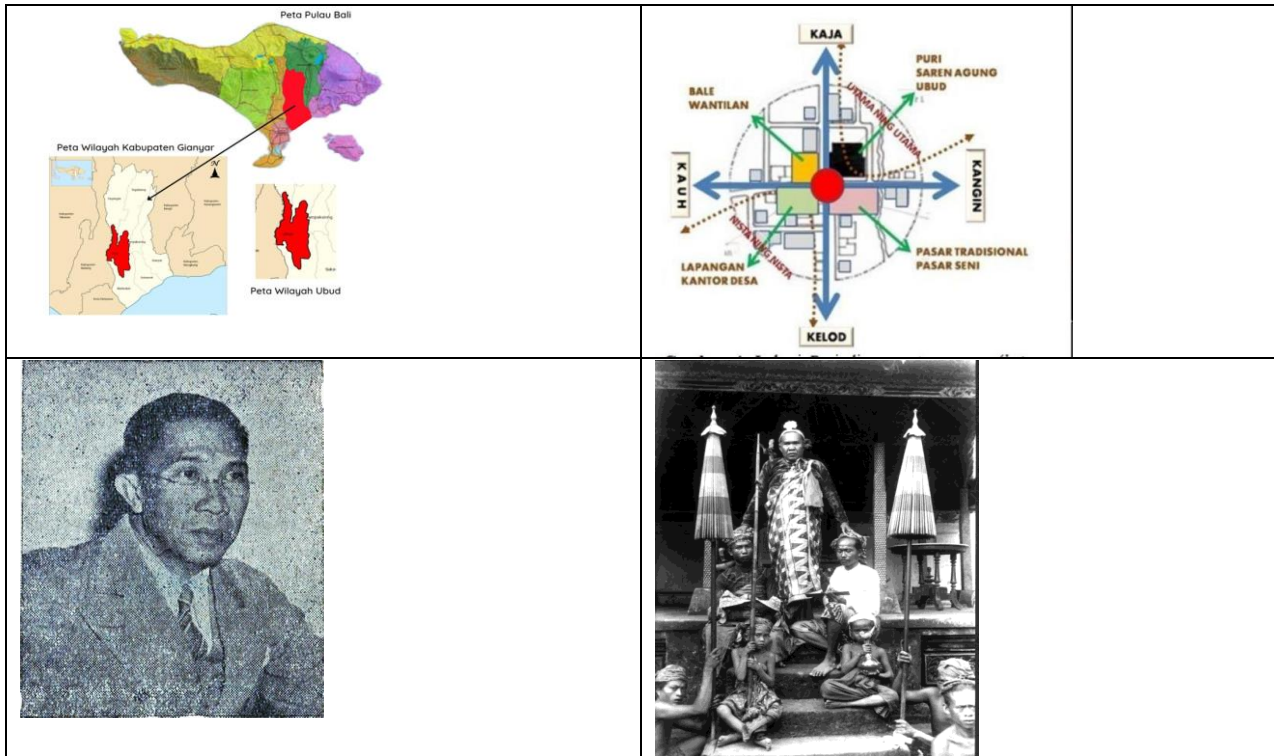
However, the cultural changes/dynamics among the noble community in Bali, have not changed the public's respect for the noble families. Likewise, because of the noble family's clever behaviour in society, one of them is donating to religious activities, and also they mingle in society without any boundaries. or partition, which is what causes the nobility to remain respected and respected.

### REFERENCES

- 1) Barker, Chris. 2004, *Cultural Studies, Teori dan Praktik* (terjemahan) Bantul: Kreasi Wacana.
- 2) Covarrubias, Miguel. 2013. *Pulau Bali*. Denpasar: Udayana University Press.
- 3) Darma Putra, I Nyoman 2016. Tjokorda Gde Putra Sukwati: *Mengemban Tutur Leluhur*. Denpasar: Jagat press.
- 4) Herlina, Nina. 2020. *Metode Sejarah Edisi Revisi 2 9e-book*. Bandung: Satya Historika. ISBN 978-602-7859-14-2.
- 5) Jamaludin. Adon Nursullah. 2017. *Sosiologi perkotaan Memahami Masyarakat Kota dan problematikanya*. CV Pustaka Setia.
- 6) Kuntowijoyo. 2016. *Raja, Priyayi, dan Kawula*. Penerbit: Ombak.
- 7) Kuntowijoyo. 2003. *Metodologi Sejarah*. (edisi kedua). Penerbit: Tiara Wacana Yogya.
- 8) Lorentius Goa, 2017. "Perubahan Sosial Dalam Kehidupan Bermasyarakat" *Jurnal Kateketik dan Pastrol* vol 2. No.2
- 9) Mantra, I.B, dkk.1995. *Bali di Persimpangan Jalan 1*. Denpasar: Nusa data Indo Budaya
- 10) Muhadjir, Noeng. 2000. *Metodelogi penelitian Kualitatif*. Yogyakarta: Rake Sarasin.
- 11) Pitana, I Gde. 1994. *Dinamika Masyarakat dan Kebudayaan Bali*. Denpasar: Balai Pustaka.
- 12) Munandar, Agus Aris. 2005. *Istana Dewa Pulau Dewata (Makna Puri Bali Abad ke 14-19)* Jakarta: Komunitas Bambu.
- 13) Putra, Ida Bagus Gde. 2022. *Komodifikasi Arena Balai Kertha Gosa-Taman Gili Bernilai Estetika dan Historis Sebagai Objek Konsumerisme di Kabupaten Klungkung* dalam buku *Fakta Melalui Kajian Sejarah, Budaya dan Sosial-Politik*, Denpasar: Pustaka Larasan.
- 14) Rodhius, Hans dan John Darling. 1980. *Walter Spies and Balinese Art*. Amsterdam: Tropical Museum.
- 15) Septiawan Sentana K. 2007. *Menulis Ilmiah Metodologi Penelitian Kualitatif*. Jakarta: Yayasan Pustaka Obor.
- 16) Sidemen, Ida Bagus. 1991. "Lima Masalah Pokok Dalam Teori Sejarah" *Widya Pustaka* No.2. Denpasar: Fakultas Ilmu Budaya Universitas Udayana.
- 17) Soekanto, Soerjono. 1990. *Sosiologi Suatu Pengantar*. Jakarta: PT. Raja Grafindo Persada.
- 18) Strauss, et.al.1997. *Dasar-Dasar Penelitian Kualitatif Prosedur, Teknik dan Teori Gronded*. Surabaya: PT. Bina Ilmu.
- 19) Suharja, Arya, et al. 2021. *Laksana Manut Sasana : Biografi Tjokorde Gde Rake Soekawati*. Badung: Sarwa Tattwa Pustaka
- 20) Sukawati, Tjokorda Oka A.A, 2004. *Ubud Bergerak*. Denpasar: Bali Media Adhikarsa.
- 21) Suartawan, I Wayan, dkk. 2019 "Strategi Komunikasi Politik Tokoh Puri Ubud Dalam Mempertahankan Eksistensi dan Tradisi Bali", *Jurnal Kumunikasi dan Teknologi Informasi Vol.11 No.1*

# Cultural Dynamics of Ubud Noble Families in the Age of Globalization

## Supplementary files



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.



## Implementation of Management Strategy in the Development of Dental Health Services for the Indonesian Maritime Community



**Nora Lelyana**

Universitas Hang Tuah, Jalan Arief Rachman Hakim No. 150, Surabaya, Indonesia

**ABSTRACT: Aim:** This qualitative research aims to explore the key geographical and demographic characteristics of the Indonesian maritime community and their impact on dental health services.

**Research Method:** This research will utilize secondary data sources such as existing studies, reports, and statistical data to analyze the geographical and demographic characteristics of the Indonesian maritime community.

**Research Findings:** The Indonesian maritime community faces complex challenges in dental health services, influenced by factors like access, social and cultural determinants, rural health, and oral health policies. Addressing these challenges requires expanding access, strengthening the dental workforce, and implementing policies that promote oral health. Socioeconomic factors, cultural beliefs, and geographic location significantly influence dental health within the Indonesian maritime community, emphasizing the need for targeted interventions. Evaluating the effectiveness of policies and initiatives related to dental health services is important in reducing disparities and identifying areas for improvement. To implement effective management strategies for dental health services, healthcare management theories, social determinants of health, and collaboration and partnerships are necessary to address the unique challenges in this community.

**Conclusion:** Implementing a management strategy that addresses the challenges in dental health services within the Indonesian maritime community is essential for improving oral health outcomes. Collaboration and partnerships, along with targeted interventions based on socioeconomic and cultural factors, are key to achieving this goal.

**KEYWORDS:** demographic characteristics, dental health services, geographic characteristics, Indonesian maritime community, management strategy

### I. INTRODUCTION

The implementation of management strategy in the development of dental health services for the Indonesian maritime community is a significant and relevant research topic in the field of dental health services. The research aims to improve access to dental care for a specific community that may have limited access to healthcare services. The research can help identify the challenges and barriers to implementing dental health services in the maritime community and develop strategies to overcome them. The research can also help identify the dental care needs of the community and develop appropriate interventions to address them.

According to a study on factors influencing the utilization of dental services in East Java, Indonesia, there is a need for urgent public health interventions to increase equitable dental care services utilization (Hariyani et al., 2020). Another study on the characteristics of dental services in rural, suburban, and urban areas upon the implementation of Indonesia National Health Insurance (NHI) for oral health needs to be evaluated by observing the dental (Phantumvanit et al., 2020). The World Health Organization (WHO) recognizes oral health as a key indicator of overall health, well-being, and quality of life. The WHO Oral Health Programme leads the work on setting the global oral health policy agenda in close collaboration with member states and other key stakeholders. Recent momentum has led to the development of key policy documents to support countries in moving towards universal health coverage for oral health by 2030. These include the Global strategy on oral health, the Global oral health action plan, and the Global oral health status report (Duangthip & Chu, 2020).

The research on the implementation of management strategy in the development of dental health services for the Indonesian maritime community can contribute to the development of management strategies that can be applied to other communities with

## **Implementation of Management Strategy in the Development of Dental Health Services for the Indonesian Maritime Community**

limited access to healthcare services. The research can also contribute to the development of policies and guidelines for the implementation of dental health services in Indonesia. The research can help improve the quality of dental health services and promote oral health in the maritime community and other communities in Indonesia.

Innovative solutions to address oral health in rural communities include returning the mouth to the body by integrating oral health and primary care, which can address dental health disparities affecting vulnerable populations, including those in rural and underserved areas. The Harvard School of Dental Medicine Initiative Integrating Oral Health and Medicine highlights educational, clinical, outcomes, and policy-based research (RHHub, 2022).

The implementation of management strategy in the development of dental health services for the Indonesian maritime community is a significant and relevant research topic in the field of dental health services. The research can help improve access to dental care for a specific community that may have limited access to healthcare services. The research can also contribute to the development of management strategies that can be applied to other communities with limited access to healthcare services. The research can help improve the quality of dental health services and promote oral health in the maritime community and other communities in Indonesia.

The Indonesian maritime community is a diverse and complex environment that spans over 17,000 islands and is located between the Indian Ocean and the Pacific Ocean. The community is characterized by its insular character, which has generated cultural diversity and enabled foreign influences (Rochwulaningsih et al., 2019). The Indonesian archipelago represents one of the most unusual areas in the world, encompassing a major juncture of Earth's tectonic plates, spanning two faunal realms, and serving as a nexus of the peoples and cultures of Oceania and mainland Asia. The community is the largest island country in the world, composed of some 17,500 islands, of which more than 7,000 are uninhabited. The major Indonesian islands are characterized by densely forested volcanic mountains in the interior that slope downward to coastal plains covered by thick alluvial swamps that, in some areas, are below sea level. The community is home to hundreds of ethnic groups, each with its own language, and has a highly diverse environment and society that sometimes seem united only by susceptibility to seismic and volcanic activity, close proximity to the sea, and a moist, tropical climate (Legge, 2023).

The population of the Indonesian maritime community is unevenly distributed among the islands and provinces, with Java being the most densely populated island. The population density varies across regions, not only among islands but also among provinces of the same island. The 1990 Population Census indicates that the population density at the national level was 93 persons per square kilometer. The uneven distribution of the population among the islands and provinces poses challenges for the government in managing land across different regions (Salma, 2020).

The Indonesian maritime community is a diverse and complex environment islands and is characterized by its insular character, cultural diversity, and susceptibility to seismic and volcanic activity. The community is home to hundreds of ethnic groups, each with its own language, and has a highly diverse environment and society. The population of the community is unevenly distributed among the islands and provinces, with Java being the most densely populated island.

Existing dental health services available to the Indonesian maritime community face several challenges and gaps. These include:

**Limited access to dental care services:** According to a study on factors affecting dental service utilization in Indonesia, access to dental care services is limited, particularly in rural areas (Melinda et al., 2020). This limited access to dental care services can be a significant challenge for the Indonesian maritime community, which is characterized by its insular character and remote location.

**Limited availability of dental professionals:** The number of dental professionals in Indonesia is limited, with only 319 specialist dentists in 2020 (Kushwaha, 2022). This limited availability of dental professionals can be a significant challenge for the Indonesian maritime community, which may have limited access to dental professionals.

**Limited awareness of oral health:** According to a review of Indonesia's dental health, there is limited awareness of oral health in Indonesia, particularly in rural areas (Anton & Diah, 2014). This limited awareness of oral health can be a significant challenge for the Indonesian maritime community, which may have limited access to dental education programs.

**Limited availability of dental insurance:** According to a report on the Indonesia dental services market, the availability of dental insurance is limited in Indonesia (Melinda et al., 2020). This limited availability of dental insurance can be a significant challenge for the Indonesian maritime community, which may have limited access to affordable dental care services.

**Limited availability of advanced dental technology:** According to the same report on the Indonesia dental services market, the availability of advanced dental technology is limited in Indonesia (Melinda et al., 2020). This limited availability of advanced dental technology can be a significant challenge for the Indonesian maritime community, which may have limited access to advanced dental care services.

The existing dental health services available to the Indonesian maritime community face several challenges and gaps, including limited access to dental care services, limited availability of dental professionals, limited awareness of oral health, limited

# Implementation of Management Strategy in the Development of Dental Health Services for the Indonesian Maritime Community

availability of dental insurance, and limited availability of advanced dental technology. These challenges and gaps can significantly impact the oral health of the Indonesian maritime community and highlight the need for the development of management strategies to overcome them.

Socioeconomic factors have a significant impact on dental health, including income levels, education, and cultural practices. Here are some key findings from the search results:

**Income levels:** Lower income levels are associated with a higher risk of dental caries and other oral health problems. This may be due to a lack of access to dental care, as well as a higher prevalence of risk factors such as poor nutrition and smoking (de Lucena et al., 2021; Trohel et al., 2016; Vasireddy et al., 2021).

**Education:** Higher levels of education are associated with better oral hygiene habits and a lower risk of dental caries. This may be due to increased knowledge about oral health and a greater ability to access and utilize dental care services (Oberoi et al., 2016).

**Cultural practices:** Cultural practices can also impact dental health. For example, some cultural practices involve the consumption of sugary or acidic foods and drinks, which can increase the risk of dental caries. Additionally, some cultural beliefs may discourage seeking dental care or prioritize other health concerns over oral health (de Lucena et al., 2021).

Overall, socioeconomic factors play a significant role in dental health outcomes. Understanding these factors can help identify populations at risk and inform interventions to reduce disparities in oral health.

## A. Statement problem, objective, and research questions

The Indonesian maritime community faces numerous challenges in accessing adequate dental healthcare services due to its unique geographical and demographic characteristics. This research aims to provide a comprehensive overview of the Indonesian maritime community, assess existing dental health services, analyze socioeconomic factors influencing dental health, and evaluate current policies and initiatives. Additionally, the research aims to propose a management strategy for enhancing dental health services within this community.

### Statement of the Problem:

The Indonesian maritime community lacks sufficient access to quality dental health services, and this issue is compounded by various challenges and gaps faced by the community. These challenges include limited healthcare infrastructure, inadequate oral health literacy, cultural practices, and socioeconomic factors. Consequently, this study aims to address these existing gaps and challenges to improve dental health services in the Indonesian maritime community.

### Objectives:

- To provide a comprehensive overview of the Indonesian maritime community, including its geographical and demographic characteristics.
- To examine the existing dental health services available to the community, identifying key challenges and gaps.
- To analyze the socioeconomic factors impacting dental health within the Indonesian maritime community, such as income levels, education, and cultural practices.
- To evaluate existing policies and initiatives related to dental health services within the community.
- To propose an effective management strategy for the development and enhancement of dental health services within the Indonesian maritime community.

### Research Questions:

- What are the key geographical and demographic characteristics of the Indonesian maritime community?
- What are the existing dental health services available to the community, and what challenges and gaps do they face?
- What are the socioeconomic factors influencing dental health within the Indonesian maritime community, such as income levels, education, and cultural practices?
- How effective are the current policies and initiatives related to dental health services within the community?
- What can be done to implement an effective management strategy for the development and enhancement of dental health services within the Indonesian maritime community?

By providing a comprehensive overview, examining existing services, analyzing socioeconomic factors, and evaluating policies and initiatives, this study aims to contribute to the improvement of dental health services in this unique community. By implementing effective management strategies, the Indonesian maritime community can ensure access to quality dental healthcare and address the prevailing challenges and gaps in oral health services.

# Implementation of Management Strategy in the Development of Dental Health Services for the Indonesian Maritime Community

## II. METHOD

Dental health services play a crucial role in ensuring the overall well-being of individuals and communities. However, many communities, especially those located in remote and maritime areas, face significant challenges in accessing adequate oral healthcare. The Indonesian maritime community is a prime example of such a population, struggling with limited access to dental health services. To address this issue effectively, researchers can adopt qualitative research methods using secondary data, as advocated by Creswell (2014). This study explores the implementation of qualitative research methods using secondary data to study the management strategy for developing dental health services for the Indonesian maritime community.

Qualitative research methods aim to explore and understand the complexities, nuances, and subjective experiences of individuals and groups. It involves collecting and analyzing non-numerical data, such as interviews, focus groups, observations, and archived documents. Secondary data, in this context, refers to existing data already collected by other researchers or organizations, which can be reanalyzed to answer new research questions.

According to Creswell (2014), qualitative research using secondary data offers several advantages. Firstly, it saves both time and resources, as researchers can utilize pre-existing datasets. Additionally, secondary data often provide a larger sample size, allowing for a more comprehensive analysis. Furthermore, revisiting secondary data allows researchers to evaluate the data from different perspectives, potentially providing new insights and confirming or challenging previous findings.

Implementation of Management Strategy:

In the context of the Indonesian maritime community, the implementation of a management strategy is crucial for developing dental health services. This strategy can encompass various aspects, such as infrastructure development, workforce training, and policy implementation. Utilizing qualitative research methods with secondary data can help identify the potential barriers, success factors, and best practices in implementing such a strategy.

To begin the research, one can identify existing datasets related to dental health services in Indonesia. These datasets could include government reports, research papers, and surveys conducted in maritime regions. Researchers can also access oral health records from local health facilities, seeking information on treatment patterns, patient demographics, and overall oral health indicators. These secondary datasets will form the foundation for the qualitative analysis.

## III. RESULT

### A. Key Geographical and Demographic Characteristics of the Indonesian Maritime Community

Indonesia is an archipelagic country located in Southeast Asia and Oceania, lying between the Indian Ocean and the Pacific Ocean (Djunarsjah & Putra, 2021). The Indonesian archipelago is composed of approximately 17,000 islands, of which more than 7,000 are uninhabited. The major Indonesian islands are characterized by densely forested volcanic mountains in the interior that slope downward to coastal plains covered by thick alluvial swamps. The major islands of Indonesia are Sumatra, Java, Kalimantan, Sulawesi, and Papua (Wolters et al., 2023).

Indonesia is the largest country in Southeast Asia, with a maximum dimension from east to west of about 3,200 miles (5,100 km) and an extent from north to south of 1,100 miles (1,800 km) (Wolters et al., 2023). The government claims an exclusive economic zone of 6,159,032 km<sup>2</sup> (2,378,016 sq mi). The additional surrounding sea areas bring Indonesia's generally recognized territory (land and sea) to about 5 million km<sup>2</sup>.

The demography of Indonesia is quite particular and is shaping the whole political game since the independence. According to the last detailed population information available (the 2010 census), inhabitants of Java islands (Javanese is the main ethnic group of Java but not the only one, the second most important is the Sundanese followed by the Madurese) were 137M compared to a total population of 237M. Java Island accounts for 58% of the population and only 6% of the landmass. If you factor in people who migrated to other islands, the population hailing from Java represents 64% of the total population (Elliot, 2018).

The Indonesian maritime community is characterized by its strategic location astride or along major sea lanes connecting East Asia, South Asia, and Oceania. The maritime community is involved in various economic activities such as trade, fishing, and other relevant economic factors. The marine policy basis of Indonesia as a maritime state is important for establishing an integrated economy. The national power of Indonesia has great potential to be the global maritime fulcrum. The security dynamics of the Indonesian maritime community are influenced by various factors such as risks to national security and relationships with neighboring countries and other relevant security factors (Latief et al., 2020).

Indonesia's maritime policies and strategies are shaped by various factors, including the country's geography, economy, and security challenges. The following initiatives have been implemented to promote sustainable development in the maritime sector:

## Implementation of Management Strategy in the Development of Dental Health Services for the Indonesian Maritime Community

- Establishment of special economic zones and development of infrastructure for maritime trade and transportation to enhance inter-island connectivity.
- Active engagement with neighboring countries to strengthen regional cooperation and address common security challenges in the maritime domain.
- Participation in international maritime security initiatives and efforts to combat piracy, illegal fishing, and other transnational crimes at sea.
- Investment in modernizing naval capabilities and improving maritime surveillance systems to ensure the safety and integrity of its waters.
- Implementation of various measures to promote sustainable and responsible maritime practices, such as establishing marine protected areas and implementing stricter regulations on waste disposal.

Indonesia's President Joko Widodo has articulated a vision of Indonesia as a global maritime axis, seeking to transform Indonesia into a maritime power (Shekhar & Liow, 2014). The country's commitment to maintaining a secure and stable maritime environment is evident through its participation in international maritime security initiatives and its efforts to combat piracy, illegal fishing, and other transnational crimes at sea (Morris & Persi Paoli, 2018).

To promote sustainable development in the maritime sector, Indonesia has established special economic zones and developed infrastructure for maritime trade and transportation to enhance inter-island connectivity (Shekhar & Liow, 2014). The government has also invested in modernizing naval capabilities and improving maritime surveillance systems to ensure the safety and integrity of its waters (Morris & Persi Paoli, 2018).

Moreover, Indonesia has implemented various measures to promote sustainable and responsible maritime practices, such as establishing marine protected areas and implementing stricter regulations on waste disposal.

### ***B. Bridging the Gap: Challenges and Gaps in Dental Health Services Available to the Community***

Access to dental health care is essential for maintaining good oral health and overall well-being. However, disparities in access to oral health care exist, particularly for low-income and uninsured individuals (Northridge et al., 2020). Social and cultural determinants also play a significant role in reducing oral health disparities (Frost & Deutchman, 2022). Rural communities face several barriers to accessing dental care, including geographic isolation, lack of transportation, and poverty. Inadequate exposure to fluoride, availability and affordability of food with high sugar content, and poor access to oral health care services are some of the factors contributing to the increase in oral diseases globally (Frost & Deutchman, 2022).

Despite the importance of dental health care, many people face barriers to accessing proper dental care, which means they will continue to suffer pain and other oral health problems (Smith, 2023). The challenges and gaps in dental health services available to the community are complex and multifaceted. By using theories such as access to oral health care, social and cultural determinants, rural health, and oral health policies, we can gain a comprehensive understanding of the existing dental health services available to the community, as well as the challenges and gaps they face.

Some possible gaps and challenges in dental health services available to the community based on the search results are:

- Disparities in access to oral health care, particularly for low-income and uninsured individuals (Northridge et al., 2020).
- Social and cultural determinants that impact the availability and utilization of dental health services (Hannan et al., 2021).
- Barriers to accessing dental care in rural communities, including geographic isolation, lack of transportation, and poverty (RHHub, 2022).
- Inadequate exposure to fluoride, availability and affordability of food with high sugar content, and poor access to oral health care services (Frost & Deutchman, 2022).

To address these gaps and challenges, several strategies can be implemented. For example, expanding access to dental care is a crucial step in addressing oral health disparities. This can include building new dental clinics, particularly in rural areas, and implementing mobile dental units to reach remote populations. Strengthening the dental workforce through training and collaboration between governments, non-governmental organizations, and the private sector can also help to address the dental care gap. Policies that promote oral health and improve access to dental health services are also needed (Frost & Deutchman, 2022).

To address oral health disparities, the following policies and initiatives can be implemented:

- Expanding Medicaid coverage for dental services can reduce financial barriers to care and improve access to dental services for low-income individuals.
- Implementing community water fluoridation programs can prevent tooth decay and improve oral health outcomes.

## **Implementation of Management Strategy in the Development of Dental Health Services for the Indonesian Maritime Community**

- Supporting school-based dental sealant programs can target vulnerable populations, such as children from low-income families who may not have access to regular dental care.
- Public awareness campaigns and education initiatives can promote oral health and encourage individuals to seek regular dental care.

According to the CDC, some racial/ethnic and socioeconomic groups have worse oral health as a result of the social determinants of health, such as lack of access to dental care and insurance (Edelstein, 2002). Expanding Medicaid coverage for dental services can reduce financial barriers to care and improve access to dental services for low-income individuals (WHO, 2023).

Community water fluoridation programs can prevent tooth decay and improve oral health outcomes. The CDC recommends community water fluoridation as a safe and effective way to prevent tooth decay (Hannan et al., 2021).

School-based dental sealant programs can target vulnerable populations, such as children from low-income families who may not have access to regular dental care. A study found that school-based dental sealant programs are effective in reducing tooth decay in children (Maternal, 2022).

Public awareness campaigns and education initiatives can promote oral health and encourage individuals to seek regular dental care. The Healthy People 2020 oral health objectives aim to increase public awareness of the importance of oral health and promote preventive measures such as regular dental check-ups and brushing teeth twice a day with fluoride toothpaste (WHO, 2023).

### ***C. Socioeconomic Factors Influencing Dental Health within the Indonesian Maritime Community***

Dental health is an essential aspect of overall health and well-being. However, several socioeconomic factors can influence dental health within the Indonesian maritime community. By using theories such as social determinants of health, cultural beliefs and practices, and geographic location, we can gain a comprehensive understanding of the socioeconomic factors influencing dental health within the Indonesian maritime community.

Based on the search results, some possible socioeconomic factors influencing dental health within the Indonesian maritime community are:

- Age, marital status, education, economic status, health insurance, and dental pain (Melinda et al., 2020).
- Cultural beliefs and practices that may impact oral health-related behaviors and practices (Butani et al., 2008).
- Geographic isolation and barriers to accessing dental care in rural areas (UNODC, 2008).

Socioeconomic factors such as age, marital status, education, economic status, health insurance, and dental pain were associated with dental service utilization in both rural and urban areas of Indonesia (Melinda et al., 2020). This suggests that access to dental care may be influenced by socioeconomic factors. Cultural beliefs and practices can also influence oral health-related behaviors and practices (Trohel et al., 2016). For example, the consumption of sugary or acidic foods and drinks may be influenced by cultural practices. Geographic isolation can also be a barrier to accessing dental care in rural areas. This can be particularly challenging for the Indonesian maritime community, which may be located in remote areas.

To address socioeconomic factors and reduce oral health disparities, the following strategies can be implemented:

- Expanding access to dental care by building new dental clinics, particularly in rural areas, and implementing mobile dental units to reach remote populations.
- Strengthening the dental workforce through training and collaboration between governments, non-governmental organizations, and the private sector.
- Increasing funding for recruitment and scholarships for underrepresented minority, lower-income, and rural populations to attend dental professional schools.
- Implementing policies that promote oral health and improve access to dental health services.

According to a report, expanding the number of public dental clinics and increasing access to dental care for the poor can help reduce oral health disparities (Patrick et al., 2006). However, the United States continues to experience dental health professional shortage areas affecting millions of people, which is one reason for inadequate access to care (Health, 2021).

To address the dental care gap, policies that promote oral health and improve access to dental health services are needed. For example, Healthy People 2020 oral health objectives aim to reduce the proportion of children and adolescents with lifetime tooth decay and children and adolescents with active and untreated tooth decay by improving patient experience and access by addressing barriers such as lack of transportation, limited cultural competence, and dental practice (Office of Disease Prevention & Promotion, 2012).

Moreover, some segments of the population, such as certain racial/ethnic minority groups, people living in poverty, and people living in rural areas, have less access to dental care (Hannan et al., 2021). Strategies to make it easier to get dental care are critical

## **Implementation of Management Strategy in the Development of Dental Health Services for the Indonesian Maritime Community**

for better oral health and overall health outcomes. For example, providing rural training tracks during dental education, admitting dental students from rural areas who would be more likely to practice in a rural community, and providing dental students opportunities to obtain a broad range of dental skills which will be needed in a rural practice can help improve access to oral health services (RHlhub, 2022).

Promoting education and awareness about the importance of oral hygiene can play a significant role in addressing oral health disparities. The following strategies can be implemented:

- Emphasizing the importance of regular brushing, flossing, and routine dental check-ups can encourage individuals to take proactive steps towards maintaining good oral health.
- Implementing preventive measures such as community fluoridation programs and dental sealant initiatives can help reduce the prevalence of dental diseases. These initiatives can target vulnerable populations, such as children from low-income families who may not have access to regular dental care.

According to a study, students with higher knowledge scores use oral hygiene aids more frequently, such as dental floss and interdental brushes (Chaushu et al., 2022). Another study suggested that a plan for supervising school brushing could be effective in preventing tooth decay (Saccomanno et al., 2023).

Moreover, the Centers for Disease Control and Prevention (CDC) works to reduce disparities in the rate of cavities and integrate oral health programs into chronic disease prevention and medical care (Edelstein, 2002). The CDC also recommends brushing teeth twice a day with fluoride toothpaste and visiting the dental office/clinic regularly to keep a healthy mouth (ECLKC, 2023).

Implementing preventive measures such as community fluoridation programs and dental sealant initiatives can help reduce the prevalence of dental diseases. For example, community water fluoridation is a safe and effective way to prevent tooth decay and improve oral health (CDC, 2022).

### ***D. Evaluating the Effectiveness of Policies and Initiatives Related to Dental Health Services within the Community***

Dental health is an essential aspect of overall health and well-being. Policies and initiatives related to dental health services within the community aim to improve access to dental care and reduce oral health disparities. By using theories such as oral health education, social and cultural determinants, and healthcare outcomes, we can gain a comprehensive understanding of the effectiveness of current policies and initiatives related to dental health services within the community.

Based on the search results, some possible factors that can influence the effectiveness of policies and initiatives related to dental health services within the community are:

- Oral health education (Bashirian et al., 2023; Nakre & Harikiran, 2013).
- Social and cultural determinants of oral health (Patrick et al., 2006).
- Healthcare outcomes, such as health outcomes and healthcare utilization costs (Ghoneim et al., 2022).

Oral health education is effective in improving the knowledge and oral health-related practices of the target population (Bashirian et al., 2023; Nakre & Harikiran, 2013). This suggests that policies and initiatives that focus on oral health education can be effective in improving dental health within the community. Social and cultural determinants also play a significant role in reducing oral health disparities. Policies and initiatives that focus on addressing social and cultural determinants of oral health can be effective in improving dental health within the community. Providing access to dental care can improve health outcomes and reduce healthcare utilization costs (Office of Disease Prevention & Promotion, 2012). Policies and initiatives that focus on improving access to dental care can be effective in improving dental health within the community.

To evaluate the effectiveness of current policies and initiatives related to dental health services within the community, it is essential to consider the outcomes of these policies and initiatives. For example, policies and initiatives that focus on oral health education should be evaluated based on the knowledge and oral health-related practices of the target population. Policies and initiatives that focus on addressing social and cultural determinants of oral health should be evaluated based on the reduction of oral health disparities. Policies and initiatives that focus on improving access to dental care should be evaluated based on the improvement of health outcomes and the reduction of healthcare utilization costs.

To assess the effectiveness of oral health education programs, it is crucial to consider the following factors:

- Accessibility of educational materials
- Level of engagement with the target population
- Extent to which individuals adopt and sustain positive oral health practices

A systematic review found that oral health education programs can be effective in improving oral health status and knowledge, attitude, and practice (Nakre & Harikiran, 2013).

## **Implementation of Management Strategy in the Development of Dental Health Services for the Indonesian Maritime Community**

To evaluate the impact of policies and initiatives aimed at addressing social and cultural determinants of oral health, it is important to consider the following indicators:

- Prevalence of dental diseases
- Utilization of preventive services
- Overall improvement in oral health outcomes

A study found that low socioeconomic status, minority status, and unemployment are associated with patterns of infrequent preventive dental care and high rates of dental diseases (Patrick et al., 2006). Another study suggested that disparities in access to oral health care are a major issue that needs to be addressed (Northridge et al., 2020).

To ensure equitable access to oral healthcare for all populations, it is crucial to examine the accessibility and affordability of dental care. A report suggested that access to oral health care is essential to promoting and maintaining overall health and well-being, yet only half of the population has access to it (Council, 2012).

A comprehensive analysis of the reduction in disparities across different socioeconomic groups and minority populations is necessary to evaluate the impact of policies and initiatives on oral health. By identifying areas of improvement and targeting interventions, policymakers and public health professionals can ensure equitable access to oral healthcare for all populations, contributing to the overall well-being and quality of life of individuals and communities.

### ***E. Implementing an Effective Management Strategy for the Development and Enhancement of Dental Health Services within the Indonesian Maritime Community***

Dental health is an essential aspect of overall health and well-being. Developing and enhancing dental health services within the Indonesian maritime community requires an effective management strategy. By using theories such as healthcare management, social determinants of health, and collaboration and partnerships, we can gain a comprehensive understanding of what can be done to implement an effective management strategy for the development and enhancement of dental health services within the Indonesian maritime community.

Based on the search results, some possible strategies that can be implemented to develop and enhance dental health services within the Indonesian maritime community are:

- Providing access to dental care to improve health outcomes and reduce healthcare utilization costs (Hsieh & Shannon, 2005).
- Addressing social determinants of oral health to reduce oral health disparities (Melinda et al., 2020).
- Establishing collaboration and partnerships with other organizations to develop and enhance dental health services (UNODC, 2008).

Effective healthcare management is essential in improving access to dental health services. Providing access to dental care can improve health outcomes and reduce healthcare utilization costs (Barber & Gertler, 2008). This suggests that effective healthcare management can be an effective strategy in developing and enhancing dental health services within the Indonesian maritime community. Addressing social determinants of oral health is also crucial in reducing oral health disparities (UNODC, 2008). Policies and initiatives that focus on addressing social determinants of oral health can be effective in developing and enhancing dental health services within the Indonesian maritime community. Collaboration and partnerships with other organizations can also be effective in developing and enhancing dental health services within the Indonesian maritime community (Kister, 1994). This can involve working with other organizations to build new dental clinics, implement mobile dental units, and provide oral health education.

To implement an effective management strategy for the development and enhancement of dental health services within the Indonesian maritime community, it is essential to consider the unique challenges faced by the community. For example, geographic isolation can be a barrier to accessing dental care in rural areas. This can be particularly challenging for the Indonesian maritime community, which may be located in remote areas. Effective healthcare management should consider these challenges and develop strategies that address them.

To overcome the challenge of geographic isolation in the Indonesian maritime community, implementing mobile dental clinics is one possible strategy. These clinics can travel to remote areas, bringing dental care directly to the community. Additionally, partnerships can be formed with local healthcare providers to establish satellite clinics in areas where access to dental care is limited. These satellite clinics can provide regular dental check-ups, preventive treatments, and basic dental procedures to ensure that the community receives timely and comprehensive oral healthcare. Furthermore, educational programs can be implemented to raise awareness about the importance of dental hygiene and encourage preventive measures within the community. By tailoring strategies to the specific needs of each community, such as offering affordable or free services to low-income individuals



## Implementation of Management Strategy in the Development of Dental Health Services for the Indonesian Maritime Community

and providing transportation for those who have difficulty accessing the clinics, the overall oral health of the community can be significantly improved. Additionally, these collaborations can also help identify and address any specific oral health issues that may be prevalent in certain populations, such as children or the elderly, leading to targeted and effective interventions.

According to a study, the primary dentist tends to provide services without clinical intervention on periodontal problems, abscesses, and lesions (Dewanto et al., 2020). Another study suggests that the low number of oral health personnel and the unequal geographical distributions of existing oral health resources are constraints for the provision of oral healthcare (Folayan et al., 2019). However, there are many clinics for dentistry in Indonesia that offer affordable prices. Furthermore, a study aimed to determine the relationship between sociodemographic and healthcare services factors that affect tooth decay and filling in Indonesia (Broomhead et al., 2019). Finally, a study conducted during the COVID-19 pandemic in Indonesia found that it is difficult to limit respondents' geographic location who take online survey research (Pasiga, 2020).

### IV. CONCLUSIONS

The Indonesian maritime community is characterized by its strategic location, diverse geography, and unique demography. The community is involved in various economic activities, and its national power has great potential to be the global maritime fulcrum. Understanding the geographical and demographic characteristics of the Indonesian maritime community is important for developing effective policies and initiatives related to dental health services within the community.

The challenges and gaps in dental health services available to the community are complex and multifaceted. By using theories such as access to oral health care, social and cultural determinants, rural health, and oral health policies, we can gain a comprehensive understanding of the existing dental health services available to the community, as well as the challenges and gaps they face. Addressing these gaps and challenges requires a multifaceted approach that involves expanding access to dental care, strengthening the dental workforce, and implementing policies that promote oral health and improve access to dental health services.

Several socioeconomic factors can influence dental health within the Indonesian maritime community. By using theories such as social determinants of health, cultural beliefs and practices, and geographic location, we can gain a comprehensive understanding of these factors. Addressing these factors requires a multifaceted approach that involves expanding access to dental care, strengthening the dental workforce, and implementing policies that promote oral health and improve access to dental health services.

Policies and initiatives related to dental health services within the community aim to improve access to dental care and reduce oral health disparities. By using theories such as oral health education, social and cultural determinants, and healthcare outcomes, we can gain a comprehensive understanding of the effectiveness of current policies and initiatives related to dental health services within the community. Evaluating the outcomes of these policies and initiatives is essential to determine their effectiveness and identify areas for improvement.

Developing and enhancing dental health services within the Indonesian maritime community requires an effective management strategy. By using theories such as healthcare management, social determinants of health, and collaboration and partnerships, we can gain a comprehensive understanding of what can be done to implement an effective management strategy. Providing access to dental care, addressing social determinants of oral health, and establishing collaboration and partnerships with other organizations are some possible strategies that can be implemented. Effective healthcare management should consider the unique challenges faced by the community and develop strategies that address them.

### REFERENCES

- 1) Anton, R., & Diah, A. M. (2014). A review of Indonesia's dental health-past, present and future. *International Journal of Clinical Preventive Dentistry*, 10(3), 121–126.
- 2) Barber, S. L., & Gertler, P. J. (2008). Strategies that promote high quality care in Indonesia. *Health Policy*, 88(2–3), 339–347. <https://doi.org/10.1016/j.healthpol.2008.04.003>
- 3) Bashirian, S., Khoshravesh, S., Ayubi, E., Karimi-Shahanjarini, A., Shirahmadi, S., & Solaymani, P. F. (2023). The impact of health education interventions on oral health promotion among older people: a systematic review. *BMC Geriatrics*, 23(1), 548. <https://doi.org/10.1186/s12877-023-04259-5>
- 4) Broomhead, T., Ballas, D., & Baker, S. R. (2019). Application of geographic information systems and simulation modelling to dental public health: Where next? *Community Dentistry and Oral Epidemiology*, 47(1), 1–11.
- 5) Butani, Y., Weintraub, J. A., & Barker, J. C. (2008). Oral health-related cultural beliefs for four racial/ethnic groups: Assessment of the literature. *BMC Oral Health*, 8(1). <https://doi.org/10.1186/1472-6831-8-26>

## Implementation of Management Strategy in the Development of Dental Health Services for the Indonesian Maritime Community

- 6) CDC. (2022, April 6). Children's Oral Health. U.S. Department of Health & Human Services. <https://www.cdc.gov/oralhealth/basics/childrens-oral-health/index.html>
- 7) Chaushu, G., Tadin, A., Poljak Guberina, R., Domazet, J., & Gavic, L. (2022). Oral Hygiene Practices and Oral Health Knowledge among Students in Split, Croatia. <https://doi.org/10.3390/healthcare10020406>
- 8) Council, N. R. (2012). Improving access to oral health care for vulnerable and underserved populations. National Academies Press.
- 9) Creswell, J. W. (2014). Research design: qualitative, quantitative, and mixed methods approach. Sage publications.
- 10) de Lucena, E. H. G., da Silva, R. O., Barbosa, M. L., de Araújo, E. C. F., Pereira, A. C., & Cavalcanti, Y. W. (2021). Influence of socioeconomic status on oral disease burden: a population-based study. *BMC Oral Health*, 21(1), 608. <https://doi.org/10.1186/s12903-021-01970-w>
- 11) Dewanto, I., Koontongkaew, S., & Widyanti, N. (2020). Characteristics of Dental Services in Rural, Suburban, and Urban Areas Upon the Implementation of Indonesia National Health Insurance. *Front. Public Health*, 8, 138. <https://doi.org/10.3389/fpubh.2020.00138>
- 12) Djunarsjah, E., & Putra, A. P. (2021). The concept of an archipelagic Province in Indonesia. *IOP Conference Series: Earth and Environmental Science*, 777(1), 012040.
- 13) Duangthip, D., & Chu, C. H. (2020). Challenges in oral hygiene and oral health policy. In *Frontiers in Oral Health* (Vol. 1, p. 575428). Frontiers Media SA.
- 14) ECLKC. (2023). Promoting Oral Health for Adults.
- 15) Edelstein, B. L. (2002). Disparities in oral health and access to care: findings of national surveys. *Ambulatory Pediatrics*, 2(2), 141–147.
- 16) Elliot. (2018, September 25). An Introduction to Indonesian Geography and Demography. THE SPICE ROAD END. <http://thespicerouteend.com/introduction-indonesian-geography-demography/>
- 17) Folayan, M. O., Rizalar, S., Papp, K. D., Amalia, R., Chairunisa, F., Alfian, M. F., & Supartinah, A. (2019). Indonesia: Epidemiological Profiles of Early Childhood Caries. *Frontiers in Public Health* | [www.frontiersin.org](http://www.frontiersin.org), 1, 210. <https://doi.org/10.3389/fpubh.2019.00210>
- 18) Frost, J. H., & Deutchman, M. (2022). Eight Ways to Mitigate US Rural Health Inequity. *AMA Journal of Ethics*. <https://journalofethics.ama-assn.org/article/eight-ways-mitigate-us-rural-health-inequity/2022-01>
- 19) Ghoneim, A., Ebnahmady, A., D'Souza, V., Parbhakar, K. K., He, H., Gerbig, M., Singhal, S., & Quiñonez, C. (2022). The impact of dental care programs on healthcare system and societal outcomes: a scoping review. *BMC Health Services Research*, 22(1), 1574. <https://doi.org/10.1186/s12913-022-08951-x>
- 20) Hannan, C. J., Ricks, T. L., Espinoza, L., & Weintraub, J. A. (2021). Addressing Oral Health Inequities, Access to Care, Knowledge, and Behaviors (2023). CDC.
- 21) Hariyani, N., Setyowati, D., Sari, M. R., Maharani, D. A., Nair, R., & Sengupta, K. (2020). Factors influencing the utilization of dental services in East Java, Indonesia. *F1000Research*, 9, 673. <https://doi.org/10.12688/f1000research.23698.1>
- 22) Health, N. I. of. (2021). Oral health in America: advances and challenges. Bethesda, MD: US Department of Health and Human Services, National Institutes of Health, National Institute of Dental and Craniofacial Research.
- 23) Hsieh, H. F., & Shannon, S. E. (2005). Three approaches to qualitative content analysis. *Qualitative Health Research*, 15(9), 1277–1288. <https://doi.org/10.1177/1049732305276687>
- 24) Kister, J. (1994). DOCUMENT RESUME ED 375 288 CE 067 442 AUTHOR Kister, Joanna; And Others TITLE Nutrition and Wellness Resource guide. A Resource for Teaching the Nutrition and Wellness Core Course Area of Ohio's Work and Family Life Program.
- 25) Kushwaha, D. (2022, September 26). Indonesia Dental Services Market Outlook to 2026: Ken Research. LinkedIn. <https://www.linkedin.com/pulse/indonesia-dental-services-market-outlook-2026-ken-deepu-kushwaha>
- 26) Latief, M., Sultan, S., & Suryanto, S. (2020, February 10). Understanding Poverty of Indonesia Maritime Society in Five Point Zero (5.0) Era. <https://doi.org/10.4108/eai.21-10-2019.2291591>
- 27) Legge, J. D. et al. (2023). Indonesia. In *Encyclopedia Britannica*. <https://www.britannica.com/place/Indonesia>
- 28) Maternal, N. (2022). Advancing Oral Health Equity. [www.HRSA.gov](http://www.HRSA.gov).
- 29) Melinda, C., Santoso, A., Bramantoro, T., Nguyen, M. C., Bagoly, Z., & Nagy, A. (2020). Factors Affecting Dental Service Utilisation in Indonesia: A Population-Based Multilevel Analysis. *International Journal of Environmental Research and Public Health*. <https://doi.org/10.3390/ijerph17155282>

## Implementation of Management Strategy in the Development of Dental Health Services for the Indonesian Maritime Community

- 30) Morris, L. J., & Persi Paoli, G. (2018). A Preliminary Assessment of Indonesia's Maritime Security Threats and Capabilities. RAND Corporation. <https://doi.org/10.7249/RR2469>
- 31) Nakre, P. D., & Harikiran, A. G. (2013). Effectiveness of oral health education programs: A systematic review. *Journal of International Society of Preventive & Community Dentistry*, 3(2), 103.
- 32) Northridge, M. E., Kumar, A., & Kaur, R. (2020). Disparities in Access to Oral Health Care. *Annu. Rev. Public Health*, 41, 513–535. <https://doi.org/10.1146/annurev-publhealth>
- 33) Oberoi, S. S., Sharma, G., & Oberoi, A. (2016). A cross-sectional survey to assess the effect of socioeconomic status on the oral hygiene habits. *Journal of Indian Society of Periodontology*, 20(5), 531.
- 34) Office of Disease Prevention, H., & Promotion, H. (2012). Using Law and Policy to Promote the Use of Oral Health Services in the United States. <https://www.healthypeople>.
- 35) Pasiga, B. D. (2020). Relationship knowledge transmission of covid-19 and fear of dental care during pandemic in South Sulawesi, Indonesia. *Pesquisa Brasileira Em Odontopediatria e Clínica Integrada*, 21, e0148.
- 36) Patrick, D. L., Shuk, R., Lee, Y., Nucci, M., Grembowski, D., Jolles, C. Z., & Milgrom, P. (2006). Reducing Oral Health Disparities: A Focus on Social and Cultural Determinants. <https://doi.org/10.1186/1472-6831-6-S1-S4>
- 37) Phantumvanit, P., Miner, C. A., Sinha, R. K., Dewanto, I., Koontongkaew, S., & Widyanti, N. (2020). Article 138 Dewanto I, Koontongkaew S and Widyanti N (2020) Characteristics of Dental Services in Rural, Suburban, and Urban Areas Upon the Implementation of Indonesia National Health Insurance. *Front. Public Health*, 8, 138. <https://doi.org/10.3389/fpubh.2020.00138>
- 38) RHIhub. (2022, July 18). Oral Health in Rural Communities. RHIhub. <https://www.ruralhealthinfo.org/topics/oral-health>
- 39) Rochwulaningsih, Y., Sulistiyono, S. T., Masruroh, N. N., & Maulany, N. N. (2019). Marine policy basis of Indonesia as a maritime state: The importance of integrated economy. *Marine Policy*, 108, 103602. <https://doi.org/10.1016/J.MARPOL.2019.103602>
- 40) Saccomanno, S., De Luca, M., Saran, S., Petricca, M. T., Caramaschi, E., Mastrapasqua, R. F., Messina, G., & Gallusi, G. (2023). Promoting oral health in schools The importance of promoting oral health in schools: a pilot study. *Eur J Transl Myol*, 33(1), 2023. <https://doi.org/10.4081/ejtm.2023.11158>
- 41) Salma. (2020, August 24). UGM Faculty of Geography Discusses SDGs, Reveals Indonesia's Potential to Become World Maritime Axis. Universitas Gadjah Mada. <https://ugm.ac.id/en/news/ugm-faculty-of-geography-discusses-sdgs-reveals-indonesias-potential-to-become-world-maritime-axis/>
- 42) Shekhar, V., & Liow, J. C. (2014, November 7). Indonesia as a Maritime Power: Jokowi's Vision, Strategies, and Obstacles Ahead. *BROOKINGS*. <https://www.brookings.edu/articles/indonesia-as-a-maritime-power-jokowis-vision-strategies-and-obstacles-ahead/>
- 43) Smith, K. (2023, July 18). Filling the Gaps. *Richmond Magazine*. <https://richmondmagazine.com/life-style/health/dental-care-providers-underserved-communities/>
- 44) Trohel, G., Bertaud-Gounot, V., Soler, M., Chauvin, P., & Grimaud, O. (2016). Socio-Economic Determinants of the Need for Dental Care in Adults. <https://doi.org/10.1371/journal.pone.0158842>
- 45) UNODC. (2008). An Introduction to Human Trafficking: Vulnerability, Impact and Action. [www.ungift.org](http://www.ungift.org)
- 46) Vasireddy, D., Sathiyakumar, T., Mondal, S., & Sur, S. (2021). Socioeconomic Factors Associated With the Risk and Prevalence of Dental Caries and Dental Treatment Trends in Children: A Cross-Sectional Analysis of National Survey of Children's Health (NSCH) Data, 2016-2019. <https://doi.org/10.7759/cureus.19184>
- 47) WHO. (2023, March 14). Oral health. WHO. <https://www.who.int/news-room/fact-sheets/detail/oral-health>
- 48) Wolters, Oliver W., Mohamad, Goenawan Susatyo, McDivitt, James F., Legge, John David, Leinbach, Thomas R., & Adam, A. W. (2023, October 17). Indonesia. *Encyclopedia Britannica*. <https://www.britannica.com/place/Indonesia>



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0 (<https://creativecommons.org/licenses/by-nc/4.0/>)), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Effect of Training Using Pullbuoy on Breaststroke Swimming Speed in Club RD Athletes



Ridho Yariansyah<sup>1</sup>, Guntur<sup>2</sup>, Septian Raibowo<sup>3</sup>, Yahya Eko Nopiyanto<sup>4</sup>, Ali Munir<sup>5</sup>

<sup>1,2,5</sup> Department of Sport Science, Yogyakarta State University, Yogyakarta, Indonesia

<sup>3,4</sup> Faculty of Teacher Training and Education University of Bengkulu, Bengkulu, Indonesia

**ABSTRACT:** Speed in swimming is very important because it affects the results of matches and the athlete's efficiency. Optimal speed results in shorter journey times, providing a competitive advantage. This study aims to determine the effect of the pull buoy training method on the breaststroke swimming speed of RD Rejang Lebong club athletes. This type of research is experimental research using a one group pre-test and post-test research design. The population in this study was the RD Rejang Lebong club, totaling 90 athletes and the sampling technique used purposive sampling with certain considerations totaling 30 athletes. The tool used to measure breaststroke swimming speed is the 50 meters swimming test. Data analysis used a paired t-test. The research results obtained  $t = 0.0002$   $t_{table} = 1.699$  at a significance level = 0.05 and the correlation test results were 49.10%. It can be concluded that there is no significant influence of the training method using a pull buoy on the 50 meters breaststroke swimming speed of RD Rejang Lebong club athletes. This is of concern to researchers and the study conducted regarding the research results is that there are several factors that make the research unsuccessful or the independent variables do not have a significant effect on attachment variables such as the level of physical readiness of athletes in carrying out training, increasing the number of training from the frequency of training per week before. and quite serious training from athletes even though in the end the research results showed insignificant results for this training.

**KEYWORDS:** Athlete, Breaststroke, Club, Exercise, Speed, Swimming.

### I. INTRODUCTION

Sports activities carried out by the community are not just a hobby, but many functions are obtained from these sports activities, such as building character, improving physical and spiritual fitness, and social relations between athletes and some even focusing on becoming an athlete. Ideally by realizing that sport is a necessity that can be an achievement especially for the younger generation, namely teenagers. There are many sports that can be learned by this teenager, one of which is swimming.

Swimming, as one of the most exciting aerial activities, provides a unique opportunity to combine aspects of play with health benefits and personal development. Through playing, children learn to understand the world around them, express themselves, and practice new skills [1]. Swimming is not just for fun, it also provides significant health benefits. This aerial activity engages almost all the muscles of the body, helping to build muscle strength, cardiovascular endurance and freezing. Swimming also has a positive impact on the respiratory system and blood circulation. Therefore, playing in the water through swimming is not only exhilarating, but also a form of exercise that is beneficial to the body.

Swimming is a sport in water[2]. Swimming is an activity carried out in water, with various forms and styles that have long been known to provide many benefits to humans [3]. Swimming has been divided into several types of movements or styles, namely freestyle, backstroke, breaststroke and butterfly stroke. Breaststroke is a style in swimming which is done by alternating strokes and kicks [4]. In the sport of swimming there is an economic principle of spending as little capital as possible and getting as much profit as possible [5]. Likewise, swimming has the same principle of expending as little energy as possible, and getting the maximum possible speed.

Based on observations and information obtained from the coach of RD club, especially intermediate class athletes, only won 1 gold medal and 1 bronze medal in the 50 meters breaststroke number, so the head coach emphasized athletes to be more active in training to improve their own best time because their speed is still quite far from the national limit and the head

## “Effect of Training Using Pullbuoy on Breaststroke Swimming Speed in Club RD Athletes”

coach will add variations to the exercises because so far breaststroke training uses the same exercises so the training results are not optimal.

Various kinds of aids in swimming can be used to reduce water resistance, one of which is a pull buoy. Media is a tool for conveying something to other people, be it in the form of electronic equipment, drawing equipment, equipment, or the people themselves as conveying information [2]. Learning media in the learning process can increase students' interest and motivation in the learning process in class [6]. The same principles regarding the use of media in the learning process can also be applied in the context of club swimming practice. The use of media in swimming practice can provide similar benefits, such as increasing students' interest, motivation, and understanding of swimming techniques and related concepts. In an effort to optimize swimming training results and achieve significant progress, the use of media has become an increasingly important aspect of the training process.

Media in the context of swimming training refers to various tools or technologies used to help athletes understand, practice and improve their swimming techniques. The use of pull buoys in swimming training has attracted attention as an effective medium for improving various aspects of swimming technique and skills. Pull buoy is swimming equipment which is a kind of floating aid which is often used for training children [7]. The function of the pull buoy is almost the same as the kick board but the buoyancy of the pull buoy is much smaller so this tool is only suitable for athletes who are experts in swimming or not for people who are just learning to swim [8]. The reasons regarding the benefits of media in the learning process include teaching methods that will be more varied [9]. New training methods can accommodate diverse training styles, increase athlete engagement and ensure deep understanding and practical application. New training methods have the potential to optimize training results, create competent athletes and face future challenges with confidence.

In breaststroke swimming, swimming strength focuses on leg movement. The leg movements in breaststroke swimming form outward and inward sweeping movements. This is due to the continuous movement of the limbs. Because it is done continuously or continuously, strong leg muscle strength is needed so that it can move up and down while swimming. This is evidenced by the results of the record time for the 50 meters breaststroke athlete club RD which is relatively low.

The gap caused by low achievement is caused by the conventional training methods used by trainers. If seen from the point of view of swimming athletes, especially at the Rejang Lebong RD club, there is a lack of knowledge about modern breaststroke swimming. Therefore, it is necessary to evaluate the program and types of training in the RD club. Because by doing an evaluation you can find out the success of the program that has been implemented [10]. The form of evaluation carried out by researchers is by applying the exercise method using a pull buoy.

Therefore, researchers use a pull buoy to be flanked on the thighs when doing breaststroke swimming, so indirectly the thighs are forced not to be pulled forward and widen to the sides to minimize frontal resistance. Therefore, to find out the effect of the training method using the pull buoy on breaststroke swimming speed, the researcher is interested in finding facts about the effect of the training method using the pull buoy on the breaststroke swimming speed of the RD Rejang Lebong club athletes.

## II. MATERIAL AND METHOD

The type of research used in this study is quantitative, using experimental methods. This method involves observing, and measuring certain variables to identify cause-and-effect relationships. This method is used on the basis of the consideration that the nature of experimental research is to try something to find out the effect or effect of a treatment or treatment. This is reinforced by the theory of the experimental method, which was revealed that experimentation is a way to look for causal relationships (causal relationships) between two factors that are deliberately generated by researchers by reducing or setting aside other factors that can interfere [11]. The research design is quasi-experimental, the quasi-experimental design uses "Pre-test and Post-test One Group Design".

The results data analysis technique used is the normality test, homogeneity test, hypothesis testing, and correlation test using the Microsoft Exel 2013 calculating tool. The normality test is carried out in order to find out whether the variable you want to use is normally distributed or not, for each score  $i$  use the Liliefors. After that, a statistical tool that can be used to determine the degree of linear relationship between a variable and another variable uses correlation analysis with the correlation formula. Comparing the ability to swim the 50 meters breaststroke pre-test and post-test using the data analysis of athletes swimming at the Rejang Lebong club RD, analysis using the t-test. The data tested relates to the results of this study and is used to better analyze. Using the hypothesis test formula

# “Effect of Training Using Pullbuoy on Breaststroke Swimming Speed in Club RD Athletes”

## III. RESULT AND DISCUSSION

### Result

The training method uses a pull buoy for breaststroke swimming speed before giving treatment to the sample, a pre-test is carried out and after being given treatment, 16 meetings are held (post-test). For the pre-test, 30 samples achieved the fastest time of 49.59 seconds and the longest time of 74.31 seconds with an average of 49.99 seconds. After being given treatment using the training method using a pull buoy, a final test was carried out and the fastest time was 40.70 seconds and the longest time was 74.82 seconds with an average value of 49.99 seconds.

**Table 1. Pre-test and Post-test Statistics**

Statistics	Pre-Test	Post-Test
<b>N</b>	30	30
<b>Average</b>	49,99	49,99
<b>Variance</b>	99,99	100,01
<b>Standard deviation</b>	9,99	10,00
<b>Minimum</b>	30,97	29,07
<b>Maximum</b>	75,33	67,99

The results of descriptive statistical analysis of the 50 meter swimming pre-test, obtained a minimum value = 30.97, maximum value = 75.33, average = 49.99, with standard deviation = 9.99 and variance = 99.99 while post-test minimum test score = 29.07, maximum score = 67.99, average = 49.99, with standard deviation = 10.00 and variance 100.01. After being tested using the correlation test, there was a change in speed, namely 49.10%.

### A. Testing Analysis Requirements

#### 1. Test Data Normality

The data normality test for the variables was carried out using the Liliefors test. For more details, see the table below as follows.

**Table 2. Summary of Data Normality Test Results**

Variable	N	Lo	Ltab	Distribution
<i>Pre-test</i>	30	0,14	0,161	<b>Normal</b>
<i>Post-test</i>	<b>30</b>	<b>0,124</b>	<b>0,161</b>	<b>Normal</b>

The table above shows the results of normality testing for pre-test data for samples that have not been treated with the training method using a pull buoy, obtained  $Lo = 0.14$  with  $N = 30$ , and  $Ltab$  at the significant test level  $\alpha = 0.05$ , which is obtained at 0.161 which is greater than  $Lo$ . It can be concluded that the pre-test data comes from a normally distributed population. Furthermore, from the results of normality testing for post-test data for samples that were treated with the training method using a pull buoy,  $Lo = 0.124$  with  $N = 30$ , and  $Ltab$  at the significant test level  $\alpha = 0.05$ , obtained 0.161 which is greater than  $Lo$ . It can be concluded that the post-test data comes from a normally distributed population.

#### 2. Homogeneity Test

The data homogeneity test is carried out using the Bartlett Test formula. For more details, see the table below as follows:

**Table 3. Summary of Homogeneity Test (Bartlett's Test)**

N	X <sup>2</sup> count	X <sup>2</sup> table	Conclusion
<b>30</b>	<b>0,00</b>	<b>42,55</b>	<b>Homogen</b>

The table above shows that the results of the homogeneity test for the pre-test and post-test data for the sample group treated with the training method using a pull buoy obtained a score of  $X^2_{count} = 0.00$  and  $X^2_{table} = 42.55$ . So  $X^2_{table}$  is greater than  $X^2_{count}$ , so it can be concluded that the two data are homogeneous.

### A. Table Captions

#### 3. Correlation Test

The results of the correlation test show that there is a correlation between variables with a value of  $0.700 > 0.367$  at the significance level  $\alpha = 0.05$  ( $n-1$ ). Then the result will be squared and multiplied by 100%, the result is 49.10%.

# “Effect of Training Using Pullbuoy on Breaststroke Swimming Speed in Club RD Athletes”

## B. Hypothesis Testing

The hypothesis proposed is that there is no influence of the training method using a pull buoy on the breaststroke swimming speed of RD Rejang Lebong club athletes. Based on the formula (paired t-test) carried out, the results of the analysis (paired t-test) in the table below are as follows:

**Table 4. Summary of Results (t Test)**

n-1	Tcount	T <sub>table</sub>	Conclusion
29	0.0002	1,699	Not significant

The results of the t test analysis stated that there was no influence of the training method using the pull buoy (x) on the 50 meters breaststroke swimming speed (y) of the RD Rejang Lebong club athletes in the intermediate class, totaling 30 athletes. This is based on the results of the t test analysis, where  $t_h = 0.0002 < t_{table} = 1.699$  at the significance level  $\alpha = 0.05$  and the correlation test results are 49.10%. It can be concluded that there is no significant influence from the training method using a pull buoy on the 50 meters breaststroke swimming speed of RD Rejang Lebong club athletes.

## IV. DISCUSSION

Description of the results of the data above regarding "The training method using a pull buoy on the 50 meters breaststroke swimming speed of RD Rejang Lebong club athletes, aims to determine the effect of the training method using a pull buoy on the breaststroke swimming speed of RD Rejang Lebong club athletes. In this research, the data that will be discussed is based on observation results, statistical calculation results and documentation results. The following is a discussion of the research conducted.

Based on calculations and hypothesis criteria, namely  $H_0$  is accepted and  $H_a$  is rejected, and because from the data obtained  $t_{count} < t_{table}$  when tested using the t-test, it is concluded that the training method using the pull buoy does not have a significant influence on the breaststroke swimming speed of RD Rejang club athletes. Lebong.

Exercise is providing stimulus to create a need for the body to adjust (adaptation) [12]. Exercise and aerobic exercise are physical activities that cause different stresses for the body. To achieve an achievement in sports, it is necessary to carry out regular and continuous exercises which can be outlined in a training program which ultimately improves abilities significantly so that the desired sporting achievements can be achieved. A good and correct training process must take into account and adjust the volume, frequency and internal recovery or rest period during training, especially in the overload principle. In the training program, researchers used the step type approach or ladder system which is based on the aim of the training, namely increasing maximum performance and skills [13].

In the training zone, there are limits for doing exercises which must be achieved by measuring the heart rate. Determining the training program is also based on testing the athlete's maximum ability to carry out exercises using a pull buoy for 1 minute. Training using a pull buoy results in physiological changes in the body parts, especially in the leg system, because in the training program the researchers aim to improve the athlete's leg technique in order to increase the 50 meters breaststroke swimming speed. The increase in work ability from the program, as a result of this exercise, is caused by physiological changes that occur in the legs.

The definition of speed is the ability to carry out similar movements in succession in the shortest time or the ability to cover a distance in a short time [14]. Training using a pull buoy is an exercise to improve breaststroke leg technique using the principle of resistance training using a sponge. During the research, all samples experienced changes in terms of doing exercise using a pull buoy. Athletes who were initially laypeople when it came to doing this form of exercise have now become proficient over time, which is certainly very different from when this form of exercise was first introduced to them. Athletes also feel pleasure when practicing new things because of the psychological condition of athletes who are in the teenage category.

Training using the pull buoy was carried out in 16 meetings, which means that when carried out it took 4 weeks to complete. In carrying out this exercise, the athlete's perseverance in carrying it out can be seen. However, the influence provided by this training method after carrying out the post-test and processing the data produced an insignificant influence. Based on the results of the initial test using the 50 meters breaststroke swimming test instrument, the average result was 49.99 seconds. Next, treatment was given in the form of a training method using a pull buoy for 16 meetings, then a final test was carried out using the same instrument. From this test, namely the 50m breaststroke swimming speed, results were obtained with an average of 49.99.

## “Effect of Training Using Pullbuoy on Breaststroke Swimming Speed in Club RD Athletes”

This became a concern for researchers and a study was carried out regarding the results of the research, namely that there were several factors that made the research unsuccessful or the independent variables did not have a significant effect on the dependent variable, such as: the athlete's level of physical readiness in carrying out training, an increase in the amount of training from the frequency of training per week before. and quite serious training from athletes even though in the end the research results showed insignificant results for this training.

It can be concluded that the training method using the pull buoy has no effect on the 50 meters breaststroke swimming speed of the RD Rejang Lebong club athletes.

### V. CONCLUSIONS

Based on the results of data analysis and discussion by testing the hypothesis using the paired t-test. The results of the analysis of the effect of the training method using a pull buoy are  $0.0002 < 1.699$  ( $t$  count  $<$   $t$  table) with a significant rate of  $\alpha = 0.05$ . Thus,  $H_0$  is accepted, namely that there is no significant influence of the training method using the pull buoy on the breaststroke swimming speed of RD Rejang Lebong club athletes. it can be concluded that the training method using the pull buoy has no effect on the 50 meters breaststroke swimming speed of the RD Rejang Lebong club athletes.

### ACKNOWLEDGEMENTS

The authors would like to send their deepest gratitude to the all students who were willing to accomplish this research. This journey has been one of growth, discovery, and collaboration, and it would not have been possible without the support, guidance, and contributions of numerous individuals and entities. In expressing my heartfelt gratitude, I extend my appreciation to those who have been instrumental in shaping this endeavor.

### REFERENCES

- 1) W. S. Suherman, P. Sutapa, and Dapan, “Peningkatan kegembiraan dan keaktifan siswa tk dalam pembelajaran dengan ‘majeda’ berbasis dolanan anak,” *Jurnal Kependidikan*, vol. 1, no. 1, pp. 1–11, 2017.
- 2) Pujiyanto, Sugiyanto, and Sutisyana, “Penerapan papan luncur dalam perkuliahan renang gaya dada mahasiswa PENJAS FKIP Universitas Bengkulu,” *Physical Education, Health and Recreation*, vol. 3, no. 2, pp. 10–18, 2019, [Online]. Available: <http://jurnal.unimed.ac.id/2012/index.php/jpehr>
- 3) N. F. Belajaya, Yarmani, and N. Y. Eko, “The relationship between swimming coach knowledge about sports psychology and achievement of swimming athletes in rejang lebong,” *Sport Gymnastics: Jurnal Ilmiah Pendidikan Jasmani*, vol. 2, no. 2, 2021, doi: 10.33369/gymnastics.
- 4) H. Chrisnanto, “Peningkatan kecepatan renang 50 meter gaya dada,” *Journal of Sport Coaching and Physical Education*, vol. 3, no. 1, 2018, doi: <https://doi.org/10.15294/jscpe.v3i1.31913>.
- 5) Insanistyo, Sugiyanto, and H. Sunandarti, “Mekanika gaya apung pada olahraga renang,” *KINESTETIK: Jurnal Ilmiah Pendidikan Jasmani*, vol. 1, no. 1, 2017.
- 6) P. A. Fariansyah, I. W. Santyasa, and N. K. Rapi, “Pengaruh model PBM berbantuan media cerita digital terhadap prestasi belajar fisika,” *Jurnal Kependidikan*, vol. 5, no. 2, pp. 206–222, 2021, [Online]. Available: <https://journal.uny.ac.id/index.php/jk/>
- 7) I. Mujika and E. Crowley, *Strength training for swimmers*. Springer International Publishing, 2019. doi: 10.1007/978-3-319-75547-2\_25.
- 8) Priana, “Pengaruh alat bantu latihan pull buoy terhadap prestasi renang gaya dada,” *Journal of S.P.O.R.T*, vol. 3, no. 1, 2019, [Online]. Available: <https://en.m.wikipedia.org>,
- 9) Mujiyono and A. P. Putra, “Perangkat praktik pengecoran untuk meningkatkan hasil belajar siswa,” *Jurnal Kependidikan*, vol. 2, no. 2, pp. 361–371, Nov. 2018.
- 10) S. Raibowo and Y. E. Nopiyanto, “Evaluasi Pembelajaran Pendidikan Jasmani Olahraga & Kesehatan pada SMP Negeri Se-Kabupaten Mukomuko melalui Pendekatan Model Context ,Input ,Process&Product (CIPP),” *Jurnal Pendidikan Kesehatan Rekreasi*, vol. 6, no. 2, pp. 146–165, 2020.
- 11) S. Arikunto, *Prosedur penelitian suatu pendekatan praktik*. Jakarta: Rineka Cipta, 2006.
- 12) Rai, *Gaya hidup sehat fitness dan binaraga*. Jakarta: Tabloid Bola, 2006.
- 13) T. O. Bompas and G. H. G., “Periodization theory and methodology of training,” *Human Kinetics*, 2009.
- 14) Harsono, *Latihan kondisi fisik*. Bandung: IKIP Bandung, 2001.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.



## Performance Evaluation of Induction Motor Behaviour on Conventional and PV System Power Sources



Ebenezer Asuquo Williams<sup>1</sup>, Ekom Enefiok Okpo<sup>2</sup>, Imo Edwin Nkan<sup>3</sup>

<sup>1,2,3</sup>Department of Electrical and Electronic Engineering, Akwa Ibom State University, Ikot Akpaden, Nigeria.

**ABSTRACT:** The present study explores the integration of photovoltaic (PV) systems for enhancement of power system quality and reliability, particularly when PV system is deployed to power inductive loads which have wide applications in commercial and industrial settings. A mixed approach is deployed using MATLAB/Simulink for the modelling and simulation process. The study investigates the impact of inductive loads on PV system, comparing its performance with a conventional power source of same power willing capacity. The PV system was modelled by connecting PV arrays in series and parallel combinations. The output of the PV arrays was fed into a three phase PWM inverter, the harmonics present at the inverter output were eliminated using properly sized Inductor- capacitor (L-C) filter circuit. Also, a three-phase conventional source of same output capacity was modelled. Comparative analysis of the impacts inductive loads has on both sources were carried out and this was accomplished by integrating three-phase asynchronous motor rated at 15kW(20HP). The induction motors were independently powered by two distinct sources and further subjected to intermittent loading conditions. The major parameters investigated includes the rotor speed, rotor current, and electromagnetic torque of the asynchronous motor. The outcome of the study showed that the conventional source outperforms the PV system. These necessitates the studies on adoption of advance strategies on how the negative impacts and challenges encountered in the course of integrating PV system to power inductive loads will be address.

**KEYWORDS:** Asynchronous Machine; Rotor Current; MATLAB/Simulink; Rotor Speed; Electromagnetic Torque; PV Array, Conventional Source; Photovoltaic System; L-C filter.

### I. INTRODUCTION

Depletion of fossil fuels and the increasing energy requirements have spurred the exploration of alternative and additional sources of electrical energy. Non-conventional energy sources seem to be the remedy to this malady, especially in situations where conventional power generation and transmission are impractical or expensive. In such cases, it is pertinent to maximize the efficiency of power generation from non-traditional sources to meet the power needs effectively (Sakshi, Roshan, & Anupam, 2017; Yang, Li, Peng, Wagner, & Mauzerall, 2018). Solar energy is relatively abundant in nature and environmentally friendly since it does not support combustion. PV systems also have minimal operation cost; therefore, it serves as a good alternative to mitigate the tremendous negative impacts conventional power sources that emits greenhouses gasses have on the atmosphere and the environment at large (Anyaehe, 2011). The deployment of PV system to power induction motors in commercial and industrial settings is a complex task but it has numerous accompanied benefits. Particularly, in remote locations and areas with erratic power supply from the main grid. Such limitations in power availability to supply inductive loads have informed the decision of many researchers to source for alternative energy (Ali, 2016). Several environmental factors influence the power quality harnessed from PV systems which includes the irradiance level, panel aging, orientation, temperature, wind, and humidity. These factors make the output power from the solar panel inherently intermittent (Nurul, Ajisman, & Amad, 2016; Song, Liu, & Yang, 2021). The reliability of the power system when inverter-based generator (IBGs) gains dominance over synchronous generators is still a major concern to power engineers (Mohammed, Alhelou, & Bahrani, 2023). The study by (Zhou, Zhang, Kathriarachchi, Dennis, & Goyal, 2022; Manoj & Kumar, 2021; Rathnayake, et al., 2021) examined the technical complexities associated with the grid forming inverters (GFM) and inverter-based generators (IGBs), focusing on enhancement of system strength and penetration of renewables. Inductive loads such as induction motors been an alternating current electric motor that relies on electromagnetic induction between the stator and the rotor to generate mechanical torque without direct electrical connections have high power

## Performance Evaluation of Induction Motor Behaviour on Conventional and PV System Power Sources

requirement. To minimize technical issues and grid disturbance (Nkan et al, 2020), assessed contingencies, aimed at stabilizing and improving the grid supply. As AC power applied to the stator establish a rotating magnetic field, which align with the rotor's magnetic field, a relative motion is established, but due to the resulting speed difference between the stator and rotor, the misalignment results in the generation of electromagnetic torque leading to mechanical rotation of the rotor couple to a shaft to drive connected loads. Induction motors comes either in single or three phase versions, where the single phases are commonly used for powering small appliances in residential and commercial settings. Capacitors are used to create a phase displacement of  $120^\circ$  between the windings in single phase induction motors, by splitting the phase. On the other hand, the three-phase induction motors have a balance rotating magnetic field with  $120^\circ$  phase angle displacement between each phase. These motors are commonly used in various industrial applications, particularly for driving heavy loads, they come in two primary types namely: squirrel cage type and wound rotor types. Studies by (Bhateja, Nguyen, Nguyen, Satapathy, & Le, 2017), investigated the performance of DC mini grid system using photovoltaic module, incorporating boost converter with maximum power point tracker (MPPT) to enhance efficient power supply. The outcome showed that the ripples present in resistive loads are less compared to inductive loads, PSIM software was deployed for validation of the model. An accurate model for induction motors was developed, with a major focus on voltage behind reactance (VBR) the model was implemented in MATLAB/Simulink, the outcome showed a significant improvement in computational efficiency, enabling precise estimation of various motor parameters and enhancement of the interface with external controllers for improved motor analysis and control (Manekar & Bodkhe, 2013). The economic growth and development of any nation are intrinsically tied to the availability of energy (Omorogiuwa and Okpo, 2015). In enhancing sustainability in power grid usage, dominated by synchronous generators, referred to conventional source, (Nkan et al, 2019 and Natala et al 2023) worked extensively on application of FACTS devices application, aimed at grid adaptability to inductive loads. Access to a reliable electricity supply plays a pivotal role in empowering individuals and facilitating personal and economic development. Performance evaluation of asynchronous motor was conducted in (Okpo et al, 2019). An innovative approach to dynamic modelling of induction motors, using a modular Simulink model was studied by (Shah, Rashid, & Bhatti, 2012), they explored the machine internal variables and the various algorithm without the need for estimators, this makes Simulink a valuable tool for both educational and research purposes in the field of electrical machine drive. The study carried out by (Sangeetha & Parthiba, 2014), discussed the efficiency of reference frames in analyzing electrical performance and presents a comprehensive guide for implementing a three-phase induction motor model in Simulink focusing on its stator and rotor equations in the stator reference frame. The research aims to simulate the rotor behavior in MATLAB/Simulink while investigating the impact of speed, torque and rotor currents on its performance with a particular focus on future investigation into flux saturation and harmonic on the supply side. Multi-type FACTS controllers for power sustainability and adaptability to inductive loads was assessed (Nkan et al, 2021). Comparative analysis of the predicted transient torque and the speed in three phase induction motor models was carried out by (Okoro, 2002; Ramprasath & Manojkumar, 2015), the study focused on comparing a conventional model with one that accounted for skin and saturation effects during motor model development. Qualitative and analytical method were employed to access the impact of rotor and stator slots with harmonics in the winding. The present study is therefore significant as it will carry out a novel comparison on the performance of induction motors when powered from two distinct sources of same capacity particularly, with a major focus on the conventional source and the PV system, so as to investigate the impacts the sources have on behavior of the motor parameters. Due to wide application of induction motors and its continuous usage in commercial and industrial settings, alternative power sources to supply such loads is needed with careful justifications. The remaining part of this paper is organized as follows: section II will present the methods adopted in the present study, section III will cover the simulations results and discussion, while section IV will give conclusion of the study and finally section V will present the recommendations.

## II. METHOD

This section elaborates on the methods deployed to implement the models and their respective subsystems in Matlab/Simulink, it explains the systematic approach used to carry out a novel comparison on the performance of inductive loads when powered from two distinct sources namely the conventional source and the PV system, the overall concept followed during the modelling process is detailed as follows:

### A. Asynchronous Machine Powered from Conventional Source

The analysis of Asynchronous machine parameters commenced with the development of the mathematical model using a three-phase conventional source with output power rating of 20.5kW in Matlab/Simulink version R2016a. The modelling process incorporated the utilization of various mathematical expressions to calculate the maximum equivalent DC voltage supplied to each phase. The expression in eq.1 is used to determine the maximum output voltage presented as follows:

## Performance Evaluation of Induction Motor Behaviour on Conventional and PV System Power Sources

$$\text{Maximum Voltage } (V_{max}) = \frac{\sqrt{2} * V_{rms}}{\sqrt{3}} \quad (1)$$

Given  $V_{rms}$  under worst condition to be 400V, the equivalent DC voltage required from each phase is given as:

$$V_{max} = \frac{\sqrt{2} * 400}{\sqrt{3}} = 326.54V$$

Conventional power source was modelled to serve the asynchronous motor rated at 15kW, the reactive power was determined by applying the power triangle formula, the per phase voltage at worst case scenario is determine as follows:

$$V_{ph} = \frac{400}{\sqrt{3}} = 230.9V \quad (2)$$

The expression for the real power is given by the following expression:

$$P = VI \cos\phi \quad (3)$$

With P defined as the output power of the three-phase asynchronous motor, V representing the phase voltage and  $\theta$  is the phase angle difference between the voltage and current. The current drawn by the motor is calculated as follows:

$$I = \frac{P}{V \cos\theta} = \frac{15000}{230 * 0.85} = 76.73A$$

$$\cos^{-1}(0.85) = 31.8^\circ$$

$$Q = VI \sin\theta \quad (4)$$

$$Q = 230 * 76.73 \sin(31.8^\circ) = 9.299kVar$$

Where Q is defined as the reactive power in kVar.

The asynchronous motor voltage in time domain and in frequency domain are represented respectively as follows:

$$V = - \frac{Nd\phi}{dt} \quad (5)$$

$$V = -Nj\omega\phi(\omega) \quad (6)$$

The voltage can also be represented as:

$$V = -j\omega LI \quad (7)$$

V represents the induced voltage in the rotor windings, N is the number of turns,  $\phi$  is the linkage flux, t is time in seconds, L is the inductance in henry, I is the current and  $\omega$  represent the angular frequency. The above expressions were appropriately considered during the modelling process of the conventional source used to supply the asynchronous motor.

Presented in fig. 1 is the model of the conventional source supplying the induction machine.

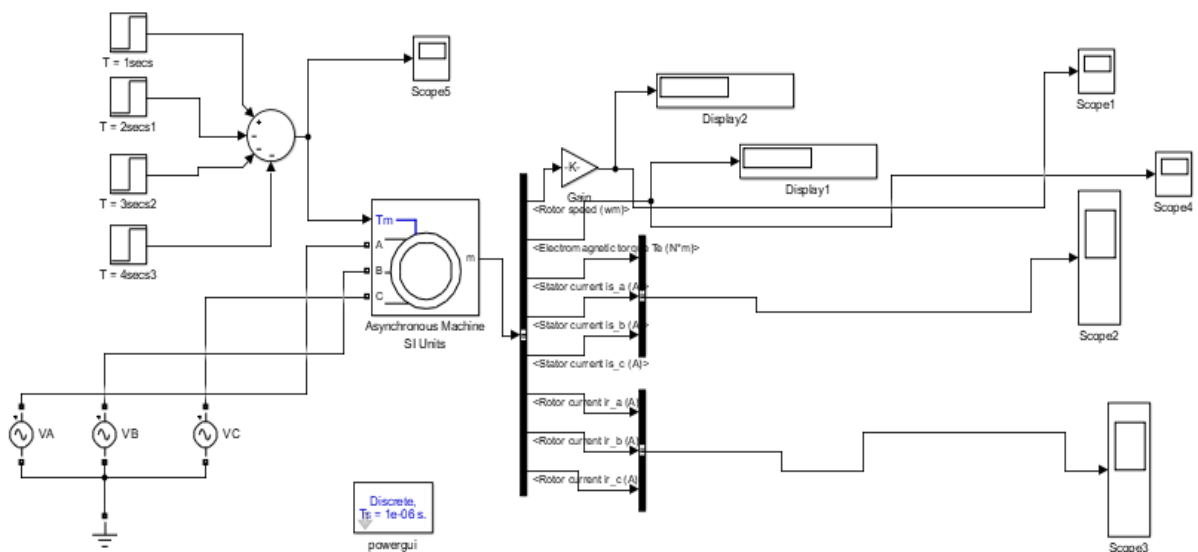


Fig. 1: Asynchronous machine powered from three phase conventional source.

# Performance Evaluation of Induction Motor Behaviour on Conventional and PV System Power Sources

## B. Sizing of the PV System

In order to model the PV system to give a specific desired power output in Simulink, the user defined module was deployed. The required power output from the PV arrays was determine by calculating the number of series and parallel connected string under standard test condition (STC) with approximately estimated peak solar intensity (PSI) of  $1\text{ kW/m}^2$  and a cell temperature of  $25^\circ\text{C}$ . To determine the number of PV arrays to be connected in series and parallel, the following mathematical relations were considered during the modelling process, the number of arrays to be connected in series is determined as follows:

$$N_s = \frac{V_{pp}}{V_{mp}} \quad (8)$$

Where  $N_s$  is defined as the number of series string,  $V_{pp}$  is the peak-to-peak voltage and  $V_{mp}$  represent the voltage at maximum power. The number of parallel strings is determined as follows:

$$N_p = \frac{P_{out}}{N_s * P_{max}} \quad (9)$$

Where  $N_p$  is the number of parallel strings,  $P_{out}$  represents the output power and  $P_{max}$  represent the maximum power from the PV array.

The fill factor (FF) that shows the quality of the PV cell, given as the ratio of the practical maximum point and theoretical maximum power point is express as follows.

$$FF = \frac{P_{maxPractical}}{P_{maxTheoretical}} = \frac{V_{mp} * I_{mp}}{V_{oc} * I_{sc}} \quad (10)$$

The system in fig. 2 is a representation of the simulation model of the PV array in Simulink.

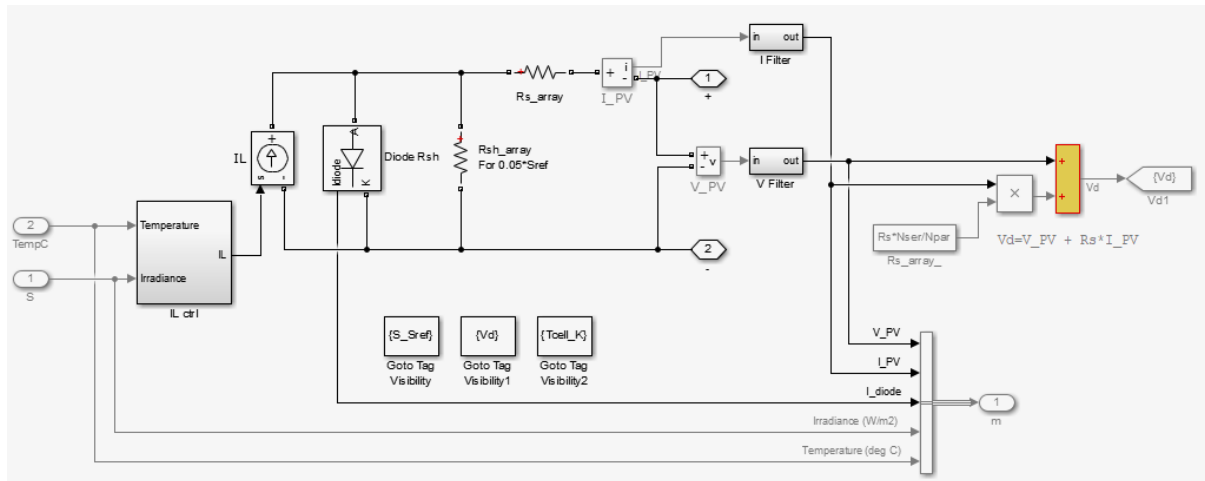


Fig. 2: Model of the PV array

## C. Inverter Circuit

The solar panel generates DC power, which necessitates conversion to AC for driving inductive loads. This conversion process involved an inverter circuit which consist of MOSFETS, a sine wave generator, input and output blocks, resistors, capacitors, and logic function blocks. The MOSFETs input gate received pulses from the sinewave generator, resulting in a pulse width modulated wave (PWM) at the inverter three phase output. To enhance optimal performance of the asynchronous motor, a pure sine wave and a balance three phase voltage must be applied to the stator. A suitably sized filtration circuit was deployed to eliminate the PWM inverter output ripples. Shown in fig. 3 is the model of the inverter circuit.

# Performance Evaluation of Induction Motor Behaviour on Conventional and PV System Power Sources

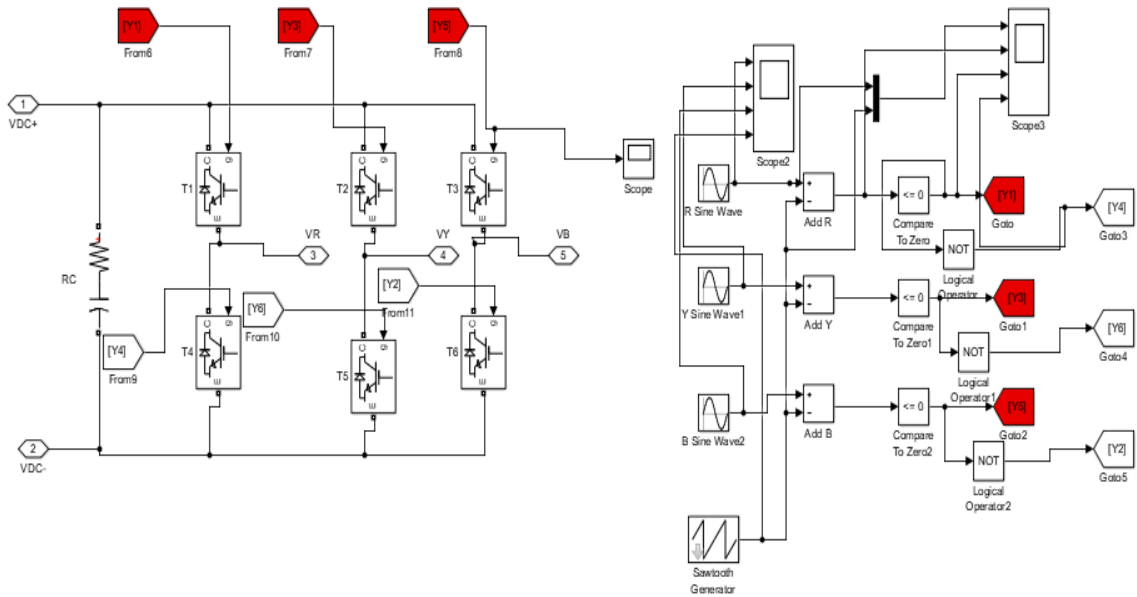


Fig. 3: Modelling of the Inverter Circuit

## D. Simulation Model of the PV System Supplying the Asynchronous Motor

The modelling of the PV system to power the asynchronous machine began with proper sizing of PV system to generate same power output as that of the conventional source counterpart, followed by the integration of three phase PWM inverter circuit. The output of the inverter circuit was passed through L-C filter to eliminate the ripples present during the process of conversion of DC to AC. Three phase asynchronous motors rated at 15kW was powered by the 20.5kW PV system so as to investigate the impact on the motor parameters. The complete model of the asynchronous motor when powered from a PV system is presented in fig. 4 as follows:

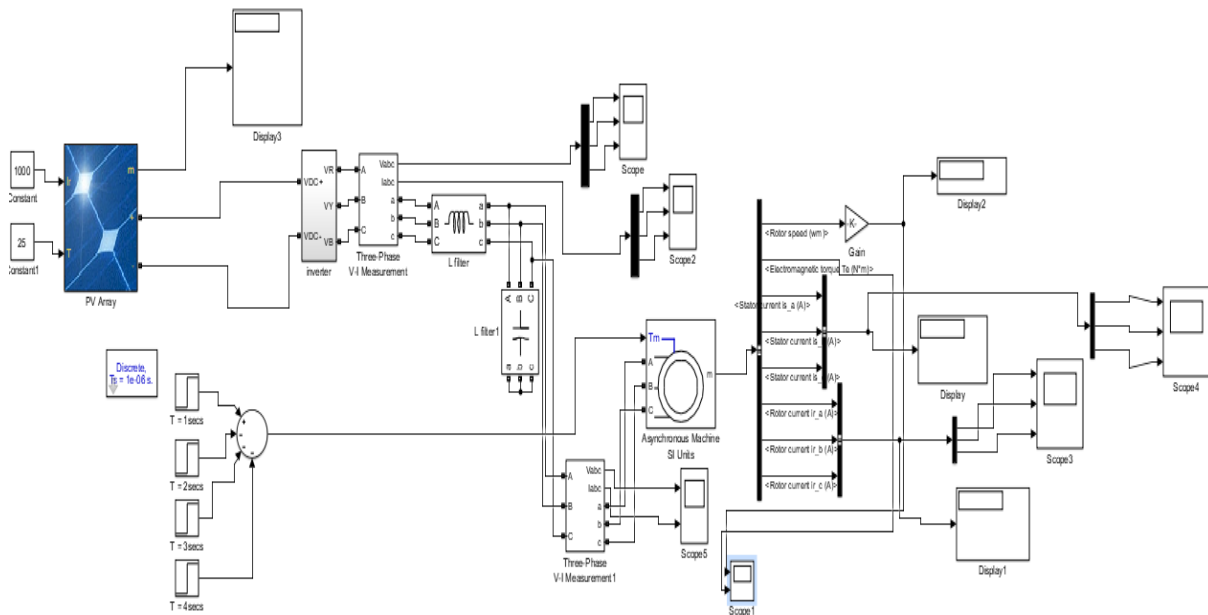


Fig. 4: Model of the PV System Supplying Inductive Load

## E. Modelling of the Asynchronous Machine

The simulation was carried out on asynchronous motors rated at 15kW, the motor was powered from two distinct sources having same power willing capacity and subjected to intermittent loading, so as to examined the behavior of the parameters when powered from the two distinct sources. presented in table 1 are the parameters deployed during the modelling process of the asynchronous machine rated at 15kW.

# Performance Evaluation of Induction Motor Behaviour on Conventional and PV System Power Sources

**Table 1: Specifications of the Asynchronous Machine Parameters**

Number	Parameter	Value
1	Input power of the motor	20Hp or 15kw
2	Motor input voltage	400V
3	Frequency	50Hz
4	Motor speed	1460RPM
5	Mechanical input	Torque (Tm)
6	Mechanical power	20515W
7	Stator resistance	0.2147 Ω
8	Stator inductance	0.000991H
9	Rotor resistance	0.2205 Ω
10	Rotor mutual inductance	0.06419H
11	Inertia(J)	0.102(Kg.m <sup>2</sup> )
12	Friction factor(F)	0.009541 (N.m.s)
13	Number of Pole pairs	2
14	Initial condition	0000

The load torque is determined by the following expression:

$$T_l = \frac{P_{output}}{\omega} \quad (11)$$

The motor output power is express as follows:

$$P_{output} = T_l * \omega \quad (12)$$

Shown in table 2 is the summary of the parameters of the asynchronous motor rated at 15Kw.

### III. RESULTS

The determined parameters during the modeling process of the PV array under standard test condition (STC) is presented in table 4 as follows:

**Table 4: Determined Parameters of the PV array**

Number	Required Parameters	Value
1	Irradiance	1kW/m <sup>2</sup>
2	Number of parallel strings	64
3	Number of series connected modules per string	32
4	Number of cells per module	60
5	Short circuit current (Isc)	0.65A
6	Open circuit voltage (Voc)	21.5
7	Current at maximum power (Imp)	0.57A

## Performance Evaluation of Induction Motor Behaviour on Conventional and PV System Power Sources

8	Temperature coefficient of short circuit current (Isc)	0.102 <sup>0</sup> c
9	Temperature coefficient of open circuit voltage (Voc)	-0.36099 <sup>0</sup> c
10	Voltage at maximum power (Vmp)	17.7V
11	Solar cell maximum power	10.089W

The graphical model that shows the power output generated from the PV array, at 1kW/m<sup>2</sup> irradiance and temperature of 25<sup>0</sup>C is presented in fig. 5:

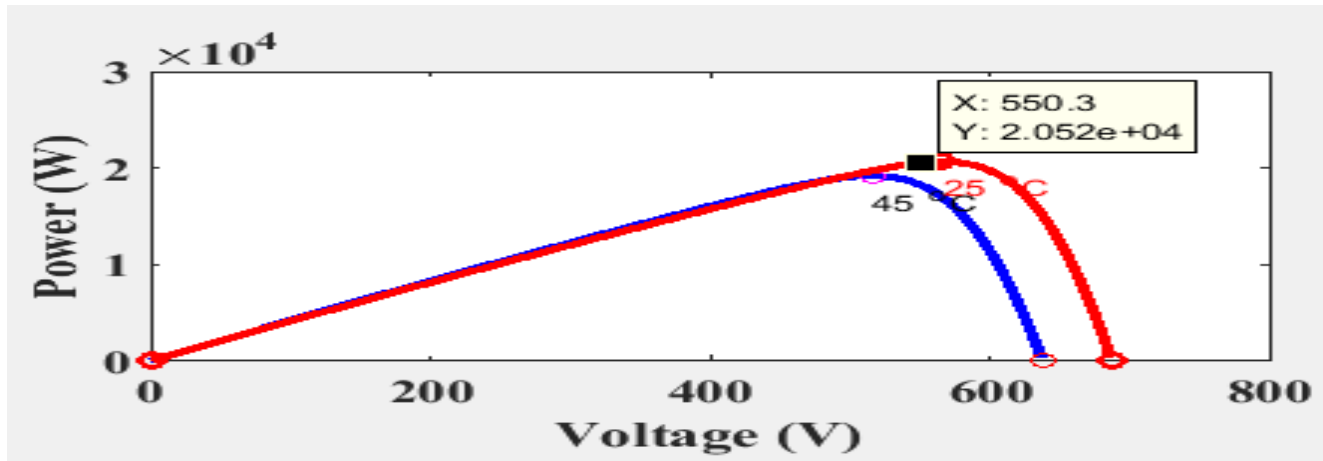


Fig. 5: Power and voltage generated from the PV system

The power output recorded by the combination of series and parallel string gives 20.5kW at 25<sup>0</sup>C temperature with maximum output voltage of 550VDC. Fig. 6 presents the three phase output voltage waveforms from the inverter.

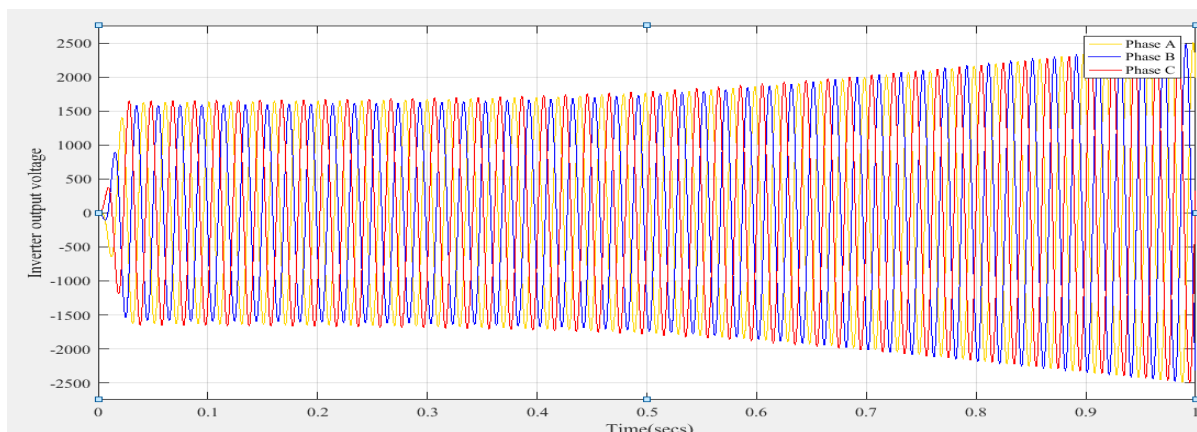


Fig. 6: Three phases inverter voltage waveform

The process of DC conversion to AC produces harmonics that generate heat and noise in the induction machine, appearing in the form of ripples, such ripples appear at the inverter output before filtration. Figs. 7 and 8 shows the distortions in the rotor and stator output waveform of the asynchronous motor before filtration.

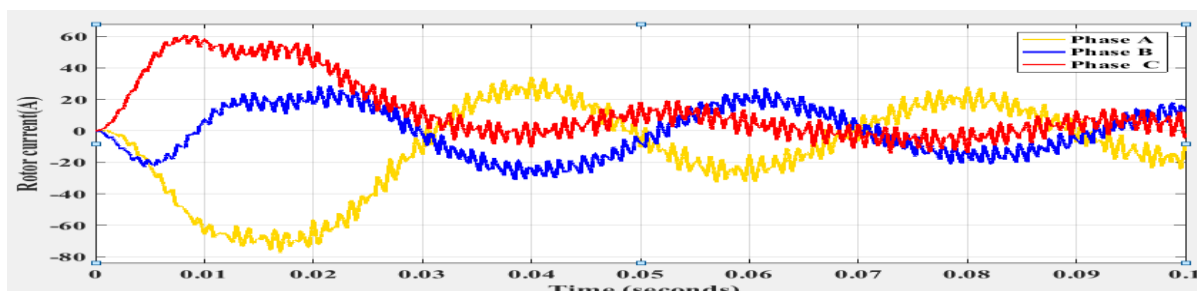


Fig. 7: Rotor current signal waveform before filtration

## Performance Evaluation of Induction Motor Behaviour on Conventional and PV System Power Sources

The output signal waveform suffers from so much distortions due to presence of harmonic component that generate lower frequency during the process of converting DC to AC. The output signal waveform of the stator current before filtration is represented in fig. 8 as follows:

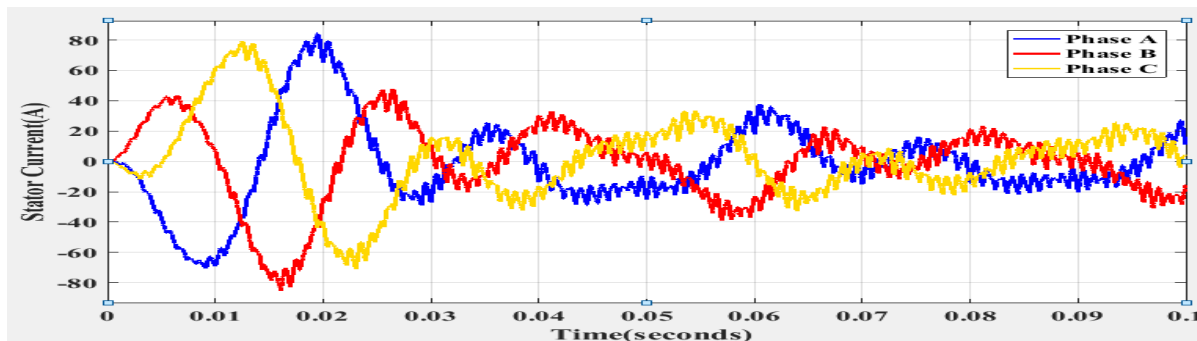


Fig. 8: Stator current of the asynchronous motor before filtration

The ripples present in the stator current waveform is significant due to effects of harmonics. These distortions were eliminated by connecting properly sized capacitors across the three phases in parallel and inductors across the three phases in series at the output of the inverter. Fig. 9 represent the output voltage signal waveform after the filtration process as follows:

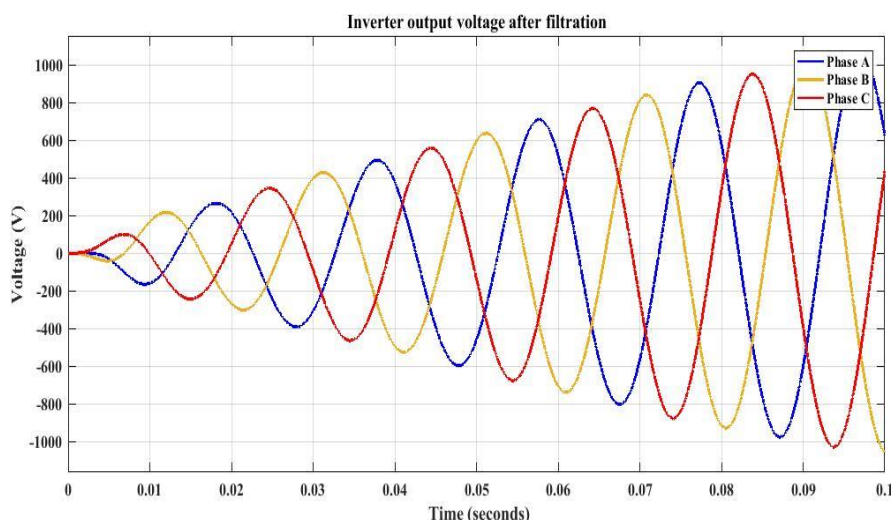


Fig. 9: Inverter output voltage signal waveform after filtration

The ripples were eliminated after the filter circuit was introduced.

### A. Evaluation on the impacts of the asynchronous motor parameters when supplied by two different power sources (conventional and PV system).

In order to investigate the impact that PV systems have on inductive loads performances, two distinct power sources were employed to separately drive asynchronous motor with output power ratings of 15kW under varying load conditions. A comprehensive examination of the impact on the machine parameters was conducted by comparing the performance of both power sources. The analysis focused on key parameters, including rotor current, electromagnetic torque of the rotor, and rotor speed. Figs. 10 and 11 shows the rotor speed of the asynchronous motor rated at 15kW when powered from both sources.



## Performance Evaluation of Induction Motor Behaviour on Conventional and PV System Power Sources

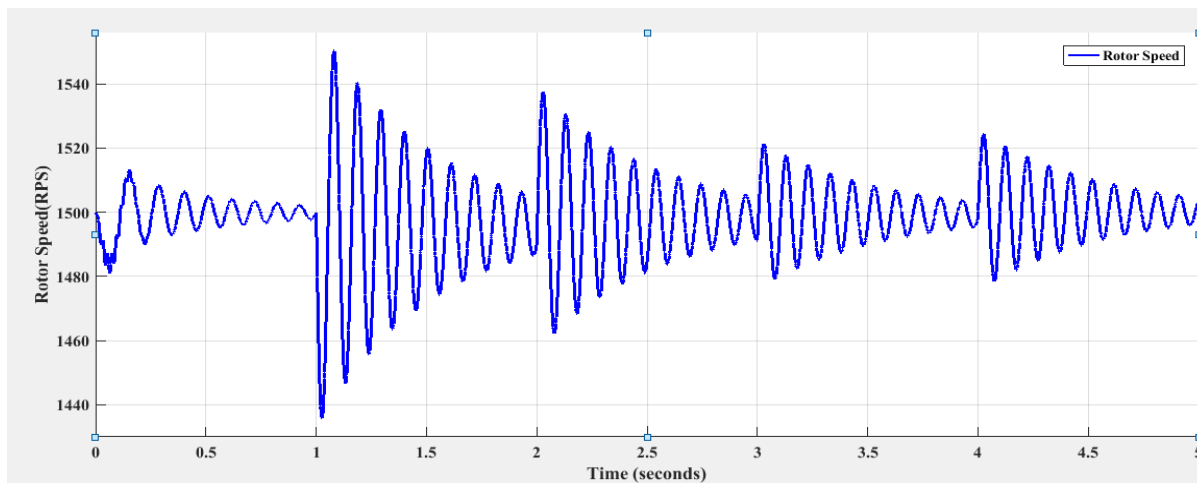


Fig. 10: Rotor speed at 15kW from PV system

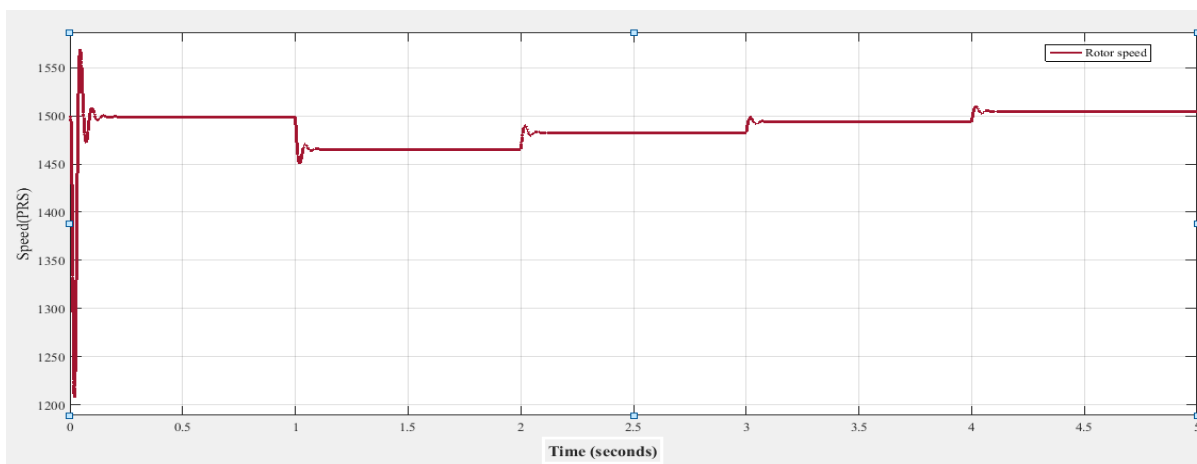


Fig. 11: Rotor speed at 15kW conventional source

The rotor speed of the induction motor rapidly stabilized when power was sourced from the conventional source, However, when the PV system was utilized to supply power to the induction motor, the rotor speed exhibited fluctuations. This observation indicates that the conventional power source, which has an equivalent capacity to the PV system, performs better than the PV system. Therefore, innovative strategies are required to address the oscillations that occur when the PV system is used to operate the asynchronous motor.

Shown in figs. 12 and 14 is the electromagnetic torque of the induction motor when powered from both sources to supply the 15kW inductive load.

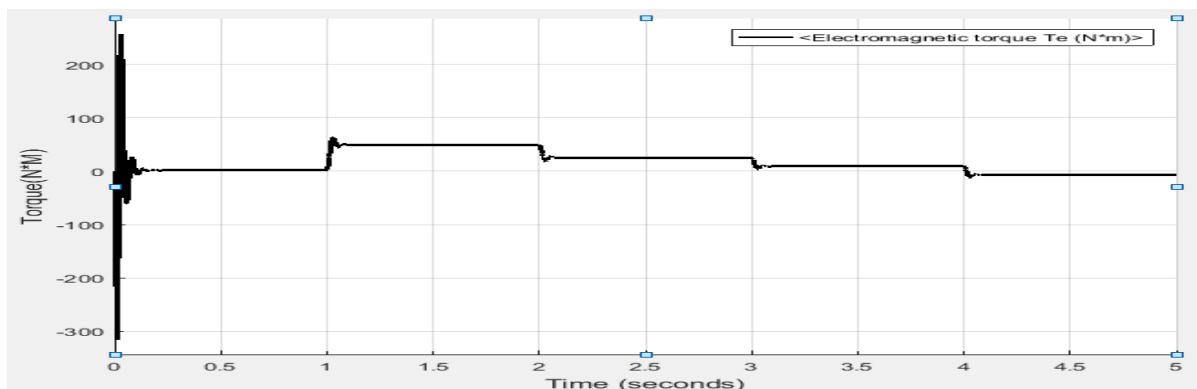


Fig. 12: Electromagnetic torque of the rotor at 15kW from conventional source.

## Performance Evaluation of Induction Motor Behaviour on Conventional and PV System Power Sources

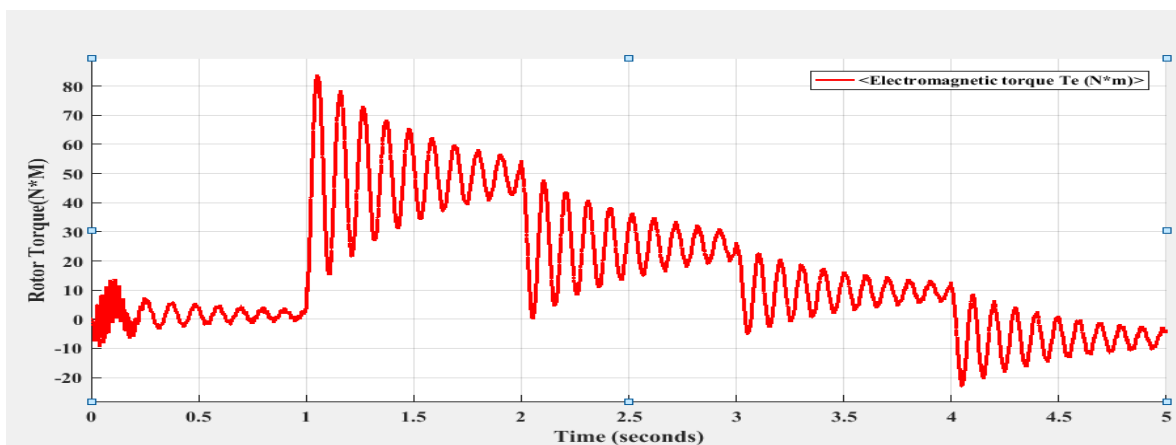


Fig. 14: Electromagnetic torque of the rotor rated at 15kW from PV system

The fluctuation in the rotor torque is significant, when the inductive load was supplied by the PV system, since it is not a redundant source like the conventional source. The toggle effect was significantly reduced when the conventional source of same capacity was deployed.

Shown in figs. 16 and 17 is the rotor current waveform from the induction motor rated at 15kW when supplied from both sources (conventional and PV system) as follows:

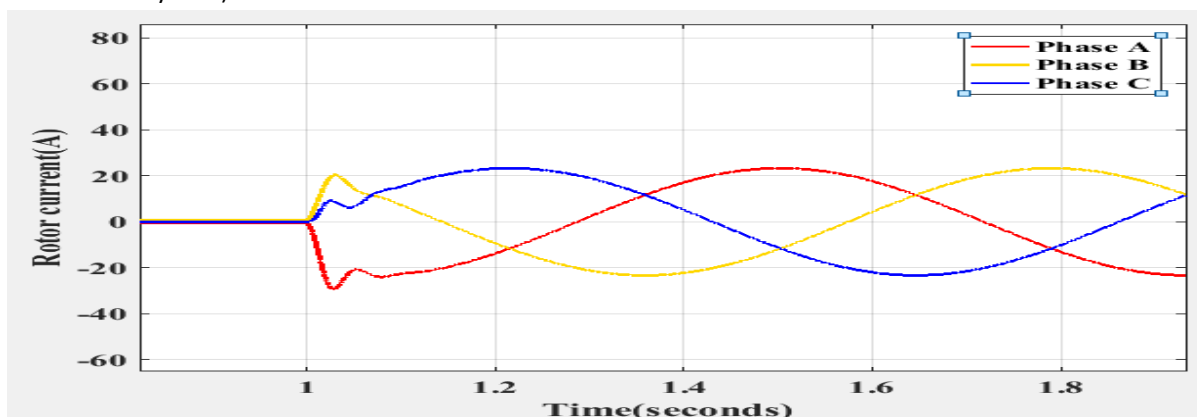


Fig. 16: Three-phase rotor current at 15kW from conventional source

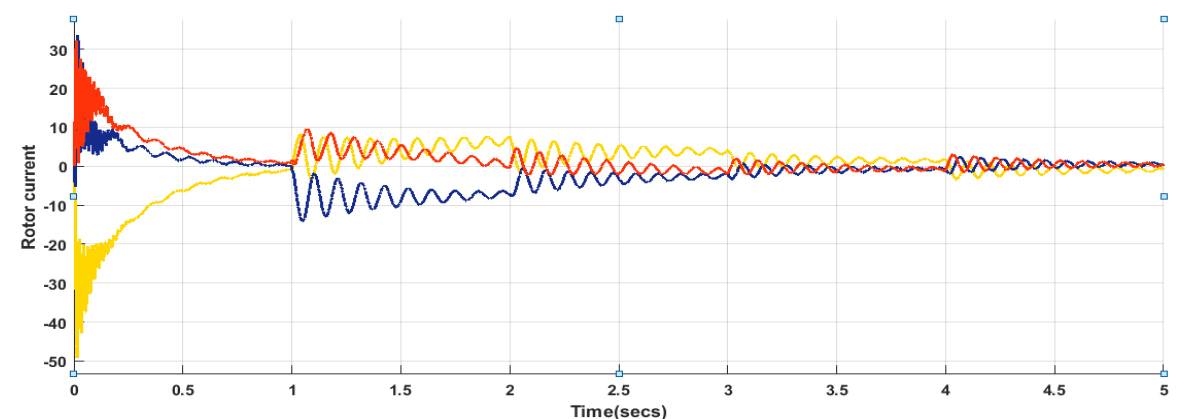


Fig. 17: Three-phase rotor current rated at 15kW from PV system

The rotor current signal waveform when powered from the PV system toggles frequently and also took a longer time to establish the required starting current for establishment of electromagnetic flux in the induction motor. whereas the conventional source been a redundant source quickly establishes the flux and stabilizes when subjected to interment loading conditions.

The current needed from the PV system to establish the electromagnetic flux greatly reduced, this showed a significant improvement in the PV system performance.

# Performance Evaluation of Induction Motor Behaviour on Conventional and PV System Power Sources

## IV. CONCLUSION

The comparison between the performance of inductive loads powered by a PV system and a conventional electric power source revealed significant reduction in harmonics, efficiency, and stability in the asynchronous machine output when supplied from the conventional source, it emphasizes on the need for adoption of advanced strategies to mitigate low-frequency generation during DC to AC conversion. To enhance PV system efficiency, advanced measures for reducing low-frequency generation and increasing solar panel power rating and battery capacity should be carefully considered, especially for extended usage during adverse weather conditions.

## V. RECOMMENDATIONS

It is therefore beneficial to deploy PV system for powering inductive loads, especially asynchronous machines due to their wide applications in various industries. To optimize their performance, it is essential to implement advanced control strategies, high-quality inverters and converters to ensure that a pure sinewave is obtained as well as to maintain a balance three phase system. Additionally, increasing the PV panels power rating beyond the load capacity, exploring advanced control systems, and conducting further research on diverse inductive loads and strategies to eliminate harmonics will enhance PV system efficiency, lead to substantial cost savings, and mitigate environmental impacts associated with greenhouse gas emission from combustion engines.

## REFERENCES

- 1) Ali, O. (2016). Modeling of Solar Photovoltaic Systems using MATLAB/SIMULINK . doi:10.1109/ICCITECHN.2016.7860182
- 2) Anyaehie, M. U. (2011). Renewable Energy for Sustainable Energy Development. *Journal of Science and Engineering Development*, 4(4), 8-18.
- 3) Bhateja, V., Nguyen, B. L., Nguyen, N. G., Satapathy, C., & Le, D.-N. (2017). Performance Evaluation of DC Microgrid using Solar PV Module. *4th International Conference on Information Systems Design and Intelligent Applications*, 672. India, Da Nang, Viet Nam.
- 4) Manekar, G., & Bodkhe, S. (2013). Modelling Methods of Three Phase Induction Motor. *International Journal of Computer Applications*, 16-20.
- 5) Manoj, L. D., & Kumar, D. K. (2021). Performnace Evaluation of DC-DC Boost Converter and its Nonlinear Analysis in Photovoltaic Based System. *IJIRT*, 7(9).
- 6) Mohammed, N., Alhelou, H. H., & Bahrani, B. (2023). *Grid-Forming Power Inverters Control and Applications*. CRC Press.
- 7) Nkan, I. E., Okoro, O. I., Obi, P. I., Awah, C. C., & Akuru, U. B. (2019). Application of FACTS Devices in a Multi-Machine Power System for Transient Stability Enhancement: A Case Study of the Nigerian 330kV 48-Bus System . *IEEE AFRICON*, (pp. 1-9). Accra, Ghana
- 8) Natala, H., Nkan, I. E., Okoro, O., & Obi, P. I. (2023). Investigation of the Transfer Capability of the Nigerian 330kV, 58-bus Power System Network using FACTS Devices . *ELEKTRIKA-Journal of Electrical Engineering* , 22(1), 53-62.
- 9) Nurul, A. Z., Ajisman, & Amad, R. Y. (2016). Modelling of photovoltaic Module using MATLAB/SIMULINK. *Material Science and Engineering*. doi:10.1088/1757-899X/114/1/012137
- 10) Omorogiwa, E. and Okpo, E. E. (2015). PV-Diesel Hybrid Power System for a Small Village in Nigeria. *International Journal of Scientific Research Engineering Technology*. Volume 1, Issue 4, ISSN (Online): 2395-566X.
- 11) Nkan, I. E., Okpo, E. E., & Okoro, O. I. (2021). Multi-Type FACTS Controllers for Power System Compensation: A Case Study of the Nigerian 48-Bus, 330Kv System. *Nigerian journal of Technological Development*, 18(1), 63-69.
- 12) Nkan, I. E., Okpo, E. E., Akuru, U. B., & Okoro, O. I. (2020). Contingency Analysis for Improved Power System Stability of the Nigerian 330Kv, 48-Bus System using Series FACTS Controllers. *AIUE Congress 2020: International Conference on Use of Energy*.
- 13) Okoro, O. I. (2002). *Dynamic and Thermal Modelling of Induction Machine with Non-Linear Effects*. Ph. D Dissertation , Kassel University, Germany.
- 14) Okpo, E. E., Okoro, O. I., Awah, C. C. and Akuru, U. B. (2019). Performance Evaluation of 5.5 kW Six-Phase Asynchronous Motor. *2019 IEEE PES/IAS PowerAfrica, Abuja, Nigeria*, pp. 639-644.
- 15) Ramprasath, E., & Manojkumar, P. (2015). Modelling and Analysis of Induction Motor using LabVIEW. *International Journal of Power Electronics and Drive Systems (IJPEDS)*, 5(3), 344-354.
- 16) Rathnayake, D. B., Akrami, M., Phurailatpam, C., Me, P. S., Hadavi, S., Jayasinghe, G., Bahrani, B. (2021). Grid Forming Inverter Modelling, Control, and Applications. *IEEE Power and Energy Society Section*, 9, 114781-114807.

## Performance Evaluation of Induction Motor Behaviour on Conventional and PV System Power Sources

- 17) Sakshi, M., Roshan, N., & Anupam, M. (2017). Modelling and Simulation of Solar Pv System for Induction Motor Drive. *International Journal of Innovative Science, Engineering and Technology*, 4, 88-96.
- 18) Sangeetha, A., & Parthiba, B. (2014). Review of Modelling and Dynamic Analysis of Three Phase Induction Motor Using MATLAB/SIMULINK. *International Journal of Science, Engineering and Technology Research (IJSETR)*, 3(3), 374-378.
- 19) Shah, S., Rashid, A., & Bhatti, M. (2012). Direct Quadrature (D-Q) Modelling of 3-phase Induction Motor using Matlab/Simulink. *Canadian Journal on Electrical and Electronics Engineering*, 3(5), 237-243.
- 20) Song, Z., Liu, J., & Yang, H. (2021). Air pollution and soiling implications for solar photovoltaic power generation: A comprehensive review. *ScienceDirect*, 298.
- 21) Yang, J., Li, C., Peng, W., Wagner, F., & Mauzerall, D. L. (2018). Climate, air quality and human health benefits of various solar photovoltaic deployment scenarios in China in 2030. *ResearchGate*, 13(6).
- 22) Zhou, Y., Zhang, R., Kathiraratchi, D., Dennis, J., & Goyal, S. (2022). Grid Forming Inverter and its Applications to Support System Strength- A Case Study. *The Institute of Engineering and Technology*, 17(2), 391-398.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Strategy for Improving the Local Economy in the Mandalika Area Using Swot Analysis and PLS-Sem Approach



Surya Angga Pranata<sup>1</sup>, M. Firmansyah<sup>2</sup>

<sup>1,2</sup>Faculty of Economics and Business, University of Mataram & Lombok, Indonesia

**ABSTRACT:** Local economic development is a collaboration between the community, local government and the private sector to create better economic conditions and generate jobs. The aim is to strengthen the economy at the local level in a sustainable manner, with the hope of improving community welfare. This research aims to determine the strengths, weaknesses, opportunities and threats in the Mandalika Region, Central Lombok, West Nusa Tenggara (NTB) Province. In this research, data collection was carried out by distributing questionnaires using purposive sampling using SWOT analysis, which collected 153 respondents. The data analysis technique uses Partial Least Square-Structural Equation Modeling (PLS-SEM). The results of the research show that the strengths and opportunities that exist in Mandalika include smooth roads, beautiful natural beauty, the Mandalika area has become a special economic zone (KEK) with central incentives, there is a large investment in the Mandalika area, and the public widely knows Lombok Island. World. Meanwhile, the weaknesses and threats that exist in Mandalika include: Not many local products are sold at the Moto Event, human resources for the workforce are still relatively limited, there are areas like Kek in Bali and Labuan Bajo as competitors, and they are known to be prone to earthquakes.

**KEYWORDS:** Local Economy, Mandalika Region, Swot Analysis Approach, PLS-SEM Approach, Special Economic Zone

### INTRODUCTION

Mandalika is a tourism area covering an area of 20,003 hectares located in Central Lombok Regency, West Nusa Tenggara. Since 2017, Mandalika has been inaugurated as a tourism Special Economic Zone (SEZ), which is expected to become an advanced tourist destination. Mandalika could become a competitor to SEZs and tourism in various places, including Bali, Labuan Bajo, etc. Not only is tourism an attraction in Mandalika, but the existence of various local foods and products can also be an attraction in the Mandalika area (Pamukçu et al., 2021). The Mandalika area could also become a space for future local economic development. In the Mandalika area, it can also be used as a variety of opportunities for marketers, researchers and business investors (Bagi, 2020).

Increasing economic development at the local level can be achieved by exploring and developing the potential that exists in various regions, a strategy known as Local Economic Development (LED). LED is a highly recommended approach today to promote job creation and reduce poverty levels, especially in the global shift towards government decentralization and overall government restructuring (Richards & Hall, 2000). This approach provides opportunities for communities to protect and manage the natural environment which directly impacts residents' quality of life, along with the realization of social and natural systems and developing interdependence (Gurău & Dana, 2018). The fiscal decentralization policy that flows down to the village level is a significant step in improving the regional economy and public services, supporting rural communities' welfare. The regional government is trying to stimulate and maximize local economic potential through LED to increase regional growth, especially in the Mandalika area, which is dominant in the tourism sector. This involves local government and community organizations collaborating to encourage, activate and support business activities to create jobs (Blakely & Bradshaw, 2002). The concept of a Tourism Village is a very important issue to consider. Rural tourism has the potential to change conventional views about tourism and can provide a new dimension to sustainable development (Aref & Gill, 2010).

The tourism destination management system is crucial to tourism development (Fifiyanti & Muhammad Luqman Taufiq, 2022). In this development process, the community is considered an active subject and not only a recipient of tourism but also an organizer and inseparable participant in tourism that reflects local culture (Laire & Gutierrez, 2022). To achieve this goal, the support of surrounding human resources is very important to increase their economic capacity and productivity. As a result, the positive benefits of developing rural tourism will be felt directly by local village communities. Apart from that, the strategy to

## Strategy for Improving the Local Economy in the Mandalika Area Using Swot Analysis and PLS-Sem Approach

drive the local economy through tourism destinations in the Mandalika area also requires strong motivation from the community; they must be willing to work together to manage their potential. Local wisdom can be used to develop superior products, advance the village, create new job opportunities, and improve the economy. (Fadri, 2019)

The development of the tourism sector in the Mandalika Region is also considered as one strategy to address inequality in growth in both rural and urban environments. It is hoped that tourism in the Mandalika area can improve living standards and environmental conditions. As an implementation of the concept of local economic development, the Mandalika tourist area has unique potential and attractions that can be developed as part of the tourism industry. Several tourist villages have been developed in Mandalika, such as Kuta Beach, Seger Beach and Aan Beach. However, there is still room for improving living standards, especially for residents. As well as identifying other villages that have the potential to become tourist villages in the Mandalika area, this also needs to be explored. It is important to remember that village communities are not only recipients of tourism but are also active in organizing tourism activities. They are important in creating unique tourism experiences reflecting distinctive local wisdom. This research aims to examine "Strategies for Improving the Local Economy in the Mandalika Region using the SWOT and PLS-SEM Analysis Approach" to analyze the local economic potential in the Mandalika Region to improve the welfare of the local community and formulate development strategies. (Wijijayanti et al., 2020)

### LITERATURE REVIEW

#### A. LOCAL ECONOMIC DEVELOPMENT (LED)

Local economic development is a collaboration between the community, local government and the private sector to create better economic conditions and generate jobs. The aim is to strengthen the economy at the local level in a sustainable manner, with the hope of improving community welfare (Huda, 2020). In essence, LED encourages collaboration in development between local governments, communities, the private sector and other related parties (Kanyane, 2008). This approach is often called a territorial development strategy based on endogenous factors such as local economic structure, human resources, and institutional regulations (Rodriguez-Pose & Tijmastra, 2007). This development approach is a socioeconomic strategy that starts from the bottom level up, which is integrated into the Provincial Growth and Development Strategy more generally to create a supportive business environment to increase competitiveness (Phago & Tsoabisi, 2010). Therefore, LED is a process managed by the city government by its constitutional mandate to develop local communities. (Maloka et al., 2014)

Tourism is one of the main drivers of local economic development in the Mandalika area (Dlomo & Rogerson, 2021). Tourism has an important role in local economic development. Tourism has significantly contributed to regional development (Normelani, 2016). The benefits of tourism can be realized through various sources of income, maintaining the balance of fragile ecosystems, strengthening ties between villages and urban areas, and adding economic value (Manu & Kuuder, 2012; Mbaiwa & Stronza, 2011). This approach is in line with the principles of local economic development, which focuses on regional management by local communities to improve their quality of life and increase the competitive ability of local businesses. (Zingi et al., 2022)

Not only can tourism be an attraction in Mandalika, but various local products and local foods can also be an attraction that can be utilized. The ability of local people who are experts in making various local products can be used to develop the local economy (Fan et al., 2022). Many local products and local foods are available in Mandalika, such as woven products made from woven bamboo and rattan and various products that can be used as souvenirs. Meanwhile, the typical food is beberuk, placing kale, urap, twang chicken, etc.

#### B. Mandalika Special Economic Zone (SEZ) as a Strategy to Improve the Local Economy

The Mandalika Special Economic Zone is one of the priority areas in national economic development, which aims to create new sources of economic growth in the region (Septiadi et al., 2022). The Mandalika Special Economic Zone (SEZ) was designated a tourist area in 2015 (Salahuddin et al., 2021). KEK Mandalika Central Lombok has been in the spotlight because it hosts a prestigious sporting event, MotoGP. Apart from that, the Mandalika area was previously announced as one of the national priorities in the tourism sector. ITDC, as this area's manager, is building several infrastructures there.

The Mandalika Special Economic Zone is part of the locations selected as priority destinations by the Indonesian Government. Therefore, this opportunity must be utilized by the local community in order to obtain the maximum benefits (Azizurrohman, Ilyas, et al., 2023). Countries have implemented special economic zones as both an alternative and a complement to promoting trade and investment through international economic legal instruments (Chaisse & Dimitropoulos, 2021). This significant investment in the Mandalika area gives rise to mixed feelings. Kuta Mandalika Village is a local community that must adapt to the regional tourism industry as the spearhead of the West Nusa Tenggara Tourism Special Economic Zone

## Strategy for Improving the Local Economy in the Mandalika Area Using Swot Analysis and PLS-Sem Approach

(Azizurrohman, Martayadi et al., 2023). On the one hand, it is hoped that the economy will grow faster, and the attractiveness of this region will encourage business growth there. However, on the other hand, there is concern that local communities may not participate optimally in this area. The surrounding community needs to prepare adequate resources, especially labor or human resources, who have the skills and capital to set up a business that can benefit from the economic growth generated by Mandalika (economic spillovers). The tourism industry in the Mandalika Lombok Special Economic Zone has created new jobs and work types previously unknown to the community (Syafuruddin et al., 2020). It is hoped that the effects of this growth can be utilized to encourage economic development, as mentioned by Comerio, Pacicco, and Serati (2020). Direct benefits are when people can work directly at tourist attractions and provide products needed by main businesses in the area. Meanwhile, indirect benefits are when people use the high circulation of money around the area to set up various derivative businesses. The study by Cristian-Constantin et al. (2015) shows that the SPA tourism sector contributes to developing other economic sectors due to tourist flows. The results of Zhang and Zhang's study (2021) also show that tourist activities benefit local communities economically.

However, working in the tourism industry is difficult because it requires special education and skills that not everyone has. Skills shortages are a major challenge in the tourism industry (Kim et al., 2021). However, even from a gender perspective, tourism can provide special employment opportunities for women (Zhang & Zhang, 2021). Wrong perceptions regarding the existence of female workers in the tourism sector have created a gender gap that is detrimental to the existence of female workers in the tourism sector. Empowering women's resources in the tourism sector requires a development approach based on the culture and local wisdom of the community, namely strengthening the capacity of women workers, which includes strengthening individual capacity and strengthening the capacity of entities (institutions) (Syafuruddin et al., 2023). Therefore, indirect benefits have the potential to be developed. The local community needs to prepare products and services that can be marketed to visitors to Mandalika to benefit from the economic growth occurring in the area. There are special needs to meet the preferences of visitors to the area. The marketing must also follow the rules so visitors can accept it; the product or service offered must be of high quality, and marketing efforts must be carried out consistently (Sutton, 1999).

According to research conducted by Fajariyah and Santoso (2015), the determining factors in local economic development (LED) involve human resources, production, institutions and infrastructure. Apart from that, according to Arumsani and Pamungkas (2014), capital also plays a role in influencing LED. Therefore, a study is needed to investigate the role of the Mandalika SEZ as an economic center for the people of Central Lombok and NTB in general, with a focus on local aspects, and also to formulate the best strategy for utilizing this area to improve the local community's economy. (Masrun et al., 2022)

### METHOD

The methodological approach in analyzing local economic improvement strategies in the Mandalika Region uses a quantitative approach using a case study approach to gain a comprehensive understanding of the investigated problems. Next, the data was analyzed using SWOT and PLS-SEM analysis to identify the most appropriate strategy for developing the local economy in the Mandalika area. (Haryoko, 2021)

The research stages of the Strategy for Improving the Local Economy in the Mandalika Area Using the SWOT Analysis and PLS-SEM Approach are:

#### A. Literature and Data Review

Literature Review is a quantitative analysis method to identify indicators related to Local Economic Development. This data was obtained from the results of primary and secondary questionnaire surveys. The general public, students and various segments of the population act as providers of primary data sources. Meanwhile, the secondary data obtained in this research are from international journals and several national journals related to the local economy.

#### B. SWOT Analysis

To analyze the potential of the tourism sector in the Mandalika Region, researchers conducted an economic evaluation of several aspects, including the agrotourism sector, rural tourism, related services, trade, and the historical cultural heritage of this region. Researchers note strengths and weaknesses and identify existing opportunities and risks. One of the strengths is the high level of processing and variety in the tourism sector, the availability of various local resources, and a qualified workforce. However, researchers also identified several weaknesses, such as the absence of incentives for companies in the tourism industry, lack of infrastructure development that supports economic activity, inefficient management, and low levels of entrepreneurial training. (Petroman et al., 2016)

# Strategy for Improving the Local Economy in the Mandalika Area Using Swot Analysis and PLS-Sem Approach

## C. PLS-SEM

PLS (Partial Least Square) is an analysis method that focuses on variance and allows simultaneously testing measurement and structural models. Structural Equation Modeling (SEM) is a field of statistics used to test complex relationships between components in one analysis. (Sarstedt et al., 2020)

SEM (Structural Equation Modeling) Usually, this method is used to describe several statistical relationships simultaneously using visualization and checking the model's validity. Complete components can be discussed simply with this strategy. It is an extension of traditional linear modeling techniques, e.g., multiple regression analysis and Analysis of Variance (ANOVA), a prerequisite for learning SEM. It can be briefly defined as combining factor and multiple regression analysis simultaneously (Sarstedt et al., 2017; Hair Jr et al., 2017a; Haenlein & Kaplan, 2004). SEM aims to understand the relationship between latent constructs (factors) generally indicated by various measures. It is also known as latent variable analysis as well as covariance structure analysis. This approach adopts a confirmatory approach rather than an exploratory approach. (Dash & Paul, 2021)

## RESULTS AND DISCUSSION

The Mandalika area has significant local economic potential, which has a major influence on the regional economy by stimulating the community's economic growth, including those in the lowest social strata. Tourism is the sector that provides the greatest participation in national economic growth, which results in special attention from the government in its development (Haris & Ningsih, 2020). Tourism is one of the factors forming the budget in every economy (Boiko et al., 2021). Tourism is considered an attractive factor in a tourist destination which importantly triggers economic growth, especially for local communities (Situmorang et al., 2019). Not only can tourism be an attraction in the Mandalika area, but Lombok's typical culinary delights are also an attraction for tourists who come to Mandalika. As part of the ten leading tourist destinations, the Mandalika Special Economic Zone needs to evaluate and develop tourism experiences, including the experience of tasting the deliciousness of various dishes, now known as 'culinary tourism' (Rizkiyah et al., 2021). Culinary tourism focuses on food as an exploration attraction and destination (Atef & Harede, 2022). Culinary tourism is becoming increasingly influential in shaping visitors' decision-making and holiday experiences and providing significant socio-cultural and economic benefits (Wondirad et al., 2021). Various kinds of typical Lombok culinary delights have the potential to be used as culinary tourism products, considering that the tourism sector is one of the fields that creates significant foreign exchange income, which is beneficial both for regional development and national economic development. (Untari & Satria, 2017). This potential can be seen in foreign nationals coming to Mandalika for vacation and relaxation. For example, recently, in Mandalika, the Moto GP Raiders arrived one week earlier than the predetermined schedule so that the Raiders could go on holiday before their scheduled match in Mandalika.

### A. Identity of Respondents

Respondent identity is a summary of the respondents' objects in the research. Regarding research identity, respondents were divided into different categories based on gender, education, address, occupation, and age. The data in Table 1 below of the respondents in this study is dominated by male respondents, namely 77 respondents and 76 female respondents. The respondents' education in this study was dominated by Strata 1 education level, namely 76 respondents, 51 respondents from the general public (workers), followed by SMA/SMK/MA education with 21 respondents, and Strata 2 five respondents. This research surveyed the community in Nusa West Southeast (NTB), including Central Lombok Regency with 95 respondents, East Lombok Regency with 20 respondents, Mataram City with 17 respondents, Bima Regency with six respondents, Sumbawa Regency with six respondents, West Lombok Regency with five respondents, North Lombok Regency 1 respondent, Dompu Regency 1 respondent, South Jakarta City 1 respondent, and Bandar Lampung City 1 respondent. Occupations are dominated by students with 71 respondents, followed by farmers with 17 respondents, teachers with 16 respondents, freelancers with eight respondents, waiters/waitresses with eight respondents, traders with seven respondents, civil servants with six respondents, entrepreneurs with six respondents, homemakers with six respondents, mechanics with three respondents, livestock breeders two respondents, 1 NGO, 1 Backend Developer, and 1 Social Media Specialist. The majority of respondents in this study were aged 17 to 21 years, with 70 respondents, followed by the age range 22-26 with 54 respondents, and above 27 with 29 respondents.



# Strategy for Improving the Local Economy in the Mandalika Area Using Swot Analysis and Pls-Sem Approach

**Table 1: Identity of Respondents**

**Respondents**

Information	Sum	Percentage
<b>Gender</b>		
Man	77	77
Woman	76	76
<b>Total</b>	<b>153</b>	<b>153</b>
<b>Education</b>		
SMA/SMK/MA	21	21
Strata 1	76	76
Strata 2	5	5
Workers	51	51
<b>Total</b>	<b>153</b>	<b>153</b>
<b>Address</b>		
Bima Regency	6	6
West Lombok Regency	5	5
Central Lombok Regency	95	95
East Lombok Regency	20	20
North Lombok Regency	1	1
Sumbawa Regency	6	6
Mataram City	17	17
Dompu Regency	1	1
South Jakarta City	1	1
Bandar Lampung City	1	1
<b>Total</b>	<b>153</b>	<b>153</b>
<b>Work</b>		
Student	71	71
Farmers	17	17
Teachers	16	16
Freelance	8	8
Waiters/Waitress	8	8
Traders	7	7
Civil Servants	6	6
Entrepreneurs	6	6
Housewives	6	6
Mechanics	3	3
Livestock breeders	2	2
NGO	1	1
Backend Developer	1	1
Social Media Specialist	1	1
<b>Total</b>	<b>153</b>	<b>153</b>
<b>Age</b>		
17 - 21	70	70
22 - 26	54	54
Above 27	29	29
<b>Total</b>	<b>153</b>	<b>153</b>

**Source:** Primary data (processed)

# Strategy for Improving the Local Economy in the Mandalika Area Using Swot Analysis and PLS-Sem Approach

## B. Descriptive Statistics

Descriptive statistics is an important part of biomedical research describing basic data characteristics (Mishra et al., 2019). The table below shows the results and answers from all 153 respondents. The questions in this research relate to Strengths, Weaknesses, Opportunities, Threats (SWOT), and the Mandalika area as a space for future local economic development. The answer criteria are 5: strongly disagree, disagree, quite agree, agree, and strongly agree. Moreover, the highest respondent results on LED were with the agreed category of 4.47, arranged in the strength category quite agree as much as 3.90, opportunity 3.81 in the quite agree category, weakness 3.60 in the quite agree category, and threat 3.31 in the quite agree category.

**Table 2: Descriptive Static or Research Table**

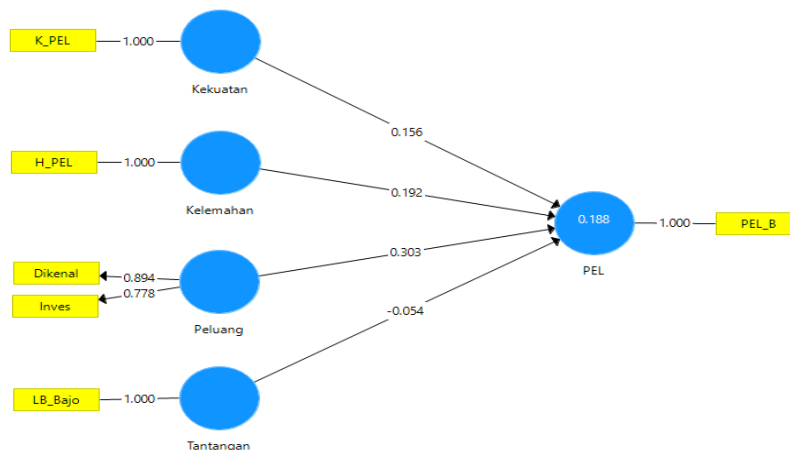
Construction	Average	Category
Strength	3,90	Quite Agree
Weakness	3,60	Quite Agree
Opportunity	3,81	Quite Agree
Threats	3,31	Quite Agree
LED	4,47	Agree

Source: Primary data (processed)

## C. Outer Model

### Convergent Validity

Convergent validity is a type of construct validity that is considered a core part of the validity of a test. The study aimed to investigate the convergent validity between eFI (emotional intelligence factor) and standard measures of frailty in research (Brundle et al., 2019). Based on the image below, it can be seen that the outer loading value of all variable indicators is greater than 0.7, so it is said to be valid. Notes: If there is an indicator whose outer loading value is smaller than 0.7, it must be removed and not used in subsequent tests.



### Discriminant Validity

Discriminant validity was originally presented as a set of empirical criteria that can be assessed from multitrait-multimethod (MTMM) matrices (Rönkkö & Cho, 2022). Assessment of discriminant validity has become a generally accepted prerequisite for analyzing relationships between latent variables. For variance-based structural equation modeling, such as partial least squares, the Fornell-Larcker criterion and cross-loading checks are the dominant approaches for discriminant validity (Henseler et al., 2015).

# Strategy for Improving the Local Economy in the Mandalika Area Using Swot Analysis and Pls-Sem Approach

**Table 3: Discriminant Validity**

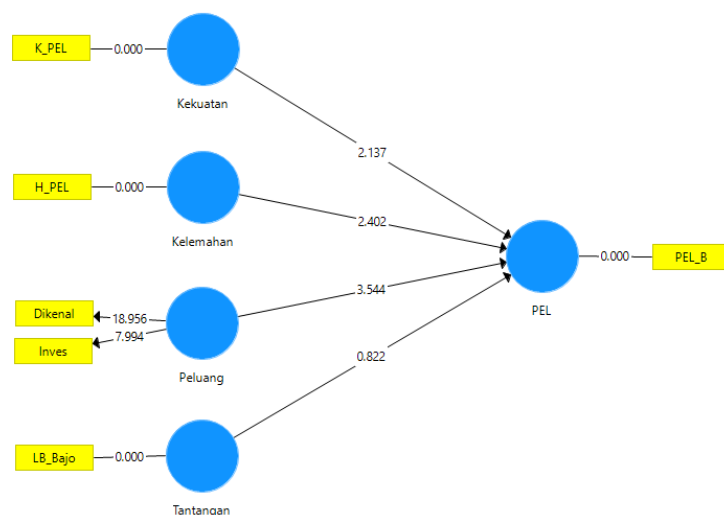
	Kekuatan_	Kelemahan	PEL	Peluang_	Tantangan
Kekuatan_	1.000				
Kelemahan	-0.098	1.000			
PEL	0.273	0.173	1.000		
Peluang_	0.445	0.034	0.374	0.838	
Tantangan	-0.020	0.257	0.018	0.085	1.000

Ave root value (Fornell Larcker criterion)

The AVE root value of each variable is greater than the AVE root of its correlation with other variables so that discriminant validity is fulfilled.

### D. Inner Model Test

An inner model is a structural framework that predicts causal connections between variables that cannot be measured directly or latent. This structural model (inner model) describes the causal relationship between latent variables that have been formed based on the substance of a theory. In testing the structural model (inner model), the Bootstrapping and Blindfolding methods are used in the SMART PLS process (Dr. et al., S E, 2021).



**Table 4: Inner Model Test**

Panel	Coefficient value	P-Values	Information
Strength-> LED	0,156	0,040	Significant
Weakness-> LED	0,192	0,017	Significant
Opportunity-> LED	0,303	0,001	Significant
Threats-> LED	-0,054	0,426	Insignificant

Note: PLS 3.0 (processed)

The results of the inner model show that the strength in the Mandalika area is positive and significant because it can be seen from the calculation, which shows a value  $< 0.05$ , namely  $0.040 < 0.05$ . Arranged Weaknesses are positive and significant, with a result of  $0.017 < 0.05$ . The opportunities in the Mandalika area are positive and significant, with a result of  $0.001 < 0.05$ . Finally, the challenges in the Mandalika area are negative and not significant, with a value of  $0.426 > 0.05$

# Strategy for Improving the Local Economy in the Mandalika Area Using Swot Analysis and Pls-Sem Approach

## CONCLUSION

This research analyzes the Strategy for Improving the Local Economy in the Mandalika Area Using the SWOT Analysis and PLS-SEM Approach. The SWOT analysis used is three analyses that show positive and significant results and one that shows negative and insignificant results. Results can be significant if the value is  $< 0.5$ , where Strengths show positive and significant results  $0.040 < 0,05$ . Weaknesses show positive and significant results  $0.017 < 0,05$ . The probability of showing positive and significant results with a value of  $0.001 < 0,05$ . The challenges in the Mandalika area show negative and insignificant results with a value of  $0.426 > 0,05$ . And the community believes that in the future the Mandalika area will become a space for future local economic development.

## REFERENCES

- 1) Atef, A., & Harede, B. (2022). The Role of Culinary Tourism in Promoting the Hotel Industry: A Case Study in Matrouh City. *Journal of Tourism, Hotels and Heritage*, 4(2). <https://doi.org/10.21608/sis.2022.143688.1059>
- 2) Azizurrohmah, M., Ilyas, G. B., Ginting, Y. M., Sudiyanti, S., & Hasanah, Y. N. (2023). Analysis of Community Readiness for the Mandalika Special Economic Zone: Using the Sapta Pesona Standard. *Journal of Economics Research and Social Sciences*, 7(2). <https://doi.org/10.18196/jerss.v7i2.16414>
- 3) Azizurrohmah, M., Martayadi, U., Najmudin, M., Fathurrahim, F., & Bratayasa, I. W. (2023). Tourism Industry and Community Readiness: A Case Study of the Mandalika Special Economic Zone (KEK). *Journal of Economics Research and Social Sciences*, 7(1). <https://doi.org/10.18196/jerss.v7i1.13652>
- 4) Baggi, D. (2020). The Taste of Travel: How Food Impacts and Modifies People's Travel Decisions. *Dissertasion: Instituto Universitario de Lisboa*.
- 5) Boiko, V., Liubynskyi, O., Strikha, L., Zarakhovskiy, O. Y., & Neilenko, S. (2021). Development of Culinary Tourism in European Countries. *INTERNATIONAL JOURNAL OF COMPUTER SCIENCE AND NETWORK SECURITY*, 21(4).
- 6) Brundle, C., Heaven, A., Brown, L., Teale, E., Young, J., West, R., & Clegg, A. (2019). Convergent validity of the electronic frailty index. *Age and Ageing*, 48(1). <https://doi.org/10.1093/ageing/afy162>
- 7) Chaisse, J., & Dimitropoulos, G. (2021). Special Economic Zones in International Economic Law: Towards Unilateral Economic Law. In *Journal of International Economic Law* (Vol. 24, Issue 2). <https://doi.org/10.1093/jiel/jgab025>
- 8) Dash, G., & Paul, J. (2021). CB-SEM vs PLS-SEM methods for research in social sciences and technology forecasting. *Technological Forecasting and Social Change*, 173(August), 121092. <https://doi.org/10.1016/j.techfore.2021.121092>
- 9) Dlomo, T. O., & Rogerson, C. M. (2021). Tourism and Local Economic Development in King Sabata Dalindyebo Local Municipality, South Africa: Stakeholder Perspectives. *African Journal of Hospitality, Tourism and Leisure*, 10(1). <https://doi.org/10.46222/AJHTL.19770720-92>
- 10) Dr. Meiryani Ak. M.Ak., CA, S E, M. M. (2021). Memahami Inner Model (Model Struktural) Dalam Smart Pls. *Binus University*, 02(3).
- 11) Fadri, Z. (2019). TABUIK: LOCAL WISDOM AS AN ALTERNATIVE FOR SUPPRESSING THE IMPACT OF STRUCTURAL CHANGE IN PARIAMAN. *Alfuad: Jurnal Sosial Keagamaan*, 3(1). <https://doi.org/10.31958/jsk.v3i1.1488>
- 12) Fan, Y., Cheng, Z., Zhang, Q., Xiong, Y., Li, B., Lu, X., He, L., Jiang, X., Tan, Q., & Long, C. (2022). Meizi-Consuming Culture That Fostered the Sustainable Use of Plum Resources in Dali of China: An Ethnobotanical Study. *Biology*, 11(6). <https://doi.org/10.3390/biology11060832>
- 13) Fifiyanti, D., & Muhammad Luqman Taufiq. (2022). Identifikasi Pengelolaan Destinasi Pariwisata Di DPD Segoro Kidul Kabupaten Bantul. *TOBA: Journal of Tourism, Hospitality and Destination*, 1(2). <https://doi.org/10.55123/toba.v1i2.594>
- 14) Gurău, C., & Dana, L. P. (2018). Environmentally-driven community entrepreneurship: Mapping the link between the natural environment, local community and entrepreneurship. *Technological Forecasting and Social Change*, 129. <https://doi.org/10.1016/j.techfore.2017.11.023>
- 15) Haris, A., & Ningsih, N. H. I. (2020). Impact Of Tourism On Community Development And Income In Kuta Mandalika Beach Kuta Village, Pujut District, Central Lombok. *JISIP (Jurnal Ilmu Sosial Dan Pendidikan)*, 4(3). <https://doi.org/10.58258/jisip.v4i3.1225>
- 16) Hariyoko, Y. (2021). Analisa Pengembangan Ekonomi Lokal Desa Mojomalang Kecamatan Parengan Kabupaten Tuban. *Jurnal Kebijakan Pembangunan*, 16(2), 197–206. <https://doi.org/10.47441/jkp.v16i2.180>
- 17) Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the Academy of Marketing Science*, 43(1). <https://doi.org/10.1007/s11747-014-0403-8>

## Strategy for Improving the Local Economy in the Mandalika Area Using Swot Analysis and PLS-Sem Approach

- 18) Huda, R. (2020). Pengembangan Ekonomi Lokal Melalui Sektor Pariwisata di Desa Serang, Kecamatan Karangreja, Kabupaten Purbalingga. *Aspirasi: Jurnal Masalah-Masalah Sosial*, 11(2). <https://doi.org/10.46807/aspirasi.v11i2.1470>
- 19) Laire, E., & Gutierrez, M. (2022). Participation in Tourism Cases on Community-Based Tourism (CBT) in the Philippines. *Ritsumeikan Journal of Asia Pacific Studies*, 37(1).
- 20) Maloka, C. M., Mashamaite, K. A., & Ledwaba, M. D. (2014). Local economic development: Linking theory and practice in South Africa's municipalities. *Mediterranean Journal of Social Sciences*, 5(20). <https://doi.org/10.5901/mjss.2014.v5n20p218>
- 21) Masrun, M., Wahidin, W., Yuniarti, T., & Firmansyah, M. (2022). Peran Kawasan Ekonomi Khusus Mandalika Lombok Terhadap Pengembangan Ekonomi Lokal (PEL). *Jurnal Sosial Ekonomi Dan Humaniora*, 8(1), 75–83. <https://doi.org/10.29303/jseh.v8i1.17>
- 22) Mishra, P., Pandey, C. M., Singh, U., Gupta, A., Sahu, C., & Keshri, A. (2019). Descriptive statistics and normality tests for statistical data. *Annals of Cardiac Anaesthesia*, 22(1). [https://doi.org/10.4103/aca.ACA\\_157\\_18](https://doi.org/10.4103/aca.ACA_157_18)
- 23) Normelani, E. (2016). The Floating Market of Lok Baitan, South Kalimantan. *Journal of Indonesian Tourism and Development Studies*, 4(1). <https://doi.org/10.21776/ub.jitode.2016.004.01.01>
- 24) Pamukçu, H., Saraç, Ö., Aytuğar, S., & Sandıkçı, M. (2021). The effects of local food and local products with geographical indication on the development of tourism gastronomy. *Sustainability (Switzerland)*, 13(12). <https://doi.org/10.3390/su13126692>
- 25) Petroman, I., Suci, C., Benea, M. C., Bolocan, R., & Marin, D. (2016). Swot Analysis of Banat and Timis Agrotourism Sector. *3rd International Multidisciplinary Scientific Conference on Social Sciences and Arts SGEM 2016, Book 2*, 5(SGEM2016 Conference Proceedings, ISBN 978-619-7105-76-6 / ISSN 2367-5659).
- 26) Rizkiyah, P., Kanom, Wijaya, S. R., & Iswati, R. (2021). The Influence of Food Quality and Tourist Satisfaction Toward Tourist Loyalty in the Mandalika Special Economic Zone. *Jurnal Akademi Pariwisata Medan*, 9(2).
- 27) Rönkkö, M., & Cho, E. (2022). An Updated Guideline for Assessing Discriminant Validity. *Organizational Research Methods*, 25(1). <https://doi.org/10.1177/1094428120968614>
- 28) Salahuddin, M. A. A., Rohayani, I. S., & Candri, D. A. (2021). Species diversity of birds as bioindicators for mangrove damage at Special Economic Zones (SEZ) Mandalika in Central of Lombok, Indonesia. In *IOP Conference Series: Earth and Environmental Science* (Vol. 913, Issue 1). <https://doi.org/10.1088/1755-1315/913/1/012058>
- 29) Sarstedt, M., Ringle, C. M., Cheah, J. H., Ting, H., Moises, O. I., & Radomir, L. (2020). Structural model robustness checks in PLS-SEM. *Tourism Economics*, 26(4). <https://doi.org/10.1177/1354816618823921>
- 30) Septiadi, D., Rosmilawati, R., Usman, A., & Hidayati, A. (2022). Socio-Economic Study of Maize Farming Households in The Buffer Area of Mandalika Special Economic Zone Central Lombok Regency. *Jurnal Biologi Tropis*, 22(3). <https://doi.org/10.29303/jbt.v22i3.4474>
- 31) Situmorang, R., Trilaksono, T., & Japutra, A. (2019). Friend or Foe? The complex relationship between indigenous people and policymakers regarding rural tourism in Indonesia. *Journal of Hospitality and Tourism Management*, 39. <https://doi.org/10.1016/j.jhtm.2019.02.001>
- 32) Sutton, J. (1999). Marketing on a shoestring. *Radiology Management*, 21(1).
- 33) Syafruddin, S., Wadi, H., & Suud, S. (2020). Tourism Industry and Women's Employment Mobility in the Special Economic Zone (SEZ) of Mandalika Kuta Lombok. *Society*, 8(1). <https://doi.org/10.33019/society.v8i1.175>
- 34) Syafruddin, Salahuddin, M., & Nurhilaliati. (2023). Accessibility of Women's Empowerment in the Tourism Industry from Mandalika Special Economic Zone. *Journal of Environmental Management and Tourism*, 14(2). [https://doi.org/10.14505/jemt.v14.2\(66\).18](https://doi.org/10.14505/jemt.v14.2(66).18)
- 35) Untari, D. T. U. T., & Satria, B. (2017). STRATEGI PENGEMBANGAN PEMASARAN "LAKSA TANGERANG" SEBAGAI SALAH SATU PRODUK WISATA KULINER DI TANGERANG. *Business Management Journal*, 10(2). <https://doi.org/10.30813/bmj.v10i2.632>
- 36) Wijijayanti, T., Agustina, Y., Winarno, A., Istanti, L. N., & Dharma, B. A. (2020). Rural tourism: A local economic development. *Australasian Accounting, Business and Finance Journal*, 14(1 Special Issue). <https://doi.org/10.14453/aabfj.v14i1.2>
- 37) Wondirad, A., Kebete, Y., & Li, Y. (2021). Culinary tourism as a driver of regional economic development and socio-cultural revitalization: Evidence from Amhara National Regional State, Ethiopia. *Journal of Destination Marketing and Management*, 19. <https://doi.org/10.1016/j.jdmm.2020.100482>

## Strategy for Improving the Local Economy in the Mandalika Area Using Swot Analysis and Pls-Sem Approach

- 38) Zingi, G. K., Mpofu, A., Chitongo, L., Museva, T., Chivhenge, E., & Ndongwe, M. R. (2022). Ecotourism as a vehicle for local economic development: A case of Tsholotsho District Zimbabwe. *Cogent Social Sciences*, 8(1). <https://doi.org/10.1080/23311886.2022.2035047>



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Simultaneous Equation: The Case of Inflation & Rupiah Exchange Rate in Indonesia 2001-2022



Rheta Da Lhutfa Salam<sup>1</sup>, Prayitno Basuki<sup>2</sup>

<sup>1,2</sup>Faculty of Economics and Business, University of Mataram & Lombok, Indonesia

**ABSTRACT:** This study aims to determine the relationship between inflation and the rupiah exchange rate in Indonesia in 2001-2022, using simultaneous equations through a two-stage least square (2SLS) approach. The method used in this study is simultaneous equation regression, in which the variables are interconnected. The data used in this study is Indonesian state data for 2001-2022, including inflation, exchange rates, interest rates, gross domestic product, and exports obtained from the Badan Pusat Statistik (BPS) Indonesia website. The results of the study based on the two-stage least square (2SLS), the simultaneous equation of inflation (INF), showed that the variable interest rate (R) and gross domestic product (GDP) had a significant effect on inflation (INF). In contrast, the exchange rate variable (ER) did not significantly affect inflation (INF). Simultaneously, the exchange rate (ER), interest rate (R), and gross domestic product (GDP) affected inflation (INF) because F (prob) was smaller from alpha = 5%. Then, in the exchange rate equation (ER), inflation variables (INF), money supply (M2) and exports (X) have a significant effect on the exchange rate. Simultaneously, Inflation (INF), money supply (M2), and exports (X) affect the exchange rate (ER) because F (prob) is smaller than alpha = 5%.

**KEYWORDS:** Simultaneous Equation, 2SLS, Inflation, Rupiah Exchange Rate, Interest Rate, Gross Domestic Product, Money Supply, Export

### I. INTRODUCTION

Issues that often concern economic thinkers and governments are exchange rates & inflation. Exchange rates & inflation should receive serious attention from relevant stakeholders, through maintenance of economic stability (Faizin, 2020). Inflation and exchange rates are important macroeconomic variables that influence each other. Inflation can affect a country's exchange rate; when it experiences economic changes, it usually affects large exchange rate movements (Khomariyah et al., 2022). According to (Fitilai et al., 2017), inflation has a strong relationship with the exchange rate. The rupiah exchange rate will decrease against foreign currencies (US dollars) when inflation increases. Likewise, it will appreciate the rupiah exchange rate against foreign currencies (US Dollars) when inflation decreases. As for the influence of exchange rates on inflation, foreign prices and nominal exchange rates directly affect inflation and aggregate demand indirectly (Rakhmat et al., 2022)

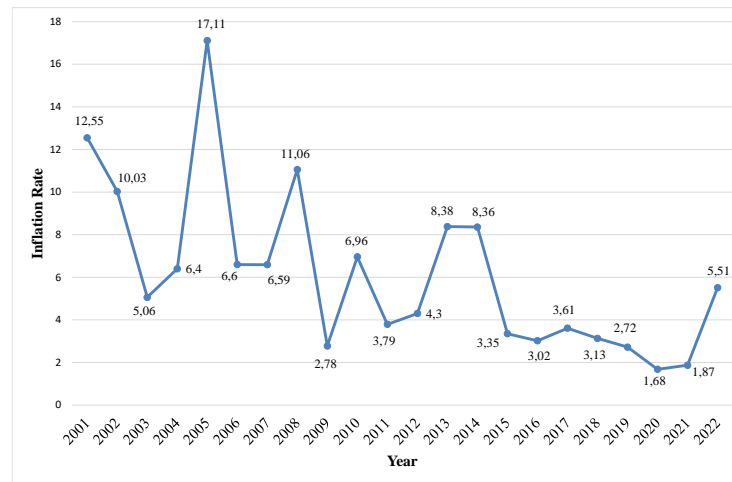
Exchange rates are used to compare currency values and prices between two countries to exchange between these currencies (Hidayat et al., 2018). According to (Arifin & Mayasya, 2018), the exchange rate of the State of Indonesia (Rupiah) against the United States (US Dollar) is influenced by the inflation rate, interest rate, and money supply. According to (Adhista, 2022), a high amount of exports can also affect the exchange rate because high exports will increase demand for domestic currency, which can cause the strengthening of the Indonesian exchange rate (Rupiah). Conversely, a decrease in a country's exports will increase its exchange rate (Sharma & Dahiya, 2023).

According to Bank Indonesia (2023), inflation is a condition in which a general increase in the price of goods and services occurs continuously within a certain period. If the increase only occurs in one or two goods, this condition cannot be considered inflation (Budhijana, 2023). High inflation will have an impact on reducing the level of public welfare (Ilmas et al., 2022). The declining level of public welfare will reduce people's purchasing power because the price of goods is higher than before inflation. Income distribution will worsen because many people cannot adapt to inflationary conditions (Susanto, 2018).

Inflation is a macroeconomic problem that often occurs in Indonesia. Therefore, Indonesia must avoid high inflation to create a healthy and stable state economy. Controlling inflation is an important thing to do because it harms the socioeconomic conditions of the community in addition to having an impact on interest rate and exchange rate instability (Harjunawati et al.,

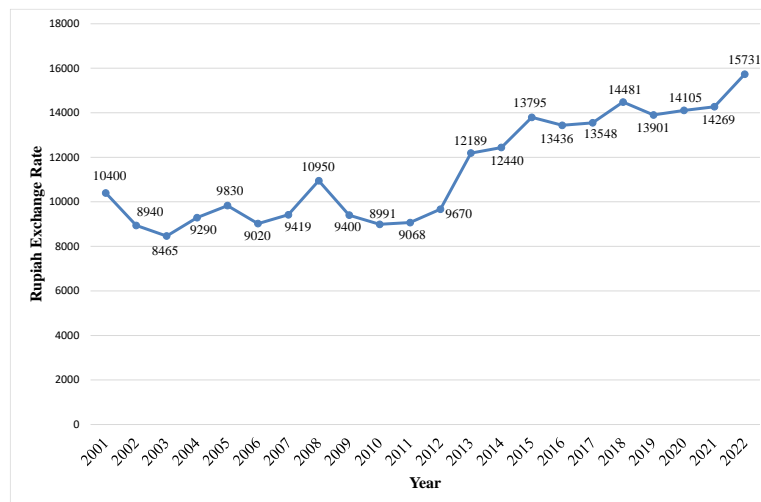
## Simultaneous Equation: The Case of Inflation & Rupiah Exchange Rate in Indonesia 2001-2022

2021). According to Bank Indonesia (Arjunita, 2016), there are three reasons for inflation to be stable. First, inflation is the cause of the decline in people's real income. If a country experiences inflation, prices will increase which has an impact on people's purchasing power will decrease. Second, inflation causes doubts in all economic actors, it will hamper economic growth. Third, the real domestic interest rate is less competitive due to high inflation and will likely pressure the rupiah exchange rate. As a result, exchange rate pressures will increase inflation to be greater, and if the exchange rate depreciates, then the price of imported goods, which are consumer goods and factors of production, will rise.



### A. Inflation Rate

Based on the inflation rate graph for 2001-2022 above, it can be observed that inflation in Indonesia experienced significant fluctuations from 2001-2022. Inflation in Indonesia in the period 2001-2015 tended to experience instability until it reached peak inflation in Indonesia of 17.11% in 2005. According to (Harmono, 2022), inflation in Indonesia increased significantly during the implementation of the fuel subsidy transfer policy. Judging from the chart above, in 2015-2021, inflation in Indonesia was quite controlled and stable. However, in 2021, the inflation rate jumped to 5.5% from the previous period, which was only 1.68%.



### B. Rupiah Exchange Rate

From the Rupiah exchange rate chart above, from 2001 to 2012, the Rupiah exchange rate tended to be stable. A significant increase in the Rupiah exchange rate reached Rp12,189 in 2013, while in the following year (2013-2022), the exchange rate tended to increase gradually to the highest point in 2022, namely the Rupiah exchange rate appreciated against the Dollar by Rp15,731.

There are previous studies that have examined the relationship between inflation and exchange rates using the simultaneous equation method; research previously conducted by Yusuf, Resmawan, & Payu (2021) showed test results that the rupiah exchange rate significantly influences the inflation equation, and the money supply, while interest rates do not have a significant effect on inflation. Then, the exchange rate is affected by inflation and the money supply, while the variable economic growth has no significant effect on the exchange rate. Rahmadeni & Veronika (2020) show that the interest rate significantly influences the results of inflation testing at 5%. In contrast, the exchange rate and money supply do not significantly affect inflation. Then



## Simultaneous Equation: The Case of Inflation & Rupiah Exchange Rate in Indonesia 2001-2022

the exchange rate is influenced by GDP at 5%, while inflation significantly affects alpha 10%. GDP has no significant effect on the exchange rate.

Based on the explanation above, simultaneous equation analysis can be used in this case because related variables tend to have simultaneous relationships. There is a relationship between variables, so the modeling in this study will apply the simultaneous regression method of the 2SLS (Two Stage Least Square) equation to determine the correlation of inflation & exchange rate variables.

### II. RESEARCH METHODS

There are six variables used, namely Inflation (INF), Rupiah Exchange Rate (ER), Interest Rate (R), Gross Domestic Product (GDP), Money Supply (M2), and export (X). The data type used is secondary data obtained through the Badan Pusat Statistik (BPS) Indonesia website. This research will use the simultaneous equation method using the 2SLS (Two Stage Least Square) Approach. Researchers use Eviews 12 as a tool to analyze data.

#### A. Simultan Equation Modeling

The simultaneous equation regression model is a model that has multiple equations and can be found feedback relationships in the variables (Gujarati & Porter, 2009) in their book. Here is a general model of simultaneous equations:

$$\begin{aligned} Y_{1t} &= \beta_{12}Y_{2t} + \beta_{13}Y_{3t} + \dots + \beta_{1M}Y_{Mt} + \gamma_{11}X_{1t} + \gamma_{12}X_{2t} + \dots + \gamma_{1K}X_{Kt} + U_{1t} \\ Y_{2t} &= \beta_{21}Y_{1t} + \beta_{23}Y_{3t} + \dots + \beta_{2M}Y_{Mt} + \gamma_{21}X_{1t} + \gamma_{22}X_{2t} + \dots + \gamma_{2K}X_{Kt} + U_{2t} \\ &\vdots \\ Y_{Mt} &= \beta_{M1}Y_{1t} + \beta_{M2}Y_{2t} + \dots + \beta_{M,M-1}Y_{M-1,t} + \gamma_{M1}X_{1t} + \dots + \gamma_{M3}X_{3t} + U_{Mt} \end{aligned}$$

#### B. Identify Orders and Ranks

Before estimating the parameter equation, you must identify the equation to determine whether the equation model used can use the Two Stage Least Square approach. Therefore, we identify it by order and rank identification tests.

#### C. Estimation Using the 2SLS (Two Stage Least Square) Approach

Estimation using the 2SLS approach can be applied to simultaneous equation models identified over identified and used in equation models identified exactly identified.

Suppose 3 simultaneous equations, as follows:

$$\begin{aligned} Y_1 &= \beta_{10} + \beta_{12}Y_2 + \beta_{13}Y_3 + \gamma_{11}X_1 + \gamma_{12}X_2 + \dots + \gamma_{1K}X_K + \varepsilon_1 \\ Y_2 &= \beta_{20} + \beta_{21}Y_1 + \beta_{23}Y_3 + \gamma_{21}X_1 + \gamma_{22}X_2 + \dots + \gamma_{2K}X_K + \varepsilon_2 \\ Y_3 &= \beta_{30} + \beta_{31}Y_1 + \beta_{32}Y_2 + \gamma_{31}X_1 + \gamma_{32}X_2 + \dots + \gamma_{3K}X_K + \varepsilon_3 \end{aligned}$$

Langkah pertama: Bentuk *reduced form*

$$\begin{aligned} Y_1 &= \pi_{10} + \pi_{11}X_1 + \pi_{12}X_2 + \dots + \pi_{1K}X_K + v_1 \\ Y_2 &= \pi_{20} + \pi_{21}X_1 + \pi_{22}X_2 + \dots + \pi_{2K}X_K + v_2 \\ Y_3 &= \pi_{30} + \pi_{31}X_1 + \pi_{32}X_2 + \dots + \pi_{3K}X_K + v_3 \end{aligned}$$

Step two: Estimation of equations  $y_1, y_2,$  and  $y_3$  in *reduced form model* step 1

$$\begin{aligned} \hat{Y}_1 &= \pi_{10} + \pi_{11}X_1 + \pi_{12}X_2 + \dots + \pi_{1K}X_K \\ \hat{Y}_2 &= \pi_{20} + \pi_{21}X_1 + \pi_{22}X_2 + \dots + \pi_{2K}X_K \\ \hat{Y}_3 &= \pi_{30} + \pi_{31}X_1 + \pi_{32}X_2 + \dots + \pi_{3K}X_K \end{aligned}$$

Third step:

Substitute the equations  $\hat{Y}_2$  and  $\hat{Y}_3$  in the equation  $Y_1$

$$Y_1 = \beta_{10} + \beta_{12}\hat{Y}_2 + \beta_{13}\hat{Y}_3 + \gamma_{11}X_1 + \gamma_{12}X_2 + \dots + \gamma_{1K}X_K$$

This model will produce an estimate of the parameters of the equation  $Y_1$

Substitution of values  $\hat{Y}_1$  and  $\hat{Y}_3$  on equation  $Y_2$

$$Y_2 = \beta_{20} + \beta_{21}\hat{Y}_1 + \beta_{23}\hat{Y}_3 + \gamma_{21}X_1 + \gamma_{22}X_2 + \dots + \gamma_{2K}X_K$$

This model will produce an estimate of the parameters of the equation  $Y_2$

Substitution of values  $\hat{Y}_1$  and  $\hat{Y}_2$  on the equation  $Y_3$

$$Y_3 = \beta_{30} + \beta_{31}\hat{Y}_1 + \beta_{32}\hat{Y}_2 + \gamma_{31}X_1 + \gamma_{32}X_2 + \dots + \gamma_{3K}X_K$$

This model will produce an estimate of the parameters of the equation  $Y_3$

# Simultaneous Equation: The Case of Inflation & Rupiah Exchange Rate in Indonesia 2001-2022

## III. RESULTS AND DISCUSSION

### A. Simultaneous Equation Model

The model of the equation is formed, as follows:

$$Y1 = \alpha_{10} + \alpha_{11}Y2 + \beta_{11}X1 + \beta_{12}X2 + \epsilon1 \quad (1)$$

$$Y2 = \alpha_{20} + \alpha_{21}Y1 + \beta_{23}X3 + \beta_{24}X4 + \epsilon2 \quad (2)$$

Information:

- Y1 : Inflation (INF)
- Y2 : Indonesian rupiah exchange rate (ER)
- X1 : Interest Rate (R)
- X2 : Gross Domestic Product (GDP)
- X3 : Money Supply (M2)
- X4 : Export (X)
- $\alpha, \beta$  : Parameter coefficients
- $\epsilon$  : Error

### B. Test Order and Rank conditions

The order must meet the identification conditions to identify the equation model using the test condition. If the model equation proves  $K-k < m-1$ , the equation is under-identified. Then, if the equation model proves  $K-k = m-1$ , the equation is exactly identified, and if the equation model proves  $K-k > m-1$ , the equation is over-identified. The following table is the result of the order condition test:

Model	K	k	K-k	M	1	m-1	Result
Y1	6	4	2	2	1	1	Over Identified
Y2	6	4	2	2	1	1	Over Identified

Information:

- K : The sum of all variables in the model, including intercepts.
- k : Number of variables in the equation model.
- M : Number of equations in the model or number of endogenous variables in the equation.

Based on the results of the order testing show, the equation model in this study is over identified so that the estimation will use 2SLS. Next, a rank condition test will be carried out; in this test, if it has one determinant that is not equal to 0, the model is identified. The following are the results of the rank condition test:

Model	Constanta	Y1	Y2	X1	X2	X3	X4
Y1	$\alpha_{10}$	1	$\alpha_{11}$	$\beta_{11}$	$\beta_{12}$	0	0
Y2	$\alpha_{20}$	$\alpha_{21}$	1	0	0	$\beta_{23}$	$\beta_{24}$

Based on the results of testing rank conditions, it is known that the value of the inflation equation coefficient in the variables  $X3 = 0$  and  $X4 = 0$  then it is formulated as follows:

$$A = [\beta_{23}] \text{ dan } B = [\beta_{24}]$$

Based on the above formula, it means  $\text{Det}|A| \neq 0$  and  $\text{Det}|B| \neq 0$ . Then, the inflation equation can be identified. Then, it is known that the value of the coefficient of the rupiah exchange rate equation in the variables  $X1 = 0$  and  $X2 = 0$ , then it is formulated as follows:

$$C = [\beta_{11}] \text{ dan } D = [\beta_{12}]$$

Based on the above formula, it means  $\text{Det}|C| \neq 0$  and  $\text{Det}|D| \neq 0$ . Then, the rupiah exchange rate equation can be identified, and this shows that both equations can use 2SLS.

### C. Reduce Form

The following is a model equation in this study:

$$Y1 = \alpha_{10} + \alpha_{11}Y2 + \beta_{11}X1 + \beta_{12}X2 + \epsilon1 \quad (1)$$

## Simultaneous Equation: The Case of Inflation & Rupiah Exchange Rate in Indonesia 2001-2022

$$Y_2 = \alpha_{20} + \alpha_{21}Y_1 + \beta_{23}X_3 + \beta_{24}X_4 + \varepsilon_2 \quad (2)$$

Then the reduction result of equations 1 and 2 is:

$$Y_1 = \pi_{10} + \pi_{11}X_1 + \pi_{12}X_2 + \pi_{13}X_3 + \pi_{14}X_4 + v_1 \quad (3)$$

$$Y_2 = \pi_{20} + \pi_{21}X_1 + \pi_{22}X_2 + \pi_{23}X_3 + \pi_{24}X_4 + v_2 \quad (4)$$

### D. 2SLS Equation Model Estimation

After testing order and rank conditions, the next stage will be estimated using the 2SLS approach.

#### 1. Estimation of the Inflation Equation (INF)

The 2SLS test on the inflation equation (INF) obtained a result of  $R^2 = 73.10\%$ , meaning that predictor variables of 73.10% influenced inflation, then the remaining 26.90% was influenced by other variables outside the model. The following is a presentation of the estimated results of the 2SLS inflation equation:

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-4.226765	4.449876	-0.949861	0.3548
ER	7.52E-05	0.000261	0.288310	0.7764
R	0.973502	0.167386	5.815923	0.0000
GDP	0.447751	0.284478	1.573938	0.1329

Based on the table above, inflation (INF) is not significantly affected by the exchange rate (ER) and gross domestic product (GDP). The interest rate (R) significantly affects inflation (INF). Simultaneously, all predictor variables affect inflation (INF) because  $F(\text{prob})$  is smaller than  $\alpha = 5\%$ . Here is a model of the inflation equation:

$$\hat{Y}_1 = -4.22676 + 7.522364Y_2 + 0.973501X_1 + 0.447751X_2 \quad (5)$$

Based on the model above, a constant value of -4.22676 is obtained, which means that if all predictor variables have a fixed value, the inflation rate in Indonesia will decrease by 4.22676. If the rupiah exchange rate increases by 1%, it increases inflation by 7.522364. Furthermore, if the interest rate increases by 1%, it will increase inflation by 0.973501. As for if GDP increases by 1%, it will increase inflation by 0.447751.

#### 2. Exchange Rate Model Estimation (ER)

The 2SLS test on the exchange rate equation (ER) obtained a value of  $R^2 = 90.71\%$ , meaning that predictor variables of 90.71% influenced inflation, then the remaining 9.29% was influenced by other variables outside the model. The following table is a presentation of the estimated results of the 2SLS exchange rate equation:

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7369.794	809.5609	9.103446	0.0000
INF	192.3883	71.33766	2.696868	0.0147
M2	0.001397	0.000153	9.125381	0.0000
X	-0.014552	0.005279	-2.756773	0.0130

Based on the table above, all predictor variables significantly influence the exchange rate (ER). Simultaneously, all predictor variables affect the exchange rate (ER) because  $F(\text{prob})$  is smaller than  $\alpha = 5\%$ . Here is a model of the exchange rate equation:

$$\hat{Y}_2 = 7369.793924 + 192.3882701Y_1 + 0.001396X_3 - 0.014551X_3 \quad (6)$$

Based on the model above, a constant value of 7369.793924 is obtained, which means that if all predictor variables have a fixed value, then the exchange rate in Indonesia will increase by 7369.793924. If the inflation rate rises by 1%, the exchange rate will increase by 192.3882701. Furthermore, if the money supply increases by 1%, the exchange rate will increase by 0.001396. As for if exports increase by 1%, it will reduce the exchange rate by 0.014551; this is in line with research conducted by (Wulandari, 2014) and (Silitonga & Ishak, 2017).

## Simultaneous Equation: The Case of Inflation & Rupiah Exchange Rate in Indonesia 2001-2022

### E. Test Classical Assumptions

A model of the equation will be said to be good if it meets the conditions of classical assumptions. Classical assumptions consist of tests of normality, autocorrelation, heteroscedasticity and multicollinearity. Here are the results of testing classic assumptions:

#### 1. Normality Test

The normality test is needed to determine whether the data used in the study is normally distributed or not, and testing can be done using the Jarque-Bera test. Here are the hypotheses before testing:

H0: Normal distributed data

H1: Data is not normally distributed

The following is a table presentation of normality test results:

Model	P-Value	Result
INF	0,116966	Accept H <sub>0</sub>
ER	0,895758	Accept H <sub>0</sub>

Based on the results of the Jarque-Bera normality test, the p-value in the inflation equation (INF) is 0.116966, and the rupiah exchange rate (ER) is 0.895758, the value is > 0.05. It can be concluded that with this value, H0 is accepted, meaning that the inflation & exchange rate equation model meets the requirements of normally distributed data.

#### 2. Autocorrelation Test

Autocorrelation tests are needed to measure whether the equation model has a relationship between disturbance variables. The Breusch-Godfrey Serial Correlation LM Test can be used in autocorrelation testing. Here are the hypotheses before testing:

H0: No autocorrelation occurs

H1: Autocorrelation occurs

The results of testing the autocorrelation assumption are presented in the following Table:

Model	Prob. Chi-Square(2)	Result
INF	0,2460	Accept H <sub>0</sub>
ER	0,3278	Accept H <sub>0</sub>

A prob value is obtained based on the autocorrelation test results. Chi-Square(2) uses the Lagrange Breusch-Godfrey Serial Correlation LM Test on the inflation equation (INF) of 0.2460 and the rupiah exchange rate (ER) of 0.3278, the value is > 0.05. It can be concluded that with this value, H0 is accepted, and there is no autocorrelation problem.

#### 3. Heteroscedasticity Test

The heteroscedasticity test is needed to measure whether the equation model has the same variance from the residual of one observation to another. The Glejser test can be used in heteroscedasticity testing. Here are the hypotheses before testing:

H0:  $\beta_k = 0$  (No heteroscedasticity occurs)

H1 :  $\beta_k \neq 0$ ;  $k=1,2,\dots,K$  (Heteroscedasticity occurs)

The results of the heteroscedasticity assumption test are presented in the following table:

Model	Prob. Chi-Square(3)	Result
INF	0,1012	Accept H <sub>0</sub>
ER	0,2512	Accept H <sub>0</sub>

Based on the results of the heteroscedasticity test with the Glejser test, the p-value in the inflation equation (INF) was 0.1012 & the rupiah exchange rate (ER) was 0.2512, the value was > 0.05. It can be concluded that with this value, H0 is accepted, and there is no heteroscedasticity problem.

#### 4. Multicollinearity Test

Multicollinearity tests are needed to find out whether in the equation model, there is a correlation between predictor variables; the identification of multicollinearity can use a high-value matrix analysis method (>0.90), this can identify the problem of multicollinearity in the equation model. The following is a presentation of the results of the multicollinearity test:

## Simultaneous Equation: The Case of Inflation & Rupiah Exchange Rate in Indonesia 2001-2022

Multicollinearity assumptions for inflation			
	ER	R	GDP
ER	1.00000	-0.503250	-0.311323
R	-0.503250	1.000000	0.060958
GDP	-0.311323	0.060958	1.000000

Multicollinearitas assumptions for exchange rate			
	INF	M2	GDP
INF	1.000000	-0.601673	-0.477371
M2	-0.601673	1.000000	0.842315
X	-0.477371	0.842315	1.000000

Based on the results of the multicollinearity test, there is no matrix value  $>0.9$ , meaning there is no multicollinearity problem. Based on the results of the classical assumption test, it can be concluded that the equation model of the inflation equation (INF) and exchange rate (ER) has met the requirements, meaning that testing using 2SLS can obtain good test results.

#### IV. CONCLUSION

Based on the two-stage least square (2SLS) test, the simultaneous inflation equation (INF) shows that the variable interest rate (R) has a significant effect on inflation (INF) while the variable exchange rate (ER) and gross domestic product (GDP) do not have a significant effect on inflation (INF), while simultaneously the exchange rate (ER), interest rate (R), and gross domestic product (GDP) affect inflation (INF) simultaneously because  $F$  (prob) is smaller than  $\alpha = 5\%$ . Then in the exchange rate equation (ER) inflation variables (INF), money supply (M2) and exports (X) have a significant effect on the exchange rate, while simultaneously Inflation (INF), money supply (M2), exports (X) affect the exchange rate (ER) simultaneously because  $F$  (prob) is smaller than  $\alpha = 5\%$ .

#### REFERENCES

- 1) Adhista, M. (2022). Analisis Ekspor, Impor, dan Jumlah Uang Beredar (M2) Terhadap Nilai Tukar Rupiah. *Jurnal Ilmiah Ekonomi Pembangunan*, 1(2), 73–92.
- 2) Arifin, S., & Mayasya, S. (2018). Faktor - Faktor Yang Mempengaruhi Nilai Tukar Rupiah Terhadap Dolar Amerika Serikat. *Jurnal Ekonomi-Qu*, 8(1), 82–96. <https://doi.org/10.35448/jequ.v8i1.4965>
- 3) Arjunita, C. (2016). Faktor-Faktor Yang Mempengaruhi Inflasi Di Indonesia. *Ecosains: Jurnal Ilmiah Ekonomi Dan Pembangunan*, 5(2), 137. <https://doi.org/10.24036/ecosains.11065357.00>
- 4) BPS. (2023). BI Rate 2005-2022. Badan Pusat Statistik.
- 5) BPS. (2023). Ekonomi Indonesia Tahun 2001-2022. Badan Pusat Statistik.
- 6) BPS. (2023). Inflasi (Umum) 2001-2022. Badan Pusat Statistik.
- 7) BPS. (2023). Kurs Tengah Beberapa Mata Uang Asing Terhadap Rupiah di Bank Indonesia dan Harga Emas di Jakarta (Rupiah), 2001-2022. Badan Pusat Statistik.
- 8) BPS. (2023). Nilai Ekspor Menurut Negara Tujuan Utama (Nilai FOB: juta US\$), 2001-2022. Badan Pusat Statistik.
- 9) BPS. (2023). Uang Beredar (Milyar Rupiah), 2001-2022. Badan Pusat Statistik.
- 10) Budhijana, B. (2023). Analysis of The Effect of Inflation, Rupiah Exchange Rate, and BI Rate on The Net Asset Value of Sharia Mutual Funds In Indonesia (2015-2019 Period). *Jurnal Ekonomi, Manajemen Dan Perbankan (Journal of Economics, Management and Banking)*, 9(2), 213–224. <https://doi.org/10.35384/jemp.v9i2.401>
- 11) Faizin, M. (2020). Analisis hubungan kurs terhadap inflasi. *Akuntabel*, 17(2), 314–319.
- 12) Fitilai, E., Program, Z., Stie, S. M., & Selatan, N. (2017). Analisis Inflasi Terhadap Nilai Tukar Rupiah Di Indonesia. *Jurnal Ekonomi Dan Bisnis Nias Selatan*, 1(1), 22–35.
- 13) Gujarati, D. N., & Porter, D. C. (2009). *BASIC ECONOMETRICS* (Fifftth Edi). McGraw-Hill Irwin.
- 14) Harjunawati, S., Hendarsih, I., Addin, S., & Marthanti, A. S. (2021). Effect of Inflation, BI Rate And Net Export To USD Central Exchange Rate to Rupiahs In Bank Indonesia For 2005-2019. *Moneter - Jurnal Akuntansi Dan Keuangan*, 8(1), 85–89. <https://doi.org/10.31294/moneter.v8i1.10338>
- 15) Hidayat, L. R., Setyadi, D., & Azis, M. (2018). Pengaruh Inflasi dan Suku Bunga dan Nilai Tukar Rupiah serta Jumlah Uang Beredar terhadap Return Saham. *Forum Ekonomi*, 19(2), 148. <https://doi.org/10.29264/jfor.v19i2.2121>

## Simultaneous Equation: The Case of Inflation & Rupiah Exchange Rate in Indonesia 2001-2022

- 16) Ilmas, N., Amelia, M., & Risandi, R. (2022). Analysis of the Effect of Inflation and Exchange Rate on Exports in 5-Year Asean Countries (Years 2010–2020). *Jurnal Ekonomi Trisakti*, 2(1), 121–132. <https://doi.org/10.25105/jet.v2i1.13561>
- 17) Indonesia, B. (2023). Inflasi. BANK INDONESIA. <https://www.bi.go.id/id/fungsi-utama/moneter/inflasi/default.aspx>
- 18) Khomariyah, R. N., Setyowati, E., & Utomo, Y. P. (2022). Analysis of the Effect of Inflation, Interest Rate, Exchange Rate, and National Income on Financial Deepening in Indonesia From 2000 to 2020. *Proceedings of the International Conference on Economics and Business Studies (ICOEBS 2022)*, 655(Icoebs), 154–161. <https://doi.org/10.2991/aebmr.k.220602.020>
- 19) Rakhmat, Warjiyo, P., & Sadli, A. M. (2022). The Influence of Exchange Rate and Foreign Capital on the Performance of Inflation Targeting Framework in Indonesia. *International Journal of Sustainable Development and Planning*, 17(5), 1585–1592. <https://doi.org/10.18280/ijstdp.170523>
- 20) Sharma, S., & Dahiya, M. (2023). Analysis of the Effect of Currency Exchange Rate, Broad Money (M3) and Oil Prices on Inflation in India. *International Journal of Economics and Financial Issues*, 13(3), 158–168. <https://doi.org/10.32479/ijefi.14304>
- 21) Silitonga, R. B. R., & Ishak, Z. (2017). Pengaruh Ekspor, Impor dan Inflasi Terhadap Nilai Tukar Rupiah di Indonesia. *Ekonomi Pembangunan*, 15(1), 53–59.
- 22) Susanto, S. (2018). Pengaruh Inflasi, Tingkat Suku Bunga, Dan Nilai Tukar Terhadap Pertumbuhan Ekonomi Indonesia. *JEBI | Jurnal Ekonomi Bisnis Indonesia*, 12(01), 52–68. <https://doi.org/10.36310/jebi.v12i01.27>
- 23) Wulandari, E. (2014). Analisis Makro Ekonomi Indonesia Periode 1980-2012. *Jurnal Ilmiah Mahasiswa*, 2(1).
- 24) Yusuf, R., Resmawan, R., & Payu, B. R. (2021). Penerapan Model Persamaan Simultan Dengan Pendekatan Two Stage Least Square Pada Kasus Inflasi Dan Nilai Tukar Rupiah Di Indonesia. *Euler : Jurnal Ilmiah Matematika, Sains Dan Teknologi*, 9(2), 71–84. <https://doi.org/10.34312/euler.v9i2.11173>



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## LEARNING MODEL: MAMA (An Alternative to Improve Learning Outcomes English Finite Students of SMP Negeri 11 Palu City)



Jamiluddin<sup>1</sup>, Maf'ulah<sup>2</sup>, Fadhilah Zamzam<sup>3</sup>, Dwi Putri<sup>4</sup>

<sup>1,2,3,4</sup> English Education Study Program Faculty of Teacher Training and Education, Universitas Tadulako.

**ABSTRACT:** Based on the results of pre-observations in class and the results of informal interviews with English teachers at SMP Negeri 11 Palu several months ago, several experiences revealed that teachers do not yet have a clear model of how to synchronize methods and approaches to suit the students' needs, especially teaching methods and techniques that suit students' needs to overcome the inability to understand and use '*English Finite*' appropriately and correctly according to the procedures for using a sentence in English. Students experience difficulty in using '*English Finite*' when practicing speaking and writing. Therefore, the aim of this research is to reveal and prove that through the '*MAMA*' type cooperative learning model, students can improve their mastery of '*English Finite*' in everyday English practice. This research is experimental research to test a '*MAMA*' type cooperative learning model. The research sample was 18 students from class VIII A as the control class group and 20 students from class VIII C as the experimental class group, at SMP Negeri 11. Furthermore, treatment or application of the '*MAMA*' type cooperative learning model was only given to the experimental group, while the control class underwent the application of conventional learning. Data collection was carried out by giving tests to both groups. Based on the pre-test results, the experimental group was 51.5, while the control group was 50.83. Furthermore, after implementing *MAMA* type learning, the experimental class was given a posttest and the result was 65.78, while the control class went through conventional learning and the posttest result was 58.23. This indicates that the increase in the 'mean score' of the experimental group was much higher than that of the control group. It can be concluded that by implementing '*MAMA*' type cooperative learning can improve students' ability to write precise and correct *English Finite* in making descriptive texts.

**KEYWORDS:** Cooperative Learning Model, Type of Make a Match (MAMA), EnglishFinite.

### I. INTRODUCTION

One aspect of grammar in the process of teaching and learning English in the classroom that must be addressed as soon as possible in this research is how learning *English Finite* can minimize errors made by students both in creating written texts and in oral form, so that in its application, both in writing and in oral form can be realized correctly.

*English Finite* is a language element that is not found in Indonesian. *Finite* is a part of a group of verbs (verbs) that express '*tense*' (present and past), '*modality*', and '*polarity*' (positive and negative). In simple language, '*Finite*' is a verb or part of a 'verb phrase' which is influenced by its environment (Agustin: 2004)

The problem of using *English Finite* is very urgent, considering that every lesson carried out by students, especially at junior high school (SLTP), is always presented with subject matter for reading, writing and speaking which always contains *English Finite* in the materials. the learning. Based on the results of the researcher's pre-observation, it is very clear that in the teaching and learning process in the classroom, teachers in their teaching tend to place more emphasis on understanding English texts, both written and spoken. In these texts you can find *English Finite* which expresses '*tenses*', '*modality*' and '*polarity*'.

In the aspects of '*tenses*', '*modality*' and '*polarity*', many students still do not understand and in the end, using *English Finite* incorrectly. Inappropriate sentence patterns written and expressed orally. In Agustien's (2001) research, it was found that interpersonal meaning is the meaning that is most difficult or slow to be mastered by students. Furthermore, he discovered that in the *clause*, this meaning is realized in the *Subject* and *Finite* and it is in this area that our students are usually confused. In fact, if students do not properly manage this area, it is likely that the pragmatic meaning will not be conveyed.

## LEARNING MODEL: MAMA (An Alternative to Improve Learning Outcomes English Finite Students of SMP Negeri 11 Palu City)

The researcher's assumption is that the mistakes made by students may be a lack of practice and lack of practice in their learning, or it could be that they need to explore learning techniques and models that make students happy and willing to study more actively so that mistakes in using *English Finite* can be overcome or at least can be avoided or reduced.

Agus Widyanoro (2017) states that students should be given as wide an opportunity as possible to use the target language to communicate. Therefore, the material developed needs to include interactions that allow students to use the target language to communicate. The material does not only teach about language, but must contain exercises for students to use that language. Thus, learning models should be created so that students can interact with each other as much as possible so that sharing and sharing of knowledge occurs (students-centered learning).

Researchers chose the 'MAMA' learning model because it provides many opportunities for students to communicate more actively with teachers or other students in the class. In this model, each student is given the opportunity to collaborate with fellow students in their learning process by looking for pairs (questions and answers) from the cards given by the teacher to each student. In this way, a more lively situation can be created thanks to increased learning motivation due to mutual sharing of knowledge and opinions from each student. The competition looks for partners, namely each holder of a question and answer card, competing with other card holders to be the best. The pair that can find the question card pair will get points. According to Rusman (2011), the 'MAMA' learning model is a type of cooperative learning developed by Lorna Curran (1994) where the advantage of this learning model is that students look for partners while learning about a concept or lesson topic in a fun atmosphere. Furthermore, Suyanto (2009) states that the 'MAMA' learning model is a learning model where the teacher prepares cards containing questions or problems and prepares answer cards then students prepare their card pairs.

Miftahul Huda (2012) states that the 'MAMA' learning model is a conceptual approach that teaches students concepts actively, creatively, interactively, effectively, and is fun for students so that concepts are easy to understand and long-lasting in students' cognitive structures.

Several research results show that learning outcomes can largely be determined by how to transfer knowledge to students. Therefore, learning models and strategies play a role in this matter. Suharlina's research results (2015) found that there are several factors that really determine the success of learning, including the approach to learning factor, the type of student learning effort which includes strategies, methods used by students to learn lesson materials. Furthermore, research results from Helda Yeti (2018) found that using the 'Make a Match' (MAMA) learning model, namely a cooperative learning model, can improve learning outcomes because students exchange ideas/opinions with their friends and foster a sense of solidarity among students.

Based on the research findings, the researcher wants to prove whether the MAMA type cooperative learning model is also suitable to be applied in the field of English education, considering that learning English is somewhat different from learning in other fields of study, because this field of study is not the language of the students. Apart from that, this learning model places more emphasis on cognitive and affective understanding, while English, apart from its affectivity, is also very important in the psychomotor aspect, namely how to use English as a global language.

In connection with the problems faced by students in learning English, researchers offer and practice a MAMA type cooperative learning model to students to improve their understanding and ability to use *English Finite*. Can this 'MAMA' learning model improve the mastery of English Finite for students at SMP Negeri 11 Palu? The aim of this research is of course to reveal and prove that through the 'MAMA' type cooperative learning model, students can improve their mastery of *English Finite* in written form (writing) through the media provided, namely describing (descriptive text) something, whether in the form of objects, a person, animal, and so on by using appropriate *English Finite*, especially in writing English sentences. It is hoped that the results of this research will become input in developing effective learning models that can be implemented by school teachers, especially in junior high schools (SLTP), so as to make students happy and motivated to learn and ultimately arouse enthusiasm for learning English.

## II. RESEARCH METHOD

This research is experimental research. Experimental research is research carried out by carrying out manipulation with the aim of determining the effects of manipulation on the observed individual behavior. The reason for choosing this method was because it was deemed suitable for researching the problem of minimal understanding and correct use of *English Finite* for students and then manipulated by treating the research sample with the MAMA type cooperative learning model in order to increase understanding and correct use of *English Finite*.

In this research, researchers used a repeated experimental design (Pretest-Posttest Control Group Design), namely a form of experiment carried out by carrying out initial measurements or observations before and after the treatment was given to the



## LEARNING MODEL: MAMA (An Alternative to Improve Learning Outcomes English Finite Students of SMP Negeri 11 Palu City)

experimental group and the control group. For more details, this design model is shown as follows:

**Table.1 Experimental Design Model Pretest-Posttest Only Control Group Design.**

R 01 (X) 02

R 03 (X) 04

Description:

R: Random

01 : Experimental Group Pretest

02 : Experimental Group Posttest

03 : Control Group Pretest

04 : Control Group Posttest

X : Treatment (*MAMA* Learning Model)

It should be noted that this research design meets the design requirements for experimental research because randomization was carried out. Therefore, conclusions regarding the influence of the independent variable on the dependent variable are more accurate because the two groups have the same and equal position. The influence of the independent variable on the dependent variable can be seen from the difference in Pretest (O1) and Posttest (O2) scores. If there is a difference between the Pretest and Posttest scores, where the Posttest score is significantly higher than the Pretest score, then it can be concluded that the treatment given has an influence on the changes that occur in the dependent variable. The population of this study were students in class VIII of SMP Negeri 11 Palu, totaling 4 parallel classes. However, to determine the research sample, the researcher took it randomly because the students' level of *English Finite* mastery was more or less the same as their level of understanding. Thus, the samples for this study were class VIII A and Class VIIC. Then the class was determined to be the experimental group and the control group class. Finally, based on the lottery carried out, the Experiment group class was class VIIC with a total of 20 students and the Control group class was class VIIIA with a total of 18 students. To obtain valid data in this research, appropriate data collection techniques are needed because it is a very important part of the research process because the data collected can describe the true condition of the subject. To find out whether the *MAMA* type cooperative learning model can improve the understanding and correct use of English Fine among students at SMP Negeri 11 Palu, the researcher will use an instrument, namely the Written Test. This written test is given in a staggered form, where one genre of text is given and each student completes it according to the appropriate and correct content of the text and contains clear meaning. At the research preparation stage, researchers have the same role, namely discussing things to prepare before going into the field. At the stage of implementing the first meeting, the researchers had the same role, namely distributing test sheets to the experimental group and control group to determine the students' prior knowledge as a form of pre-test. At the teaching (treatment) stage, each researcher has a different role where the head researcher teaches and applies the '*MAMA*' learning model in the class, while the first and second research members distribute the equipment needed by students in the class. Meanwhile, the fourth research member monitored the course of the teaching and learning process (treatment). After completing the treatment (teaching) in the experimental class, the researchers shifted to the control class by teaching the same material, but did not provide the '*MAMA*' learning model treatment, but in teaching *English Finite* applied conventional learning which was often practiced by teachers -their teacher. The number of meetings was the same as the number of meetings held in the experimental class. After several meetings, a post-test was given to both groups. The form of the post-test given is the same. This form of test is used to determine the success of teaching *English Finite* during several meetings in class. Data collected from the results of the 'pre-test' and 'post-test' were analyzed quantitatively, then compared with the 'means scores' obtained from the two groups so that the results could be seen clearly. These results can provide information about this research.

### III. RESULTS AND DISCUSSION

#### A. Research Results.

In this section the researchers present and describe the test results obtained, starting from the pre-test results and post-test results given to the students who were the samples in this study.

##### Pretest Results

This research is a form of experiment, where before implementing *MAMA* (Make a Match) type cooperative learning, the researcher gives a pretest to measure students' prior knowledge. This test is to determine the prior knowledge of students' ability to use *English Finite* appropriately and correctly in creating descriptive text that describes an object in the form of a description

## LEARNING MODEL: MAMA (An Alternative to Improve Learning Outcomes English Finite Students of SMP Negeri 11 Palu City)

of a person before being given treatment, namely the application of *MAMA* type learning. The results of the pretest carried out on August 1, 2023, both the experimental group and the control group can be seen as follows:

**Table 2. Experimental Group of Pretest Results**

No	Initial Names	Max. score	Row Score	Standart Score	Criteria
1	MR	20	9	45	Failed
2	NA	20	12	60	Average
3	AN	20	11	55	Failed
4	ZX	20	10	50	Failed
5	MS	20	14	70	Very Good
6	FT	20	12	60	Average
7	KD	20	13	65	Good
8	FK	20	11	55	Failed
9	FG	20	11	55	Failed
10	HK	20	11	55	Failed
11	KZ	20	15	75	Very Good
12	RH	20	12	60	Average
13	AP	20	12	60	Average
14	AD	20	8	40	Failed
15	Ms	20	6	30	Failed
16	BN	20	9	45	Failed
17	AI	20	9	45	Failed
18	SF	20	9	45	Failed
19	NB	20	5	25	Failed
20	NK	20	7	35	Failed
Total Score				1030	
Means score of Pretest				51,5	

After looking at the table of pretest results for experimental class students, it can be seen that there was a student who got a score of 75 (very good), as well as a student who got a score of 70 (very good). Most of them got a score of 60 (average). The table above can also be seen that there are some students who still get very low scores, namely a score of 55 (failed) and even some students still get a score of 25. This indicates that the majority of students do not know the appropriate and correct use of *English Finite* in writing descriptive text even though the text is very simple. Furthermore, after knowing the individual pretest scores in the experimental group, the researcher calculated the 'means score' using the formulation from Arikunto (2013) as follows:

$$\begin{aligned}
 M &= \Sigma/N \\
 &= \frac{1030}{20} \\
 &= 51,5
 \end{aligned}$$

**Table 3. Control Group of Pretest Results**

No	Initial Names	Max. Score	Row Score	Standart Score	Criteria
1	RE	20	9	45	Failed
2	AY	20	12	50	Failed
3	NA	20	11	55	Failed
4	AK	20	10	45	Failed
5	AN	20	14	50	Failed
6	RB	20	12	65	Good
7	AT	20	13	70	Very good
8	SR	20	11	40	Failed
9	RF	20	11	50	Failed
10	AL	20	11	65	Good
11	GP	20	15	65	Good
12	NF	20	12	50	Failed

**LEARNING MODEL: MAMA (An Alternative to Improve Learning Outcomes English Finite Students of SMP Negeri 11 Palu City)**

13	IR	20	12	60	Average
14	AL	20	8	55	Failed
15	AR	20	6	70	Very Good
16	FS	20	9	55	Failed
17	WW	20	9	30	Failed
18	JB	20	9	50	Failed
Total Score				915	
Means Score of Pretest				50,83	

Based on the table above, it can be seen that the control group's pretest results, the highest score obtained was 70, which was obtained by as many as 2 students. The lowest score obtained from the control group's pretest results was 30. Others received a score of 60. The highest score obtained by students was 50. This shows that students' understanding of the appropriate and correct use of *English Finite* in writing descriptive text is still far from expectations. we are together because if we pay attention to the average score, the control group students got an average score of 50.83. Thus, the 'mean score' of the control class can be obtained as follows:

$$\begin{aligned}
 M &= \Sigma/N \\
 &= \frac{915}{18} \\
 &= 50,83
 \end{aligned}$$

After giving a pretest to the two groups regarding the use of *English Finite* in descriptive form, it can be seen that the majority of students have not fully understood the use of *English Finite* in creating descriptive texts. This can be seen from the pretest results for both the experimental group and the control group, where the mean score obtained was on average below the KKM English language standards that had been set at SMP Negeri 11 Palu.

**Posttest Results**

After carrying out several treatments (implementation of *MAMA* type cooperative learning) in the Experimental group, the researcher gave a posttest to this group. The posttest was carried out on August 9 2023, but when the posttest was given to this group, there were several students who did not have time to take this posttest. Likewise, after carrying out the teaching and learning process several times for the control group without implementing *MAMA* type cooperative learning, but only using conventional learning, namely the learning used by their teachers in general. After the learning process was carried out, the researcher also gave a post-test to see the results obtained in the control group. The posttest was given to the control group, namely on August 10 2023. However, when the posttest was carried out in this group, there was one student who did not have time to take the posttest so the number of students who took the pretest and posttest in the control group were different. The post-test results from the two groups can be seen as follows:

**Table 4. Experimental Group of Posttest Results**

No	Initial Names	Max.Score	Row Score	Standart Score	Criteria
1	MR	20	12	60	Average
2	NA	20	15	75	Very good
3	AN	20	12	60	Average
4	ZX	20	10	50	Failed
5	MS	20	12	60	Average
6	FT	20	17	85	Very good
7	KD	20	16	70	Very good
8	FK	20	12	60	Average
9	FG	20	14	70	Very good
10	HK	20	16	70	Very good
11	KZ	20	18	90	Very Good
12	RH	20	15	75	Very good
13	AP	20	14	70	Very good
14	AD	20	12	60	Average
15	MS	20	11	55	Failed
16	BN	20	10	50	Failed
17	AI	20	12	60	Average

**LEARNING MODEL: MAMA (An Alternative to Improve Learning Outcomes English Finite Students of SMP Negeri 11 Palu City)**

18	SF	-	-	-	-
19	NB	20	10	50	Failed
20	NK	20	16	80	Very good
Total Score				1.250	
Means Score of Posttest				65,78	

Based on the table above, it can be seen that there are several students who got very good scores, namely scores of 90, 85, and 80. This shows that each of these students can better understand the use of *English Finite* through implementing *MAMA* type cooperative learning. If we pay attention to the students' post-test results, the average has increased. However, there are also those who are still not successful in accordance with the completion score (KKM) that has been set at school, but in general they experience an increase in understanding of the test results obtained. After obtaining each student's test results, the researcher calculated the 'mean score' of the experimental class as follows:

$$\begin{aligned}
 M &= \Sigma/N \\
 &= \frac{1.250}{19} \\
 &= 65,78
 \end{aligned}$$

**Table 5. Control group of Posttest Results**

No	Initial Names	Max. Score	Row Score	Standart Score	Criteria
1	RE	20	12	60	Average
2	AY	20	12	60	Average
3	NA	20	10	50	Failed
4	AK	20	10	45	Failed
5	AN	20	13	65	Good
6	RB	20	12	60	Average
7	AT	20	15	75	Very good
8	SR	20	10	50	Failed
9	RF	20	12	60	Average
10	AL	20	9	45	Failed
11	GP	20	15	75	Very good
12	NF	20	11	55	Failed
13	IR	20	12	60	Average
14	AL	20	10	50	Failed
15	AR	20	10	50	Failed
16	FS	-	-	-	-
17	WW	20	11	55	Failed
18	JB	20	13	65	Good
Total Score				990	
Means Score of Posttest				58,23	

Based on the table above, it can be seen that there were several students who got a score of 75. This was the highest score obtained in the control class. There are some students whose post-test scores are not yet satisfactory, where in general these students get a score of 50, although there is an increase in understanding of the use of *English Finite* in descriptive writing, but there is no significant change, but the average has changed. Next, the researcher calculated the 'mean score' of the control class as follows:

$$\begin{aligned}
 M &= \Sigma/N \\
 &= \frac{990}{17} \\
 &= 58,23
 \end{aligned}$$

After comparing the results of the two groups (experimental group and control group), the researchers found that there were differences in test results between the experimental group and the control group. The experimental group's posttest score was 65.78, while the control group's posttest score was 58.23. If you look at these results, of course each group has experienced an

## LEARNING MODEL: MAMA (An Alternative to Improve Learning Outcomes English Finite Students of SMP Negeri 11 Palu City)

increase. When comparing the pretest and posttest results of the experimental group, there was an increase in test results of 14.28. This increase is very significant. Furthermore, if you look at the comparison of the control group's pretest results and the control group's posttest results, there was an increase of 7.4. The change is not very significant. When comparing the pretest results of the experimental group and the posttest results of the experimental group, there was an increase of 14.28. This indicates that the implementation of *MAMA* type cooperative learning can increase students' understanding of the use of *English Finite* because it has experienced a very significant increase. Furthermore, if you pay attention to the scores obtained from each student, generally there has been an increase. This can be seen from the completeness score of each student.

### B. Discussion

The aim of this research is to improve students' understanding of *English Finite* through the application of *MAMA* type cooperative learning. The hope of this learning model is that students can increase their understanding of the use of *English Finite* when they describe objects/people in English. After implementing *MAMA* type cooperative learning, students generally experience an increase in understanding which can be seen from the research results through the test results obtained, where in the initial test (pretest) students before implementing the *MAMA* type cooperative learning model had an average experimental class score of 51.5. However, after implementing *MAMA* type cooperative learning several times in class, students were given a test (posttest) and the results increased, namely 65.78. This indicates that there has been an increase of 14.28, which is very significant. Even though there was an increase, researchers found and saw that the mistakes made by the majority of students were due to the influence of Indonesian language patterns which were directly transferred into English, without looking at the elements in the use of *English Finite* which must be in accordance with the subject of the sentence being made. (subject-verb agreement).

If you look at the results of previous research, for example research conducted by Sri Selamat (2013) published in the *Sebelas Maret University Education Journal*, the research results show that most errors in using *English Finite* are because students generally combine English sentence patterns and sentence patterns of Indonesian. The results of this research also found that students generally transfer Indonesian language patterns into English patterns, for example '*He a student*', in using English, students write '*He is a student*' - that is, eliminating *English Finite* (*is*). Likewise, students generally make mistakes due to the influence of Indonesian language patterns, for example '*He study English every day*', which should be '*He studies English every day*'. This error occurs because it is caused by an '*interference*' problem as well.

The results of research conducted by Dewa Nyoman Suprpto (2020) revealed that the *MAMA* type cooperative learning model can improve the English learning outcomes of class VIII A students, SMP Negeri 1 Ubud. Furthermore, the results of class action research conducted by Samsur (2018), revealed that the *MAMA* type cooperative learning model can improve student learning outcomes from every meeting held in class. The results of research conducted by Darliati, Amra Ariyani, Nurul Asma (2021) revealed that *MAMA* type cooperative learning can improve English learning outcomes for class VIII students at Satap Pulo Bottoa State Middle School. Based on data processing, student learning outcomes have increased at each meeting when compared to before taking action.

The increase in student learning outcomes can be seen from the class average score which was only 58 before taking action and after taking action by implementing the *MAMA* type cooperative learning model in cycle I experienced an increase of 68.78, so the average student learning score in cycle I was 10.78%. In cycle II, student learning outcomes also increased if we compare it with cycle I, namely with a class average of 77.88, an increase of 9.07 with an increase percentage of 18.15%. This means that student learning outcomes have increased in each cycle through the implementation of *MAMA* type cooperative learning.

When looking at the research results published in scientific journals, all the research results reveal that the implementation of *MAMA* type cooperative learning can improve students' English learning outcomes. The results of our research also found that the learning process in the classroom by implementing *MAMA* type learning does provide many opportunities for students to discuss and exchange opinions with each other because they work in groups, teaching each other between one student and another. so that the learning process occurs indirectly.

One type of learning that is interesting and fun and recommended by experts is 'cooperative learning'. According to Faizi (2013), with this learning model teachers are expected to be able to encourage students to feel that they need each other or what is usually called positive interdependence which can be achieved through: interdependence in achieving goals, interdependence in completing tasks, interdependence of materials or resources, interdependence roles, interdependence of gifts. By using this *MAMA* type cooperative model, it can increase social sensitivity and solidarity, enable students to learn from each other about attitudes, skills, information, social behavior and views, enable the formation and development of social values and commitment and there are many other benefits that can be gained. obtained through the use of the cooperative learning model. Kristianti (2010) states that this *MAMA* type learning model can be used as an alternative to increase student motivation and learning

## LEARNING MODEL: MAMA (An Alternative to Improve Learning Outcomes English Finite Students of SMP Negeri 11 Palu City)

outcomes. Students learn while playing to provide opportunities for students to learn in a relaxed manner and foster a sense of responsibility, good cooperation, sportsmanlike competition and learning involvement. The results of this research also found that starting from the first meeting (treatment I) and subsequent meetings, it seems that the implementation of this *MAMA* type of cooperative learning can make students share their knowledge with each other about what was instructed during the teaching (treatment) in the classroom, resulting in a good academic atmosphere. positive and makes students increasingly focused on the tasks given by the researchers in class. Researchers can state that the learning models, strategies or techniques carried out in the classroom have a strong impact on the teaching and learning process that occurs for students.

### IV. CONCLUSION

#### Conclusion

The conclusion of this research is that implementing *MAMA* type cooperative learning can improve students' ability to write precise and correct *English Finite* in making descriptive texts. The proof can be seen from the means score obtained by the experimental class group before implementing *MAMA* type learning in the classroom was 51.5, but after implementing *MAMA* type cooperative learning students got an increase in their ability to write appropriate *English Finite* in making descriptive texts, namely 65.78.

### REFERENCES

- 1) Agustien, .I.R Helena 2001. *Kinerja Komunikatif Kelompok Intelektual Muda*: Dalam Kajian Serba Linguistik. Jakarta: PT Gunung Mulia dan Universitas Atmajaya.
- 2) Agustien, .I.R Helena. 2004. *Materi pelatihan Terintegrasi: Bahasa Inggris*. Jakarta: Direktorat pendidikan Dasar dan Menengah. Departemen Pendidikan Nasional
- 3) Agus Suprijono. 2013. *Cooperatif Learning*. Yogyakarta: Pustaka Pelajar.
- 4) Agus Widiantoro. 2017. *Activating the Desire to Learn*. Purwokerto: 2<sup>nd</sup> ELTiC Conference Universitas Muhammadiyah.
- 5) Arikunto. 2010. *Prosedur Penelitian*. Suatu pendekatan peraktek. Jakarta: Rineke Cipta.
- 6) Darliati, Ariyani A, Asma N. 2021. *Penerapan model pembelajaran Tipe Make A match dalam meningkatkan hasil belajar bahasa Inggris Siswa kelas VII SMP negeri SATAP Pulo Battoa*. Jurnal Profesi kependidikan, Vol2. No.1, April 2021.
- 7) Faizi, Mastur. 2013. *Ragam Metode Mengajarkan Eksakta pada Murid*. Jogyakarta: DIVA Press.
- 8) Helda Yeti dan Neni Mulya. 2018. *Penerapan Model Pembelajaran Kooperatif Tipe Make a Match untuk Mengembngan Motivasi Belajar*. Bandar Lampung: Jurnal Imiah Pendidikan Usia Dini. ESSN 2622-5182. Vol.1 No.2.
- 9) Heru Kurniawan. 2015. *Pembelajaran Kreatif Bahasa Indonesia*. Jakarta: Kencana.
- 10) Kasihani, KE. Suyanto. 2003. *English for Junior High School*. Jakarta: Direktorat Pendidikan Dasar dan Menengah. Departemen Pendidikan Nasional
- 11) Lorna Curran. 1994. *Metode Pembelajaran Make a Match*. Jakarta: Pustaka Pelajar
- 12) Miftahul Huda. 2011. *Cooperatif Learning (Metode, Teknik, Struktur, dan Model Penerapan)* Yogyakarta: Pustaka Pelajar.
- 13) Miftahul Huda. 2013. *Model-Model Pengajaran dan Pembelajaran: Isu-isu Metodis dan Paradigmatis*. Yoyakarta: Pustaka Pelajar.
- 14) Rohmalina Wahab. 2015. *Psikologi Belajar*. Jakarta: Rajagrafindo Persada.
- 15) Rusman. 2011. *Model-Model Pengembangan Pembelajaran Mengembangkan Profesionalisme Guru*: Jakarta. PT. Rajawali Pers.
- 16) Samsur, 2018. *Penerapan Model pembelajaran Kooperatif Tipe Make A match untuk meningkatkan hasil Belajar IPS Siswa Kelas V Sekolah Dasar*. Jurnal Primary Program Studi pendidikan Guru sekolah dasar FKIP, Universitas Riau. Vol.7/No.1. Hal: 170-177
- 17) Sugiona. 2012. *Metode penelitian Pendidikan*. Bandung: Alfabeta
- 18) Suharlina. 2015. *Pengaruh Metode Pembelajaran terhadap Prestasi Belajar Bahasa Inggris Peserta Didik kelas VII di Madrasah Tsanawiyah Gunung Silanu, Kec. Bangkala, Kab. Jeneponto*. Skripsi Unplished. Makassar: Fakultas Tarbiyah dan Keguruan UIN Alauddin Makassar
- 19) Suprpto D.N. 2020. *Penggunaan Model Pembelajaran Make a Match Sebagai Upaya Meningkatkan Hasil Belajar Bahasa Inggris Siswa*. Journal of Education Action Research. Universitas pendidikan Ganesha, Vol. 4. No.3, Agustus 2020
- 20) Suyanto. 2010. *Konsep Dasar Awal Usia Dini*. Jakarta: Departemen Pendidikan Nasional.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Childhood Obesity and the Risk of Hypertension in the Caribbean Region: A Narrative Review



Feimatta Immah Sowa, Md, Mph, Pg. Dip.

**ABSTRACT: Introduction:** Childhood obesity is a rising epidemic affecting both developed and developing countries worldwide. In the Caribbean, estimates of obesity in children are noted to be above the predicted global values, and evidence suggests that the rise in obesity levels is due to environmental influences in dietary practices and physical inactivity.

**Methods:** This review aims to determine the effects of childhood obesity and the associated risks of developing hypertension in the Caribbean population. Research articles were identified using computer-based search engines such as Google Scholar, PubMed, ScienceDirect, World Health Organization (WHO), and Caribbean Public Health Agency (CARPHA) databases. Researched articles with various study designs were then thoroughly analyzed to extract detailed information about obesity in childhood and the risks for hypertension in later years.

**Results:** Rapid weight gain in infancy and high (body mass index) BMI levels in childhood are associated with higher blood pressure values and increased cardiovascular risk. Additionally, direct baseline elevation of blood pressure (B.P.) measurements, noted in obese/overweight children compared to their nonobese counterparts, confirm the hypothesis that childhood obesity is positively associated with hypertension.

**Conclusion:** This review article provides detailed facts about childhood obesity, the risk for hypertension, and improvement recommendations and calls attention to the health implications of obesity-related hypertension in children if left untreated.

**KEYWORDS:** childhood obesity, childhood hypertension, obesity in Caribbean youths.

### INTRODUCTION

Childhood obesity is a global epidemic of increasing public health concern, and studies in the Caribbean have reported a rise in childhood obesity levels more extraordinarily than the global average of 5% (Henry, 2016).<sup>(1)</sup> Records from 2016 global estimates reveal that approximately 340 million children and adolescents between 5-19 years of age were obese/overweight, and a substantial rise in the prevalence of obesity from 4% in 1975 to approximately 18% in 2016 was noted (World Health Organization, WHO, 2020a).<sup>(2)</sup>

Higher trends in obesity levels of Caribbean children have been attributed to culturally and economically motivated changes in dietary practices, such as the overconsumption of energy-dense foods and shifts toward lower levels of physical activity (Henry, 2016).<sup>(1)</sup>

Once obesity develops, it has been noted that children are more likely to stay obese or overweight into adulthood, increasing their susceptibility to the early development of cardiovascular comorbidities and early death (Rees et al., 2009; Shrivastava et al., 2014).<sup>(3,4)</sup>

Hypertension, a condition previously classified as rare among children, is now considered a significant health concern, especially in obese/overweight children and adolescents where the prevalence of childhood hypertension is noted to rise (Shrivastava et al., 2014, Song et al., 2019).<sup>(4,5)</sup>

One primary explanation for the elevations in blood pressure (B.P.) levels in overweight or obese children is that the accumulation of fat cells (adipocytes) in the body eventually leads to activation of the neurohormonal sympathetic system, especially in the renal (kidney) vascular beds, which increases secretion of renin and other renal system substances that indirectly raise B.P. levels (Brady, 2017).<sup>(6)</sup>

This review aims to determine whether there is an association between childhood obesity and how adiposity influences hypertension in youths and early adulthood in the Caribbean region.

# Childhood Obesity and the Risk of Hypertension in the Caribbean Region: A Narrative Review

## METHODOLOGY

For this review, a narrative approach was used to analyze various electronic databases, such as PubMed, Google Scholar, New England Journal, University of the West Indies, and corporate websites, such as the World Health Organization (WHO), Caribbean Public Health Agency (CARPHA), the Healthy Caribbean Coalition (HCC), and the Pan American Health Organization (PAHO). Articles were selected for analysis if they:

- Contained descriptive data on childhood exposure to obesity/overweight, the outcomes on health and adulthood.
- Have published data in journals, public and controlled search engines with free or unrestricted access to materials.
- Studies were published within the last two decades (2003-2023).
- Articles were written in the English language.

This review was conducted to appraise previously conducted research, with the aim of increasing awareness of childhood obesity and its effects on health and prevention mechanisms in the Caribbean region, as well as promoting future research into country-specific analytic studies on obesity-related hypertension.

## LITERATURE REVIEW

The predominance of global obesity in most low- and middle-income countries over the past decades has led to epidemiologic transitions from a period of infectious diseases and dietary deficits to a period of noncommunicable diseases with a resultant increase in chronic conditions such as heart diseases, cancers, and diabetes (Arisaka et al., 2020; Bridger, 2009; Scribner et al., 2018).<sup>(7-9)</sup>

### Obesity and Standard Measurement/Reference Calculations

Overweight and obesity are described as medical conditions where there is an excessive amount of body fat accumulation into cells called adipocytes (World Health Organization (WHO), 2020a; National Institute of Health (NIH), 2021).<sup>(2,10)</sup>

Since childhood obesity most likely progresses into adulthood, appropriate measuring parameters and reference cutoff ranges must be available and standardized to define and classify the stages of obesity. Body mass index (BMI) calculation {using the weight in kilograms (kg) divided by height in meters squared ( $m^2$ )} was proposed as a standard reference used to define childhood obesity. However, differences in calculated reference ranges affected uniformity in the prevalence estimates of obesity, given that BMI substantially changes with age and height in children, as opposed to adults (Wang and Lim, 2012).<sup>(11)</sup> The need for a more refined consensus on reference methods that would be adequate for international comparisons was therefore acknowledged. As a result, sex-age-specific measurements were considered, and organizations such as the International Obesity Task Force (IOTF) and the World Health Organization (WHO) developed global reference ranges that are useful. However, the WHO's growth standard references for children worldwide are globally used based on local preferences for either previously used BMI percentile charts or the more recent z score BMI values.

Therefore, obesity as defined using BMI percentiles is when BMI  $\geq$  95th percentile for age-and-sex, and overweight is BMI  $\geq$  85th percentile but  $<$  95th percentile for age-and-sex, whereas BMI z scores  $\geq 1$  define overweight, and BMI z score  $\geq 2$  defines obesity in children and adolescents (Brady, 2017; Wang and Lim, 2012; De Onis et al, 2012).<sup>(6,11,12)</sup>

## DEFINITION OF HYPERTENSION

Hypertension in children is defined as elevated B.P. levels  $\geq$  90<sup>th</sup> percentile for children 0-12 years of age and  $\geq$  120/80 mmHg for children 13 years and older, where the values 120/80 represent systolic blood pressure (SBP) and diastolic blood pressure (DBP), respectively, and the determination of elevated B.P. is based on a standard distribution of B.P. in healthy normal-weight children (Riley et al., 2018; Mahbuba et al, 2021).<sup>(13,14)</sup> However, reviews from other articles define childhood hypertension as SBP  $\geq$  130 mmHg and DBP  $\geq$  80 mmHg taken on 3 or more outpatient visits for all children under 18 years of age (Pike et al, 2021).<sup>(15)</sup>

### Global Status of Childhood Obesity and Hypertension

It has been proposed by many that rapid weight gain in infancy and early childhood has a significant impact on the appearance of obesity in children (Arisaka et al., 2020; Bridger, 2009).<sup>(7,8)</sup> There is evidence that children evaluated to be obese/overweight in infancy had higher probabilities of staying obese through adolescence and that even though at a slower rate, the body mass index (BMI) became progressively higher from infancy into adolescence (Brady, 2017; CARPHA, 2021; Geserick et al., 2018; HCC, 2019).<sup>(6,16-18)</sup> A report on adolescents from the article by Geserick et al., 2018, stated that the period of excessive weight gain (measured by rapid BMI acceleration) most likely started between 2 and 6 years of age, and once initiated, the BMI continues to increase through adolescence, magnifying the symptoms of obesity in affected adolescents. Moreover, higher BMI levels were associated with elevated blood pressures and increased cardiovascular risk (Brady, 2017; Friedemann et al., 2012; Kelly et al., 2015).<sup>(6,19,20)</sup> Furthermore, the rate of overweight or obesity in youths was increased in those who were large for gestational age (LGA)



## Childhood Obesity and the Risk of Hypertension in the Caribbean Region: A Narrative Review

compared with those who were average or small for gestational age (SGA), potentially raising their BMI levels and risk for hypertension (Geserick et al., 2018).<sup>(17)</sup> Direct B.P. measurements in obese/overweight children and adolescents also revealed higher B.P. levels when equated to their nonobese counterparts, confirming the hypothesis that childhood obesity is positively associated with hypertension (CARPHA, 2014; Puri et al., 2008; Schwiebbe et al., 2012; Umer et al., 2017).<sup>(21–24)</sup>

### Current Situation on the Prevalence of Childhood Obesity in the Caribbean Region

Although there are available data from major Caribbean organizations about obesity-related hypertension, only a handful of analytic studies from individual nations about current obesity-related hypertension issues have been conducted, raising questions about the validity of prevalence estimates. There is, however, sufficient recorded data on the rise in unhealthy weights among young people in the Caribbean. Reports from various Caribbean nations show that the prevalence of overweight and obesity in children lies between 28% and 35% (CARPHA, 2021; Health Caribbean Coalition (HCC), 2019).<sup>(16,18)</sup> Between 2001 and 2010, the prevalence of overweight in Caribbean children less than five years old increased from 6% to 14%; the prevalence for both overweight and obesity in boys 11-13 years of age was 27% and 33% for girls between the same age range, (Henry, 2016; HCC, 2019).<sup>(1,18)</sup> Moreover, girls, especially adolescent females, are noted to have increased risks for overweight and obesity in the Caribbean and Latin American regions (Traboulay & Hoyte, 2015).<sup>(41)</sup>

Country-specific Global School-based Student Health Surveys (GSHS) conducted by the World Health Organization (WHO) prove unsatisfactory effects of overweight and obesity among young Caribbean people. For example, in Dominica (2009), the rates of overweight and obesity in children between 13 and 15 years old were 24.8% and 9.1%, respectively; Guyana (2010) recorded rates of 15.3% for overweight children of the same age range and 4.1% for obese children; and in Barbados (2011), rates were 31.9% and 14.2%, respectively (HCC, 2019)<sup>(18)</sup>

Presently, 1 in every 3 Caribbean children is overweight or obese, and the major causes are unhealthy diets, powered by increased intakes of ultra-processed, energy-dense but nutrient-poor foods, excess consumption of sugary and carbonated soft drinks, and increased sedentarism (HCC, 2019).<sup>(18)</sup>

There is evidence that risk factors for hypertension, cardiovascular diseases, and diabetes, such as increased blood pressure (B.P), excess abdominal and waist circumferences due to adiposity, and insulin resistance have already risen in obese Caribbean children (CARPHA, 2021).<sup>(16)</sup> In effect, reports prove that diseases such as hypertension and other cardiovascular illnesses, diabetes, and stroke have thus far started to manifest in the Caribbean youth population (CARPHA, 2021).<sup>(16)</sup>

Additionally, the movement from locally grown foods (fruits, legumes, vegetables, and less processed animal products) to a more highly processed, energy-dense diet and more animal-sourced products, accompanied by environmental lifestyle influences, has extensively promoted the obesity epidemic in many Caribbean populations over the last 30 years (CARPHA, 2014; PAHO, 2015, Traboulay & Hoyte, 2015).<sup>(21,25 41)</sup>

### RISK FACTORS AND HEALTH EFFECTS OF OVERWEIGHT/OBESITY

In general, BMI rises in the first year of life and then slows down until the age of 5-6 years. The second rise in BMI after the first year of life is known as adiposity rebound (Kang, 2018).<sup>(26)</sup> It seems evident that the earlier the stage of adiposity rebound in childhood, the greater the risk of developing obesity in later years (Bridger, 2009; Rolland-Cachera, 2006).<sup>(8,27)</sup>

There are a handful of instrumental factors believed to be responsible for developing overweight and obesity in Caribbean children. These risk factors include insufficient/lack of exclusive breastfeeding in infancy, birth weight, eating habits, childhood lifestyle, physical activity, environmental and socioeconomic factors, and genetic predisposition (Henry, 2016; CARPHA, 2014).<sup>(1,21)</sup>

#### Birth weight

Some studies report that children born large for gestational age (LGA) are more likely to have higher BMI levels during infancy and adolescence and become obese when compared to those who had an average weight or were small for gestational age (Geserick, 2018).<sup>(17)</sup> However, others refute this claim by proving that lower birth weights are associated with more significant risks for obesity and chronic diseases later in life (Taylor-Bryan et al., 2018).<sup>(28)</sup> Poor maternal nutrition, prenatal infections, smoking, or alcohol abuse during pregnancy could result in intrauterine growth restriction and the birth of children small for gestational age (SGA) or low birth weight (Arisaka et al., 2020).<sup>(7)</sup>

A follow-up of SGA/low birth weight babies reveals that they tend to have rapid weight recovery (catch-up growth) by suppressing the sympathetic nervous system to reduce energy spending and conserve more energy. Moreover, rapid weight regain can cause high-speed fat accumulation, promoting resistance to insulin and leptin hormones, which will result in increased lipogenesis (increased fat cell formation and accumulation) from insulin resistance and increased hunger with decreased energy expenditures from leptin resistance (Arisaka et al., 2020; Bridger, 2009).<sup>(7,8)</sup> Thus, these babies are more prone to develop obesity and likely

## Childhood Obesity and the Risk of Hypertension in the Caribbean Region: A Narrative Review

cardiovascular adverse outcomes if not halted sooner. Stimulating mothers of SGA babies to engage in exclusive breastfeeding and encouraging adequate prenatal care would promote healthy growth in the postpartum period and infancy.

### Insufficiency or lack of exclusive breastfeeding in infancy

There is evidence that breast-fed infants for at least the first 6 months of life are less likely to suffer from obesity, given that breastfeeding is a known protective factor against obesogenic agents (HCC, 2019; CARPHA, 2014; Rito et al., 2019).<sup>(18,21,29)</sup> In addition, there are sufficient explanations that breastfeeding stimulates a hormonal response such as formula feeding but causes a decreased insulin response in the body compared to formula-fed infants (Rito et al., 2019).<sup>(29)</sup> Thus, breastmilk provides sufficient nutrients for adequate growth compared to formula feeds that promote rapid growth by a more significant induction of insulin and its actions on tissues, leading to fat accumulation, an increase in unhealthy weight, and the likelihood of hypertension in later years (Arisaka et al., 2020, Rito et al., 2019).<sup>(7,29)</sup> Furthermore, human breast milk contains abundant Bifidobacteria, which are helpful microorganisms and function as probiotics that protect the gut lining against harmful substances aiding in digestion (Rito et al., 2019).<sup>(29)</sup> However, obese children have been noted to have fewer of these bacteria in their digestive tract, which could be explained by the lack of/reduced breastfeeding.

Although the importance of breastfeeding is vastly promoted and encouraged in the Caribbean and exclusive breastfeeding at birth is initiated by many mothers, most women do not continue breastfeeding past three months. For example, a study in Jamaican women showed that after six months, the number of breastfeeding mothers dropped to 15%, and between 6 and 11 months when additional feeds were introduced, 85% of mothers did not follow the needed feeding guidelines, which meant that fewer children received adequate and proper nutrition (Henry, 2016).<sup>(1)</sup> Similar reports within this region show that an average of 88% of mothers start breastfeeding, but this value depreciates as the amount of exclusive breastfeeding varies within the first six months of life (average is 39%), reaching as low as 5% in some nations (CARPHA, 2014).<sup>(21)</sup> Encouraging exclusive breastfeeding for at least six months could prevent obesity in infancy and thus help reduce future risk for hypertension.

### Eating habits and childhood lifestyles

Inappropriate dietary practices and physical inactivity, especially in infancy and adolescence, are significant challenges leading to overweight/obesity, and inadequacies in policies for food supply, processing, marketing, and transport, as well as environmental lifestyle changes, have all been identified as reasons for obesogenic conduct in many Caribbean nations (Henry, 2016).<sup>(1)</sup> Over the last 30 years, feeding habits have drastically changed from locally and culturally produced healthy foods to more energy-dense foods that are highly processed, containing increased quantities of salt, sugar, fat, and other unhealthy substances (CARPHA, 2020a; Singh et al, 2017).<sup>(16,30)</sup> This fact, along with less physical activity due to increased advances in transportation modalities, reduced educational promotion of exercises within schools, increased urbanizations, and increased sedentarism secondary to changes from outdoor games to increased screen-time games, has also influenced modifications in the lifestyles of Caribbean children (Henry, 2016; HCC, 2019; WHO,2021).<sup>(1,18,31)</sup> Additionally, it is worth noting that most parents are part of the problem rather than being part of the solution. For instance, parents/guardians who adopt unhealthy diets and physically inactive lifestyles are more likely to expose their children to similar unhealthy habits (Henry, 2016).<sup>(1)</sup>

### Environmental influences

Relevant environmental behaviors proven to increase unhealthy weights include lack of healthy food choices in educational centers, commercial food advertisements, and the inexistence of community recreational or physical activity centers. Surveys have shown that school-going children consume enormous quantities of snacks and sugary foods (high in saturated fats, sugars, and less vital nutrients) than vegetables or fruits while also engaging in activities requiring minimal exercise in schools. Additionally, children are more likely to recall food advertisements when compared to other advertisements on-screen media, which increases cravings for such foods (CARPHA, 2014).<sup>(21)</sup> Substantial evidence likewise shows that increased weight, high BMI levels in childhood, and a positive family history of high blood pressure were significantly positively associated with increased B.P. in adolescence (Nichols and Cadogan, 2006).<sup>(32)</sup> Thus, there is an increasing correlation between obesity and higher B.P. levels in adolescents, which should motivate national stakeholders to implement action plans to help prevent hypertension among Caribbean youths (Henry, 2016; Schwiebbe et al., 2012).<sup>(1,23)</sup>

## THE ROLE OF OBESITY IN HYPERTENSION AND CONSEQUENCES OF CHILDHOOD HYPERTENSION

A vast amount of evidence indicates that elevated body weight is associated with higher B.P. values in children. Overweight or obese children typically present with high BMI and high B.P. levels at baseline, increasing the odds of developing hypertension later in life compared to children with normal weight or lower BMI levels (Brady, 2017; Kelly et al., 2015; Puri et al., 2008).<sup>(6,20,22)</sup>

## Childhood Obesity and the Risk of Hypertension in the Caribbean Region: A Narrative Review

In addition, some studies provide further proof that excluding B.P. values of overweight or obese children from a pool of recorded data with normal-weight children, B.P. levels were notably lower across the board (Brady, 2017).<sup>(6)</sup>

A study performed in 9–10-year-old Barbadian children in 2015 showed that one-third of these children were overweight/obese, and 12% had an associated high blood pressure (Gaskin et al, 2015).<sup>(42)</sup>

Many pathways have been proposed to explain how obesity is related to B.P. elevations and hypertension.

Nevertheless, a dominant consensus is that adiposity increases the size and quantity of fat cells, which increases secretory substances/hormones called adipokines from adipose/fat cells {leptin, interleukin 6 (Il-6) and resistin}, thus incapacitating the body's regulation of fat metabolism (Brady, 2017; Schwiebbe et al., 2012).<sup>(6,23)</sup> As a result of high circulating levels of adipokines, the sympathetic nervous system (SNS) becomes excessively activated, which in turn affects most vital organs. In overweight or obese states, SNS activation preferentially influences the renal vascular bed, directly causing vasoconstriction and increasing B.P. levels and stimulating renin production. Renin then activates the renin-angiotensin-aldosterone system (RAAS), which indirectly elevates B.P. levels by increasing renal tubular reabsorption of sodium and water into the vasculature. Direct increases in B.P. levels also occur due to elevated angiotensin II effect, a potent vasoconstrictor, further elevating B.P. levels (Brady, 2017; Vecchiola et al., 2016).<sup>(6,33)</sup> Additionally, extra weight gains will promote supplementary rises in adiposity, potentiating more SNS activation and secretion of the RAAS stimulating factors, contributing to further rises in B.P. levels (Brady, 2017).<sup>(6)</sup>

Dyslipidemia is another issue that overweight and obese children face, as it predisposes them to have abnormal lipid profiles, with elevated levels of triglycerides, free fatty acids, and low-density lipoproteins (LDL-cholesterol). However, individuals with increased adiposity levels present with further disruptions in lipid metabolism by having low values of the 'good cholesterol,' high-density lipoproteins (HDL-cholesterol), believed to help lower heart diseases and stroke risks (Brady, 2017; Bridger, 2009).<sup>(6,8)</sup> In addition, the increased influx of macrophages into adipose tissue due to distortions in the lipid/cholesterol profile in overweight or obese children causes a build-up of fat plaques and inflammatory products in arterial vessels (atherosclerosis), leading to chronic inflammation of adipose tissue and vasculature (Brady et al., 2017; Dorresteyn et al., 2012).<sup>(6,34)</sup>

Another noteworthy instrumental factor in obesity-related hypertension is the accumulative effects of oxidative stress (build-up of oxygen free radicals), caused by obesogenic products, among others, which stimulates activation of SNS that eventually promotes poor vascular function and impaired excretion of sodium, clinically manifesting as hypertension (Brady, 2017).<sup>(6)</sup>

Elevations in body fat accumulation in obese individuals also promote fat deposition in and around many internal (visceral) organs, particularly the kidneys. For example, in fatty kidneys, there are increased adipose tissue deposits in the renal sinus, which will increase compression of vessels exiting or entering the kidneys, thereby raising renal interstitial pressure, and leading to elevated sodium and water reabsorption and higher B.P. levels (Brady, 2017; Foster et al., 2011).<sup>(6,35)</sup>

Hypertension is a known risk factor influencing the appearance of other cardiovascular diseases, including heart failure, cardiomyopathies, coronary artery disease, and arrhythmias (Wulh, 2018).<sup>(36)</sup> Moreover, obesity-related hypertension contributes to stroke, chronic kidney disease, disabilities, and even death (Song et al., 2019).<sup>(5)</sup>

### RECOMMENDED STRATEGIES FOR THE PREVENTION AND MANAGEMENT OF OVERWEIGHT AND OBESITY

Heart diseases are the leading causes of death worldwide, followed closely by stroke, and hypertension significantly elevates the risks for both conditions (WHO, 2020b). Therefore, more attention must be directed to factors likely to increase the burden of cardiovascular diseases in younger populations and establish/implement ways to prevent them (WHO, 2020b).<sup>(37)</sup> Strategies to improve dietary habits, encourage and participate in physical activity, and modify environmental influences in favor of healthier lifestyles will positively reduce overweight or obesity, thereby decreasing the prevalence of obesity-related hypertension in childhood. Essential stakeholders, including parents and guardians, educational sectors, community members, and governmental departments, should take responsibility and engage in the fight against the rising epidemic of unhealthy weight in children and adolescents (Genovesi et al., 2019).<sup>(38)</sup>

Some recommended measures based on the WHO Commission on ending childhood obesity include interventions to promote healthy diets; to encourage physical activity; action plans for adequate preconception, antenatal and pregnancy care; to motivate early healthy childhood dietary choices, physical activity, and weight management; and to provide healthy food options and physical activity for school-age children (CARPHA, 2014; WHO, 2016).<sup>(21,39)</sup>

National leaders must consider fiscal policies and regulations for food production, marketing, and labeling to promote healthy diets among community members. Measures to promote local farmer production by establishing food fairs and the marketing of more natural home-grown products at affordable prices could motivate changes to dietary habits.

Influences such as media advertising (television, internet, and other social media commercial breaks) and celebrity endorsements should be tailored to project more healthy food choices to limit the persuasive power of food marketing notifications on childhood

## Childhood Obesity and the Risk of Hypertension in the Caribbean Region: A Narrative Review

vulnerability (PAHO,2015).<sup>(25)</sup> Furthermore, increased taxations on highly processed, poor-nutrient, and unhealthy foods should be discussed and considered for implementation by policy levers.

Suggestive evidence that extended periods of breastfeeding may reduce childhood overweight and obesity by approximately 10% and that mothers who exclusively breastfeed their babies lose post pregnancy weight faster are stimulating findings that could positively encourage and modify breastfeeding practices during the postpartum period (PAHO, 2015).<sup>(25)</sup> Monitoring established breastfeeding measures through adequate primary health care and hospital programs could motivate mothers to participate.

Individual healthy eating behaviors, physical activity, and weight management are paramount in the fight to reduce unhealthy weights in children and adolescents. Healthy food choices in parents or guardians undoubtedly impact eating patterns in children. In addition, engaging in a type of exercise (such as physically active sports, gym practices, walking, swimming) can inspire children to adopt similar practices. Additionally, encouraging family-based or group-based physical activities, reducing time spent on screen devices, and stimulating outdoor playtime (at home, parks, recreational centers, beach visits) can help decrease sedentarism and promote healthy weight management.

Poverty, ignorance, inadequate living conditions, and lack of accessibility or affordability of healthcare facilities, especially in low- and middle-income countries, could prevent or reduce adherence and compliance to set obesity-related programs (Ford et al., 2017).<sup>(41)</sup> Therefore, supplementing deficits in these areas can influence favorable lifestyle modification, which is beneficial for all.

There is substantial evidence that implementing school-based interventions to provide nutrient-rich healthy food options that meet children's dietary demands effectively changes eating habits and stimulates healthy weights (PAHO, 2015).<sup>(25)</sup> Therefore, initiatives to establish/improve and implement food programs according to nutrition and food safety norms while integrating daily physical activity into school curricula would suffice to stimulate and strengthen childhood overweight and obesity reductions successfully.

Furthermore, health awareness and risk assessment checks in schools, such as B. P records of children within a classroom, at the start of the term and at least one (1) repeat check at the end of the term will assist with the early detection and intervention of at-risk children for hypertension.

Finally, policymakers could ensure that surveillance strategies to effectively monitor and assess progress, evaluative schemes on available facilities, emerging deficits, and challenges in management capability, and research into improvement modalities are well operational for subsequent re-evaluations and improvements to equally profit all persons concerned.

### CONCLUSION

In closing, this review provides a comprehensive evaluation of how childhood obesity is associated with the risk for hypertension. Recorded results that Caribbean nations have already noted a rise in hypertension among the overweight and obese young population is a growing concern, and recommended strategies must be initiated and monitored to control unhealthy weight progression. There is also a current need for additional well-designed research at country-specific levels to determine the extent of obesity-associated hypertension, affiliated risk factors, and possible improvements in screening methods, prevention, and management of overweight and obese children.

### Acronyms and Abbreviations

AR: Adiposity Rebound

BMI: Body Mass Index

B.P.: Blood Pressure

CARPHA: Caribbean Public Health Agency

HCC: Healthy Caribbean Coalition

HDL: High-density Lipoproteins

LDL: Low-density Lipoproteins

LGA: Large for Gestational Age

NEJM: New England Journal of Medicine

NIH: National Institute of Health

PAHO: Pan American Health Organization

RAAS: Renin-angiotensin-aldosterone-system

SES: Socioeconomic status

SGA: Small for Gestational Age

SNS: Sympathetic Nervous System

WHO: World Health Organization

# Childhood Obesity and the Risk of Hypertension in the Caribbean Region: A Narrative Review

## DECLARATIONS

### Ethical Approval and Consent to Participate

There was no need for ethical approval or consent to participate in this review.

### Consent for publication

Not applicable

### Availability of data and materials

All data generated or analyzed during this study are included in this published article.

### Competing/Conflicting interests

The author declares no conflict of interest in authorship, financial relations or issues pertaining to publication.

### Funding

No financial support was received for the work of this research.

### Authors' contributions

FIS is the sole contributor to the conception, design, acquisition, and interpretation of the data for this review. FIS is responsible for the drafting and final approval of the version to be published; and agrees to be accountable for all aspects of the work ensuring integrity and accuracy.

### Acknowledgements

Not applicable

## REFERENCES

- 1) Henry FJ. Childhood Obesity in the Caribbean: Weighty Challenges & Opportunities. *Obesity & Control Therapies: Open Access*. 2016 Oct 15;3(1):1–4.
- 2) World Health Organization, (WHO). Obesity and Overweight [Internet]. World Health Organization. 2020. Available from: <https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight>.
- 3) Rees A, Thomas N, Brophy S, Knox G, Williams R. Cross sectional study of childhood obesity and prevalence of risk factors for cardiovascular disease and diabetes in children aged 11–13. *BMC Public Health [Internet]*. 2009 Mar 24;9(1). Available from: <https://bmcpublihealth.biomedcentral.com/articles/10.1186/1471-2458-9-86>
- 4) Shrivastava SRBL, Shrivastava PS, Ramasamy J. Childhood obesity: a determinant of adolescent and adult hypertension. *International Journal of Preventive Medicine [Internet]*. 2014 Mar 1 [cited 2023 Nov 21];5(Suppl 1): S71-72. Available from: <https://pubmed.ncbi.nlm.nih.gov/24791195/>
- 5) Song P, Zhang Y, Yu J, Zha M, Zhu Y, Rahimi K, et al. Global Prevalence of Hypertension in Children. *JAMA Pediatrics*. 2019 Oct 7;173(12):1.
- 6) Brady TM. Obesity-Related Hypertension in Children. *Frontiers in Pediatrics*. 2017 Sep 25;5(197).
- 7) Arisaka O, Ichikawa G, Koyama S, Sairenchi T. Childhood obesity: rapid weight gain in early childhood and subsequent cardiometabolic risk. *Clinical Pediatric Endocrinology*. 2020;29(4):135–42.
- 8) Bridger T. Childhood obesity and cardiovascular disease. *Paediatrics & Child Health*. 2009 Mar;14(3):177–82.
- 9) Scribner RA, Radix RL, Gilliland AE, Leonardi C, Ferguson TF, Noel TP, et al. Absence of Adolescent Obesity in Grenada: Is This a Generational Effect? *Frontiers in Public Health [Internet]*. 2018 Aug 3 [cited 2021 Apr 3];6. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6086203/>
- 10) NIH. Overweight and Obesity | National Heart, Lung, and Blood Institute (NHLBI) [Internet]. Nih.gov. 2019. Available from: <https://www.nhlbi.nih.gov/health-topics/overweight-and-obesity>.
- 11) Wang Y, Lim H. The global childhood obesity epidemic and the association between socio-economic status and childhood obesity. *International Review of Psychiatry [Internet]*. 2012 Jun;24(3):176–88. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4561623/>
- 12) de Onis M, Onyango A, Borghi E, Siyam A, Blössner M, Lutter C. Worldwide implementation of the WHO Child Growth Standards. *Public Health Nutrition*. 2012 Apr 12;15(09):1603–10.
- 13) Riley M, Hernandez AK, Kuznia AL. High Blood Pressure in Children and Adolescents. *American Family Physician [Internet]*. 2018 Oct 15;98(8):486–94. Available from: <https://pubmed.ncbi.nlm.nih.gov/30277729/>
- 14) Mahbuba S, Mollah Md.A, Sultana A, Rahat F, Khanam M, Iman K, et al. Childhood Obesity and Hypertension: How to Save our Future Generation [Internet]. *ResearchGate. Bangladesh Renal Journal*. 2.(1):30-35; 2021. Available from: [https://www.researchgate.net/publication/355710467\\_Childhood\\_Obesity\\_and\\_Hypertension\\_How\\_to\\_Saveour\\_Future\\_Generation](https://www.researchgate.net/publication/355710467_Childhood_Obesity_and_Hypertension_How_to_Saveour_Future_Generation)

## Childhood Obesity and the Risk of Hypertension in the Caribbean Region: A Narrative Review

- 15) Pike M, T. Alp İkizler, Lipworth L, Cassianne Robinson-Cohen. 75561 Association of childhood hypertension with early adulthood obesity and hypertension. *Journal of clinical and translational science*. 2021 Mar 1;5(s1):31–2.
- 16) Childhood Obesity. Understanding the Situation [Internet]. [carphafoundation.carpha.org](http://carphafoundation.carpha.org). Caribbean Public Health Agency, (CARPHA); 2021 [cited 2021 Nov 21]. Available from: <http://carphafoundation.carpha.org/What-We-Do/Childhood-Obesity>
- 17) Geserick M, Vogel M, Gausche R, Lipek T, Spielau U, Keller E, et al. Acceleration of BMI in Early Childhood and Risk of Sustained Obesity. *New England Journal of Medicine*. 2018 Oct 4;379(14):1303–12.
- 18) PREVENTING CHILDHOOD OBESITY IN THE CARIBBEAN. Civil Society Action Plan 2017-2021. [Internet]. Healthy Caribbean Coalition, HCC; 2019. Available from: <https://www.healthycaribbean.org/wp-content/uploads/2017/10/Preventing-Childhood-Obesity-in-the-Caribbean-CSAP-2017-2021.pdf>
- 19) Friedemann C, Heneghan C, Mahtani K, Thompson M, Perera R, Ward AM. Cardiovascular disease risk in healthy children and its association with body mass index: systematic review and meta-analysis. *BMJ* [Internet]. 2012 Sep 25;345(sep25 2): e4759–9. Available from: <https://www.bmj.com/content/345/bmj.e4759>
- 20) Juonala M, Kelly R, Magnussen CG, Sabin MA, Cheung M. Development of hypertension in overweight adolescents: a review. *Adolescent Health, Medicine, and Therapeutics* [Internet]. 2015 Oct; 6:171–87. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4622556/>
- 21) Safeguarding Our Future Development Plan of Action for Promoting Healthy Weights in the Caribbean: Prevention and Control of Childhood Obesity [Internet]. Caribbean Public Health Agency (CARPHA); 2014. Available from: <https://carpha.org/Portals/0/xBlog/documents/HealthyWeights.pdf>
- 22) Puri M, Flynn JT, Garcia M, Nussbaum H, Freeman K, DiMartino-Nardi JR. The Frequency of Elevated Blood Pressure in Obese Minority Youth. *The Journal of Clinical Hypertension*. 2008 Feb;10(2):119–24.
- 23) Schwiebbe L, Talma H, Renders C, Visser R, Kist-van Holthe JE, HiraSing RA. High prevalence of hypertension in obese children in the Caribbean. *Paediatrics and International Child Health*. 2012 Nov;32(4):204–7.
- 24) Umer A, Kelley GA, Cottrell LE, Giacobbi P, Innes KE, Lilly CL. Childhood obesity and adult cardiovascular disease risk factors: a systematic review with meta-analysis. *BMC Public Health*. 2017 Aug 29;17(1).
- 25) Plan of Action for the Prevention of Obesity in Children and Adolescents [Internet]. [paho.org](http://paho.org). Pan American Health Organization, (PAHO); 2015 [cited 2021 Nov 21]. Available from: [https://iris.paho.org/bitstream/handle/10665.2/49138/obesity-plan-of-action-child\\_eng\\_2015.pdf?sequence=1](https://iris.paho.org/bitstream/handle/10665.2/49138/obesity-plan-of-action-child_eng_2015.pdf?sequence=1)
- 26) Kang MJ. The adiposity rebound in the 21st century children: meaning for what? *Korean Journal of Pediatrics* [Internet]. 2018 Dec 15;61(12):375–80. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6313085/>
- 27) Rolland-Cachera MF, Deheeger M, Maillot M, Bellisle F. Early adiposity rebound: causes and consequences for obesity in children and adults. *International Journal of Obesity*. 2006 Nov 28;30(S4): S11–7.
- 28) Taylor-Bryan CR, Badaloo AV, Boyne MS, Osmond C, Forrester TE. The Association of Early Life Factors with Body Composition in Peripubertal Jamaican Children [Internet]. *West Indian Med J* 2018; 67 (5). 2018. Available from: doi: 10.7727/wimj.2018.166
- 29) Rito A, Buoncristiano M, Spinelli A, Salanave B, Kunešová M, Hejgaard T, et al. Association between Characteristics at Birth, Breastfeeding and Obesity in 22 Countries: The WHO European Childhood Obesity Surveillance Initiative – COSI 2015/2017. *Obesity Facts* [Internet]. 2019;12(2):226–43. Available from: <https://www.karger.com/Article/FullText/500425>
- 30) Singh S, Shankar R, Singh GP. Prevalence and Associated Risk Factors of Hypertension: A Cross-Sectional Study in Urban Varanasi. *International Journal of Hypertension* [Internet]. 2017;2017(5491838):1–10. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5733954/>
- 31) World Health Organization, (WHO). Obesity and overweight [Internet]. World Health Organization. 2021. Available from: <https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight>
- 32) Dorresteijn JAN, Visseren FLJ, Spiering W. Mechanisms linking obesity to hypertension. *Obesity Reviews*. 2011 Aug 10;13(1):17–26.
- 33) Nichols S, Cadogan F. Blood pressure and its correlates in Tobagonian adolescents. *West Indian Medical Journal*. 2006 Oct;55(5).
- 34) Vecchiola A, Lagos CF, Carvajal CA, Baudrand R, Fardella CE. Aldosterone Production and Signaling Dysregulation in Obesity. *Current Hypertension Reports*. 2016 Feb 2;18(3).
- 35) Foster MC, Hwang SJ, Porter SA, Massaro JM, Hoffmann U, Fox CS. Fatty Kidney, Hypertension, and Chronic Kidney Disease. *Hypertension*. 2011 Nov;58(5):784–90.

## Childhood Obesity and the Risk of Hypertension in the Caribbean Region: A Narrative Review

- 36) Wühl E. Hypertension in childhood obesity. *Acta Paediatrica*. 2018 Sep 19;108(1):37–43.
- 37) World Health Organization, (WHO). The Top 10 Causes of Death [Internet]. World Health Organization. 2020. Available from: <https://www.who.int/news-room/fact-sheets/detail/the-top-10-causes-of-death>
- 38) Genovesi S, Giussani M, Orlando A, Battaglino MG, Nava E, Parati G. Prevention of Cardiovascular Diseases in Children and Adolescents. *High Blood Pressure & Cardiovascular Prevention*. 2019 Apr 30;26(3):191–7.
- 39) World Health Organization, (WHO). ENDING CHILDHOOD OBESITY REPORT OF THE COMMISSION ON [Internet]. 2016. Available from: [https://apps.who.int/iris/bitstream/handle/10665/204176/9789241510066\\_eng.pdf](https://apps.who.int/iris/bitstream/handle/10665/204176/9789241510066_eng.pdf)
- 40) Ford ND, Patel SA, Narayan KMV. Obesity in Low- and Middle-Income Countries: Burden, Drivers, and Emerging Challenges. *Annual Review of Public Health*. 2017 Mar 20;38(1):145–64.
- 41) Traboulay E, Hoyte O. Mini review: Obesity in Caribbean Youth. *The West Indian Medical Journal* [Internet]. 2015 Jun 1 [cited 2020 Nov 4];64(3):250–62. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4763901/>
- 42) Gaskin PS, Hall RV, Chami P, St. John MA, Gaskin DA, Molaodi OR, et al. Associations of Blood Pressure with Body Composition among Afro-Caribbean Children in Barbados. Tayo BO, editor. *PLOS ONE*. 2015 Mar 27;10(3): e0121107.
- 43) Hassan S, Oladele C, Galusha D, Adams OP, Maharaj RG, Nazario CM, et al. Anthropometric measures of obesity and associated cardiovascular disease risk in the Eastern Caribbean Health Outcomes Research Network (ECHORN) Cohort Study. *BMC Public Health*. 2021 Feb 25;21(1).



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## The Effectiveness of Massage and Stretching Therapy against Neck Pain and Range of Motion (Rom) in Online Game Players



Hafiz Mahesvi <sup>1</sup>, Ali Satia Graha<sup>2</sup>

<sup>1,2</sup>Departement of Sport Science, Faculty of Sport and Health Science, Yogyakarta State University, Yogyakarta, Indonesia.

**ABSTRACT:** As is known, massage is a non-pharmacological method that can be beneficial for muscle strength and flexibility. Static positions in playing online games with a long duration play a role in causing neck disorders. This study aims to examine the effectiveness of massage and stretching therapy on healing neck injuries in online game players. This study used a pre-experimental design with one group posttest-pretest design. The population in this study was students who visited Burjo Pamungkas who played online games (3-5 hours) a day. The study sample was 20 people determined by purposive sampling. The data collected were pain scale data with Numeric Rating Scale and ROM measured by Goniometer, both before and after a combination treatment of massage and stretching for 40 minutes. . The analysis technique used is Wilcoxon Signed Rank with a signification level of 5%. The results of this study showed that the combination treatment of massage and stretching can reduce pain scale and increase neck Range of Motion (ROM) significantly ( $p < 0.05$ ). From the calculation of the effectiveness of the treatment, it was found that the effectiveness of reducing the pain scale by 57% and the effectiveness of increasing ROM by an average of 24.01%.

**KEYWORDS:** Massage, Stretching, Pain, Range of Motion, Online Games.

### I. INTRODUCTION

Working with computers and using smartphones for long periods of time can lead to repeated use of certain muscles, which can ultimately lead to muscle injury and cumulative damage from acute trauma to the neck. The use of smartphones is considered to be the most popular portable electronic device, and recent estimates suggest that about 77% of the world's population owns such gadgets. The main reason behind the popularity of smartphone usage globally is for communication and entertainment purposes. The growth of internet technology contributes significantly to progress in various aspects of life. One form of internet technology that is experiencing rapid development is online games (Puspita & Rohedi, 2018). But, keep in mind that a significant increase in gaming does not necessarily bring benefits and can pose risks, especially for vulnerable individuals such as children and those at risk for gaming disorders (King et al., 2019). The negative impact of excessive gaming is recognized, including potential disruptions to mental health, sleep patterns, and physical health (Saunders et al., 2017). One of the negative effects of playing online games for physical health can cause muscle tension in the neck. Neck pain is a common problem experienced by two-thirds of the population worldwide. Specifically, it is estimated that every year, about 16.6% of the adult population experiences discomfort in the neck, and 0.6% of the total sufferers experience severe neck pain (Hasnah et al., 2019).

Playing online games involves the act of sitting for a long time in a fixed position, causing the muscles to constantly work in static conditions. This can result in adaptations in muscle tissue, which in turn leads to tension or shortening of the muscles. This condition can press on the surrounding nerves and eventually cause pain in the area. Online game players often engage in sitting activities in a position that is maintained for more than 3 hours in one playing session. Game players often experience problems with neck pain, which can affect the musculoskeletal system and cause chronic pain and decreased joint locomotion. A common symptom that appears in musculoskeletal problems, which cause restriction of joint space, involves pain. Therefore, pain and Range of Motion (ROM) are closely related in this context.

In this case, an efficient and economical method is needed to overcome problems in the musculoskeletal system. Almost everyone at some point in their lives will experience this difficulty. Disorders of the musculoskeletal system, such as osteoarthritis, rheumatoid arthritis, injuries, and syndromes, can appear as a result of daily activities. The disorder is often caused by several factors, including poor eating habits, which can lead to obesity or malnutrition, as well as spending time in a static work position



## **The Effectiveness of Massage and Stretching Therapy against Neck Pain and Range of Motion (Rom) in Online Game Players**

for long hours. But in this case there are several things that can be done to overcome the problem such as physical therapy, exercise therapy, and several other therapies. This physical therapy involves a number of approaches, including manual therapy such as isometric post relaxation and myofascial release, exercise therapy such as stretching, strengthening, stabilization, and endurance training, as well as other methods such as thermotherapy, cryotherapy (Gross et al., 2015), laser therapy, infrared therapy, electrotherapy such as TENS and ultrasound (AM et al., 2010), dry needling (Cerezo-Téllez et al., 2016), and acupuncture (Calamita et al., 2018).

In this case, it is necessary to apply economical but effective therapies, including physical therapy using massage therapy and exercise therapy that can be used by all circles of society. Massage therapy, as a self-medication method, can reduce pain levels and improve function compared to the absence of treatment in some musculoskeletal conditions (Bervoets et al., 2015). Swedish-type massage, introduced by Per Hendrik Ling (1776-1839), is the most common style of relaxing massage taught and applied worldwide. This technique uses five basic manual movements, also known as strokes, namely effleurage (gliding movements), petrissage (kneading and lifting), friction (moving layers of tissue under the skin), vibration, and tapotement (percussion) (Elibol & Cavlak, 2019). The manipulation provided is in the form of effleurage, petrissage, and tapotement manipulation.

Exercise therapy, or exercise therapy, is increasingly integrated in the management of chronic diseases through physical exercise programs. Training is a process of developing training skills that combines theory and practice. It involves the application of procedures and provisions derived from a scientific approach, applying organized and planned principles. The goal is to achieve the results of the exercise according to the set time (Nasrulloh et al., 2021, 2020; Nugroho et al., 2021). Stretching is considered an activity that provides health benefits to the musculoskeletal system. It can improve the smoothness of metabolic processes and blood circulation, while the stretching effect creates contractions without causing additional damage to tissues (pumping action effect). As a result, metabolic processes and blood circulation can run more smoothly.

Based on observations made at Burjo Pamungkas, one of the online game players who was playing games at Burjo Pamungkas named Rifqi, 20 years old, 176 cm tall and weighing 69 kg. Playing games for approximately 5 hours per day, so that when you finish playing online games, you feel complaints in the neck that when the neck is moved to turn your head left and right, it will hurt. There has been no treatment for neck pain and ROM done, therefore this study aims to find out whether the combination treatment of massage therapy and stretching is effective to reduce pain levels and increase neck ROM in online game players.

### **II. METHOD**

This research is a type of pre-experimental research using one group pre test and post test design. From the research design described before being given massage and stretching treatment, measurements of pain scales and neck ROM were carried out. After that, then given a massage treatment for 36 minutes and continued with stretching for 4 minutes. Long duration of treatment for 40 minutes. After completion of the massage and stretching treatment, post-test pain scale and post-test ROM are immediately calculated. The population of Burjo Pamungkas visitors who play online games is 50 people. The sample in this study amounted to 20 people with male inclusion criteria, age range 20-27 years, college students, duration/frequency of playing online games 2-6 hours per day, Online game players who experience tension and muscle pain after playing online games, Willing to follow research proven by signing informed consent. And the exclusion criteria for professional online game players, online game players who experience body anatomy abnormalities, burns, or open wounds in the neck area, and shoulders, online game players who experience severe neck muscle tension (unable to move the neck at all) and accompanied by fever.

The pain instrument uses the Numerica Rating Scale (NRS). Neck ROM refers to the ability of the neck joint to move in the direction of flexion, extension, lateral flexion, and rotation. ROM measurements of the neck can be done using a device called a goniometer. The massage therapy used is the manipulation of efflurase, petrissase and tapotement. Efflurase manipulation is given treatment for 10 minutes, then Petrissase manipulation is given treatment for 5 minutes. After that, tapotement manipulation treatment was given, namely beating and clapping. Tapotement beating is done around the shoulder with slow intensity, done 5 times for 2 minutes, while tapotement clapping is also done 5 times for 2 minutes with moderate intensity. The overall massage time is about 36 minutes. The data obtained will then be analyzed with the Wilcoxon signed rank test for ordinal data or data with abnormal distribution with a signification level of 5%. The data is processed with the help of the SPSS 23 program.

### **III. RESULT**

The results of research and discussion will be presented sequentially, including (1) Results; Normality Test with Saphiro Wilk (2) inferential statistical analysis test with Wilcoxon Signed Rank to prove massage therapy and exercise therapy in dealing with

## The Effectiveness of Massage and Stretching Therapy against Neck Pain and Range of Motion (Rom) in Online Game Players

muscle pain in the neck and ROM (3) Test the effectiveness of massage therapy and exercise therapy in managing pain and ROM. It will be presented comprehensively as follows: Normality Test.

**Table 1. Description of Research Subjects**

Variable	Lowest (n=20)	Highest (n=20)	Avrg (n=20)
Age	20	27	22.1
Weight (kg)	50	100	64.15
Height (cm)	165	182	170.7
Game play duration (Minute)	120	360	240

Table 1 shows the characteristics of research subjects ranging from age to duration of playing games, for the average age is 22.1 with the youngest age of 20 years and the oldest age of 27 years, then at body weight with an average of 64.15 with a body weight of at least 50 kg and a maximum of 100 kg, next for height has an average of 170.7 cm with the lowest 165 cm and the highest 182 cm, Finally, for the duration of playing games with an average of 240 minutes with the shortest time of 120 minutes and the longest of 360 minutes. With the description of research subject data that has been described above, the following are the results of the research data normality test:

**Table 2. Research Data Normality Test Results**

Data	N	Mean	SD	Sig.
Pre-Painful	20	6,85	1,49	0,000
Post-Painful	20	2,95	1,19	0,025
Pre-Flexion	20	29,80	10,08	0,013
Post-Flexion	20	39,20	11,91	0,044
Pre-Extension	20	41,75	14,45	0,129
Post-Extension	20	53,20	13,08	0,029
Pre-Lateral-Left	20	32,75	5,43	0,670
Post-Lateral-Left	20	40,35	4,06	0,006
Pre-Lateral-Right	20	32,65	4,75	0,231
Post-Lateral-Right	20	40,25	3,92	0,445
Pre-Rotation-Left	20	42,70	8,62	0,144
Post-Rotation-Left	20	49,80	7,66	0,025
Pre-Rotation-Right	20	40,20	4,07	0,756
Post-Rotation-Right	20	49,05	3,73	0,171

Table 2 shows the normality test results. Data tested for normality include pretest, posttest, Mean, SD, Sig. All observed data are pain and ROM consisting of flexion, extension, lateral, rotation from each treatment group. The normality test results show that there are normally distributed data, and some data are not normally distributed. Based on these results, research data is not feasible to be analyzed using parametric analysis, so data analysis uses non-parametric statistical analysis. The difference test with the Wilcoxon Signed Rank Test was used to compare the pretest and posttest between the treatment group and the control group. The different test results with the Wilcoxon Signed Rank Test are as follows:

**Table 3. Pretest and Posttest Difference Test Results with Wilcoxon Signed Rank Test**

Data	Z	Asymp. Sig.(2-tailed)
Post Painful-Pre Painful	-3.943	0,000
Post Flexion-Pre Flexion	-3,931	0,000
Post Extension-Pre Extension	-3,829	0,000
Post Lateral Left-Pre Lateral Left	-3,831	0,000

## The Effectiveness of Massage and Stretching Therapy against Neck Pain and Range of Motion (Rom) in Online Game Players

Post Lateral Right-Pre Lateral Right	-3,928	0,000
Post Rotation Left-Pre Rotation Left	-3,926	0,000
Post Rotation Right-Pre Rotation Right	-3,927	0,000

Table 3 shows the results of the Wilcoxon Signed Rank Test analysis on the data of each treatment group. The results of this test showed a significant difference in data regarding namely pain, flexion, extension, lateral, rotation. From the results of the significance analysis used is 5% or 0.05 significance with the value of all data being  $<0.05$ , it can be concluded that between the data scale of pretest and posttest subjects or with a combination treatment of massage therapy and stretching reduces the degree of neck pain and increases ROM in online game players significantly.

Next, an effectiveness test is carried out with the formula; effectiveness = Pretest – Posttest: Pretest: 100%. For pain effectiveness, data was obtained at 57%, while the percentage value of the effectiveness of increasing ROM in motion, flexion motion was 31.54%, extension motion was 27.42%, left lateral motion was 23.2%, right lateral motion was 23.27%, left rotational motion was 16.62%, and right rotation motion was 22.01%. If taken on average, the percentage value of the effectiveness of increasing ROM in this study was 24.01%.

### IV. DISCUSSION

From the results of statistical data analysis shows that there is a significant decrease in the degree of pain and there is a significant increase in ROM both flexion, extension, lateral, and rotational movements in patients with neck injuries. On significant pain changes in data before and after massage and stretching therapy treatment ( $p = 0.000$ ) with effectiveness of 57%. Research conducted by (Hernowo & Ambardini, 2019) indicates that the combination of frirage massage and PNF exercises has a significant impact on pain reduction. Comparison of data before and after treatment showed a significance value ( $p < 0.05$ ), with an effectiveness rate of 51.13%. Next on the results of ROM research (flexion, extension, lateral, and rotation) significantly after massage and stretching therapy treatment, which was shown by a value of ( $p = 0.000$  with an effectiveness of 24.01%.

Massage therapy, as one of the oldest forms of therapy, has been shown to provide positive results (Cherkin et al., 2011). This therapy can reduce pain levels and improve the ability of individuals experiencing pathology (Furlan et al., 2010). Its significant health benefits include improved blood circulation, muscle relaxation, and improved nerve function (Sritoomma et al., 2012). Massage Therapy is known as a method that stimulates balance and overall relaxation of the body (Moyer et al., 2004). Massage serves as an effective trigger and potential mechanical stimulus for the pain gate process. Through this way, massage reduces natural discomfort, stimulates the release of opiates more efficiently, and helps achieve more intense pain control without causing any side effects.

Stretching involves the use of manual or mechanical force to extend structures subjected to tightening and hypomobility adaptively (Mahajan et al., 2012). Stretching has an impact in restoring ROM and restoring the original length of the muscle. In addition, stretching also increases muscle torsion and provides an analgesic effect by increasing the pain threshold (Herman & Smith, 2008). The decrease in pain through stretching muscles during stretching exercises is due to reduced muscle spasm and increased blood circulation in vasodilated muscles. In addition, the decrease in pain by stretching muscles is also related to the control gate theory, which states that pain perception can improve if the focus is on the pain, but can be reduced through distractions that distract from the feeling of pain. The neurophysiological response in muscles depends on two main components, namely the muscle spindle and the Golgi Tendon Organ (GTO). The muscle spindle acts as a receptor that detects stimuli in the form of muscle lengthening. GTO is a type of proprioceptor located at the junction between muscles and tendons, tasked with detecting muscle tension when stretching exercises occur. The inhibitory effect of the Golgi Tendon Organ (GTO) causes sudden relaxation of the entire muscle. This inhibition occurs when there is a strong contraction or strain on a tendon during stretching. This state creates an immediate reflex response that inhibits muscle contraction and causes a rapid drop in tension. This reduction in tension acts as a protective mechanism that aims to prevent tearing of the muscle or release of tendons from attachment to the bone. This mechanism automatically contributes to an increase ROM in the neck joint.

### V. CONCLUSION

Based on the results of the research that has been obtained, it can be concluded: 1. The combination of massage therapy and stretching can reduce pain levels significantly ( $p < 0.05$ ), with effectiveness by 57%. 2. The combination of massage and stretching therapy can increase ROM significantly ( $p < 0.05$ ) with an average effectiveness of 24.01%.

## The Effectiveness of Massage and Stretching Therapy against Neck Pain and Range of Motion (Rom) in Online Game Players

### REFERENCES

- 1) AM, L., KM, R., CG, M., & JH, M. (2010). Conservative interventions provide short-term relief for non-specific neck pain: a systematic review [corrected] [published erratum appears in J PHYSIOTHER 2010;56(4):222]. *Journal of Physiotherapy (Australian Physiotherapy Association)*, 56(2).
- 2) Bervoets, D. C., Luijsterburg, P. A. J., Alessie, J. J. N., Buijs, M. J., & Verhagen, A. P. (2015). Massage therapy has short-term benefits for people with common musculoskeletal disorders compared to no treatment: A systematic review. *Journal of Physiotherapy*, 61(3). <https://doi.org/10.1016/j.jphys.2015.05.018>
- 3) Calamita, S. A. P., Biasotto-Gonzalez, D. A., De Melo, N. C., Fumagalli, M. A., Amorim, C. F., de Paula Gomes, C. A. F., & Politti, F. (2018). Immediate Effect of Acupuncture on Electromyographic Activity of the Upper Trapezius Muscle and Pain in Patients With Nonspecific Neck Pain: A Randomized, Single-Blinded, Sham-Controlled, Crossover Study. *Journal of Manipulative and Physiological Therapeutics*, 41(3). <https://doi.org/10.1016/j.jmpt.2017.09.006>
- 4) Cerezo-Téllez, E., Torres-Lacomba, M., Fuentes-Gallardo, I., Perez-Muñoz, M., Mayoral-Del-Moral, O., Lluch-Girbés, E., Prieto-Valiente, L., & Falla, D. (2016). Effectiveness of dry needling for chronic nonspecific neck pain: A randomized, single-blinded, clinical trial. *Pain*, 157(9). <https://doi.org/10.1097/j.pain.0000000000000591>
- 5) Cherkin, D. C., Sherman, K. J., Kahn, J., Wellman, R., Cook, A. J., Johnson, E., Erro, J., Delaney, K., & Deyo, R. A. (2011). A comparison of the effects of 2 types of massage and usual care on chronic low back pain: A randomized, controlled trial. *Annals of Internal Medicine*, 155(1). <https://doi.org/10.7326/0003-4819-155-1-201107050-00002>
- 6) Elibol, N., & Cavlak, U. (2019). Massage therapy in chronic musculoskeletal pain management: a scoping review of the literature. *Journal of the Romanian Sports Medicine Society*, XV(1), 3067–3073.
- 7) Furlan, A. D., Yazdi, F., Tsertsvadze, A., Gross, A., Van Tulder, M., Santaguida, L., Cherkin, D., Gagnier, J., Ammendolia, C., Ansari, M. T., Ostermann, T., Dryden, T., Doucette, S., Skidmore, B., Daniel, R., Tsouros, S., Weeks, L., & Galipeau, J. (2010). Complementary and alternative therapies for back pain II. In *Evidence report/technology assessment (Issue 194)*.
- 8) Gross, A., Kay, T. M., Paquin, J. P., Blanchette, S., Lalonde, P., Christie, T., Dupont, G., Graham, N., Burnie, S. J., Gelle, G., Goldsmith, C. H., Forget, M., Hoving, J. L., Brønfort, G., & Santaguida, P. L. (2015). Exercises for mechanical neck disorders. In *Cochrane Database of Systematic Reviews (Vol. 2017, Issue 6)*. <https://doi.org/10.1002/14651858.CD004250.pub5>
- 9) Hasnah, Irianto, & Sri, S. L. (2019). Nusantara Medical Science Journal. *The Effect of Freeletic Sport To Vo2 Max Levels on the Freeletic Community Members*, 4(1), 14–18.
- 10) Herman, S. L., & Smith, D. T. (2008). Four-week dynamic stretching warm-up intervention elicits longer-term performance benefits. *Journal of Strength and Conditioning Research*, 22(4). <https://doi.org/10.1519/JSC.0b013e318173da50>
- 11) Hernowo, D. F., & Ambardini, R. L. (2019). Efektivitas Terapi Kombinasi Masase Frirage Dan Latihan Pnf Terhadap Pemulihan Cedera Panggul. *Medikora*, 18(2), 86–91. <https://doi.org/10.21831/medikora.v18i2.29201>
- 12) King, D., Koster, E., & Billieux, J. (2019). Study what makes games addictive. In *Nature (Vol. 573, Issue 7774)*. <https://doi.org/10.1038/d41586-019-02776-1>
- 13) Mahajan, R., Kataria, C., & Bansal, K. (2012). Comparative Effectiveness of Muscle Energy Technique and Static Stretching for Treatment of Subacute Mechanical Neck Pain. *International Journal of Health and Rehabilitation Sciences (IJHRS)*, 1(1). <https://doi.org/10.5455/ijhrs.00000004>
- 14) Moyer, C. A., Rounds, J., & Hannum, J. W. (2004). A Meta-Analysis of Massage Therapy Research. *Psychological Bulletin*, 130(1). <https://doi.org/10.1037/0033-2909.130.1.3>
- 15) Nasrulloh, A., Deviana, P., Yuniana, R., & Pratama, K. W. (2021). THE EFFECT of SQUAT TRAINING and LEG LENGTH in INCREASING the LEG POWER of VOLLEYBALL EXTRACURRICULAR PARTICIPANTS. *Physical Education Theory and Methodology*, 21(3). <https://doi.org/10.17309/TMFV.2021.3.08>
- 16) Nasrulloh, A., Prasetyo, Y., Nugroho, S., Yuniana, R., Pratama, K. W., Mustapha, A., Idrus, S. Z. S., & Nasrulloh, A. (2020). Tricet Method to Increase the Hypertrophy Muscle. *Journal of Physics: Conference Series*, 1529(3). <https://doi.org/10.1088/1742-6596/1529/3/032006>
- 17) Nugroho, S., Nasrulloh, A., Karyono, T. H., Dwihandaka, R., & Pratama, K. W. (2021). Effect of intensity and interval levels of trapping circuit training on the physical condition of badminton players. *Journal of Physical Education and Sport*, 21. <https://doi.org/10.7752/jpes.2021.s3252>
- 18) Puspita, R. H., & Rohedi, D. (2018). The Impact of Internet Use for Students. *IOP Conference Series: Materials Science and Engineering*, 306(1). <https://doi.org/10.1088/1757-899X/306/1/012106>
- 19) Saunders, J. B., Hao, W., Long, J., King, D. L., Mann, K., Fauth-Bühler, M., Rumpf, H. J., Bowden-Jones, H., Rahimi-Movaghar, A., Chung, T., Chan, E., Bahar, N., Achab, S., Lee, H. K., Potenza, M., Petry, N., Spritzer, D., Ambekar, A.,

## The Effectiveness of Massage and Stretching Therapy against Neck Pain and Range of Motion (Rom) in Online Game Players

Derevensky, J., ... Poznyak, V. (2017). Gaming disorder: Its delineation as an important condition for diagnosis, management, and prevention. In *Journal of Behavioral Addictions* (Vol. 6, Issue 3). <https://doi.org/10.1556/2006.6.2017.039>

- 20) Sritoomma, N., Wendy, M., Marie, C., & Siobhan, O. (2012). The effectiveness of Swedish massage and traditional Thai massage in treating chronic low back pain: A review of the literature. In *Complementary Therapies in Clinical Practice* (Vol. 18, Issue 4). <https://doi.org/10.1016/j.ctcp.2012.07.001>



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Development of Badminton “Wheelchair” Disabled Accuracy Test Instruments



Maulana Aditya Pamungkas<sup>1</sup>, Devi Tirtawirya<sup>2</sup>, Wahyu Dwi Yulianto<sup>3</sup>

<sup>1,2,3</sup> Department of Sport Science, Yogyakarta State University, Yogyakarta Indonesia

**ABSTRACT:** Research This mean to (1) Develop instrument test accuracy in athletes badminton chair wheel . (2) Testing validity and reliability instrument test accuracy badminton chair wheel . Type study This is development (Research and Development). Research design development using the Thiagarajan development model , namely 4D, Define, Design, Development, and Dissemination. (1) Define : do analysis need with trainer and observation field , (2) Design : designing guidelines test , (3) Development ( development ): developing a test model accuracy hair parry chair wheel , (a) Validity test fill with 2 lecturers experts and 3 trainers hair parry chair wheel , (b) Reliability test with ates trials carried out by 10 athletes and 2 trials . Research result show that : Validity and reliability test : validity fill from (1) backhand service: 0.85-1.00, (2) flick service: 0.85-1.00, (3) backhand netting: 0.85-1.00, (4) forehand netting: 0.85-1.00, (5) dropshot: 0.85-1.00, (6) lob: 0.85-1.00, meaning the whole item has level validity good content , reliability mark significance (1) backhand service: 0.005, (2) flick service: 0.001, (3) backhand netting: 0.000, (4) forehand netting: : 0.000, (5) dropshot: : 0.000, (6) lob: 0.002 value significance <0.05, can concluded that results the own good correlation or own level good reliability between tests 1 and 2.

**KEYWORDS:** test instrument accuracy, fluff parry, chair wheel

### I. INTRODUCTION

Disability is a person's limitation in carrying out daily activities. Physical disabilities are the number 3 physical limitations such as autism and mental retardation (Cooley, 2004). Paralympic participation shows progress in various countries (Rowe, 2019). One of these advances that can be felt is wheelchair badminton. This is in line with what experts say, that badminton is one of the most popular sports that has a fast movement in the world and is a sport that can easily be played by anyone. (Sucharitha, 2014).

According to Seipdanius et al (2019), sports theory and measurement are the basis for balancing training methods and also for determining indicators to improve sports performance. Because in general the realm of theory and sports measurement is to develop theories that are useful for measuring athletes' abilities, performance and achievements in sports (Sepdanius, 2019). Measuring and evaluation tests in sports are not only carried out for normal badminton athletes, but wheelchair badminton is required to carry out tests and measurements to find out weaknesses and strengths as well as to serve as a guideline for designing training programs. This is supported by literature which shows that tests and measurements based on field trials are important sports science and rehabilitation tools in the evaluation of wheelchair users (Vanlandewijck, 2006). The advantages of the field test are that it is more economical and easier to administer (Vanlandewijck, 2006), however there are several problems that need to be studied in depth regarding the field test and measurements in wheelchair athletes.

Based on field observations on 26 October 2022, GOR Rahma Surakarta at the NPCI Java Provincial Championships, remember that wheelchair badminton athletes hit the shuttlecock several times not far from their opponents, so that the shuttlecock's shooting is not good, and points are obtained from shots that move in the same direction as a dropshot. or netting. Then, in addition, to strengthen the observations above, the research carried out an analysis by completing a questionnaire on 6 wheelchair badminton coaches consisting of coaches from the districts of Banyumas, Peikalongan, Bantul, DIY Province, and 2 coaches from the NPC Indonesia National Training Center.

With the existence of an accuracy thesis that will be created later, it is hoped that it will help athletes and coaches to know to what extent athletes manipulate a shot and to what extent the ability of wheelchair badminton athletes through the results of the accuracy thesis analysis that will later be carried out, can also be carried out through a competition based on the results. Analysis can be an important tool or material in determining a training program. In accordance with Eirdal Tasgin's opinion, Eit All (2020) states that in a performance balance, organizing training programs or materials for evaluating the results of competition analysis

## Development of Badminton “Wheelchair” Disabled Accuracy Test Instruments

are materials or tools that really contribute to this balance, so that they can increase or determine changes in an athlete's abilities. (Erdal Tasgin, 2020).

. Based on the background that has been described above, the author will develop an accuracy thesis instrument for wheelchair badminton athletes which aims to make it easier and help coaches to carry out accuracy thesis on wheelchair badminton athletes and later the results of the accuracy thesis can help determine and develop a training program to support performance. The advantages of this thesis guideline are that apart from making it easier for coaches to identify their athletes, and simple in implementing and determining results, this thesis guideline can also be used as evaluation material which can certainly be the basis for coaches to know and improve the athlete's performance to achieve achievements.

### II. MATERIALS AND METHODS

The method used in this research is balancing or concomitant, also called Reiseiarh and Deiveilopmeint. Research and Research are methods used in research which will produce a specific product and to test the effectiveness of that product (Sugiyono, 2014). The research method used in this research is the 4D balancing model. According to Adei Grobi Irawan (2017), the 4D balancing model is a balancing model for balancing learning which consists of four stages, namely (1) Definition stage: front end analysis, student analysis, task analysis, concept analysis, and formulation of learning objectives, (2) Design stage: drafting the thesis. Media selection, format selection, initial design, (3) stage 3 balancing: expert assessment and limited trials, then, stage (4) dissemination: validation testing, screening and adoption (Irawan A.G., 2018).

The subjects used are in accordance with the problem formulation and research design, namely as follows: 1. Research subjects The expert test (content validity test) uses 7 expert subjects consisting of 3 academic experts (3 sports evaluation lecturers) and 4 professional experts (trainers who have national certification or area for disabled badminton athletes).

2. The reliability test subjects used 10 wheelchair athletes who had experience playing wheelchair badminton at regional and national levels)

3. The practicality test subjects were 5 wheelchair badminton coaches and 10 wheelchair badminton athletes.

The data collection technique uses interviews and a list of questions from a questionnaire or questionnaire, the questionnaire is given to material experts, coaches and athletes. The rating scale used is a Likeirt scale with 5 scales, (1) very poor, (2) poor, (3) sufficient, (4) good, and (5) very good. The Likeirt scale is an assessment scale for assessing opinions, attitudes and views.

### III. DISCUSSION

Validation results fill

Beirbased results validity fill from some existing indicators \_ determined that is indicator For short seirvicei blow which consists of of 5 questions , for blow flick seirvicei 5 questions , for Drop shot 5 questions . For blow Neitting backhand 5 questions , for blow neitting foreihand 5 questions and for lob shot 5 questions , ringing amount question which is 30, in fact all item questions asked \_ to five experts contained material \_ from 2 lecturers and 3 trainers hair parry chair wheel whole mark validity fill is 0.85-1.00, that is whole item I have level validity good content . \_

Reliability results

Pearson Product Moment Test Results Test Reliability Level

Short service

N	r-table	-count (test-1)	Significance	Status
10	0.632	0.803	0.005	Reliability
N	r-table	-count (test-2)	Significance	Status
10	0.632	0.803	0.005	Reliability

Based on the Pearson product moment test, it was found that the r-table value was 0.632, r-calculation (this-1) 0.803 and r-calculation (this-2) 0.803, then the significance value was 0.005. If the r-calculation is greater than the r-table and the significance value is <0.05, it can be concluded that the results have good correlation or have a level of reliability. Therefore, the thesis on the accuracy of short shots in the results of thesis 1 and 2 has a good level of reliability.

Flick service

N	r-table	-count (test-1)	Significance	Status
10	0.632	0.764	0.010	Reliability
N	r-table	-count (test-2)	Significance	Status
10	0.632	0.764	0.010	Reliability

## Development of Badminton “Wheelchair” Disabled Accuracy Test Instruments

Based on the Pearson product moment test, it was found that the r-table value was 0.632, r-calculation (this-1) 0.764 and r-calculation (this-2) 0.764, then the significance value was 0.005. If the r-calculation is greater than the r-table and the significance value is  $<0.05$ , it can be concluded that the results have good correlation or have a level of reliability. Therefore, the service flick shot accuracy thesis in the results of thesis 1 and 2 has a good level of reliability.

### Backhand netting

N	r-table	-count (test-1)	Significance	Status
10	0.632	0.976	0,000	Reliable
N	r-table	-count (test-2)	Significance	Status
10	0.632	0.976	0,000	Reliable

Based on the Pearson product moment test, it was found that the r-table value was 0.632, r-calculation (this-1) 0.976 and r-calculation (this-2) 0.976, then the significance value was 0.000. If the r-calculation is greater than the r-table and the significance value is  $<0.05$ , it can be concluded that the results have good correlation or have a level of reliability. Therefore, the backhand shooting accuracy test in the results of test 1 and 2 has a good level of reliability.

### Forehand Netting

N	r-table	-count (test-1)	Significance	Status
10	0.632	0.961	0,000	Reliable
N	r-table	-count (test-2)	Significance	Status
10	0.632	0.961	0,000	Reliable

Based on the Pearson product moment test come on found r-table value is 0.632, r-count (this-1) 0.961 and r-count (this-2) 0.961, then mark significance is 0,000. If r-count more big from r-tables and values significance  $<0.05$ , can concluded that results mentioned I have good correlation \_ or I have level reliability . By karena That their accuracy blow netting forehand on the result thesis 1 and 2 have level good reliability.

### DropShot

N	r-table	-count (test-1)	Significance	Status
10	0.632	0.955	0,000	Reliable
N	r-table	-count (test-1)	Significance	Status
10	0.632	0.955	0,000	Reliable

Based on the Pearson product moment test, it was found that the r-table value was 0.632, r-calculation (this-1) 0.955 and r-calculation (this-2) 0.955, then the significance value was 0.000. If the r-calculation is greater than the r-table and the significance value is  $<0.05$ , it can be concluded that the results have good correlation or have a level of reliability. Therefore, the test of dropshot accuracy in the results of thesis 1 and 2 has a good level of reliability.

### Lob

N	r-table	-count (test-1)	Significance	Status
10	0.632	0.844	0.002	Reliable
N	r-table	-count (test-2)	Significance	Status
10	0.632	0.844	0.002	Reliable

Based on the Pearson product moment test, it was found that the r-table value was 0.632, r-calculation (this-1) 0.844 and r-calculation (this-2) 0.844, then the significance value was 0.002. If the r-calculation is greater than the r-table and the significance value is  $<0.05$ , it can be concluded that the results have good correlation or have a level of reliability. Therefore, the lob shot accuracy thesis in the results of thesis 1 and 2 has a good level of reliability.

## IV. CONCLUSION

Based on the results of research that has been carried out, it can be concluded that:

1. Research on balancing accuracy strokes for wheelchair badminton athletes which is carried out based on the results of observations, field surveys and the dominant strokes used by wheelchair badminton athletes resulting in special accuracy stroke



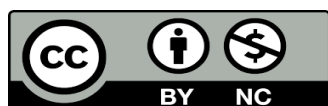
## Development of Badminton “Wheelchair” Disabled Accuracy Test Instruments

these guidelines for wheelchair badminton athletes which are realized in the form of guidebook. The special accuracy stroke test for wheelchair badminton athletes includes 6 strokes, namely; 1) short service, 2) flick service, 3) dropshot, 4) forehand shooting, 5) backhand shooting, and 6) lob.

2. Based on the results of the validity and reliability tests, (1) the results of the content validity of several indicators that have been determined, namely the indicators for the short shot which consists of 5 questions, for the flick shot 5 questions, for the drop shot 5 questions, for the backhand shooting stroke 5 questions, for the forehand shooting stroke 5 questions and for the lob stroke 5 questions, with the number of questions being 30, in fact all the questions submitted to five subject matter experts consisting of 2 lecturers and 3 wheelchair badminton coaches total value Content validity is 0.85-1.00, meaning that the entire item has a good level of content validity. (2) the reliability results, namely from all the test items, the r-calculation is greater than the r-table and the significance value is <0.05, it can be concluded that these results have good correlation or have a level of reliability. Therefore, the thesis accuracy in 6 strokes in the results of thesis 1 and 2 has a good level of reliability.

## REFERENCES

- 1) Cooley, W. C. (2004). Providing a primary care medical home for children and youth with cerebral palsy. *Pediatrics*, 1106-1113.
- 2) Eirdal Tasgin, S.L. (2020). Notational Analysis Of Wheelchair Women's Badminton Matches In The International Badminton Tournament. *Turkish Journal of Sport and Exercise*, 67-71.
- 3) Irawan AG, N. P. (2018). Instructional materials development through 4D model. *In SHS Web of Conferences* EDP Sciences, Vol. 42, p. 00086.
- 4) Rowe, D. (2019). Hey worlds that are watching: Media, politics, diplomacy, and the 2018 PyeongChang Winter Olympics. *Journal of Communication & Sport*, 7(1), 3-22.
- 5) Seipdanius, E. A. (2019). *Tests and Measurement in Sport*. Depok: King of Grafindo Persada.
- 6) Sucharitha, B. S. (2014). Effectiveness of plyometric training on anaerobic power and agility in female badminton players. *International Journal of Pharmacy and Clinical Research and Bio-Sciences*, 3(4), 754-761.
- 7) Sugiyono. (2014). *Metode Penelitian Kuantitatif Kualitatif dan R & D*. Bandung: CV ALFABETA.
- 8) Vanlandeijck, Y. C. (2006). Determinants of shuttle run performance in the prediction of peak VO<sub>2</sub> in wheelchair users. *Disability and Rehabilitation*, 28(20), 1259-1266.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Project Based Learning and Physical Activity for Cognitive Ability Stimulation in Early Childhood Education: Study Literature



Salmawati<sup>1</sup>, Ika Budi Maryatun<sup>1</sup>, FransFile Manihuruk<sup>2</sup>, Maria Della Strada Dea Meylinda<sup>3</sup>

<sup>1</sup>Early Childhood Education Study Program, Faculty of Education and Psychology, Yogyakarta State University, Road Colombo No. 1, Karangmalang, Yogyakarta 55281, Indonesia.

<sup>2</sup>Sport Science Study Program, Yogyakarta State University. Road Colombo No. 1, Karangmalang, Yogyakarta 55281, Indonesia.

<sup>3</sup>Physical Education Study Program, Yogyakarta State University. Road Colombo No. 1, Karangmalang, Yogyakarta 55281, Indonesia

**ABSTRACT:** Project-based learning is a learning approach model that allows students to carry out learning using their own approach with the help of the teacher. Physical activity in early childhood is physical movement carried out by the body's muscles and supporting systems. This research aims to determine Project Based Learning and Physical Activity to Stimulate Cognitive Abilities in Early Childhood Education. This type of research uses literature study. The database in this study with article criteria comes from Sinta. In this study, 3 articles were used as references for researchers to carry out reviews. Characteristics of the 3 articles, 1). Publications from the last 9 years, 2). The articles reviewed are related to the focus of this research. Then the procedure for searching for articles needed in this research is based on Google web: 1). Google scholar and 2). Google Chrome. The analysis of this research focuses on Project Based Learning and Physical Activity to Stimulate Cognitive Abilities in Early Childhood Education. It was concluded that Project Based Learning and Physical Activity are closely related to stimulating cognitive abilities in early childhood education.

**KEYWORDS:** Project Based Learning, physical activity, early childhood education

### I. INTRODUCTION

The Father of Indonesian National Education Ki Hajar Dewantara defined the meaning of education as the demands in the life of children's growth, while the meaning of education is to guide all the natural strengths that exist in children, so that they as humans and as members of society can achieve the highest safety and happiness. its height. Education is a humanistic process which is hereafter known as humanizing humans (Pristiwanti et al., 2022) . Therefore, we should be able to respect the human rights of every human being. Students in other words, students are not human machines that can be controlled at will, but they are a generation that we need to help and care for in every change towards maturity so that they can form independent human beings who think critically and have good moral attitudes. For this reason, education not only forms people who are different from other people who can carry out eating and drinking activities, dress and have a house to live in, this is what is called humanizing humans (Ibrahim, 2015).

Early childhood education is the basic level of education. Education at this time is a coaching effort aimed at children from birth to six years of age, which is carried out through providing stimulation (Saputra, 2018) . In early childhood education institutions, educators are required to develop children's potential, so that later children will be able to face creative problems to lead to stimulants of early childhood cognitive abilities (Heikka et al., 2013) . Teachers also don't just provide knowledge to their students, they also have to pay attention to the special things within the students, because if these things are developed, then it will be something special for the child and there is a lot of potential in the child and everything needs to be developed. , one of which is the potential for creativity and stimulant of cognitive abilities (Schwartz et al., 2022).

Early Childhood Education is a stimulus and stimulation effort carried out for newborn children up to the age of six Golden Age which is carried out by providing educational stimuli to help the growth and development of children, both physically and spiritually so that children are ready to enter further education (Khalifaoui et al., 2021) . Early childhood education functions to foster, grow and develop all the potential of early childhood optimally so that basic behavior and abilities are formed according

## Project Based Learning and Physical Activity for Cognitive Ability Stimulation in Early Childhood Education: Study Literature

to the stage of development so that they are ready to enter further education (Supriani & Arifudin, 2023) . Continuity between supervisors (parents), educators (tutors) in providing education from an early age. In practice, play groups must of course apply the basic principles of learning that must be fulfilled, one of the principles is playing while learning (Nurdiani, 2013). The principle of playing while learning really prioritizes playing activities rather than learning, meaning that learning activities in early childhood education (PAUD) are dominated by activities that are fun and exciting for children and vice versa, not activities that are boring for children or even painful for children (Maghfiroh & Suryana, 2021).

Project-Based Learning (PBL) is a learning approach in which children learn through active participation in relevant, real-life based projects or assignments. Project-based learning is an approach that is often used because problem solving is carried out by the person concerned (Suparman et al., 2021). Project-based learning is a good approach to use in solving learning problems because this approach focuses on students thinking critically to solve the problems they face (Amin et al., 2020). Learning using project-based learning is a good approach in overcoming educational learning problems (Prabandaru et al., 2020).

It was further stated that project-based learning is a learning approach model that allows students to carry out learning using their own approach with the help of the teacher, of course (Nurtanto et al., 2020) . Project-based learning provides a real or situational context for learning. Students are introduced to problems that are similar to situations in the real world, this helps young children link academic concepts with practical experience, stimulates cognitive stimulant thinking in a broader context. In problem-based learning , young children are invited to think critically and creatively to find solutions to problems given using a learning approach (Kokotsaki et al., 2016) . This process stimulates cognitive abilities such as analysis, synthesis, evaluation of learning approaches and young children learn not only to understand facts, but also to apply their knowledge to overcome concrete challenges (Hayati & Syaikh, 2020) Although young children may not have fully mastered verbal skills, project-based learning can stimulate their cognitive abilities through collaboration and communication. Simple group activities can help them share ideas, work together, and build mutual understanding (Kaldi et al., 2011) .

In the context of project-based learning, young children are invited to think creatively in finding solutions to given problems. This can involve various types of creative activities, such as drawing, role playing, or making simple models, and this stimulation stimulates their cognitive abilities in generating new ideas. Project-based learning helps develop children's cognitive abilities to think flexibly and find alternative solutions. This stimulates adaptive thinking, where children learn that problems can have more than one solution (Harjanty & Muzdalifah, 2022) .

Project-based learning encourages young children to become active learners, and not only receive information, but also apply, process and produce something as a result of learning (Genc, 2015) . Project-Based Learning can be an effective way to stimulate early childhood cognitive abilities, while also building a foundation for understanding more complex academic concepts in the future.

And in physical activity, early childhood children are also able to carry out activities that lead to stimulation of cognitive abilities. Physical activity is physical movement carried out by the body's muscles and supporting systems. Physical activity is any body movement produced by skeletal muscles that requires energy expenditure (Sholihin & Sugiarto -, 2015) . The physical activity of playing is very popular with every young child and this can be seen from the fact that most of the time spent by children is playing and this indirectly has a significant influence on children's development and stimulation of cognitive abilities in early childhood (Pratiwi , 2017) .

The individual physical development of each early childhood child includes four aspects: namely; The nervous system which greatly influences the development of intelligence and emotions, the muscles which influence the development of strength and motor abilities, the endocrine glands which cause the emergence of new behavioral patterns (Nugraha, 2015) . Older children will be physically healthy if they are physically active and to be physically active, older children need a combination of health-related fitness attributes (e.g. cardiovascular endurance, heart rate, and blood pressure response to exercise and body composition ) and fitness related to performance (e.g. motor skills) and physical activity carried out by young children can increase the stimulation of their cognitive abilities (Khomaeny et al., 2020) .

## II. RESEARCH MATERIALS AND METHODS

This research uses a *literature review method*. Literature review is a process of finding out and studying research results that have been published by researchers relating to previous scientific work regarding the reasons why researchers decided to choose certain themes or titles that collect from several previous studies (Primawanti & Ali, 2022) . The data collection technique in this research uses web-based internet by focusing on articles that are relevant to this research. The data used is a type of secondary data, meaning that researchers do not go directly into the field.

## Project Based Learning and Physical Activity for Cognitive Ability Stimulation in Early Childhood Education: Study Literature

Please note that the procedure for searching for articles relevant to this research uses the Synta database with the help of the *Google Chrome engine* and *Google Scholar*. The article search system uses keywords originating from the title of this research. As many as 15 articles were found during the article search process, but of the 15 articles found, only 3 articles were used as references by researchers for conducting reviews. This is because 12 articles were not included in this study. The researcher also emphasized that all data used for this research was sourced from the national or SINTA *data base* with provisions for the last 6 years so that its existence is still relevant today.

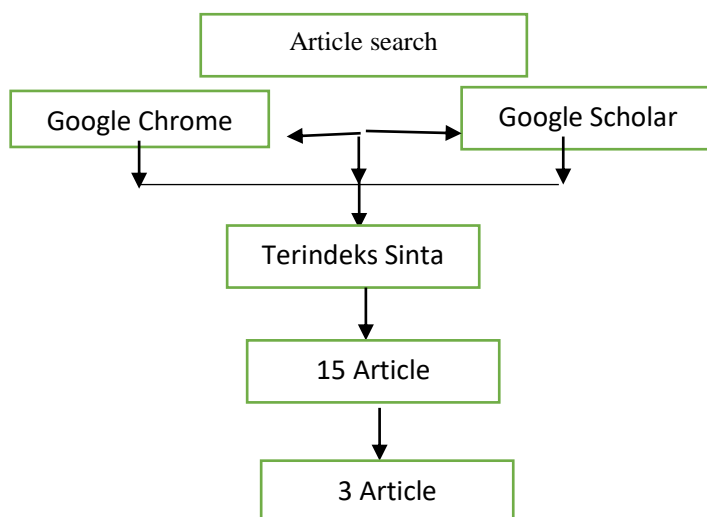


Figure 1. Research Framework

### III. DISCUSSION

Table 1 below is three (3) articles that are the main reference or source for the author in completing this research, because the database in the research comes from the articles listed in the table below which are used as references for reviewing. Third (3) the article has several components or criteria that need to be included in the table below, namely 1). Author's name, 2). Article title, 3). Journal name, 4). The research results include, a. the variable being measured, b. number of samples and c. The following statistical tests are used in detail in 3 articles relevant to this research as follows:

Table 1. List of articles used as references

No	Author's Name and Year of Publication	Title	Journal Name	Research result
1	(Sari et al., 2017)	Implementation of Project Based Learning for Early Age Children	Motoric Journal (Media of teaching oriented and children)	The research results show: <i>Project Based Learning</i> for early childhood children develops a project either individually or as a group to produce a product. The topic in the project approach must be concrete, close to the child's personal experience, interesting, and have emotional and intellectual potential. Implementation of Project Based Learning in early childhood, divided into 3, namely: total project learning, partial project learning and occasional project learning
2	(Rehny & Sari, 2023)	Efforts to Develop Cognitive Abilities in the Science Process Using the Kindergarten	Journal of Innovation, Early Childhood Creativity (JIKAD)	The results of this research indicate that teacher activity at meeting II reached the criteria of being very active. The children's activities at meeting

## Project Based Learning and Physical Activity for Cognitive Ability Stimulation in Early Childhood Education: Study Literature

		Group A Project Based Learning Model		It reached the criteria of being very active and the results of the children's cognitive development achievements at meeting II with a score of 86% were in the category of developing as expected.
3	(Rubiyatno, 2014)	The Role of Sports Activities for Children's Growth and Development	Journal of Sports Education	The results of the research show that sports activities or physical activities, even though they are only unstructured activities such as walking, cycling, playing jump rope and running around, by carrying out movement activities like these, children's motor and cognitive abilities will be better and their growth and development will be optimal. .

Early childhood education plays a very important role in the basic formation of children's cognitive abilities. One approach that can be used to stimulate children's cognitive abilities is Project Based Learning (PBL) (Handayani & Sinaga, 2022) (Handayani & Sinaga, 2022). Project Based Learning provides opportunities for children to develop their creativity through problem solving and exploring ideas. Early childhood children learn to work together and collaborate with their friends, developing social and emotional skills (Wahyuni & Hasriani, 2023) .

Teachers act as facilitators who guide children through the project, providing support when needed. The application of Project Based Learning in early childhood education can be a positive step in stimulating children's cognitive abilities, preparing them to understand the world around them better (Hardiyanti & Rosnaeni, 2023) . By ensuring the relevance of the project, the active role of the teacher, and the support of parents, Project Based Learning can be an effective tool in creating a meaningful and deep learning environment for young children.

Project Based Learning stimulates children's creativity by providing projects that are challenging and require creative thinking. Through these activities, children can explore new ideas and think outside conventional boundaries. Project Based Learning is designed to develop various cognitive skills, such as problem solving, critical thinking, and abstract thinking skills (Rosmana et al., 2022), Children learn through in-depth practical experiences. Project Based Learning ensures that learning occurs in a real or relevant context for young children (Ramli & Jayanti, 2023) . This makes learning more meaningful and can be connected to everyday life in early childhood.

Project Based Learning often involves questions and research. This helps foster an inquisitive attitude in children, encouraging them to continue asking questions and looking for answers (Junita et al., 2021) . Project Based Learning can end with an exhibition of children's work (Sukmana & Amalia, 2021) . This provides an opportunity for them to share their knowledge and experience. Young children may have limited understanding of concepts, so it is necessary to simplify complex concepts. Early childhood children's gross and fine motor skills are still developing, so PBL projects must be adapted to their physical abilities. Project Based Learning (PBL) can be an effective approach to stimulate cognitive abilities in early childhood. By providing interesting and relevant learning experiences (Nurhayanti et al., 2021). Project Based Learning helps develop various cognitive skills, creativity and critical thinking abilities in young children (Prasetyaningtyas et al., 2021) .

Physical activity has an important role in stimulating cognitive abilities in early childhood education (Fitriani & Adawiyah, 2018) . Early childhood children are experiencing a phase of rapid brain development, and involvement in physical activity can provide a number of positive benefits, both physical and cognitive (Pradika et al., 2022). Physical activity helps improve children's concentration and attention, and through body movements, they learn to focus on the tasks or instructions given (Jauhari et al., 2019) .

Physical activity, especially involving gross and fine motor movements, contributes to the development of children's motor skills, which are also related to cognitive abilities (Ermona & Wirjatmadi, 2018) . Physical activities that involve challenges and games can stimulate creative thinking and problem-solving abilities in young children. Physical activities such as running, playing ball, or playing in the park can provide physical stimulation and diverse sensory experiences (Zahari et al., 2022) .

## Project Based Learning and Physical Activity for Cognitive Ability Stimulation in Early Childhood Education: Study Literature

Challenges can arise from space or physical resource limitations. The solution may involve creativity in designing physical activities that suit the available environment. Maintaining consistency in providing physical activity is a challenge, but can be overcome by creating a regular schedule and supporting the participation of young children. Physical activity has a significant positive impact on the cognitive development of early childhood. By providing an environment that supports movement and physical activity, we can stimulate brain development and increase children's readiness for further learning. The integration of physical activity with a holistic educational approach can provide long-term benefits for children's development in various aspects of early childhood life.

### IV. CONCLUSION

From the results of the article review, the researcher drew the conclusion that *Project Based Learning* and Physical Activity are closely related to stimulating cognitive abilities in early childhood education.

### REFERENCES

- 1) Amin, S., Utaya, S., Bachri, S., Sumarmi, S., & Susilo, S. (2020). Effect Of Problem Based Learning On Critical Thinking Skill And Enviromental Attitude. *Journal For The Education Of Gifted Young Scientists*, 8(2), Article 2. <https://doi.org/10.17478/Jegys.650344>
- 2) Ermona, N. D. N., & Wirjatmadi, B. (2018). Hubungan Aktivitas Fisik Dan Asupan Gizi Dengan Status Gizi Lebih Pada Anak Usia Sekolah Dasar Di Sdn Ketabang 1 Kota Surabaya Tahun 2017. *Amerta Nutrition*, 2(1), 97. <https://doi.org/10.20473/Amnt.V2i1.2018.97-105>
- 3) Fitriani, R., & Adawiyah, R. (2018). Perkembangan Fisik Motorik Anak Usia Dini. *Jurnal Golden Age*, 2(01), Article 01. <https://doi.org/10.29408/Goldenage.V2i01.742>
- 4) Genc, M. (2015). The Project-Based Learning Approach In Environmental Education. *International Research In Geographical And Environmental Education*, 24(2), 105–117. <https://doi.org/10.1080/10382046.2014.993169>
- 5) Handayani, A., & Sinaga, S. I. (2022). Penerapan Model Project Based Learning Dalam Meningkatkan Kemampuan Berpikir Kritis Anak Usia Dini. *PAUD Lectura: Jurnal Pendidikan Anak Usia Dini*, 6(01), 146–154. <https://doi.org/10.31849/Paud-Lectura.V5i03.10670>
- 6) Hardiyanti, N., & Rosnaeni, R. (2023). Meningkatkan Kreativitas Anak Usia 5-6 Tahun Pada Pembelajaran Project Based Learning. *JURNAL PEMIKIRAN DAN PENGEMBANGAN PEMBELAJARAN*, 5(2), Article 2. <https://doi.org/10.31970/Pendidikan.V5i2.694>
- 7) Harjanty, R., & Muzdalifah, F. (2022). Implementation Of STEAM Project-Based Learning In Developing Early Childhood Cooperation. *Atfaluna: Journal Of Islamic Early Childhood Education*, 5(1), Article 1. <https://doi.org/10.32505/Atfaluna.V5i1.4093>
- 8) Hayati, M., & Syaikhu, A. (2020). Project-Based Learning In Media Learning Material Development For Early Childhood Education. *AL-ATHFAL : JURNAL PENDIDIKAN ANAK*, 6(2), 147–160. <https://doi.org/10.14421/Al-Athfal.2020.62-05>
- 9) Heikka, J., Waniganayake, M., & Hujala, E. (2013). Contextualizing Distributed Leadership Within Early Childhood Education: Current Understandings, Research Evidence And Future Challenges. *Educational Management Administration & Leadership*, 41(1), 30–44. <https://doi.org/10.1177/1741143212462700>
- 10) Ibrahim, R. (2015). Pendidikan Multikultural: Pengertian, Prinsip, Dan Relevansinya Dengan Tujuan Pendidikan Islam. *ADDIN*, 7(1), Article 1. <https://doi.org/10.21043/Addin.V7i1.573>
- 11) Jauhari, M. T., Santoso, S., & Anantanyu, S. (2019). Asupan Protein Dan Kalsium Serta Aktivitas Fisik Pada Anak Usia Sekolah Dasar. *Ilmu Gizi Indonesia*, 2(2), Article 2. <https://doi.org/10.35842/Iggi.V2i2.86>
- 12) Junita, N. P., Ilyas, S. N., & Alriani, I. (2021). Penerapan Model Project Based Learning (Pjbl) Untuk Meningkatkan Kemampuan Motoric Halus Peserta Didik Kelompok B Tk It Mumtazah Kota Bengkulu. *JURNAL PEMIKIRAN DAN PENGEMBANGAN PEMBELAJARAN*, 3(4), Article 4.
- 13) Kaldi, S., Filippatou, D., & Govaris, C. (2011). Project-Based Learning In Primary Schools: Effects On Pupils' Learning And Attitudes. *Education 3-13*, 39(1), 35–47. <https://doi.org/10.1080/03004270903179538>
- 14) Khalfaoui, A., García-Carrión, R., & Villardón-Gallego, L. (2021). A Systematic Review Of The Literature On Aspects Affecting Positive Classroom Climate In Multicultural Early Childhood Education. *Early Childhood Education Journal*, 49(1), 71–81. <https://doi.org/10.1007/S10643-020-01054-4>
- 15) Khomaeny, E. F. F., Ulfah, M., & Hamzah, N. (2020). Pengaruh Aktivitas Fisik Dan Lingkungan Alamiah Bagi Daya Tahan Tubuh Anak Usia Dini. *Awlady : Jurnal Pendidikan Anak*, 6(2), Article 2. <https://doi.org/10.24235/Awlady.V6i2.6206>

## Project Based Learning and Physical Activity for Cognitive Ability Stimulation in Early Childhood Education: Study Literature

- 16) Kokotsaki, D., Menzies, V., & Wiggins, A. (2016). Project-Based Learning: A Review Of The Literature. *Improving Schools*, 19(3), 267–277. <https://doi.org/10.1177/1365480216659733>
- 17) Maghfiroh, S., & Suryana, D. (2021). *Media Pembelajaran Untuk Anak Usia Dini Di Pendidikan Anak Usia Dini*. 5.
- 18) Nugraha, B. (2015). Pendidikan Jasmani Olahraga Usia Dini. *Jurnal Pendidikan Anak*, 4(1), Article 1. <https://doi.org/10.21831/jpa.v4i1.12344>
- 19) Nurdiani, Y. (2013). Penerapan Prinsip Bermain Sambil Belajar Dalam Mengembangkan Multiple Inteligencia Pada Pendidikan Anak Usia Dini (Study Kasus Di PAUD Daarul Piqri Kelurahan Leuwigajah Cimahi Selatan ). *Empowerment : Jurnal Ilmiah Program Studi Pendidikan Luar Sekolah*, 2(2), Article 2. <https://doi.org/10.22460/Empowerment.V2i2p85-93.601>
- 20) Nurhayanti, D., Hajerah, H., & Zainuddin, I. (2021). Penerapan Model Project Based Learning Dalam Meningkatkan Kemampuan Membilang Anak 1- 10 Dengan Media Kongkrit Pohon Angka Pada Kelompok A Di TK Tunas Bangsa Indramayu Jawa Barat. *JURNAL PEMIKIRAN DAN PENGEMBANGAN PEMBELAJARAN*, 3(4), Article 4.
- 21) Nurtanto, M., Fawaid, M., & Sofyan, H. (2020). Problem Based Learning (PBL) In Industry 4.0: Improving Learning Quality Through Character-Based Literacy Learning And Life Career Skill (LL-LCS). *Journal Of Physics: Conference Series*, 1573(1), 012006. <https://doi.org/10.1088/1742-6596/1573/1/012006>
- 22) Prabandaru, R. D., Lismadiana, L., & Nanda, F. A. (2020). Problem-Based Learning Approach To Improve Service Skills Of Badminton In Physical Education Learning. *International Journal Of Education And Learning*, 2(1), 14–24. <https://doi.org/10.31763/ijele.V2i1.74>
- 23) Pradika, R. R. T. A., Sari, A. D., & Suminar, I. T. (2022). Hubungan Aktivitas Fisik Dengan Kejadian Obesitas Pada Anak Usia Sekolah: Literature Review. *Citra Delima Scientific Journal Of Citra Internasional Institute*, 6(1), Article 1. <https://doi.org/10.33862/Citradelima.V6i1.277>
- 24) Prasetyaningtyas, W. E., Pentury, H. J., & Anggraeni, A. D. (2021). Implementing 21st Century Skills In Project Based Learning To Develop Young Learners Literacy. *Jurnal Pkm (Pengabdian Kepada Masyarakat)*, 4(3), Article 3. <https://doi.org/10.30998/Jurnalpkm.V4i3.6901>
- 25) Pratiwi, W. (2017). Konsep Bermain Pada Anak Usia Dini. *Tadbir: Jurnal Manajemen Pendidikan Islam*, 5(2), Article 2.
- 26) Primawanti, E. P., & Ali, H. (2022). Pengaruh Teknologi Informasi, Sistem Informasi Berbasis Web Dan Knowledge Management Terhadap Kinerja Karyawan (Literature Review Executive Support Sistem (ESS) For Business). *Jurnal Ekonomi Manajemen Sistem Informasi*, 3(3), 267–285. <https://doi.org/10.31933/Jemsi.V3i3.818>
- 27) Pristiwanti, D., Badariah, B., Hidayat, S., & Dewi, R. S. (2022). Pengertian Pendidikan. *Jurnal Pendidikan Dan Konseling (JPDK)*, 4(6), Article 6. <https://doi.org/10.31004/Jpdk.V4i6.9498>
- 28) Ramli, A. F., & Jayanti, D. (2023). Project Based Learning Untuk Meningkatkan Motorik Halus Anak Usia Dini TKN Nilla Gading Rompegading. *JURNAL PEMIKIRAN DAN PENGEMBANGAN PEMBELAJARAN*, 5(2), Article 2. <https://doi.org/10.31970/Pendidikan.V5i2.595>
- 29) Rehny, Z., & Sari, N. P. (2023). Upaya Mengembangkan Kemampuan Kognitif Pada Proses Sains Menggunakan Model Project Based Learning Kelompok A TK. *Jurnal Inovasi, Kreatifitas Anak Usia Dini (JIKAD)*, 3(2), Article 2. <https://doi.org/10.20527/jikad.V3i2.9132>
- 30) Rosmana, P. S., Iskandar, S., Janah, R. M. M., Thifana, A. R., Susanti, R., & Marini, F. P. (2022). Pengaruh Pembelajaran Project Based Learning Pada Sekolah Dasar Di Masa Pandemi. *Jurnal Pendidikan Tambusai*, 6(1), 3678–3684. <https://doi.org/10.31004/jptam.V6i1.3438>
- 31) Rubiyatno, R. (2014). Peranan Aktivitas Olahraga Bagi Tumbuh Kembang Anak. *Jurnal Pendidikan Olah Raga*, 3(1), Article 1. <https://doi.org/10.31571/jpo.V3i1.138>
- 32) Saputra, A. (2018). Pendidikan Anak Pada Usia Dini. *AT-TA'DIB: JURNAL ILMIAH PRODI PENDIDIKAN AGAMA ISLAM*, 192–209.
- 33) Sari, A. Y., Rodiyah, Sujati, & Zulfah, U. (2017). Implementasi Pembelajaran Project Based Learning Untuk Anak Usia Dini. *Motoric*, 1(1), Article 1. <https://doi.org/10.31090/Paudmotoric.V1i1.547>
- 34) Schwartz, M., Ragnarsdóttir, H., Toren, N. K., & Dror, O. (2022). Towards A Better Understanding Of Preschool Teachers' Agency In Multilingual Multicultural Classrooms: A Cross-National Comparison Between Teachers In Iceland And Israel. *Linguistics And Education*, 101125. <https://doi.org/10.1016/j.linged.2022.101125>
- 35) Sholihin, A. D., & Sugiarto -. (2015). Analisis Aktivitas Fisik Dan Aktivitas Belajar Pada Mahasiswa Fakultas Ilmu Keolahragaan Universitas Negeri Semarang Dalam Memanfaatkan Waktu Luang. *Journal Of Sport Science And Fitness*, 4(4), Article 4. <https://doi.org/10.15294/jssf.V4i4.10095>

## Project Based Learning and Physical Activity for Cognitive Ability Stimulation in Early Childhood Education: Study Literature

- 36) Sukmana, I. K., & Amalia, N. (2021). Pengaruh Model Pembelajaran Project Based Learning Terhadap Peningkatan Motivasi Belajar Dan Kerja Sama Siswa Dan Orang Tua Di Era Pandemi. *EDUKATIF : JURNAL ILMU PENDIDIKAN*, 3(5), Article 5. <https://doi.org/10.31004/edukatif.v3i5.1068>
- 37) Suparman, Juandi, D., & Tamur, M. (2021). Review Of Problem-Based Learning Trends In 2010-2020: A Meta-Analysis Study Of The Effect Of Problem-Based Learning In Enhancing Mathematical Problem-Solving Skills Of Indonesian Students. *Journal Of Physics: Conference Series*, 1722(1), 012103. <https://doi.org/10.1088/1742-6596/1722/1/012103>
- 38) Supriani, Y., & Arifudin, O. (2023). PARTISIPASI ORANG TUA DALAM PENDIDIKAN ANAK USIA DINI. *Plamboyan Edu*, 1(1), 95–105.
- 39) Wahyuni, S., & Hasriani, H. (2023). Upaya Meningkatkan Perilaku Prosocial Anak Usia Dini Menggunakan Model Project Based Learning. *JURNAL PEMIKIRAN DAN PENGEMBANGAN PEMBELAJARAN*, 5(2), Article 2. <https://doi.org/10.31970/Pendidikan.V5i2.496>
- 40) Zahari, Q. F., Prashanti, N. A. S., Salsabella, S., Jumiatmoko, J., Hafidah, R., & Nurjannah, N. E. (2022). Kemampuan Fisik Motorik Anak Usia Dini Dengan Masalah Obesitas. *Jurnal Obsesi : Jurnal Pendidikan Anak Usia Dini*, 6(4), 2844–2851. <https://doi.org/10.31004/obsesi.v6i4.1570>



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.



## Nutrition Status and Selected Factors Associated with Malnutrition of Children between 2-5 Years of Age in Medical Officer of Health Area Attanagalla, Sri Lanka



D M J B Dissanayake<sup>1</sup>, G P Nilanthi Pathirana<sup>2</sup>, K R Avanthi Rupasinghe<sup>3</sup>

<sup>1</sup>Medical Superintendent of Base Hospital Hingurakgoda

<sup>2,3</sup>Acting Consultant in Medical Administration, Ministry of Health Sri Lanka

**ABSTRACT:** Gampaha district is the second most populous district of Sri Lanka and prevalence of stunting, wasting and underweight among 2 to 5 years old children has been on average, at a level higher than 10%. This study aims to describe the nutrition status and selected factors associated with malnutrition of children of 2 to 5 years of age, in the Medical Officer of Health Attanagalla area in Sri Lanka.

A community based cross sectional study was carried out in all fifty Public Health Midwife areas in Attanagalla, Gampaha district from January to March 2014 among 455 children, within the age category of 2 to 5 years. Interviewer administered, pre tested and structured questionnaire was used by five trained data collectors, to obtain data from the mothers or female guardians of the children.

Results show that among the children prevalence of stunting (16.3%), wasting (9.5%) and underweight (18.7%) were identified based on anthropometric measurements. All three nutritional indices were high among male children ( $P > 0.05$ ) and children within the age categories of 36-47 months and 48-59 months were more susceptible ( $Df=2$ ,  $P > 0.05$ ). Higher level of education ( $Df=1$ ,  $P < 0.01$ ), both parents being employed and high income had a positive impact on the reduction of the three indices. Breast feeding only during the first six months and adopting complimentary feeding during the first six months since birth, had a significant ( $P < 0.05$ ) impact. Lack of knowledge on proper feeding practices during a child's illness and unsafe drinking water ( $P < 0.01$ ), were other key concerns.

Implementing community empowering and educational programmes are recommended in reducing malnutrition in the Medical Officer of Health Attanagalla area in Sri Lanka.

**KEYWORDS:** children, malnutrition, stunting, underweight, wasting

### I. INTRODUCTION

Malnutrition persists as one of the most serious health problems in the world (Cattaneo, et al. 2008) and recognised as the main contributory factor to child mortality. Risks of malnutrition (World Health Organization, 2009) are known to be extremely high during the foetal development stages in the uterus and also during the first two years of life. Any damage caused during this period is irreversible and the impact will be felt throughout the lifecycle.

Since gaining independence in 1948, Sri Lanka has achieved remarkable improvement in educational, health and social sectors. Nevertheless, the nutritional levels of children have not been satisfactory and prevalence of underweight, stunting, wasting and overweight has been prominent during the last few decades (Jayatissa, 2009). Statistics have revealed that, the levels of three key nutritional indices have shown a gradual decline in the recent past and when compared with 2012, the levels in 2013 (Family Health Bureau, 2013) were underweight (17%), stunting (11.2%) and wasting (13%).

Factors causing under nutrition differ and are identified as basic, underlying and immediate. Distribution of resources in a country play a key role in terms of being able to provide the basic facilities to build a nation with healthy people. Political, social and economic aspects of a country has a significant impact on the poverty levels, education, household income, food security and quality of health services of its population. Accordingly, there are certain salient factors which, have been identified as the major root causes for malnutrition.

## Nutrition Status and Selected Factors Associated with Malnutrition of Children between 2-5 Years of Age in Medical Officer of Health Area Attanagalla, Sri Lanka

Based on demographics and geographical presence, Gampaha is the second most populated district in Sri Lanka with a population of 2.4 million, at an annual growth rate of 1.7% (Medical Statistics Unit, 2018), in a land area of 1,341 sq.km. The Medical Officer Area (MOH) of Attanagalla is identified as a significant representation of the Gampaha district population which, consists of different ethnicities. This study assesses the factors impacting the nutritional status of the children between the age group of 2 to 5 years, residing in the MOH area of Attanagalla.

### II. METHODOLOGY

A community based descriptive cross sectional study was carried out within the boundary area of MOH Attanagalla which, is one of the sixteen MOH divisions in the Gampaha district. Mid-year population of the area recorded in 2013 was 192,995 amongst which, 8282 children consisted of 2 to 5 years age group. A staff strength of fifty Public Health Midwives (PHMs) and seven Public Health Inspectors (PHIs) are assisting the MOH Attanagalla to serve a demographically, socially, economically and culturally diverse urban and rural populace. Based on the above facts the study population was identified of children between the age categories of 2 to 5 years, who have been living in Attanagalla, MOH area since birth. A sample size of 455 children were considered for this study which, was carried out during the period of 4<sup>th</sup> August to 31<sup>st</sup> December 2014. A division within the PHM area was identified as a cluster and nine children within the specified age category were selected from all fifty PHM areas. The remaining five children were chosen from PHM areas where the population was five thousand or more persons. Furthermore, in households where there was more than one eligible child, the younger child was selected and in the event if there were no residents at the house visited or the eligible child was not available, the particular residence was visited again.

Structured, interviewer administered and pre tested questionnaire was used to collect data from the mothers or female guardians of the children. Questionnaire was structured in a manner which, captured the feedback related to broad categories such as identification, demographic and socio economic, feeding and other dietary practices, environmental factors and general health of the child and health services. Five (n=5) trained, data collectors administered the questionnaire by visiting each household, of the identified sample population.

Pearson Chi square test, (or Fisher exact test) was used to identify the factors associated with malnutrition and SPSS statistical software as well as Anthro (WHO Anthro version 3.2.2) (Garenne, et al. 2012) were used to calculate the nutrition z-scores of the children.

### III. RESULTS

The majority of the respondents who provided the required feedback were mothers (n=420, 92.3%) and the age group of the study population were mostly (n=192, 42.2%) between 24 to 35 months. The socioeconomic characteristics showed that, in terms of education levels the majority of the mothers (n=259, 56.9%) and fathers (n=246, 54.1%) have studied up to G.C.E. Ordinary Level and both parents had a very high level (99.6%) of literacy as well. In terms of parenting aspects, 81.3% (n=370) were housewives while 18.7% were employed and their children were being looked after by the grandmothers (88.9%). However, the fathers too played a critical role in the upbringing of the children. Most of the fathers were employed as professional/ technicians (n=128, 28.3%), with the greater population (n=242, 53.2%) having a monthly household income within the range of Rs.20,000/= to Rs. 32,000/=. The residential environment remained quite modest, with majority of the houses (n=390) having basic facilities and constructed in a standard manner.

The prevalence of stunting (16.3%), wasting (9.5%), underweight (18.7%) and overweight (0.9%) among the children in Attanagalla MOH area were identified, based on applicable procedures of using standard equipment and anthropometric measurements ((Garenne, et al. 2012). Analysing the variations of the key nutritional indices with the main demographic characteristics selected for this study, indicated the following results as shown in Table 1.

Overall analysis did reveal that, children between the age categories of 48-59 months were stunted (Df=2, P>0.05) and were affected by wasting ( $X^2=0.042$ , Df=2) while underweight was prominent among children of 36 to 47 months ( $X^2=0.471$ , Df=2, P>0.05) and overall more male children were prone to these health concerns.

**Table 1: Analysis based on Key Demographic Characteristics**

Demographic characteristic	Stunting	Wasting	Underweight
<b>Age (months)</b>			
24-35	14.2%	9.1%	17.3%
36-47	16%	9.6%	20%

**Nutrition Status and Selected Factors Associated with Malnutrition of Children between 2-5 Years of Age in Medical Officer of Health Area Attanagalla, Sri Lanka**

48-59	19.5%	9.8%	19.5%
<b>Sex</b>			
Male	19.3%	9.9%	19.7%
Female	13.1%	9%	17.6%
<b>Ethnicity</b>			
Sinhala	16.3%	9%	19.2%
Muslim	15.9%	13.6%	13.6%

In terms of socio economic aspects the nutritional indices of the children were analysed and the details are summarised in Table 2.

**Table 2: Analysis based on Key Socio economic Characteristics**

Socio economic characteristic	Stunting	Wasting	Underweight
<b>Education (Up to G.C.E. O/ Level only)</b>			
Mother	21.4%	10.3%	21.8%
Father	19%	11.7%	23.1%
<b>Education (Up to G.C.E. A/ Level)</b>			
Mother	8.7%	8.2%	14.1%
Father	11.5%	5.5%	10.9%
<b>Occupation</b>			
<b>Father</b>			
Semi-skilled	18.9%	13.2%	18.9%
Unskilled	-	-	-
Unemployed	18.2%	18.2%	27.3%
<b>Mother</b>			
Semi-skilled	9.1%	18.2%	18.2%
Unskilled	18.2%	18.2%	18.2%
Unemployed	17.8%	9.9%	9.9%
<b>Income level (Rs.)</b>			
Up to 19999	18.2%	19.5%	22.1%
20000-31999	18.9%	6.1%	19.3%
>32000	11.4%	9.4%	16.1%

Education level of both parents has played a decisive role in child care, as a noteworthy reduction was witnessed in stunting (Df=1, P<0.01) and underweight (mother: P<0.05 and father: P<0.01) where, the parents have studied up to G.C.E. A/Level. Wasting was less (P<0.05) among children whose fathers had studied beyond G.C.E.O/Level but an increased (n=28, 10.3%, P>0.05)

prevalence was seen among the children of the mothers who had studied only up to G.C.E O/Level. Father’s unemployment (27.3%) status had impacted significant underweight concerns of the children and with regard to stunting both parents (father: 18.2%, mother: 17.8%) being unemployed, has had a considerable effect as well. It was obvious that, the children (Df=2, stunting=18.2%, wasting=19.5%, underweight=22.1%) of families earning less Rs. 20,000/= monthly income were suffering from nutritional deficiencies.

Further analysis was done to assess the impact based on breast feeding practices, feeding methods adopted by mothers during illnesses suffered by children and also on hygiene levels of drinking water. As shown in Table 3, the results indicated varied impact on the growth of the children.

**Table 3: Analysis based on Identified Feeding Practices and Drinking Water Hygiene**

Factor Description	Stunting	Wasting	Underweight
<b>Breast feeding</b>			
<6 months	25.4%	15.3%	28.8%

**Nutrition Status and Selected Factors Associated with Malnutrition of Children between 2-5 Years of Age in Medical Officer of Health Area Attanagalla, Sri Lanka**

6 months completed	14.8%	8.3%	16.9%
<b>Complementary practices</b>			
<6 months	25%	15.3%	28.3%
6 months completed	15.1%	8.3%	17.2%
<b>Feeding practices during episodes of illness</b>			
Less food than usual	22.2%	14.8%	29.6%
Liquid diet only	17.9%	12.8%	23.1%
More food than usual	12.1%	6.1%	10.6%
Food as usual	14.8%	7.4%	15.7%
<b>Drinking water source</b>			
Own well	14.5%	9.7%	18.5%
Public supply	12.8%	5.1%	12.8%
Tube well	37.5%	25.0%	37.5%
Other	58.8%	17.6%	41.2%
<b>Methods of purifying water</b>			
None	16.1%	16.1%	21.0%
Boiling	16.7%	8.0%	18.4%
Filtering	14.6%	7.3%	19.5%
Other	-	50.0%	-

Common observation was that, the children who were being breast fed only for a period of less than six months showed significant signs of stunting ( $Df=1$ ,  $P<0.05$ ), wasting ( $X^2=2.917$ ,  $Df=1$ ,  $P>0.05$ ) and underweight ( $X^2=4.790$ ,  $Df=1$ ,  $P<0.05$ ). Similar results were seen among the group of children who were less than six months of age, whose mothers adopted complimentary feeding methods. During episodes of sicknesses, the feeding methods adopted by parents or guardians have had an impact on the child's nutritional indices. Being offered less food than the usual quantity and liquid diet had led to an increase in stunting ( $Df=3$ ,  $P>0.05$ ), wasting and underweight ( $Df=3$ ,  $P<0.01$ ). In terms of hygiene and the sterility of consumed water, children who were exposed to tube wells and other sources of water as well as not adopting water purification methods, were very much susceptible for deficiencies related to their growth.

#### IV. DISCUSSION

The sample population selected for this study, residing in the Attanagalla MOH area, was a representation of varied ethnicities, religions, cultural practices, education and income levels which, in turn seemed to have impacted the nutritional status among the children, in different ways.

Though a direct comparison was not possible to gauge the variances in the nutritional indices of the children in this area, when compared with the DHS survey done in 2006/2007 (Jayatissa, 2009) for children of under 5 years, a significant reduction in wasting (2006/2007 years: 14.7% and 2014 year: 9.5%) was seen in this study. Nevertheless, the declining trend on stunting and underweight was minimal ( $\leq 2\%$ ). The National Nutrition and Micronutrient survey conducted in 2012 revealed contrasting results but was based on the entire Gampaha district. According to this survey, prevalence of stunting (9.4%) was less while wasting (18.5%) and underweight (21.7%) was high. Considering a more relevant comparison, the Annual Nutrition month data in Gampaha district in 2013 revealed that, stunting (7.9%), wasting (9.8%) and underweight (13.5%) among the children between 2 to 5 years had reduced or indicated an improvement.

Outcome of this study showed that, all three nutritional indices were more prevalent among male children ( $P>0.05$ ) and children within the age categories of 36-47 months and 48-59 months were more vulnerable ( $Df=2$ ,  $P>0.05$ ). This fact was evident in a study ( $n=3542$ ) done in Malaysia as well within the age category of 6 to 12 years of children. Furthermore, higher level of education ( $Df=1$ ,  $P<0.01$ ), both parents being employed and high level of monthly income had a positive impact, as all three indices showed an improvement. Children of mothers who adopted breast feeding only for a time period of six months and also who adopted alternative feeding practices during the first six months, were significantly ( $p<0.05$ ) exposed to low nutrition. Lack of knowledge regarding proper feeding practices during child's illness and unsafe drinking water ( $P<0.01$ ), were other key concerns which, affected the prevalence of malnourishment among the selected group of children, in the Attanagalla, MOH area.

## Nutrition Status and Selected Factors Associated with Malnutrition of Children between 2-5 Years of Age in Medical Officer of Health Area Attanagalla, Sri Lanka

### V. CONCLUSIONS

It should be mentioned that, the varied demographics, socioeconomic and environment factors, hygiene standards of consumed water, episodes of illnesses, together with the feeding practices adopted by mothers have impacted the nutritional standards of the children identified for this study. Further as explained, the deep rooted cultural beliefs of the two prominent communities (i.e. Sinhalese and Muslims) in the Attanagala area, would have somewhat impacted the life style and decision making process, of the parents of these children. In such an environment specific and relevant intervention strategies, need to be considered to overcome concerns related to malnutrition.

Furthermore, though the educational levels of both parents were at satisfactory levels it was evident that, the mothers lacked knowledge on key aspects related to nutrition especially feeding practices and hygiene. The active involvement of PHMs in creating awareness, conducting relevant training and educational programmes would help the mothers and caregivers, to gain a proper understanding of adopting proper nutritive diets and improving standards of cleanliness to overcome undernourishment. In order to eradicate malnutrition it is important to enforce regular monitoring and evaluation systems, which will help to gauge the effectiveness of the plans and programmes implemented in the specific areas. This could be carried out with the involvement of the Regional Director of Health Services (RDHS) and MOH while, it should not be limited to a particular area or region of the country. If Sri Lanka is to achieve the specific Millennium Development Goals (MDGs) (Senanayake, 2011) as specified by WHO, it is imperative for the government health officials to implement stringent evaluation systems across the country, to monitor the variances in the key nutritional indices of children

### ACKNOWLEDGMENT

The authors acknowledge the support given by the officials at the Provincial Directorate of Health Services, Western Province, Regional Director of Health Services Gampaha District and the staff at Medical Office of Health in Attanagalla, Sri Lanka.

### COMPETING INTERESTS

The authors declare no competing interests.

### REFERENCES

- 1) Cattaneo, A, et al. *Child nutrition in countries of the Commonwealth of Independent States : time to redirect strategies ?* 12, 2008, Vol. 11. 1209–1219. doi:10.1017/S136898000800326.
- 2) World Health Organization, *WHO Annual Report 2009*. s.l. : WHO, 2009.
- 3) Jayatissa, R. *Nutrition and Food Security Assessment in Sri Lanka - 2009*,. 2010.
- 4) Family Health Bureau . *Family Health Bureau Report*. Colombo : Family Health Bureau , Ministry of Health, Sri Lanka, 2013.
- 5) Medical Statistics Unit, Ministry of Health, Nutrition and Indigenous Medicine. *ANNUAL HEALTH STATISTICS, 2016*. Colombo : Medical Statistics Unit, Ministry of Health, Nutrition and Indigenous Medicine, 2018.
- 6) Garenne, M, Maire, B and Fontaine, O. *Adequacy of child anthropometric indicators for measuring nutritional stress at population level*. 9, 2012, Vol. 16. 1533–1539. doi:10.1017/S136898001200448X.
- 7) Senanayake, H, et al. *Achieving Millennium Development Goals 4 and 5 in Sri Lanka*. 2011. 78–87. doi:10.1111/j.1471-0528.2011.03115.x.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Evaluation of the Special Sports Class (KKO) Program Using the Illuminative Model at SMP Negeri 3 Samigaluh Kulon Progo



Wulung Reksonegoro<sup>1</sup>, Sumarjo<sup>2</sup>, Zaza Afniendar Fakhrurozi<sup>3</sup>

<sup>1,2,3</sup> Universitas Negeri Yogyakarta, Yogyakarta, DIY, 55281, Indonesia

**ABSTRACT:** This research was conducted with the aim of (1) to know and describe the illuminative model activities related to the coaching of special sports classes at SMP Negeri 3 Samigaluh, (2) to provide insight information and guidance to teachers/coaches in understanding and implementing KKO, (3) to know the facilities and infrastructure that support the implementation of achievement coaching carried out in the Special Sports Class (KKO) at SMP Negeri 3 Samigaluh and (4) to know the results of coaching the achievements of the Special Sports Class (KKO) at SMP Negeri 3 Samigaluh carried out by schools and sports teachers/coaches with the illuminative model.

This research uses a qualitative approach with an illuminative model. This research was conducted at SMP Negeri 3 Samigaluh, Kulon Progo. The research was conducted in September-October 2023. The subjects of this research were the principal, teachers, coaches, and 6 special sports class students. The data analysis technique used by Miles & Huberman with data triangulation. The instruments used were observation, interview, and documentation.

The results showed the achievement of the implementation of the KKO coaching program at SMP Negeri 3 Samigaluh has been running quite well. although the implementation of a written coaching curriculum for KKO classes does not yet exist. Teachers' insight in understanding and implementing the KKO program at SMP Negeri 3 Samigaluh teachers understand enough in implementing KKO coaching at SMP Negeri 3 Samigaluh, teachers and coaches are also considered to have enough practice. The adequacy of facilities and infrastructure in coaching KKO at SMP Negeri 3 Samigaluh is good enough, although overall the facilities and infrastructure used are still inadequate. The success of the KKO coaching program at SMP Negeri 3 Samigaluh using this evaluation has only been running since 2022, so the resulting achievements are not yet available.

**KEYWORDS:** Evaluation, Illuminative Model, Special Sports Class Program (KKO)

### I. INTRODUCTION

In learning in school teachers need to apply learning models that can make students feel successful in themselves to increase student self-esteem as character building in schools [1]. In the era of Society 5.0, which carries the concept of a superior society and character, the development and coaching of sports have made significant progress. In addition, students with high self-esteem always strive to continue learning, have good confidence in their abilities, and realize their limitations [2]. These changes are mainly influenced by sports performance coaching efforts, which is a key factor in improving sports performance. Achievement coaching must be optimally organized in accordance with the program that has been compiled in the athlete coaching system. [3], points out that it does keep children off the streets, but it also instills very important lessons in the life of a student-athlete. The government, through the Directorate of Junior High School Development and the Directorate General of Primary and Secondary Education Management, Ministry of National Education, implemented a special sports class program at the secondary education level. This program, which is organized through a pilot project in selected schools, aims to increase students' interest and channel their talents into becoming potential athletes in the future. State that elite sports schools in Germany have promotional facilities, which in cooperation with competitive sports, schools, and all accommodations must guarantee conditions that support top sports in the future while maintaining opportunities for primary and secondary education for learners who are considered very talented[4].

The Special Sports Class (KKO) program was established with the main aims and objectives, namely: 1) as a forum for fostering potential student sportsmen for national and international achievements, 2) fostering sportsmen with high dedication to making the nation proud, and 3) fostering the academic achievements of student sportsmen to support future security. The KKO implementation policy is in accordance with Indonesian Law Number 11 of 2022 concerning Sports, article 26 paragraph 6,

## Evaluation of the Special Sports Class (KKO) Program Using the Illuminative Model at SMP Negeri 3 Samigaluh Kulon Progo

which emphasizes the formation of sports activity units, sports classes, coaching and training centers, sports schools, and tiered and sustainable sports competitions in educational institutions.

Thus, potential students in sports activities can develop their talents through the KKO program at school, while maintaining focus on school learning objectives and prioritizing academic activities. Based on data from the Kulon Progo Regency Education, Youth and Sports Office (Disdikpora), the Special Sports Class (KKO) program is implemented in 4 junior high schools. The schools that organize the KKO pathway in Kulon Progo Regency include SMP Negeri 1 Panjatan, SMP Negeri 2 Galur, SMP Negeri 1 Nanggulan and SMP Negeri 3 Samigaluh. With the opening of the KKO pathway in junior high schools, it is hoped that schools can provide more optimal services to students who have sports talents and interests. "High school athletes/students should be increasingly encouraged to participate in one sport throughout the year to improve their sports skills" [5].

SMP Negeri 3 Samigaluh was selected as one of the schools implementing the Special Sports Class Program (KKO) in Kulon Progo Regency. This decision was based on several factors, including the regulation of Permen No. 34/2006 on fostering the achievements of students with potential intelligence and special talents in sports. SMPN 3 Samigaluh is also well known for its potential sporting achievements, especially in volleyball, karate, and gateball, ranging from sub-district to national levels. The success of the KKO program at SMPN 3 Samigaluh is supported by the availability of competent sports teachers/trainers and the full support of the principal and teachers of SMPN 3 Samigaluh. In addition, the village heads of Sidosari and Sidoharjo, along with village officials, provided significant support, involving six hamlets around the school.

Although the school faces several challenges, such as limited infrastructure and facilities, as well as the selection of sports that are not yet popular nationally, SMPN 3 Samigaluh remains optimistic that it can achieve achievements, especially in the sport of gateball which is considered to have great potential. The school tries to make adjustments, although limited in the types of sports offered and the development of the KKO curriculum.

KKO at SMPN 3 Samigaluh involves students in coaching and training by professional teachers/trainers. Nonetheless, periodic evaluation is considered important to ensure that the KKO program is running as intended. The illuminative evaluation model was chosen to obtain recommendations for improvement based on field data analysis.

The results of this study are expected to provide a detailed picture of the implementation of the KKO program at SMPN 3 Samigaluh over the past two years. This evaluation is expected to help improve and enhance the KKO program, achieving the goal of successful and effective coaching at the junior high school level.

## II. METHOD

### Type of Evaluation

The type of research used in this program evaluation is an illuminative model evaluation. The illuminative model evaluation is used to obtain accurate and objective information and compare what has been achieved from the special sports class coaching program at SMP Negeri 3 Samigaluh, Kulon Progo, with what should be achieved based on the program set by the government (Directorate of Sports Education).

The evaluation research method used in this study is an evaluation research method based on the Illuminative model. The evaluation activities are linked to the learning milieu in the context of the school as a material and psychosocial environment, where teachers and students can interact optimally [6]. The purpose of the evaluation is to study carefully and carefully the implementation of the KKO learning system, the factors that influence it, the advantages and disadvantages of the KKO learning system, and the effect of the system on the learning experience of students.

Through this method, the evaluation results are more descriptive and interpretative rather than measurement and prediction. Evaluation serves as input for decision-making purposes in order to adjust and improve the learning system in KKO. The object of this model evaluation includes the background and development of the learning system, the process of implementing the learning system and the learning outcomes of KKO students, the difficulties experienced from planning to implementation, including the side effects of the KKO learning system itself. The methods used are not standardized but selective.

Based on the objectives and evaluation approach, researchers use the illuminative model because with this model no one has used an evaluation study that uses the illuminative model. illuminative model there are 3 evaluation phases that must be done, namely: observe, further inquiry, and seek to explain.

### Place and Time of Research

This research was conducted at SMP Negeri 3 Samigaluh, Kulon Progo. The research time was held from September 02 to October 25, 2023.

### Research Subjects

## Evaluation of the Special Sports Class (KKO) Program Using the Illuminative Model at SMP Negeri 3 Samigaluh Kulon Progo

Determination of research subjects using purposive sampling technique, namely the selection of data sources based on certain considerations. The criteria used for determining the sample involve (1) the person in charge of KKO, (2) the PJOK teacher, (3) the sports coach at KKO, and (4) students who have participated in championships at least at the regional level. The research subjects were divided into two categories, namely primary (KKO person in charge and PJOK Teacher) and secondary (sports coaches in KKO and students).

### Instruments and Data Collection Techniques

Data collection methods in this study, as described [7], include participant observation, in-depth interviews, and documentation data as support. The following are the data collection techniques used:

#### 1. Observation

- Observation was conducted to obtain a real picture of the object of research. Researchers directly went to the field, using the five senses to observe and understand the condition of the object of research.
- States that observation has an important role in ensuring data validity [8]. Researchers personally observed the events that became the focus of the research to gain confidence in the validity of the data.

#### 2. Interview

- Interviews are used to obtain more definite and in-depth information about the object of research from relevant and trustworthy informants.
- According to Esterberg an interview is a meeting of two people to exchange information and ideas through questions, so that meaning can be constructed on a particular topic [8].
- Interviews are not only used to find out things from respondents that are more in-depth but also as a major tool in qualitative research methods. Interview results are used to triangulate data.

#### 3. Documentation Data

- Secondary data as support is obtained through documentation. Documents relevant to the object of research are used as additional data sources.

This research focuses on observation and interviews as the main tools to understand the conditions and get in-depth information from the research subjects. The interview guidelines were prepared in accordance with the predetermined grids.

### Data collection instruments

Measurement instruments for qualitative data collection are based on aspects:

- a. Program background, and program objectives seen from the support of the government, community, and parents of athletes.
- b. Athlete human resources, coach human resources, and infrastructure that support KKO activities
- c. Organizational management, training programs, funders, rewards to athletes, competition, application of science and technology, and media support.
- d. Programs that have been implemented and achievements that have been achieved.

### Validity and Reliability of Data Validity

To ensure the validity and scientificity of data in qualitative research, data validity testing is carried out through several aspects, namely:

#### 1. Credibility test (internal validity)

- Conducted by extending observation, increasing persistence in research, triangulation, discussions with peers, negative case analysis, and member check.
- The goal is to achieve a level of confidence in the findings and prove the results of the research with double proof.

#### 2. Credibility Test on Research

- Involves triangulation techniques as part of the degree of trust criteria.
- Data triangulation is done by cross-checking, and combining interview data, observation, and documentation.
- Involving content validity and construct validity, with content validity testing through rational analysis by expert I, an expert in sports management and sports evaluation.

#### 3. Dependability Test (Reliability)

- Research is considered reliable if others can repeat or replicate the research process.
- Continuous communication with the supervisor from the beginning to the end of the research to get input for the scientificity and truth of the research.

#### 4. Confirmability Test (Objectivity)

- Refers to the extent to which researchers can demonstrate neutrality in the meaning/interpretation of research results.



## Evaluation of the Special Sports Class (KKO) Program Using the Illuminative Model at SMP Negeri 3 Samigaluh Kulon Progo

- This is done through confirmability audits by providing raw data, analysis notes, process notes, and an audit trail in the form of interview transcripts, observation results, field notes, data reduction results, research photographs, and documents attached to the end of the report.

By following this procedure, research can ensure the validity, scientificity, and trustworthiness of the data collected in the context of qualitative research.

### Data Analysis Technique

Qualitative analysis in this study was carried out continuously during observations, interviews, and documentation. The data analysis method used was descriptive analysis, with the main stages involving data reduction, data presentation, and conclusion drawing or verification. The following are the stages of data analysis that were followed:

#### 1. Data Reduction

- The process of selecting, focusing, simplifying, abstracting, and transforming rough data from field notes.  
- Conducted continuously during the research, with the aim of producing sharp analysis, classifying, directing, and discarding irrelevant data.

#### 2. Data Presentation

- Data from the findings in the field are presented in the form of narrative text, describing the implementation of coaching in the club.  
- If necessary, the data presented can be reduced again to obtain more valid information.

#### 3. Conclusion Drawing and Verification

- Looking for meaning from the data by paying attention to patterns, regularities, explanations, configurations, and causal relationships.  
- Conclusions were drawn and verified by reviewing the data and field notes, following the guidance of the supervisor, and summarizing the results of verification in a matrix.

In addition, there is a section explaining the success criteria, which are always linked to the predetermined evaluation criteria. Success criteria are also referred to as "benchmarks" or "standards", which are used as benchmarks or minimum limits in assessment. Criteria or standards are created to make it easier for evaluators to assess the value of the components being assessed so that evaluations can be carried out with agreement and consider conformity with what was previously determined.

### III. RESEARCH RESULT

The evaluation of the KKO program aims to provide recommendations to schools to improve the management of the program. Although the evaluation was considered a straightforward task, its implementation proved challenging. Recommendations were provided from a sports management perspective, with school management having the authority to make changes to the KKO program. Findings from the research and evaluation will be outlined in detail, discussing relevant implications. Thus, this evaluation provides relevant and comprehensive information to school management to support decision-making regarding the management of the KKO program.

#### 1. Achievement of KKO Coaching Program Implementation at SMP Negeri 3 Samigaluh

- The implementation of the KKO coaching program at SMP Negeri 3 Samigaluh has started quite well, although there is no written curriculum specifically for KKO classes.  
- The principal stated that there is no official vision and mission, the organizational structure has not yet been formed, and the training programs are still in the early stages.  
- The coach and principal stated that the activities have been running well, although not yet fully structured.

#### 2. Teachers' Insights in Understanding and Implementing the KKO Program at SMP Negeri 3 Samigaluh

- Teachers and coaches at SMP Negeri 3 Samigaluh have a good understanding of implementing KKO coaching.  
- Teachers and coaches have targets in carrying out training and learning and are considered to have good credibility.

#### 3. Adequacy of Facilities and Infrastructure in KKO Coaching at SMP Negeri 3 Samigaluh

- Facilities and infrastructure at SMP Negeri 3 Samigaluh are considered quite good but still not in accordance with the number of students, especially for some sports equipment.  
- Teachers and coaches state that BOS funds and community support are used to fulfill the lack of facilities and infrastructure.

#### 4. The success of the KKO Coaching Program at SMP Negeri 3 Samigaluh using the Illuminative evaluation model.

- The results of KKO coaching have not produced significant achievements, because this program only started in 2022. Students who enter the KKO class have not gone through selection, which can affect the quality of students' interests and talents.

## Evaluation of the Special Sports Class (KKO) Program Using the Illuminative Model at SMP Negeri 3 Samigaluh Kulon Progo

- Support from various parties, including schools and communities, is needed to improve athlete achievement and change the stigma of sports in society.

1. The program environment, both from internal and external factors, is one of the topics discussed in the context [10]. Special sports classes are special classes that have students with special talents in sports. In Indonesia, sports schools or special sports classes are different from other educational institutions [11]. Learners receive special services in developing their special talents, thus special sports class students have acceleration in terms of achieving sports achievements according to their talents and the types of sports they pursue. Special Sports Class (KKO) is expected to increase interest and channel student talent to become potential athletes in the future. Not all schools are able to implement special sports classes (KKO), but in the Yogyakarta area, KKO has been widely implemented by several schools, one of which is SMP N 3 Samigaluh.

The implementation of KKO is basically in realizing the educational objectives contained in Law No. 20 of 2003 concerning the National Education System in Article 5 paragraph 4 which reads "Citizens who have the potential for special intelligence and talent are entitled to special education". As well as research conducted by Adi & Fathoni (2020) states that enrolling athletes in public schools tends to affect their performance in sports. Therefore, based on these problems, Special Sports Schools in Indonesia were established to facilitate education for student-athletes. There is always a link between internal and external factors and the efforts of sports organizations to achieve a level of professionalism [12]. In the implementation of special sports classes at SMP N 3 Samigaluh, it is felt that it is still not optimal because there are still deficiencies in the implementation of special sports class coaching, including the implementation of KKO which is still new, human resources (students) who are still ordinary, the lack of school facilities and infrastructure owned. Therefore, it is necessary to evaluate the coaching of KKO at SMP N 3 Samigaluh.

2. The role of each material for optimal performance. The teacher does it very well, even though he encounters obstacles, he never gives up and is always patient with students. Teachers responsible for implementing KKO must have a comprehensive understanding of the intricacies of overseeing performance sports, performance sports coaching methodologies, and the procedures involved in monitoring and evaluating performance sports training [13]. Teachers always care and never give up on guiding their students so that they are not left behind in their lessons and everything goes well. As explained by Pambudi (2019), special education for gifted students is formal education organized and managed to provide educational services for students who have special talents in the field of sports so that they can realize the potential of extraordinary talents that exist in themselves to achieve the goal of becoming a truly successful person optimally.

The role of the coach is not inferior to the teacher, the coach's performance is very good. Coaches can develop students into outstanding athletes who can make themselves and their schools proud. Coaches have a very important role in improving children's education in special sports classes (KKO) [14]. Therefore, improving cognitive abilities requires from all supporting aspects, one of which is the coach.

The coach never gives up hope, always trying to train his students to the maximum in order to become superior athletes. The methods used by teachers and trainers are very appropriate, as evidenced by the ease with which students absorb the material delivered by teachers and trainers. There are three key factors that contribute to the achievement of a coach. First, having an academic foundation in disciplines closely related to sports is essential. Second, having extensive experience in sports, both as an athlete and as a coach, is essential. Lastly, maintaining a constant motivation to improve one's knowledge in the field of cutting-edge sports science is essential [15]. The students were very serious and excited about learning and practicing without any burden. Although the facilities and infrastructure are not complete, this does not pose a serious obstacle for students and trainers not to practice. The lack of facilities and infrastructure further encourages students to excel in their studies, so that in the future the government will pay attention to it. The existing infrastructure at SMPN 3 Samigaluh Kulon Progo is still very minimal. Good management will determine the success of a program [16].

3. Various sports really need the availability of very adequate infrastructure facilities to support the maximum achievement of athletes. Evaluating the level of efficiency and success of an education program can be done through the results assessment process, as described in the research of Toosi et al. (2018). To organize schools with special sports talents or in words that are often known as Special Sports Classes, supporting facilities are needed in accordance with the provisions stipulated by the Ministry of National Education (2010). (1) These facilities include having sports equipment with a minimum number of 2: 3 to the number of students during learning, (2) a training center, (3) a rehabilitation center, and (4) an assessment center. Although in terms of facilities and infrastructure, it is still minimal, it does not discourage coaches and athletes from improving their abilities according to their sports. For facilities and infrastructure, although incomplete, it is not a serious obstacle for students and coaches not to practice. The training process to improve sports achievements for students in each school organizing KKO at the junior high school level in Samigaluh, the school provides an allocation of time once a week. Match trials in order to find out

## Evaluation of the Special Sports Class (KKO) Program Using the Illuminative Model at SMP Negeri 3 Samigaluh Kulon Progo

the development of training that has been done well. Trials organized by the school for all sports are held with other schools in the Special Region of Yogyakarta and outside the Special Region of Yogyakarta that organize KKO. Trials are also conducted at the initiative of the coach himself with clubs and other schools. The training program made by the coach to carry out the training process for KKO students does not exist in school documents. The training program to carry out the training process has not been made by each coach. The training session program when the coach conducts the training was not found by the researcher.

4. The illuminative model is a comprehensive model and contains complete coverage in conducting evaluations to collect data, present accurate and objective information that occurs in the field, especially regarding program implementation, and draw conclusions based on established criteria. The illuminative model is used because it is more suitable for evaluating program implementation which is expected to provide input to parties related to the implementation of special sports class achievement coaching at the junior high school level in Kulon Progo, Yogyakarta.

Sports achievement coaching for KKO students which is carried out in a well-organized manner in each KKO organizing school is expected to be able to provide better sports achievement coaching services. "High school athletes/students should be increasingly encouraged to participate in one sport throughout the year to improve their sports skills" [17]. "To foster sports achievements in educational institutions, in each educational pathway, sports activity units, sports classes, coaching and training centers, sports schools, and the holding of tiered and sustainable sports competitions".

The key factors for the successful implementation of the Sports Class program are 4 (four) factors, namely: (1) The competence of competent human resources so as to be able to produce high and superior performance in implementing the Sports program, (2) SMP Negeri 3 Salatiga's committed to the success of the sports program implementation, (3) The transparency of funding has an impact on the openness of activities and cooperation between groups to jointly seek financial support if they encounter capital shortages, (4) Potential land, potential infrastructure, potential human resources (principals, teachers, education personnel, students, school committees, parents) can help in the implementation of sports programs [18]. Strategies must always be present in the implementation of the program, one of which is The existence of a program strategy that can be carried out and structured so that it can achieve its goals. The strategic choices that have been made must be interpreted explicitly within the framework of the vision and mission [19].

In this study, it was found that the implementation of the special sports class program needs to be improved so that the role of each component runs optimally. Nevertheless, there are several obstacles in the implementation and development of special sports classes, such as the absence of a training process for KKO students in school documents, the absence of a training program by each coach, and the absence of a training session program when the coach conducts training. Although the school's facilities and infrastructure are incomplete, it is not a serious obstacle for students and coaches not to practice. The illuminative evaluation model is used in this study to provide input to stakeholders in the implementation of the performance development of special sports classes at the Kulon Progo Yogyakarta junior high school level.

### V. CONCLUSIONS

The results showed that the implementation of the Special Sports Class (KKO) coaching program at SMP Negeri 3 Samigaluh has been running well, although it does not have a written curriculum for KKO classes. Teachers and coaches are considered to understand and have sufficient experience, and the facilities and infrastructure at the school have supported KKO coaching. However, there are still shortcomings in terms of student selection and lack of learning resources that need to be explored. Evaluation of the success of the KKO program only began in 2022, so there have not been significant achievements, and student admissions have not been through selection, so the interests and talents of students are considered only mediocre.

### REFERENCES

- 1) Rodriguez-Ayllon, M., Cadenas-Sánchez, C., Estévez-López, F., Muñoz, N. E., Mora-Gonzalez, J., Migueles, J. H., Molina-García, P., Henriksson, H., Mena-Molina, A., Martínez-Vizcaíno, V., Catena, A., Löf, M., Erickson, K. I., Lubans, D. R., Ortega, F. B., & Esteban-Cornejo, I. (2019). Role of Physical Activity and Sedentary Behavior in the Mental Health of Preschoolers, Children and Adolescents: A Systematic Review and Meta-Analysis. *Sports Medicine*, 49(9), 1383–1410. <https://doi.org/10.1007/s40279-019-01099-5>.
- 2) Akçakoyun, F. (2018). Analysis of Self-Esteem Levels of Students in Physical Education and Sports High School. *Journal of Education and Training Studies*, 6(2), 73. <https://doi.org/10.11114/jets.v6i2.2951>.
- 3) Cooper D. (2001) *Medicine and Science in Sports and Exercise*, NJ: Prentice Hall, Englewood Cliffs.

## Evaluation of the Special Sports Class (KKO) Program Using the Illuminative Model at SMP Negeri 3 Samigaluh Kulon Progo

- 4) Emrich, E., et al.: Evaluation of the Elite Schools of Sport. (2009). Empirical Findings From an Individual and Collective Point of View. Article in International Review for the Sociology of Sport. 44/2-3 151-171.
- 5) Post, Eric. G., dkk. (2017). "Association of Competition Volume, Club Sport and Sports Specialization With Sex and Lower Extremity Injury History In High School Athletes". Journal: Sport Health, Vol. XX No. X
- 6) Arifin, Z. (2019). Evaluasi pembelajaran : prinsip, teknik, dan prosedur. (Cetakan kesebelas). Bandung: PT Remaja Rosdakarya.
- 7) Arikunto, S. & Jabar, C.S.A. (2014). Evaluasi program pendidikan. Edisi kedua. Jakarta: PT. Bumi Askara.
- 8) Moleong, J.L. (2010). Metode penelitian kualitatif. Bandung: PT Remaja Rosdakarya.
- 9) Sugiyono. (2018). Metode penelitin kuantitatif, kualitatif, dan R&D. Bandung: Alfabeta.
- 10) Teshome, Z., Wolde, B., Abrham, T., & Tadesse, T. (2022). Evaluating the Practices and Challenges of Youth Volleyball Development in Amhara Regional State, Ethiopia by Using the. Healthcare, 10 (719), 1–17.
- 11) Adi, S., & Fathoni, A. F. (2020). Blended learning analysis for sports schools in Indonesia. International Journal of Interactive Mobile Technologies, 14(12), 149–164. <https://doi.org/10.3991/IJIM.V14I12.15595>.
- 12) McEntergant & Werthein (2005) Physical Activity & Youth Involvement [http://www.hksi.org.hk/hksdb/physicalactivity2\\_youngactive](http://www.hksi.org.hk/hksdb/physicalactivity2_youngactive).
- 13) Santoso, N. (2020). Evaluasi Program Kelas Khusus Olahraga Tingkat Sekolah Menengah Atas Di Kabupaten Kulon Progo Yogyakarta. MAJORA: Majalah Ilmiah Olahraga, 26(1), 8–19. <https://doi.org/10.21831/majora.v26i1.30512>.
- 14) Indrayana, B. (2017). Peranan Kepelatihan Olahraga Sebagai Pendidik, Pelatih Dan Pembina Olahraga Di Sekolah. Jorpres (Jurnal Olahraga Prestasi), 13(1), 34–42. <https://doi.org/10.21831/jorpres.v13i1.12882>.
- 15) Santoso, N. (2020). Evaluasi Program Kelas Khusus Olahraga Tingkat Sekolah Menengah Atas Di Kabupaten Kulon Progo Yogyakarta. MAJORA: Majalah Ilmiah Olahraga, 26(1), 8–19. <https://doi.org/10.21831/majora.v26i1.30512>.
- 16) Khodari, R. (2017). Evaluasi program pendidikan kelas khusus olahraga Sekolah Menengah Atas Negeri 1 Sewon Bantul Yogyakarta. Multilateral Jurnal Pendidikan Jasmani Dan Olahraga, 15 (2), 124–132. <https://doi.org/10.20527/multilateral.v15i2.2740>.
- 17) Pambudi, D. K. Evaluasi Program Penyelenggaraan Kelas Khusus Olahraga Sekolah Menengah Atas Dikaji Dengan Model Countenance Stake.
- 18) Widodo, Slameto, & Dwikurnaningsih, Y. (2018). EVALUASI PROGRAM KELAS OLAHRAGA DI SMP NEGERI 3 SALATIGA. 6–28.
- 19) Papulova, Z. (2014). The Significance of Vision and Mission Development for Enterprises in Slovak Republic. Journal of Economics, Business and Management, 2(1), 12–16. <https://doi.org/10.7763/joebm.2014.v2.90>.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## The Relationship between the Level of Knowledge of Students on the School Health Effort Program and the Role of Physical Education, Sports, and Health Teachers in Clean and Healthy Living Behavior of Elementary School Student



Tri Putro Santoso Budi<sup>1</sup>, Sumarjo<sup>2</sup>, Zaza Aazfnindar Fakhrurozi<sup>3</sup>

<sup>1,2,3</sup> Universitas Negeri Yogyakarta, Yogyakarta, DIY, 55281, Indonesia

**ABSTRACT:** This study aims to determine the relationship between the level of knowledge of students on the UKS program on clean and healthy living behavior of elementary school students. The relationship between the role of physical education teachers to the clean and healthy living behavior of elementary school students. The relationship between the level of knowledge of students on the UKS program and physical education teachers on the clean and healthy living behavior of elementary school students. The method used in this research is the quantitative research method. The data used is primary data collected using a questionnaire. The subjects in this study were elementary school students of Gugus 3 and 5 in Kapanewon Sleman and physical education teachers of Gugus 3 and 5 elementary schools in Kapanewon Sleman. Data analysis techniques using correlation and multiple regression analysis with a significance level of 5%. The results of the analysis in hypothesis test 1 show the price of  $r$  count =  $0.753 > r$  (0.05) (12) = 0.576, it is concluded that there is a positive and significant relationship between the level of student knowledge of the school health effort program on the clean and healthy living behavior of elementary school students. Based on the results of hypothesis 2 testing, the price of  $r$  count =  $0.607 > r$  table (0.05) (12) = 0.576, it is concluded that there is a relationship between the role of physical education, sports, and health (PJOK) teachers on the clean and healthy living behavior of elementary school students. Based on the results of hypothesis test 3, it is known that the price of  $F$  count is  $5.915 > F$  table (3.07) at the 5% significance level, it is concluded that there is a significant relationship between the relationship between the level of knowledge of students in the school health effort program and the role of physical education, sports and health (PJOK) teachers on clean and healthy living behavior of elementary school students.

**KEYWORDS:** UKS program, the role of PJOK teacher, clean and healthy living behavior

### I. INTRODUCTION

Health is organized to improve the ability of students to live healthy lives in a healthy environment so that students can learn, grow, and develop harmoniously and optimally into quality human resources. Law No. 36 of 2009 on Health states first, that health is a human right and one of the elements of welfare that must be realized by the ideals of the Indonesian nation. Secondly, every activity to maintain and improve the highest degree of public health is based on the principles of non-discrimination, participation, and sustainability in the context of the formation of Indonesian human resources and improving the degree of health. Third, things that cause public health problems will cause great economic losses for the country. Fourth, every development effort must be based on health insights because it is the responsibility of both the government and the community. Fifth, Law No. 23 of 1992 is no longer to the development, demands, and legal needs of society so a new health law needs to be replaced. UKS was established as an effort to carry out health education which is carried out in an integrated, conscious, planned, good, and responsible manner by schools [1].

Schools as the main facility where the teaching and learning process takes place are expected to be able to become schools that can improve the health status of their school community. This goal will certainly be achieved if the school and its environment are fostered and developed optimally, among others, through School Health Efforts (UKS), School Health Efforts (UKS) are activities carried out to improve the health of school-age children in every path, type, and level of education. The basic concept consists of curriculum, teaching and learning practices, school organization, clean and safe environment, and services.

## **The Relationship between the Level of Knowledge of Students on the School Health Effort Program and the Role of Physical Education, Sports, and Health Teachers in Clean and Healthy Living Behavior of Elementary School Student**

Schools are convenient places to implement health promotion interventions targeting children [2]. The government program to improve health services, health education, and fostering a healthy school environment or the ability to live a healthy life for school residents is carried out through UKS. This is done through the UKS program which includes health education to maintain clean and healthy living behavior in the school environment, provide health services, and develop healthy school coaching [3]. The importance of UKS activities is supported by the fact that in Indonesia the school-age group is the largest age group in the population. School Health Effort is part of a school-age child health program that has three main programs, namely health education, health services, and fostering a healthy school environment.

The form of government programs in school children's health services is implemented with TRIAS UKS. School Health Efforts are a vehicle for learning to increase the ability to live a healthy life and shape the healthy behavior of school-age children who are in school to higher education [4]. State that UKS is an effort to provide health care to registered students, carried out by medical personnel or individuals who have related expertise such as social workers, visiting nurses, counselors, psychologists, and dentists [5]. It is a program established by the government to help schools achieve success in supporting children's health, knowledge, attitudes, and behavior. It runs from elementary school to high school but is now primarily implemented in elementary schools. The purpose of School Health Efforts (UKS) is to improve the quality of education and learning achievement of students through improving physical and spiritual clean living behavior so that students can grow and develop harmoniously and optimally along with independence in activities and ultimately become quality human beings (Kurnia Hidayat, 2020). This is because elementary schools are very large communities (groups), vulnerable to various diseases, and are the basis for further education.

Through direct observation in the field conducted on Saturday, May 13, 2023, researchers found various problems that exist in Primary Schools in Gugus 3 and 5 in Kapanewon Sleman, among which the UKS program has not been implemented properly, only has a room without a clear management structure. Other problems that arise in schools are the condition of students' bathrooms that are not kept clean, there is still garbage in the yard and school environment that is not disposed of in its place, the pattern of snacks and snacks available in the school environment is sometimes not controlled by teachers, the lack of medicines in the UKS room. The use of the UKS room that is not by its function, such as the UKS is used by students as a place to relax or play during breaks, a place to put toys, can have bad consequences for students who, for example, are seriously injured because they cannot be treated immediately. There is a delay in first aid if there is no teacher responsible for handling it. UKS should be implemented as an effort to improve students' ability to live a healthy life in a healthy environment, so that students can learn, grow, and develop harmoniously, and as optimally as possible in quality to become human resources [6].

Through interviews conducted by the researcher on May 13, 2023, at 11:00 a.m.-finish which took place in Primary Schools of Gugus 3 and 5 in Kapanewon Sleman which amounted to 13 primary schools, the researcher found several explanations. Various answers were expressed by several teachers, namely the condition of the UKS room which did not have a health care structure, especially UKS, the absence of a special coach who helped provide knowledge about UKS in schools and the lack of teacher knowledge about health in schools was one of the factors that caused the UKS program to not run optimally, and the UKS room was too neglected. The decline in the implementation of UKS programs and activities is partly due to the non-implementation of UKS programs, coaching, and development of UKS in the school.

Through a preliminary study conducted, by Suganda, a teacher is a title of an office, position, and profession for someone who serves himself in the field of education through patterned, formal, and systematic interactions. The situation of teachers in Primary Schools in Gugus 3 and 5 in Kapanewon Sleman when interviews were conducted only provided health education in outline, there was no further emphasis on providing education and examples so that nothing was applied in everyday life by students in the school and home environment.

However, what happens in the field has a significant comparison, this is evident from the results of observations showing that 75% of students do not know what UKS and PHBS are, in terms of knowledge they only know the UKS room but in terms of the knowledge they do not understand. PHBS is a healthy lifestyle based on the principle of maintaining health [7]. "Clean and Healthy Living Behavior is a set of behaviors that are carried out with awareness as a result of learning that allows individuals or families to help themselves in the field of health and play an active role in creating the highest possible health" [8]. Based on Law number 36. of 2009 concerning Health article 79 states that "School Health is organized to improve the ability of healthy living of students in a healthy living environment so that students learn to grow, develop harmoniously.

Awareness of clean and healthy living behaviors that are still minimal is likely to cause various diseases that often attack school children. Several factors that affect physical health include the child's own health, the physical and social environment at school, the quality of life of parents, children's knowledge about health, and health services in their environment [9]. So that the

# **The Relationship between the Level of Knowledge of Students on the School Health Effort Program and the Role of Physical Education, Sports, and Health Teachers in Clean and Healthy Living Behavior of Elementary School Student**

learning process can run optimally and students are able to maximize learning achievement at school. Therefore, the importance of instilling health needs through a health approach is the most appropriate solution. Clean and Healthy Living Behavior (PHBS) is all health behaviors carried out on awareness so that family or family members can help themselves in the health sector and play an active role in health activities in the community. [10] states that "The Clean and Healthy Living Behavior Program (PHBS) is one of the health promotion efforts that aim to enable everyone to live in a clean and healthy environment by creating a conducive condition for individuals, families, groups and communities." Clean and Healthy Living Behavior (PHBS) is a habit that must be instilled from an early age and supported by all parties [11]. The realization of PHBS in the school setting needs to be pursued, especially in increasing the self-awareness of its targets, namely students and school residents, and supported by the existence of facilities and infrastructure. This self-awareness arises because of the knowledge gained through the school health promotion program in the form of UKS. UKS has a dominant role that can help improve students in implementing clean and healthy living behavior, especially in the school environment.

Healthy living behavior must be carried out with full awareness anywhere and anytime so that it can provide examples to others about the importance of clean and healthy living behavior. Healthy living habits require diligence in habituation in every child and must be started from an early age [12]. After students have a high awareness and understanding of PHBS, fewer students will be found sick in the school environment. In several journals, it can be concluded that schools that implement and implement the UKS program in accordance with the provisions will have a major effect on student behavior, especially in PHBS, and be able to increase student learning motivation. Indicators of environmental health coaching referring to PHBS coaching data by Puskesmas amounted to 15 indicators including cutting nails, not smoking, brushing teeth, using shoes, there is a UKS room with first aid equipment, there are youth health cadres, healthy funds, using clean water, throwing garbage in its place, healthy school stalls, regular exercise and washing hands with soap (CTPS), and measuring TB / BM regularly.

Implementing PHBS in the school environment aims to empower students, teachers, and the community to have the understanding, intention, and skills to carry out PHBS and play an active role in developing a healthy school environment. The implementation of PHBS should start from an early age so that it becomes a habit that is carried over to adulthood. Since children in elementary school are still at a young age, support from individuals around them, such as parents, teachers, and friends, is needed.

Based on the results of observations and interviews conducted by researchers, it can be concluded that in the school environment, especially in Primary Schools in Cluster 3 and 5 in Kapanewon Sleman, there are still many students who do not understand UKS, especially the UKS program and lack of concern in carrying out PHBS, as well as the lack of teacher roles in UKS programs and clean and healthy living behavior, so researchers want to conduct thesis research entitled the relationship between the level of student knowledge on school health effort programs and the role of physical education teachers on clean and healthy living behavior of primary school students in cluster 3 and 5 Kapanewon Sleman.

## **II. METHOD**

### **Type of Research**

This study uses a correlation analysis research method chosen because the focus is to investigate the relationship between two or more variables, namely how variations in one variable relate to variations in other variables (Zaenal Arifin, 2011: 48). In this study, the researcher is looking between the two independent variables of students' level of knowledge on the UKS program and the role of PJOK teachers to one dependent variable of Clean and Healthy Living Behavior.

In addition, the statement says that correlation research involves collecting data to determine whether there is a relationship and how strong the relationship is between two or more variables. The approach in this study uses a quantitative approach [13]. Is research with a positivist foundation that aims to examine certain populations or samples [14]. Data analysis in quantitative is statistical with the aim of describing and testing predetermined hypotheses. In this study, researchers will collect data on the UKS program, the role of the PJOK Teacher, and the clean and healthy living behavior of students at Murten State Elementary School using research instruments that have been previously designed. The data will then be analyzed statistically to test hypotheses and look for relationships or influences between the variables studied. This quantitative research method provides clarity and objectivity in collecting and analyzing data so that research results can be interpreted more accurately and can be used as a basis for decision-making or program development in the future.

### **Place and Time of Research**

The place of this research was at elementary schools in Gugus 3 and 5 in Kapanewon Sleman, Sleman Regency, Yogyakarta Special Region 55511. Gugus 3 itself has six (6) elementary schools, namely, Pendowoharjo Elementary School, Nyaen 1

# The Relationship between the Level of Knowledge of Students on the School Health Effort Program and the Role of Physical Education, Sports, and Health Teachers in Clean and Healthy Living Behavior of Elementary School Student

Elementary School, Nyaen 2 Elementary School, Jetisjogopaten Elementary School, Tlacap Elementary School, and IBS Elementary School. Cluster 5 consists of SDN Kadisobo 2, SDN Kadisobo 3, SDN Trimulyo, SD Muh Mantaran, SDN Sidomulyo, MI Al Ihsan. This research will be conducted in September 2023.

## Research Population and Sample

### Population

The population in this study were all Physical Education, Sports, and Health teachers of Gugus 3 and 5 elementary schools in Kapanewon Sleman, students of Gugus 3 and 5 elementary schools in Kapanewon Sleman.

### Sample

This research will use purposive sampling. Purposive sampling is a sampling technique carried out with the aim of selecting respondents who have certain characteristics relevant to the research. The criteria in this study are (1) upper grade students, (2) PJOK teachers who have been teaching for one year. This study used samples of fourth, fifth, and sixth-grade students of Primary Schools in Gugus 3 and 5 in Kapanewon Sleman, as well as Physical Education, Sports, and Health teachers of Primary Schools in Gugus 3 and 5 in Kapanewon Sleman, (3) for students, students who have been UKS administrators at the school, (4) students who have visited the UKS.

## Research Instruments and Research Techniques

Tests are one of the important research instruments in obtaining data on students' knowledge in an educational program. The UKS (Usaha Kesehatan Sekolah) program is one of the programs launched by the Indonesian government to improve the health of students and the school environment.

Tests used in research on knowledge of the UKS program must be well-designed to measure students' knowledge precisely and accurately. Overall, tests are one of the important research instruments in measuring the knowledge of primary school students in Gugus 3 and 5 in Kapanewon Sleman about the UKS program. In designing a test, researchers need to consider several factors, such as research objectives, program context, test format, difficulty level, and test validity and reliability. Thus, the research results obtained can provide accurate information about students' knowledge in the UKS program and can help improve effectively.

**Table 1. Score Acquisition**

Questions	Value
Correct	1
False	0

## Questionnaire

A questionnaire is a research instrument used to collect data from respondents through a series of structured questions. This instrument can be used in various types of research, both qualitative and quantitative. In quantitative research, questionnaires are used to collect large amounts of data and allow researchers to analyze the data with statistical methods. Whereas in qualitative research, questionnaires are used to obtain data from respondents involved in the research.

In this study, questionnaires or questionnaires were filled in according to their respective roles. Questionnaires or questionnaires on the role of physical education, sports, and health teachers were filled out by PJOK teachers, while the clean and healthy living behavior questionnaire was obtained by fourth, fifth, and sixth-grade elementary school students in Gugus 3 and 5 in Kapanewon Sleman.

## Technical Data Analysis

After the data has been collected, the next step is to analyze the data to reach conclusions from this study. To process the data, we used statistical techniques, specifically descriptive analysis with percentages. The data will be explained through tables, graphs, and diagrams, as well as calculations of mean, mode, median, decile, percentile, data distribution, average, standard deviation, and percentage.

$$P = \frac{f}{N} \times 100\%$$

Description:

P: Percentage sought

F: Frequency



# The Relationship between the Level of Knowledge of Students on the School Health Effort Program and the Role of Physical Education, Sports, and Health Teachers in Clean and Healthy Living Behavior of Elementary School Student

N: Number of respondents

After that, the next step is to classify the scores obtained from each variable. The score will be divided into three categories. This classification is carried out based on the calculated mean and standard deviation (SD) values.

**Table 2. Variable tendency**

NO	Interval Formula	Category
1	$X > ( M + 1,5 SD)$	Very Good
2	$(Mi + 0,5 SD ) < X < ( M + 1,5 SD)$	Good
3	$(Mi - 0,5 SD ) < X < ( M + 1,5 SD)$	Good enough
4	$( Mi - 0,5 SD ) < X < ( M - 1,5 SD)$	Not Good
5	$X > ( M - 1,5 SD)$	Not Very Good

X: Score

M: Mean

SD: Standard Deviation

Prerequisite Test

Normality Test

The normality test is used to determine whether the data distribution follows a normal distribution pattern or not. Data that is considered good and suitable for supporting research models is data that has a normal distribution. The basic concept of the Kolmogorov-Smirnov normality test is to compare the distribution of the data to be tested (sample data) with a standard normal distribution. The advantage of this test is its simplicity and the lack of differences in perception between observers, which often occurs in normality tests that use a graphical approach.

**Table 3. Normality Test**

Variabel	Z	p	Sig.	Description
UKS Program	0,606	0,856	0,05	Normal
The Role of the PJOK Teacher	0,536	0,936	0,05	Normal
Clean and Healthy Living Behavior	0,769	0,596	0,05	Normal

From the table above, it shows that the significance value (p) of all variables is greater than 0.05, so, the data is normally distributed. Since all data are normally distributed, the analysis can proceed with parametric statistical analysis.

Linearity Test

The linearity test is used to determine whether the independent variable and the dependent variable have a linear relationship or not. Researchers use the help of statistical programs to process the data. The criteria can be met if Fcount compared to Ftable

$$F_{hitung} = \frac{S_{TC}^2}{S_G^2}$$

at the 5% significance level has a smaller value so it can be concluded that it has a linear relationship.

**Table 4. Linearity Test**

Relationships	P	Sig 5 %	Description
Relationship between students' knowledge level on the UKS programme and PHBS	0,355	0,05	Linear
Relationship between the role of physical education teacher and PHBS	0,822	0,05	Linear

Simple Regression Analysis

The simple regression equation can be used to predict how high the causal relationship between one independent variable and one dependent variable is. The steps in performing a simple regression analysis are:

Creating a simple linear line

$$Y' = a + bX$$

# The Relationship between the Level of Knowledge of Students on the School Health Effort Program and the Role of Physical Education, Sports, and Health Teachers in Clean and Healthy Living Behavior of Elementary School Student

Description:

Y': Allowable values

a: Constant or if the price  $X = 0$

B: regression coefficient

X: independent variable value

Testing the significance of the t-test is conducted to test the significance of the constant and each independent variable will affect the dependent variable, namely with the formula:

$$F_{hitung} = \frac{S_{TC}^2}{S_G^2}$$

Description:

t: t count

r: correlation coefficient

n: nth sum

The t-test basically indicates how much impact the independent variables individually have in explaining the dependent variable. If the calculated t value is greater than or equal to the t table value, for example, 1.645 with a significance level of 5% and a sample size of n (df = n-2), then the impact is considered significant and the hypothesis can be accepted. Conversely, if the calculated t value is smaller than the t table value (e.g. 1.645 at 5% significance level), then the impact is considered insignificant and the hypothesis is rejected.

Multiple Regression Analysis

This analysis was used to test the effect of understanding the UKS program and the role of parents in explaining healthy living behavior. In multiple regression analysis, the steps to be taken are as follows:

Make a line equation with two predictors, with the formula:

$$Y = a_1X_1 + a_2X_2 + k$$

Description :

Y: criterium

$X_1X_2$ : predictor 1, predictor 2

$a_1$ : coefficient predictor 1

$a_2$ : coefficient predictor 2

k: constant number

Looking for the coefficient of determination between the predictor  $X_1X_2$  and the criterion Y, with the formula:

$$R^2 = \frac{(a_1\sum X_1Y + a_2\sum X_2Y)}{\sum Y^2}$$

Description:

$R^2$ : coefficient determination between Y and  $X_1, X_2$

$a_1$ : coefficient predictor  $X_1$

$a_2$ : coefficient predictor  $X_2$

$\sum X_1$ : sum of products between  $X_1$  and Y

$\sum X_2$ : sum of products between  $X_2$  and Y

### III. RESEARCH RESULT

Clean and Healthy Living Behavior (PHBS) is a habit that must be instilled from an early age and supported by all parties [15]. PHBS includes a series of behaviors that are carried out with awareness as a result of learning, which allows individuals or families to help themselves in the field of health and play an active role in creating public health.

Clean and Healthy Living Behavior (PHBS) continues to be a major concern of the government, as evidenced by the inclusion of PHBS as one of the main indicators in achieving health improvement in the 2015-2030 Sustainable Development Goals (SDGs) program. In the SDGs, PHBS is considered a prevention strategy with a positive impact that can be seen in a short time at three levels of society, namely in the school, family, and community environment [16]. Optimal PHBS in schools is of course influenced

## **The Relationship between the Level of Knowledge of Students on the School Health Effort Program and the Role of Physical Education, Sports, and Health Teachers in Clean and Healthy Living Behavior of Elementary School Student**

by the role of the UKS program that is optimally implemented and the role of the PJOK teacher who is able to provide health education and guide it.

1. The relationship between the level of knowledge of students on the UKS program on the clean and healthy living behavior of elementary school students

The results of the analysis in hypothesis test 1 show the price of  $r_{count} = 0.753 > r_{(0.05)}(12) = 0.576$  these results mean that there is a significant relationship between the school health effort program and the clean and healthy living behavior of school students. Clean and healthy living behavior is a health behavior that is carried out on awareness so that everyone can help themselves in the field of health and play an active role in health activities in the community.

Schools should be given special attention as a target of PHBS in the educational environment because school age in children is a time that is vulnerable to various diseases, and often these diseases appear at the age of 6-10 years the role of school health efforts (UKS) becomes important in this context (Center for Health Promotion, 2010). Schools are one of the main institutions in supporting PHBS of primary school-age children. Through this learning process, it is expected that students' knowledge will increase, enabling them to analyze and understand the situations they face, and making them competent in communicating and applying this knowledge in their daily lives (Tambuwun et al., 2019). In this case, the role of the UKS program is very important, so that PHBS in schools can be implemented properly. This significant relationship indicates that the UKS program is directly proportional to the application of PHBS for students, if the UKS program can run well, the application of PHBS will also have good results.

UKS (School Health Effort) is a health program implemented in the school environment to improve the health of students and school communities. The UKS program is based on health and education theories related to health promotion and disease prevention. Health is the key to early development that must be implemented from an early age, especially in elementary schools. Libraries in schools can also be optimized to become infrastructure in supporting knowledge by providing books that discuss clean and healthy living behaviors.

2. The Relationship between the Role of Physical Education Sports and Health Teachers (PJOK) Towards Clean and Healthy Living Behavior of Elementary School Students

Based on the results of the second hypothesis test, the price of  $r_{count} = 0.607 > r_{table}(0.05)(12) = 0.576$ , these results mean that if there is a significant relationship between the role of physical education, sports, and health (PJOK) teachers and the Clean and Healthy Living Behavior of Elementary School Students. WHO health is a condition in which a person is not only free from disease or weakness, but also balanced between physical, mental, and social functions. Therefore, measuring the quality of life related to health involves three areas of function, namely physical, psychological (cognitive and emotional), and social.

Lifestyle or health behavior problems in elementary school-age children are usually related to personal hygiene, the environment, and the birth of various diseases that often attack school-age children, making it clear that the values of PHBS in schools are still minimal and have not reached the expected level, therefore an intervention activity is needed that can improve knowledge, attitudes, and actions about PHBS in school children [17]. In the application of clean and healthy living behavior in students, it cannot be separated from the role of teachers at school. Physical education, sports, and health teachers not only play a role in the field but also provide knowledge and support in terms of healthy behavior [18]. As previously described, clean and healthy living behavior is a set of behaviors that implement self-awareness related to health and cleanliness so as to achieve a healthy living environment.

All problems can be solved with one word, namely education. To familiarize healthy living is done by maintaining personal hygiene and environmental hygiene. By improving environmental health, it is hoped that it can also improve personal health because there are so many benefits. PJOK is a series of physical or psychomotor activities based on understanding (cognitive) and implementation, which aims to shape individual behavior related to attitudes or affections (such as honesty, confidence, sportsmanship, and discipline), as well as social behavior [18]. One of the strategic efforts to mobilize and empower schools to live clean and healthy can be done by implementing clean and healthy living behaviors in the school. School health education works well because children spend most of their time there. In addition to being a learning environment, schools need to be a place to improve student health by encouraging clean and healthy living behaviors (PHBS) and creating a healthy environment [19]. For this reason, it is still necessary to have direction and guidance from teachers regarding the importance of clean and healthy living behavior in the school environment. In this regard, teachers should be able to set an example for the habituation of a clean and healthy lifestyle in the school environment by applying the role of a teacher, where the role of the teacher can be said to be not only teaching. In education, teachers have an important role in making the knowledge taught acceptable to students. The role of the teacher will always describe the expected pattern of behavior in his various interactions, whether with

## The Relationship between the Level of Knowledge of Students on the School Health Effort Program and the Role of Physical Education, Sports, and Health Teachers in Clean and Healthy Living Behavior of Elementary School Student

students, fellow teachers, or others. Teachers are among the main formers of prospective citizens [20]. The role of the teacher is not only limited to teaching (conveying knowledge), but also as a guide, developer, and manager of learning activities that can facilitate student learning activities in achieving predetermined goals. Teachers as people whose duties are related to efforts to educate the nation's life in all its aspects through optimizing the various potentials possessed by students.

3. The relationship between the level of knowledge of students on the UKS program and the role of physical education teachers in the clean and healthy living behavior of elementary school students.

Based on the results of the third hypothesis test, it is known that the price of F count is  $5.915 > F$  table (3.07) at the 5% significance level, thus meaning that there is a significant relationship between the relationship between the level of student knowledge on the UKS program and the role of the PJOK teacher on the clean and healthy living behavior of elementary school students. In efforts to promote a healthy lifestyle, there are several factors that play a role. PJOK teachers have a strategic role in forming a strong foundation for the quality of healthy life of future generations. This task is related to development in the school environment, so there are several competencies that need to be possessed by a PJOK teacher, such as understanding and knowledge of the purpose and benefits of School Health Efforts (UKS), skills in the field of UKS, and the ability to compile reports on UKS activities [21].

In order for UKS to run well, physical education, sports, and health teachers must have a good role in the UKS program and have good efforts. Efforts to improve students' understanding of PHBS are carried out through the use of videos. In this case, the efforts of PJOK teachers are to provide health education and create an environment and mentality for students to grow and develop with interesting things that make students enthusiastic [22]. A PJOK teacher is an individual who has the knowledge, skills, and authority to teach PE subjects. With this knowledge, skills, and authority, they are responsible for the management of School Health Efforts. The implementation of UKS programs is a way to improve the quality of student health. Therefore, the success of the UKS program can be achieved when PE teachers are able to manage it well.

These results show that if the continuity between the UKS program and the role of the teacher must be in line, meaning that the role of the teacher in running the UKS program can run well, then the PHBS of elementary school students also runs well. Knowledge and behavior about clean and healthy lifestyles (PHBS) are important factors in improving and forming healthy living habits in the future. Measurement of knowledge and PHBS is done to obtain information about the child's profile as soon as possible with the aim of improving and developing the child's ability to create a good quality of life.

## V. CONCLUSIONS

Based on the results of research and discussion, the conclusions of this study can be drawn as follows:

There is a significant relationship between students' level of knowledge about the School Health Program (UKS) and clean and healthy living behavior in elementary schools. Students who have better knowledge about UKS tend to have better clean and healthy living behaviors. In addition, the role of physical education, sport, and health (PJOK) teachers also has a strong influence on the clean and healthy living behavior of students in primary schools. PJOK teachers who are active in providing health education and creating an environment that supports PHBS are able to positively influence student behavior. The continuity and cooperation between the UKS Program and the role of PJOK teachers are very important in achieving effective PHBS. Both complement each other in shaping students' clean and healthy living behavior. Thus, health education in schools has a vital role in shaping the clean and healthy living behavior of the younger generation, creating a healthier environment, and improving their quality of life.

## REFERENCES

- 1) Tim Esensi (2012). Mengenal UKS. Jakarta:Penerbit Erlangga
- 2) Huys, N., De Cocker, K., De Craemer, M., Roesbeke, M., Cardon, G., & De Lepeleere, S. (2017). School Gardens: A Qualitative Study on Implementation Practices. *International Journal of Environmental Research and Public Health*, 14(12). <https://doi.org/10.3390/ijerph14121454>
- 3) Yarnita, Y., Kusumaningrum, T. S., Isnaniar, I., Gasril, P., Maswarni, M., Widiyanto, J., Norlita, W., & Chairil, C. (2018). Pelatihan Kesehatan Tentang Usaha Kesehatan Sekolah (UKS), Perilaku Hidup Bersih dan Sehat (PHBS) dan Pertolongan Pertama pada Kecelakaan (P3K) di SMAN 05 Tapung Kab. Kampar. *Jurnal Pengabdian UntukMu NegeRI*, 2(1), 25–28. <https://doi.org/10.37859/jpumri.v2i1.385>

## The Relationship between the Level of Knowledge of Students on the School Health Effort Program and the Role of Physical Education, Sports, and Health Teachers in Clean and Healthy Living Behavior of Elementary School Student

- 4) Suganda, O., Syafrial, S., Sutisyana, A., Arwin, A., & Prabowo, A. (2021). Peran Guru Pendidikan Jasmani Olahraga dan Kesehatan (PJOK) Dalam Kegiatan Pelaksanaan Usaha Kesehatan Sekolah (UKS) Di Smk Negeri Se-Kabupaten Bengkulu Utara. *SPORT GYMNASTICS : Jurnal Ilmiah Pendidikan Jasmani*, 2(2), 319–327.  
<https://doi.org/10.33369/gymnastics.v2i2.17102>
- 5) Antonova, D., Kunev, S., Venelinova, N., & Kostadinova, I. (2021). Data Management Conceptual Algorithm of Transnational Digital Scientific Infrastructure as an Answer to the Globalization Challenges. *SHS Web of Conferences*, 92(January), 05002. <https://doi.org/10.1051/shsconf/20219205002>
- 6) Aminah, S., Wibisana, E., Huliatusunisa, Y., & Magdalena, I. (2021). Usaha Kesehatan Sekolah (UKS) untuk Meningkatkan Perilaku Hidup Bersih dan Sehat (PHBS) Siswa Sekolah Dasar. *Jurnal JKFT: Universitas Muhamadiyah Tangerang*, 6(1), 18–28.
- 7) Suharjana. (2020). Kebiasaan Berprilaku Hidup Sehat dan Nilai-Nilai Pendidikan Karakter. *Jurnal Pendidikan Karakter*, 2(2), 189–202.
- 8) Aswadi, Syahrir, S., Delastara, V., & Surahmawati. (2017). Gambaran Perilaku Hidup Bersih dan Sehat (PHBS) pada Siswa Siswi SDK Rita Pada Kecamatan Kota Komba Kabupaten Manggarai Timur Propinsi Nusa Tenggara Timur. *Al-Sihah : Public Health Science Journal*, 9(2), 187–196.
- 9) Sadaat, Q. U. (2017). School Health Program (SHP). April.
- 10) Hartaty, H., & Kurni Menga, M. (2022). Pemberdayaan Masyarakat Melalui Penyuluhan Perilaku Hidup Bersih Dan Sehat Untuk Meningkatkan Derajat Kesehatan Masyarakat. *Abdimas Polsaka*, 1(1), 16–21.  
<https://doi.org/10.35816/abdimpolsaka.v1i1.7>
- 11) Masykuroh, K. (2020). Implementasi perilaku hidup bersih dan sehat (PHBS) disekolah rujukan nasional TK'Aisyiyah 4 tet. *JPP PAUD FKIP Untirta*, 7(1), 35–48. <http://jurnal.untirta.ac.id/index.php/jpppaud/index> IMPLEMENTASI
- 12) Apriani, L., & Gazali, N. (2018). Pelaksanaan trias usaha kesehatan sekolah (UKS) di sekolah dasar. *Jurnal Keolahragaan*, 6(1), 20–28. <https://doi.org/10.21831/jk.v6i1.14456>
- 13) Sukardi. 2003. Metode Penelitian Pendidikan. Jakarta: Bumi Aksara.
- 14) Sugiyono. (2015). Metode penelitian pendidikan: pendekatan kuantitatif, kualitatif, dan R & D. Alfabeta
- 15) Masykuri, M. S. (2019). Kreativitas Guru Pendidikan Jasmani Olahraga Dan Kesehatan Dalam Mengatasi Keterbatasan Sarana Dan Prasarana Di Sekolah Menengah Kejuruan Swasta Se-Kabupaten Bantul. *Universitas Negeri Yogyakarta*,
- 16) Kementerian kesehatan. (2011). Peraturan Menteri Kesehatan Republik Indonesia. Peraturan Menteri Kesehatan No. 2406 TAHUN 2011 Tentang Pedoman Umum Pembinaan Perilaku Hidup Bersih Dan Sehat (PHBS), 4.
- 17) Sumiran, R. E, Maramis, F. R. R, Pelealu, F. J. O. (2017). Gambaran perilaku hidup bersih dan sehat (PHBS) sekolah di SD Advent 01 tikala Manado. 6(3), 2-3. Diakses dari <https://ejournal.unsrat.ac.id/index.php/kesmas/article/view/23066>.
- 18) Fawaid, M. F. Al, Supriyadi, & Zaini, M. (2018). Hubungan Peran Guru Pendidikan Jasmani Olahraga dan Kesehatan (PJOK) dengan Pelaksanaan Program TRIAS UKS di SMP N 1 Tanggul Jember. 28, 1–11.  
<http://repository.unmuhjember.ac.id/id/eprint/10389>
- 19) Warsono. (2017). GURU : ANTARA PENDIDIK , PROFESI , DAN AKTOR SOSIAL. *The Journal of Society & Media*, 1(1), 1–10.  
<https://journal.unesa.ac.id/index.php/jsm/article/viewFile/1249/867>
- 20) Nopiyanto, Y. E., Raibowo, S., Prabowo, A., Sulastri, & Alimuddin. (2021). Peran Guru Penjas dalam Kesiapsiagaan Bencana Alam Gempa Bumi di Sekolah Dasar Kecamatan Taba Atas. *Jurnal Pendidikan Dan Kesehatan Rohani*, 7(2), 295–303.
- 21) Muliadi, M. (2018). Peran Guru Pendidikan Jasmani Olahraga Dan Kesehatan Terhadap Pelaksanaan Program Usaha Kesehatan Sekolah (UKS) Di Sekolah Dasar. *JIKAP PGSD: Jurnal Ilmiah Ilmu Kependidikan*, 2(2), 19.  
<https://doi.org/10.26858/jkp.v2i2.6858>
- 22) Paturusi, A. (2012). Manajemen pendidikan jasmani dan olahraga. Jakarta: Rineka Cipta



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Review on Effects of Organophosphate Pesticides in Human Health and Way to Mitigates its Harmful Impacts



Mr. Subrata Kumar Payra<sup>1</sup>, Ms. Deepa Goswami<sup>2</sup>, Mrs. Sanchita Pan<sup>3</sup>, Mr. Atanu Bera<sup>4</sup>,  
Ms. Supriya Jana<sup>5</sup>, Mr. Jagmohan Sing<sup>6</sup>, Mr. Atanu Bhowmik<sup>7</sup>

<sup>1</sup>Assistant Professor, Zoology Department, Panskura Banamali College, 721152, West Bengal, India.

<sup>2</sup>PhD Scholar, Chemical Engineering Department, Jadavpur University, Kolkata, 700032.

<sup>3</sup>SACT, Zoology Department, Jhargram Raj College, Jhargram, 721507.

<sup>4</sup>M.Sc, PhD Scholar under Vidyasagar University, Medinipur, 721102.

<sup>5,6</sup>B.Sc. in Zoology, Jhargram Raj College, Jhargram, 721507.

<sup>7</sup>M.Sc, in Botany, From Vidyasagar University, Medinipur, 721102.

**CORRESPONDING AUTHOR : Mr. Subrata Kumar Payra**

**ABSTRACT:** Due to increasing the human population day by day, for the control of the human population, needs to increase the agricultural productivity, for agricultural production is increasing we use pesticide. Pesticides not only kill the target pest species also affect non-target organisms. Pesticide pollution has become a significant problem all over the world. This is mainly due to the abuse and overuse of pesticides which remain in the soil for several years and leach into water bodies. Pesticides are chemical (synthetic or semi-synthetic) agents that control and destroy pest population. Organophosphate pesticides are major bulk that includes malathion, parathion, diazinon, fenthion, chlordecone, Imidacloprid, dichlorvos, chlorpyrifos, ethion, nerve gases (soman, sarin, tabun, VX), ophthalmic agents (echothiophate, isofluorophate), and anthelmintics (trichlorfon). Herbicides (tribufos or DEF, merphos) are tricresyl phosphate etc. Though various pesticides were banned due to its harmful impacts on human health and environment, but still some has been used in paddy fields, greenhouse culture, horticulture and even hydroponics. They persistent in nature (bio-accumulation and bio-magnification by the food chain, especially through pieces) and cause acute or chronic toxicity. They contain very noxious components that harm our neuronal system by cholinergic effects. Pesticide also has an unfavorable effect on aquatic organisms such as ataxia causing late maturation in fish. Various physical and chemical methods are used for the reduction the toxicity of pesticides, physically and chemically pesticide reduction process is costly and hazardous. One good strategy is applied for the remediation of pesticides is bioremediation, i.e- use of various modified strain of agricultural microbes especially bacteria.

**KEYWORDS:** Pesticides, Chlorpyrifos, Bio-magnification, Cholinergic effect and Bioremediation.

### INTRODUCTION

Organophosphates (OPs) are large group about 40% of total pesticide, (Rao et al., 2005) of chemical that used over past 7 decades in livestock practice, human health and welfare, and defensive agents. These are class of insecticides, several of which are highly toxic as contain cholinesterase inhibitor property thus directly or indirectly deals with CNS, i.e. Neurological disorders, (Gupta, 2001). Besides of this the direct exposure of it causes skin etching, seizure, respiratory disorders and ultimately death of organisms. The route of explosion may be differ in different organism, such as dermal adsorption, inhalation and through diet via food web in ecosystem (Costa, 2018). Thirty-six of OPs are presently registered for use in the United States, and all can potentially cause acute and sub-acute toxicity. Organophosphates are used in agricultural fields, homes, gardens and horticulture, and veterinary practices. Parathion and chlorpyrifos, has no longer registered for any use. All share a common mechanism of cholinesterase inhibition and can cause similar symptoms, although there are some differences within the class. However, that there is a wide range of toxicity in these agents and wide variation in dermal absorption. Organophosphates poison insects and other animals, including birds, amphibians and mammals (via ecological food chain), primarily by phosphorylation of the acetylcholinesterase enzyme (AChE) at nerve end plate. The result is a loss of available AChE so that the effectors organ becomes over- stimulated by the excess acetylcholine (ACh, the impulse-transmitting substance) in the nerve ending. At skeletal muscle junctions, excess ACh

## **Review on Effects of Organophosphate Pesticides in Human Health and Way to Mitigates its Harmful Impacts**

may be excitatory (cause muscle twitching) but may also weaken or paralyze the cell by depolarizing the end plate. Impairment of the diaphragm and thoracic skeletal muscles can cause respiratory paralysis (Routt and Roberts, 1999). In the CNS, high Ach concentrations cause sensory and behavioral disturbances, in coordination, depressed motor function and respiratory depression. Increased pulmonary secretions coupled with respiratory failure are the usual causes of death from organophosphate poisoning. Some of the most commonly reported early symptoms include headache, nausea, dizziness and hyper-secretion, the latter of which is manifested by sweating, salivation, lacrimation and rhinorrhea. Muscle twitching, weakness, tremor, in coordination, vomiting, abdominal cramps and diarrhea all signal worsening of the poisoned state. Organophosphate herbicides interacting with soil biota and altering the biomass of environment (Usman et al., 2017). Some organophosphates, such as diazinon, fenthion and methyl parathion, have significant lipid solubility, allowing fat storage with delayed toxicity due to late release. 3,4 Delayed toxicity may also occur atypically with other organophosphates, specifically dichlorofenthion and demton-methy. Many organo-thiophosphates readily undergo conversion from thions (P=S) to oxons (P=O). Conversion occurs in the environment under the influence of oxygen and light and, in the body, chiefly by the action of liver microsomal enzymes. Level of threat are detected in various way: dose determination by LC50 and LD50 of OPs pesticide, various physio-chemical and biological parameter test of target tissue and symptoms (Zhang et al, 2017). Various degradation strategies should be taking now days like abiotic degradation by chemical oxidation, catalytic hydrolysis, adsorbing agents and gamma radiation. Major disadvantages of it are high cost and natural unsustainability. Another most effective and eco-friendly method is bioremediation by microbial strains on which more research and technology involved. In some cases the patient with severe exposure of OPs are treated with atropine like drugs. India is fourth largest producer of pesticide in the world that largely affects on India's GDP and economy. Pesticide Management Bill (PMB, 2020) is an opportunity to clean up India's food and farming system.

### **RESULT**

#### **1.1. The Impacts of Organophosphate Pesticides on Human Health:**

##### **Choline Esterase Effects:**

The cholinergic i.e. blocked the substrate binding site of Acetyl choline esterase enzyme, effects brought about by repeated administration of less than a single fatal dose are similar in type to the acute single-dose effects (WHO, 1986).

##### **Dermal or Cutaneous Effects:**

Shoot particle and pesticide droplets during spray at agricultural field directly expose at dermal contact, cause skin rashes and allergic manifestation.

##### **Immediate or Acute Toxicity:**

Acute toxicity is the ability of a substance to cause harmful impacts immediately in a single exposure or dose or any severe poisonous effect resulting from a single short-term exposure to a toxic substance. LD50 (lethal dose 50) is defined as the dose that kills 50% of a test population of the exposed animals (Ghosh and Philip, 2006). In an acute study, neurotoxic signs were seen at 190 mg/kg in rats, and were more prominent in females. Also, in vitro studies have shown butyl cholinesterase to be more sensitive to profenofos inhibition than acetyl cholinesterase (AChE) (McDaniel and Moser, 2004).

##### **Chronic Toxicity**

Chronic toxicity is the capacity of a substance to cause long-term or delayed adverse health effects. Several reports proved the chronic toxicity of atrazine on various test organisms. After the sign of respiratory distress and paralysis of the limbs, 40% rats were died at an atrazine oral dose of 20 mg/kg/day for 6 months. Body organs like brain, liver, kidneys, ovaries etc., were affected by organophosphates poisons and made structural and chemical changes, as well as growth retardation. In a study carried out for two years with dogs, results showed that 7.5 mg kg<sup>-1</sup> day<sup>-1</sup> atrazine dose caused decreasing in food intake and increased heart and liver weights. The NOEL on rat was 70 mg kg<sup>-1</sup> whereas in dog it was 15 mg kg<sup>-1</sup> of body weight (Sameeh, 2004).

##### **Long term Neuropathic Effects**

Delayed neuropathy has occurred occasionally in human being, livestock and experimental animals after intoxication with a variety of OPs esters. However, many OPP that might, theoretically, cause neuropathy, would only do so at a dose far above the lethal dose (WHO, 1986).

##### **Carcinogenic Effects**

Many OPs pesticides have not shown carcinogenic potential in animal experiments, but some pesticides do, through induction of tumors in rats and mice. No generalizations can be made due to some compounds exhibit mutagenic activity, whereas other compounds do not (WHO, 1986).

# Review on Effects of Organophosphate Pesticides in Human Health and Way to Mitigates its Harmful Impacts

## Reproductive Effects

A number of pesticides clearly have the potential to cause reproductive toxicity in animals, and several compounds e.g. (chlordecone) are known to affect human reproduction (Sameeh, 2004). Also OPs included insecticides (malathion, parathion, diazinon, fenthion, dichlorvos, chlorpyrifos, ethion), nerve gases (soman, sarin, tabun, VX), ophthalmic agents (echothiophate, isoflurophate), and antihelminthics (trichlorfon). Herbicides (tribufos [DEF], merphos) are tricresyl phosphate-containing industrial chemicals.

## Immunotoxicity

The scientific evidence suggesting that many pesticides damage the immune system. Animal studies have found that pesticides alter the immune system's normal structure, disturb immune responses, and reduce animal's resistance to antigens and infectious agents. In case of Malathion which is considered a very low toxic compound (oral LD50= 2100 mg/kg bw), for example, not regulates the immune system, especially affecting non-specific immune mechanisms (Sameeh, 2004).

## Cytogenetic Effects

Cytogenetic damage related to pesticides exposure has been reported in various populations. Some investigators have reported significant differences in the percentage of chromosomal aberrations (CAs) in exposed individuals (range, 2.66–10.30%) compared with control (range, 0.53– 5.52%) (Sameeh, 2004).

## Teratogenic Effects

Detailed data on the effects of organophosphate occupational exposure on pregnant women and their fetuses are not available, although such information would be valuable. In humans only a few cases of acute organophosphorus insecticide poisoning during pregnancy have been described. A 24-year-old woman in her third month of pregnancy injected herself with Malathion in a suicide attempt. A therapeutic abortion was performed 2 months later. Continuation of the pregnancy was considered to be dangerous, although the condition of the fetus was not described (WHO, 1986).

## Effects on the Immune System

The most Organophosphorus pesticides elicit autoimmune reactions and suppress the production of antibodies against various vaccines (Zackov, 1983).

### 1.2. Symptoms of Organophosphate Pesticide Poisoning (Acute to Chronic)

Level of Exposition	Mild Exposition	Moderate Exposition	High Exposition	Very High Exposition
Symptoms	Poor vision	Muscle Tremor	Slow heartbeat	Paralysis
	Nausea/Vomiting	Disorientation and balance	Coma	Fertility Disorder
	Muscle twitching	Diarrhoea	Narrow pupil	Cancer
	Abnormal Salivation	Cough	Excessive saliva, tears, and urination	Pancreatic disorders
	Headache	Sneezing	Neurological impaired	Digestive problems
	Weakness	Severe vomiting	Heart and lung abnormalities	Blood sugar
	Agitation		Difficulty in Breathing	Neurological disorder

Table. Shows level of exposure combine with manifested symptoms. Source: Article, A treatise on Organophosphate Pesticide pollution by Kaushal J. et al., 2020.

### 4.3 Bioremediation:

Bioremediation reduces pesticide contamination of agricultural soils by biodegradation processes via the metabolic activities of microorganisms. It is an efficient, cost-effective, and environment-friendly treatment. During the bioremediation processes, the microorganisms use the pesticides as co-substrates in their metabolic reactions together with other nutrients, thus eliminating them from the environment. The efficiency of these processes depends on the characteristics of pesticides, such as their distribution, their bioavailability, and their persistence in soil. It is necessary to promote the availability of pesticides to microorganisms: this is negatively affected by the adhesion of pesticides to soil particles and their low water solubility [Ortiz-



## Review on Effects of Organophosphate Pesticides in Human Health and Way to Mitigates its Harmful Impacts

Hernández et al, 2014]. In addition, the soil characteristics and the environmental conditions, such as pH, water content, microbial diversity, and temperature, influence the bioremediation efficacy.

Sl. No.	Organophosphate Pesticide	Microbes/ Microbial strain that metabolically degrade
1	Chlorpyrifos	<i>Bacillus pumilus</i> strain C2A1, <i>Pseudomonas. aeruginosa</i> , <i>P. stutzeri</i> , <i>P. putida</i> , <i>Bacillus aryabhata</i> , <i>Stenotrophomonas</i> sp., <i>Leuconostoc mesenteroides</i> , <i>Trichoderma harzianum</i> , <i>Penicillium vermiculatum</i> , and <i>Mucor</i> sp. etc
2	Malathion	<i>Pseudomonas</i> sp., <i>P. stutzeri</i> , <i>Arthrobacter</i> , <i>Stenotrophomonas</i> sp., <i>Leuconostoc mesenteroides</i>
3	Diazinon	<i>Serratia marcescens</i> D1101. and <i>Pseudomonas</i> sp., <i>LactoBacillus brevis</i> , <i>Mycobacterium</i> sp., and <i>Stenotrophomonas</i> sp.
4	Methyl-parathion	<i>Pseudomonas</i> sp., <i>Xanthomonas</i> sp., <i>Pseudomonas</i> sp., <i>P. stutzeri</i> , <i>Arthrobacter</i> , <i>Stenotrophomonas</i> sp., <i>Leuconostoc mesenteroides</i> , <i>Brevis</i> L., <i>Plantarum</i> L., <i>Sakei</i> .
5	Fenitrothion	<i>Burkholderia</i> sp. strain NF1000, <i>Arthrobacter aurescenes</i> TW17, <i>Corynebacterium</i> and <i>Arthrobacter</i> sp..
6	3-methyl-4- nitrophenol by	<i>Ralstonia</i> sp. SJ98

### CONCLUSION

Ever bursting human population demands more food, cloth and daily needs thus we must increase our livestock production many more in a poor illegal methods. That leads to the damage of microbial community and natural stability and sustainability, thus human health. Various controlling measurement should take but bioremediation or phytoremediation is most effective one. With modern researches, advance technologies, legislative strategy and human awareness we can protest against it. Controlling human population is one of most effective indirect method. If that is gone continuously the future generation will suffer most hazardously.

### ACKNOWLEDGEMENTS

The first author is thanks to his parents and beloved brother for supporting various purposes. The second author is grateful to her parents for continuous encouragement and supports. The third author is thanks to her teacher Debasish Chanda for his ideal teaching and also guiding to her. The fourth author owe his deepest sense of gratitude and regard to his teacher Dr. Pritiranjana Pahari, Assistant professor Co- coordinator, PG Department of Zoology, Tamralipta Mahavidyalaya for his suggestion, encouragement and support. The fifth author is thanks to her teacher Biswajit Ghosh, Assistant teacher in physics, Kharbandhi S.C. High School, Kharbandhi, W.B. for his ideal teaching and also guiding. The seventh author is thanks to his parent for continuous support.

**Conflict of Interest:** The Authors declare no conflict of interest.

**Funding:** The work doesn't require any external funding.

### REFERENCES

- 1) Abhijith BD, Ramesh M, Poopal RK (2016) Responses of metabolic and antioxidant enzymatic activities in gill, liver and plasma of *Catla catla* during methyl parathion exposure. *J Basic Appl Zool* 77:31–40.
- 2) Abhilash PC, Singh N (2009) Pesticide use and application: an Indian scenario. *J Hazard Mater* 165:1–12.
- 3) Abraham J, Silambarasan S (2016) Biodegradation of chlorpyrifos and its hydrolysis product 3,5,6-trichloro-2-pyridinol using a novel bacterium *Ochrobactrum* sp. *JAS2: a proposal of its metabolic pathway. Pestic Biochem Physiol* 126:13–21.

## Review on Effects of Organophosphate Pesticides in Human Health and Way to Mitigates its Harmful Impacts

- 4) Akbar S, Sultan S (2016) Soil bacteria showing a potential of chlorpyrifos degradation and plant growth enhancement. *Braz J Microbiol* 47(3):563–570.
- 5) Akbar S, Sultan S, Kertesz M (2014) Bacterial community analysis in chlorpyrifos enrichment cultures via DGGE and use of bacterial consortium for CP biodegradation. *World J Microbiol Biotechnol* 30:2755–2766.
- 6) Alavanja MC, Samanic C, Dosemeci M, Lubin J, Tarone R, Lynch CF, Knott C, Thomas K, Hoppin JA, Barker J, Coble J, Sandler DP, Blair A (2003) Use of agricultural pesticides and prostate cancer risk in the agricultural health study cohort. *Am J Epidemiol* 157:800–814.
- 7) Anwar S, Liaquat F, Khan QM, Khalid ZM, Iqbal S (2009) Biodegradation of chlorpyrifos and its hydrolysis product 3,5,6-trichloro-2-pyridinol by *Bacillus pumilus* strain C2A1. *J Hazard Mater* 168(1):400–405.
- 8) Barcelo D (1991) Occurrence, handling and chromatographic determination of pesticides in the aquatic environment. A review. *Analyst* 116(7):681–689.
- 9) Bharagava RN, Chowdhary P, Saxena G (2017a) Bioremediation: an ecosustainable green technology: its applications and limitations. In: Bharagava RN (ed) *Environmental pollutants and their bioremediation approaches*, 1st edn. CRC Press/Taylor & Francis Group, Boca Raton, pp 1–22. <https://doi.org/10.1201/9781315173351-2>.
- 10) Blakley BR, Yole MJ, Brousseau P, Boermans H, Fournier M (1999) Effect of chlorpyrifos on immune function in rats. *Vet Hum Toxicol* 41(3):140–144.
- 11) Chandra R, Saxena G, Kumar V (2015) Phytoremediation of environmental pollutants: an eco-sustainable green technology to environmental management. In: Chandra R (ed) *Advances in biodegradation and bioremediation of industrial waste*, 1<sup>st</sup> edn. CRC Press/Taylor & Francis Group, Boca Raton, pp 1–30. <https://doi.org/10.1201/b18218-2>.
- 12) Charoensri K, Esuchart U, Nouwarath S, Pairote P (2001) Degradation of methyl parathion in an aqueous medium by soil bacteria. *Sci Asia* 27:261–271.
- 13) Chaudhry GR, Ali AN, Wheeler WB (1988) Isolation of a methyl parathion-degrading *Pseudomonas* sp. that possesses DNA homologous to the opd gene from a *Flavobacterium* sp. *Appl Environ Microbiol* 54:288–293
- 14) Deng S, Chen Y, Wang D, Shi T, Wu X, Ma X, Li X, Hua R, Tang X, Li QX (2015) Rapid biodegradation of organophosphorus pesticides by *Stenotrophomonas* sp. G1. *J Hazard Mater* 297:17–24.
- 15) Dhanjal NIK, Kaur P, Sud D, Cameotra SS (2014) Persistence and biodegradation of quinalphos using soil microbes. *Water Environ Res* 86:457–461.
- 16) Elersek T, Filipic M (2011) Organophosphorous pesticides – mechanisms of their toxicity. In: Stoytcheva M (ed) *Pesticides – the impacts of pesticides exposure*.
- 17) Engel LS, Hill DA, Hoppin JA, Lubin JH, Lynch CF, Pierce J, Samanic C, Sandler DP, Blair A, Alavanja MC (2005) Pesticide use and breast cancer risk among farmers' wives in the agricultural health study. *Am J Epidemiol* 161:121–135.
- 18) EPA (2020) Environmental protection agency reregistration eligibility decision for profenofos. [http://www.epa.gov/oppsrrd1/REDs/profenofos\\_red.pdf](http://www.epa.gov/oppsrrd1/REDs/profenofos_red.pdf).
- 19) Fawzy I, Iman Z, Hamza A (2007) The effect of an Organophosphorus insecticide on the hepatic, renal and pulmonary tissues of mice fetuses Egypt. *J Med Lab Sci* 16:99–113.
- 20) Feng F, Ge J, Li Y, Cheng J, Zhong J, Yu X (2017) Isolation, colonization, and Chlorpyrifos degradation mediation of the endophytic bacterium *Sphingomonas* strain HJY in Chinese chives (*Allium tuberosum*). *J Agric Food Chem* 65(6):1131–1138.
- 21) Gangireddygar VSR, Kalva PK, Ntushelo K, Bangeppagari M, Djami Tchatchou A, Bontha RR (2017) Influence of environmental factors on biodegradation of quinalphos by *Bacillus thuringiensis*. *Environ Sci Eur* 29(1):11.
- 22) Ghanem I, Orfi M, Shamma M (2007) Biodegradation of chlorpyrifos by *Klebsiella* sp. isolated from an activated sludge sample of waste water treatment plant in Damascus. *Folia Microbiol* 52(4):423–427.
- 23) Gilani RA, Rafique M, Rehman A, Munis MFH, ur Rehman S, Chaudhary HJ (2016) Biodegradation of chlorpyrifos by bacterial genus *Pseudomonas*. *J Basic Microbiol* 56:105–119.
- 24) Gupta R. C., 2001, *Toxicology of Organophosphate and Carbamate compounds*, pp. 5-14.
- 25) Huang QY, Huang L, Huang HQ (2011) Proteomic analysis of methyl parathion-responsive proteins in zebrafish (*Danio rerio*) brain. *Comp Biochem Physiol C Toxicol Pharmacol* 153(1):67–74.
- 26) Ishag AESA, Abdelbagi AO, Hammad AMA, Elsheikh EAE, Elsaid OE, Hur J-H, Laing MD (2016) Biodegradation of chlorpyrifos, malathion and dimethoate by three strains of bacteria isolated from pesticide-polluted soils in Sudan. *J Agric Food Chem* 64:8491–8498.
- 27) John EM, Sreekumar J, Jisha MS (2016) Optimization of Chlorpyrifos degradation by assembled bacterial consortium using response surface methodology. *Soil Sedimentol Contam* 25:668–682.

## Review on Effects of Organophosphate Pesticides in Human Health and Way to Mitigates its Harmful Impacts

- 28) Malghani S, Chatterjee N, Hu X, Zejiao L (2009a) Isolation and characterization of a profenofos degrading bacterium. *J Environ Sci (China)* 21:1591–1597.
- 29) M. A. Ghorab, M. S. Khalil, 2015, Toxicological Effects of Organophosphates Pesticides. doi: 10.11648/j.ijema.20150304.13. *International Journal of Environmental Monitoring and Analysis*.
- 30) Mohapatra PK (2008) Textbook of environmental microbiology. I.K. International Publishing House Pvt. Ltd, New Delhi.
- 31) Nair AM, Rebello S, Rishad KS, Asok AK, Jisha MS (2015) Biosurfactant facilitated biodegradation of quinalphos at high concentrations by *Pseudomonas aeruginosa* Q10. *Soil Sediment Contam* 24:542–553.
- 32) Ortiz-Hernández, M.L.; Rodríguez, A.; Sánchez-Salinas, E.; Castrejón-Godínez, M.L. Bioremediation of Soils Contaminated with Pesticides: Experiences in Mexico. In *Bioremediation in Latin America: Current Research and Perspectives*; Alvarez, A., Polti, M.A., Eds.; Springer: Cham, Switzerland, 2014; ISBN 9783319057385
- 33) Prakash A, Khan S, Aggarwal M, Telang AG, Malik JK (2009) Chlorpyrifos induces apoptosis in murine thymocytes. *Toxicol Lett* 189:S83.
- 34) Rani NL, Lalitha-kumari D (1994) Degradation of methyl parathion by *Pseudomonas putida*. *Can J Microbiol* 4:1000–1004.
- 35) Salunkhe VP, Sawant IS, Banerjee K, Rajguru YR, Wadkar PN, Oulkar DP, Naik DG, Sawant SD (2013) Biodegradation of profenofos by *Bacillus subtilis* isolated from grapevines (*Vitis vinifera*). *J Agric Food Chem* 61:7195–7202.
- 36) Singh BK, Walker A, Morgan JAW, Wright DJ (2003) Effect of soil pH on the biodegradation of chlorpyrifos and isolation of a chlorpyrifos-degrading bacterium. *Appl Environ Microbiol* 69:5198–5206.
- 37) Suleiman U., Kundiri A. M., maximilien N.. 2017. Effects of Organophosphate Herbicides on Biological Organisms in Soil Medium, a mini review, *J. Ecol. Toxicol.*, 1 (2017).
- 38) Tallur PN, Mulla SI, Megadi VB, Talwar MP, Ninnekar HZ (2015) Biodegradation of cypermethrin by immobilized cells of *Micrococcus* sp. strain CPN 1. *Braz J Microbiol* 46(3):667–672.
- 39) Tilman D, Cassman KG, Matson PA, Naylor R, Polasky S (2002) Agricultural sustainability and intensive production practices. *Nature* 418:671–677.
- 40) Venkateswarl S., C. H., Eddleston M., 2005 Pesticide Poisoning in South India: Opportunities for Prevention and Improved Medical Management, *Trop. Med. Int. Health*, 10 (2005), pp. 581-588.
- 41) WHO (2004) Methyl parathion in drinking-water. WHO/SDE/WSH/03.04/106. [http://www.who.int/water\\_sanitation\\_health/dwq/chemicals/methylparathion.pdf](http://www.who.int/water_sanitation_health/dwq/chemicals/methylparathion.pdf).
- 42) Yadav M, Shukla AK, Srivastva N, Upadhyay SN, Dubey SK (2016) Utilization of microbial community potential for removal of chlorpyrifos: a review. *Crit Rev Biotechnol* 36(4):727–742.
- 43) Zheng Y, Long L, Fan Y, Gan J, Fang J, Jin W (2013) A review on the detoxification of organophosphorus compounds by microorganisms. *Afr J Microbiol Res* 7:2127–2134.
- 44) Zhongli C, Shunpeng L, Guoping F (2001) Isolation of methyl parathion-degrading strain M6 and cloning of the methyl parathion hydrolase gene. *Appl Environ Microbiol* 67:4922–4925.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Effect of Topical Gel Administration of Secretome Hypoxia Mesenchymal Stem Cells (SH-MSCs) on IL-10 and TNF- $\alpha$ Gene Expression (In Vivo Experimental Study in Male Rats of Wistar Strains Model of Fluconazole-Induced Alopecia)



Indah Permata Hati<sup>1\*</sup>, Agung Putra<sup>2</sup>, Titiek Sumarawati<sup>3</sup>

<sup>1</sup> Postgraduate student of Biomedical Sciences, Faculty of Medicine, Universitas Islam Sultan Agung, Jl Kaligawe KM 4 Semarang 50012

<sup>2,3</sup> Department of Biomedical Sciences, Faculty of Medicine, Universitas Islam Sultan Agung, Jl Kaligawe KM 4 Semarang 50012

**ABSTRACT:** Alopecia is a dermatological disorder characterized by disturbances in the shorter anagen phase and longer telogen phase in the hair cycle. Therapy with irritant side effects and contact dermatitis, scalp allergies, causes increased hair loss. Alternative therapy using secretome hypoxia mesenchymal stem cells (SH-MSCs) which is safe and effective is an option. Objective to determine the effect of topical administration of SH-MSCs gel on IL-10 and TNF- $\alpha$  gene expression in Wistar rats with a fluconazole-induced alopecia-like model. In vivo experimental research using a Post Test Only Control Group Design research design. This study used 4 groups, namely 2 treatment groups and intervention with a topical SH-MSCs gel dose of 20  $\mu$ L and a dose of 40  $\mu$ L, 1 treatment group that did not receive intervention (base gel control) and 1 group of healthy mice. Skin tissue analysis was carried out on day 22 to assess IL-10 and TNF- $\alpha$  gene expression using the RT-PCR method. IL-10 gene expression using the One way Anova test obtained a value of 0.00 ( $p < 0.05$ ) so that there was a significant difference in IL-10 gene expression between groups in mice with the alopecia like model. The results of the TNF- $\alpha$  gene expression data with a value of 0.00 ( $p < 0.05$ ) showed significant differences between treatment groups. Administration of various doses of SH-MSCs topical gel increased IL-10 gene expression and decreased TNF- $\alpha$  gene expression in Wistar rats with a fluconazole-induced alopecia-like model, with the use of SH-MSCs topical gel at a dose of 40  $\mu$ L having the greatest effect. most significant compared to other groups.

**KEYWORDS:** Alopecia like, SH-MHSCs topical gel, TNF- $\alpha$ , IL-10

### I. INTRODUCTION

Alopecia is a dermatological disorder caused by bacterial or fungal infections, inflammation, or immune dysregulation. <sup>1</sup> The disorder is characterized by a shorter anagen phase and a longer telogen phase in the hair cycle. <sup>1</sup> Several proinflammatory cytokines such as tumor necrosis factor- $\alpha$  (TNF- $\alpha$ ) coordinate cyclical hair growth in the pathogenesis of alopecia. <sup>2,3</sup> pathological T cells express IFN- $\gamma$  and IL-17 early in the disease, with a significant increase in the production of cytokines IL-4 and IL-10. <sup>3</sup> Topical therapy using minoxydil to maintain hair gives side effects such as irritants and contact dermatitis, allergies to the scalp. Cases of allergic reactions to the inactive ingredient propylene glycol found in some topical solutions containing galenic cause increased hair loss during minoxydil use. <sup>4</sup> There is a need for other therapies using secretomes. Safe and effective therapeutic approaches, one of which is with secretome hypoxia mesenchymal stem cells (SH-MSCs). <sup>5</sup> Application of secretome therapy to alopecia is still little data reported, so further research needs to be done.

In cases of alopecia, 1-2% baldness spreads throughout the scalp (alopecia totalis) or throughout the epidermis (alopecia universalis). The incidence of alopecia areata is reported to be 0.1-0.2% with a lifetime risk probability of 1.7% in both men and women. <sup>6</sup> For a decade of prospective studies looking at an allecian incidence of 0.7% of outpatients with new dermatology. <sup>7</sup>

Research shows SH-MSCs contain various anti-inflammatory cytokines, such as *transforming growth factor* (TGF- $\beta$ ), *interleukin-10* (IL-10). <sup>8</sup> IL-10 can inhibit the inflammatory process through containment of NF $\kappa$ B activation. On the other hand, TGF- $\beta$  also plays a role in the differentiation of Th cells into T-reg which plays an important role in the immunomodulation process. <sup>9</sup> MSC secretome

## Effect of Topical Gel Administration of Secretome Hypoxia Mesenchymal Stem Cells (SH-MSCs) on IL-10 and TNF- $\alpha$ Gene Expression (In Vivo Experimental Study in Male Rats of Wistar Strains Model of Fluconazole-Induced Alopecia)

therapy has proven to be a new option for treating alopecia, the outer root sheath cells play a role in maintaining hair follicle structure and supporting bulge areas.<sup>10</sup> Promotes hair follicle proliferation and reduces inflammation, and resists rat hair loss in alopecia.<sup>11</sup> The MSC *secretome* serves as an inflammation sensor that has anti-inflammatory and pro-inflammatory effects.<sup>12</sup> In another study, *Secretome* MSCs in inflammatory conditions activated anti-inflammatory cytokines such as IL-10 and TGF- $\beta$ , as well as molecular proliferation, especially platelet-derived growth factor (PDGF) and vascular endothelial growth factor (VEGF) with conditioned culture media.<sup>12,13</sup> Using topical gel SH-MSCs proved more effective than combination subcutaneous injections in day 6 animals, the topical group experienced significant increases in PDGF and fibroblast density when compared to the combination group using subcutaneous injection.<sup>14</sup>

Hair transplantation can replace areas of baldness with healthy hair, but the amount of hair is not always sufficient for replacement in patients with severe loss. The use of genes, cells, and tissues as sources of new therapies is one of the hallmarks of modern medicine. Advances in regenerative medicine have increased interest in applying stem cells to engineered tissue to reconstitute damaged tissue and developing regenerative therapies for the skin.<sup>16</sup> By secreting TGF $\beta$ 1, IL10, and PGE2, MSC secretomes have the capacity to make iTreg cells and have immunomodulatory abilities that modulate the inflammatory environment.<sup>17</sup> Growth factor through platelets is one of several factors that can regulate cell growth, differentiation, and activation by activation of chemotaxis, angiogenesis, and fibroblast proliferation.<sup>18</sup> These findings suggest that dissolved molecules secreted by MSC secretomes as CM could be one of the most effective healing treatments.<sup>14</sup>

Previous research reported that MSC secretomes have been widely used to accelerate wound healing through topical applications, which have proven effective.<sup>19</sup> The immunosuppressive ability of MSC secretomes is based on the production of cytokines such as TGF- $\beta$ , IDO, NO, PGE2, IL-10, and TSG-6.<sup>20</sup> IL-10 and TGF- $\beta$ 1 are powerful anti-inflammatory cytokines that help regulate excessive inflammatory responses. IL-10, in particular, dampens pro-inflammatory signals by inhibiting the release of pro-inflammatory cytokines such as IFN-, IL-2, and TNF- $\alpha$ .<sup>21</sup> TNF- $\alpha$  is an active stimulator molecule that increases the secretion of various inflammatory cytokines. TNF- $\alpha$ -activated MSC secretomes suppress inflammation by inducing IL10 production in macrophage cells.<sup>22</sup> A study found that IL-10 levels decreased after 24 hours with intravenous infusion of MSC secretomes in rats.<sup>23</sup> Co-SMAD4 is also involved in promoting IL-10 T-cell production by directly activating IL-10 promoters.<sup>24</sup> MSCs strongly produce other cytokines or growth factors, including TGF- $\beta$ , as evidenced by the release of IL-10, These findings support previous studies that reported IL-10 increased at 6 and 12 hours later decreased at 24 hours.<sup>22</sup>

In this study, researchers wanted to see the ability of topical gel secretome hypoxic mesenchymal stem cells doses of 20  $\mu$ L and 40  $\mu$ L on IL-10 levels and TNF- $\alpha$  levels with alopecia rats on day 6 post-inflammatory to see the picture of both IL-10 and TNF- $\alpha$  parameters in the process of accelerating hair healing and growth.

## II. MATERIAL AND METHOD

### Study Design and Experimental Animals

This research is an *in vivo* experimental study using *Post Test Only Control Group Design* research design. The study subjects used 24 male Wistar rats aged 2-3 months with a body weight of 200 g and according to inclusion and inclusion criteria, acclimatized for 7 days. This study used 4 groups, a healthy group without treatment (P1/K1), a negative control group, namely rat with alopecia smeared with base gel/day then on day 6 skin tissue was taken to be examined for IL-10 and TNF- $\alpha$  gene expression with the RT-qPCR method (P2/K2), the group with alopecia given MSC topical gel dose 20  $\mu$ L in 100 mg gel daily as much as 1x in the morning, day 6 skin tissue was taken to check IL-10 and TNF- $\alpha$  gene expression by RT-qPCR method (P3/K3), and group tikus with alopecia given MSC topical gel dose 40  $\mu$ L in 100 mg gel daily as much as 1x in the morning, Day 6 skin tissue was taken to check IL-10 and TNF- $\alpha$  gene expression by RT-qPCR method (P4/K4). The research subject has been declared fit by veterinarians from Animal House Stem Cell and Cancer Research (SCCR), Faculty of Medicine, Sultan Agung University.

### Research Materials

The research materials used culture materials, namely mouse umbilical cord, *dinitrophenyl-bovine* serum albumin (DNP-BSA), *aluminum hydroxide* gel (Al(OH)), 2,4-Dinitrochlorobenzene 1.5% (DNCB), acetone-olive oil NaCl 0.9%, PBS, DMEM, FBS, fungizone, and penstrep. While the ingredients used for the treatment process are water-based gels, 70% alcohol, PBS, Ketamine, and Xylazine, and other ingredients such as Aquadest, NaCl 0.9%, Fungizon 0.5%, Streptomycin-penicillin 1% (penstrep), and Povidon iodine.

# Effect of Topical Gel Administration of Secretome Hypoxia Mesenchymal Stem Cells (SH-MSCs) on IL-10 and TNF- $\alpha$ Gene Expression (In Vivo Experimental Study in Male Rats of Wistar Strains Model of Fluconazole-Induced Alopecia)

## Research Equipment

This study used equipment in the form of cell culture equipment consisting of *Biosafety Cabinet* (BSC), micropipettes, CO<sub>2</sub> incubators, *dissecting kits*, and 75T flasks. Hypoxic culture conditions were obtained using a *hypoxic chamber*. Oxygen meters are used to measure oxygen levels in the *hypoxic chamber*. In addition, this study also sterilized swabs to apply topical gel SH-MSCs. Tools used for IL-10 and TNF- $\alpha$  gene expression analysis such as *Centrifuges*, *Beaker glass*, *Cell counters*, Disposable pipettes, 1 cc syringes, Light microscopes, Shavers, Surgical tool sets, Micropipettes, Masks, *Handsoons*, Experimental animal cages, *Micropipette with tips* (blue tip, yellow tip, pink tip), Pipette filler, *Conical tube* (15 ml, 50 ml), *Biosafety*, *Inverted microscope*, *Cryotube* 1 ml, *Scissor*, and Tweezers.

## Procedure of Mesenchymal Stem Cell Isolation from Umbilical Cord

Work on *biosafety cabinet class 2*, the equipment used has been sterilized first, The steps are as follows: **(1)** Umbilical cord is collected and placed in a sterile container containing 0.9% NaCl, **(2)** Umbilical cord is placed into a *petri dish* with tweezers, washed thoroughly using PBS **(3)** Separate *Umbilical cord* From the fetus of mice and blood vessels are removed. **(4)** Chop the *Umbilical cord* until smooth and place it on the 25T flask evenly and let stand for 3 minutes until the tissue adheres to the surface of the flask. **(5)** A complete medium consisting of DMEM, fungizon, penstrep, and FBS) is added slowly until it covers the network. **(6)** The explant is incubated in the incubator at a temperature of 37°C and 5% cO<sub>2</sub>, cell culture will appear after 14 days. **(7)** The medium is replaced every 3 days by removing half of the medium and replacing it with a new medium. **(8)** Cell maintenance is carried out until the cell reaches 80% consequence.

## Hypoxia Process

**(1)** MSC culture that reaches 80% confluence plus complete medium up to 10 mL to the flask then transfer it into the *hypoxic chamber*. **(2)** Nitrogen gas is channeled through the inlet valve and an oxygen meter is placed in the sensor hole to measure the oxygen concentration in the *chamber*. **(3)** Nitrogen addition until the indicator needle shows a concentration of 5% oxygen. **(4)** The *chamber* containing the flask is incubated for 24 hours at a temperature of 37°C. **(5)** After 24 hours, the culture media is taken and filtered using TFF to obtain SH-MSC which is then mixed with gel according to the dose of P3/K 3 and P4/K4.

## Topical Gel Preparation Manufacturing Process

**(1)** The preparation of SH-MSC gel is done by mixing 200 mg of gel with secretomes in P3 and P4. **(2)** Stirring is carried out under aseptic conditions to form a homogeneous mixture of physical characteristics of observations under a microscope.

## Making Preparations and Giving Treatment to Test Subjects

**(1)** Rats that have been given topical gel every day for 6 days containing SH-MSC dose 40  $\mu$ L. The negative control rats were given the base gel treatment. **(2)** Skin samples in all groups were taken to make histological preparations by paraffin method and Hematoxylin-Eosin (HE) staining. **(3)** Skin samples of mice in all groups were taken and fixed in a 10% NBF solution. **(4)** The skin sample is rinsed with 70% alcohol until clean from the remaining fixative solution. **(5)** Skin samples are put in 70%, 80%, 90%, 96%, and absolute alcohol for 30 minutes each for dehydration process. **(6)** The skin sample is inserted into the toluol until clear or transparent for 1 hour. **(7)** Infiltration into paraffin is carried out in the oven at a temperature of 56-60°C by inserting skin samples into a mixture of toluol and paraffin in a ratio of 3:1, 1:1, and 1:3 for 30 minutes each. Skin samples were put into pure paraffin I, pure paraffin II, and pure paraffin III each treatment for 30 minutes. **(8)** *Embedding*, a skin sample of pure paraffin is implanted into a paraffin block mold that has contained liquid paraffin and waited until the paraffin hardens. **(9)** Skin samples in paraffin blocks were sliced with a slice thickness of 6  $\mu$ m using microtomes. **(10)** Slices of tissue samples are attached to the glass of objects by applying *Mayer's* albumin and dripping with a little aquade and then heated on a *hot plate* until the slices stick perfectly. **(11)** Histological preparations indeparafination by insertion into *xylol* for 24 hours. **(12)** *Staining* is done with hematoxylin-eosin dyes. The *xylol* content is absorbed with filter paper, then successively put into alcohol 96%, 90%, 80%, 70%, 60%, 50%, 40%, 30%, and aqueous each done for 1-2 minutes. The preparation is put in Hematoxylin dye for 5-10 seconds, then rinsed under running water for 10 minutes. Further process the preparation dipped in 30%, 40%, 50%, 60%, 70% alcohol for 3-5 minutes each. The preparation is infused into eosin for 5-10 minutes, then dipped in 70%, 80%, 90%, and 96% alcohol for 3-5 minutes respectively, then dried with filter paper. The preparation is put in *xylol* for 15 minutes, then the histological preparation is dripped *canada balsam*. **(13)** Preparations are covered with cover glass, labeled, and stored in preparation boxes.

## RNA Extraction and cDNA Synthesis

**(1)** The skin sample is inserted in a tube containing 300  $\mu$ L RNA later and stored at -20°C. **(2)** Skin samples of 50 mg were then inserted in a tube containing 1ml of trizol then homogenized with ultrasonicator and incubated at room temperature for 5 min. **(3)** Add 0.2 ml of *Choloform* and incubate at room temperature 2-3 minutes, centrifuge at a speed of 2000 rpm at 4 °C for 15

## Effect of Topical Gel Administration of Secretome Hypoxia Mesenchymal Stem Cells (SH-MSCs) on IL-10 and TNF- $\alpha$ Gene Expression (In Vivo Experimental Study in Male Rats of Wistar Strains Model of Fluconazole-Induced Alopecia)

minutes. (4) The sample centrifuged results form 3 layers, the pink bottom side contains protein, the white middle side contains DNA and the clear upper side contains RNA (*aqueous phase*), separate the upper side into different tubes. (5) *Aqueous phase* sample plus 0.5 mL isopropanol then resuspensions and incubation for 10 minutes, then centrifuged at a speed of 2000 rpm with a temperature of 4°C for 10 minutes. (6) Remove the supernatant and add 1 mL of 70% ethanol to be resuspended at 4°C for 5 minutes. (7) Add with 50  $\mu$ L NFW (nuclease-free water). (8) RNA samples were quantified using  $\mu$ Drop with a wavelength of 260 nm by spectrophotometer method. (9) RNA samples of 0.1  $\mu$ L in 1  $\mu$ L NFW were added 5  $\mu$ L NFW for denaturation incubated at 65°C using a *thermal cycler* for 5 minutes. (10) Add RNA sample 2  $\mu$ L 4x DN master mix then incubate at 37°C with *thermal cycler* for 5 minutes. (11) Continue with the *reverse transcription* process by adding 2  $\mu$ L 4x DN master mix then incubate at 37°C with a *thermal cycler* for 15 minutes, at 50°C for 5 minutes, and at 98°C for 5 minutes using a *thermal cycler*. (12) Store the cDNA sample at -20°C.

### IL-10 and TNF- $\alpha$ Gene Expression Reading by Real Time-Polymerase Chain Reaction (RTq-PCR)

(1) IL-10 and TNF- $\alpha$  gene expression was analyzed on RTq-PCR. (2) Sequentially mix 1  $\mu$ L of sample cDNA, 2x SensiFAST SYBR No-ROX Mix of 10  $\mu$ L, *forward primer* 0.8  $\mu$ L and *reverse primary* 0.8  $\mu$ L and NFW 7.4  $\mu$ L. (3) *IL-10 primers used are F: 5'-CTGTCACGGAGATCAATGTGG-3'* and R: 5'-AAGGCGTAGCTGAACAAGGTG-3'. (4) TNF- $\alpha$  primers used are F: 5'-AGGCAATAGGTTTTGAGGGCCAT-3 and R: 5'-TCCTCCCTGCTCCGATTCCG-3' (5) The qPCR process is carried out at a temperature of 95°C for 2 minutes, a temperature of 95°C for 5 seconds and a temperature of 56°C for 20 seconds as many as 40 cycles, the qPCR process is carried out to analyze the probe hydrolyzed at a wavelength of 520 nm. (6) Quantification of qPCR data is analyzed using EcoStudy software.

### Statistical Analysis

The data in this study was processed, edited and tabulated, then descriptive tests were carried out including independent and bound variables using ratio data scales. then, data normality tests were carried out using the *Shapiro Wilk* test and data variance tests using *Levene's Test*. The results obtained the distribution of normal data ( $p > 0.05$ ) and the same data variant ( $p > 0.05$ ), then using the *One Way Anova* test difference test for IL-10 parameters. While the results for the TNF- $\alpha$  parameters obtained a normal data distribution ( $p > 0.05$ ) and homogeneous data variants ( $p > 0.05$ ), then using the *One Way Anova* test difference test. Next, both parameters were performed *Post Hoc LSD* tests to determine the most influential dose group. Data processing in research using SPSS 26.0 for Windows desktop application.

## III. RESULT

### Isolation of SH-MSCs from Umbilical Cord

The use of the umbilical cord of Wistar rats who were 19 days pregnant, SH-MSCs isolation was added media consisting of DMEM (*Dulbeccos Modified Eagle Medium*), fungizone, penstrep, and FBS, the isolation results were then cultured in a plastic flask. When the MSC culture results were examined under a microscope, cells with spindle-like cell shapes were attached to the base of the flask at 80% confluence, as shown in figure 1.

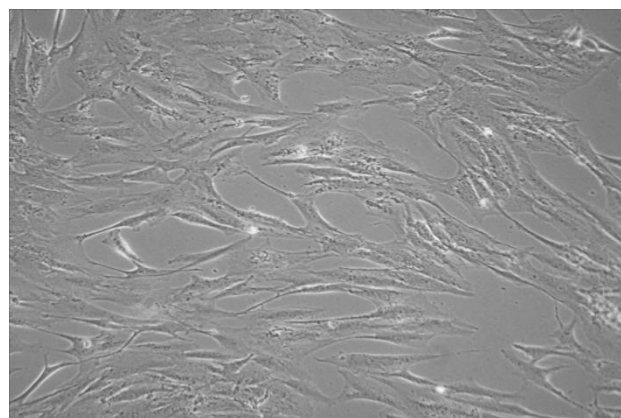
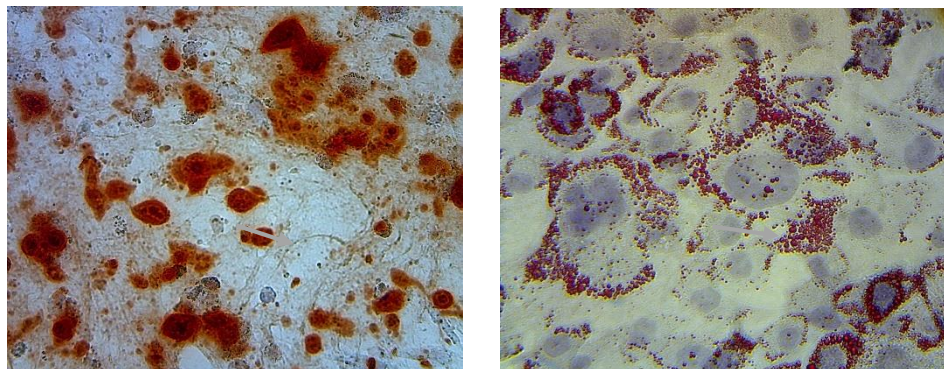


Figure 1. Result of MSC Culture.

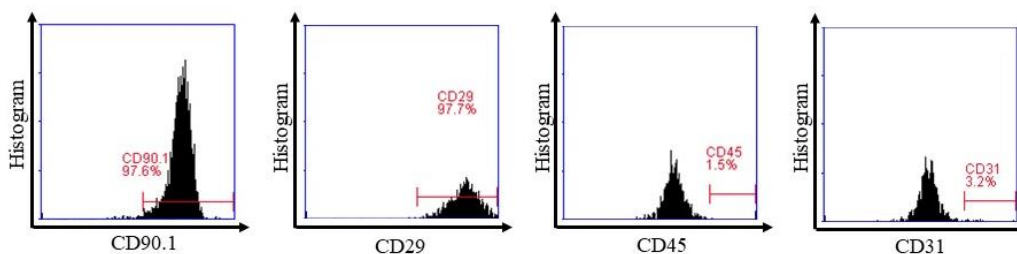
Validation of the results of the MSC cell isolation process is carried out by looking at the ability of MSCs to develop into osteogenic and adipogenic cells. In adipogenic differentiation tests, *oil red O* staining is used to show the formation of red lipid droplets. The formation of calcium deposits is clearly visible in red and is shown by osteogenic differentiation test using *Alizarin red* staining.

**Effect of Topical Gel Administration of Secretome Hypoxia Mesenchymal Stem Cells (SH-MSCs) on IL-10 and TNF-  $\alpha$  Gene Expression (In Vivo Experimental Study in Male Rats of Wistar Strains Model of Fluconazole-Induced Alopecia)**



**Figure 2. Adipogenic differentiation test, oil red staining O osteogenic differentiation test using Alizarin red staining.**

The isolation findings of SH-MSCs demonstrate the ability to express various special surface markers, which is confirmed by *flow cytometry*.



**Figure 3. Confirmatory test with flow cytometry.**

MSC expresses CD45 (97.6%), CD31 (97.7%), CD90 (1.5%), and CD29 (3.2%).

This study isolated *growth factors and anti-inflammatory cytokines contained in SH-MSCs to obtain pure SH-MSCs using secretomes isolated from MSCs isolated from MSCs preconditioned hypoxia 5% using Tangential flow filtration (TFF), SH-MSCs containing anti-inflammatory cytokines and growth factors, after the filtration process was analyzed the content of growth factor cytokines and anti-inflammatory, measurement of growth factor content in SH-MSCs is carried out using the ELISA method. The results of SH-MSCs analysis are known to contain PDGF levels of 1093.51 ± 53.85 pg / mL, VEGF levels of 1015.43 ± 56.95 pg / mL, bFGF levels of 1167.31 ± 68.53 pg / mL, IL-10 levels of 675.31 ± 41.35 pg / mL, and TGF- $\beta$  levels of 459.71 ± 20.03 pg / mL.*

**Table 1. Analysis of cytokine growth factor and anti-inflammatory content, in SH-MSCs.**

Molecules	SH-MSCs Value ± SE (pg/mL)
VEGF	1015.43 ± 56.95
PDGF	1093.51 ± 53.85
bFGF	1167.31 ± 68.53
IL-10	675.31 ± 41.35
TGF- $\beta$	459.71 ± 20.03

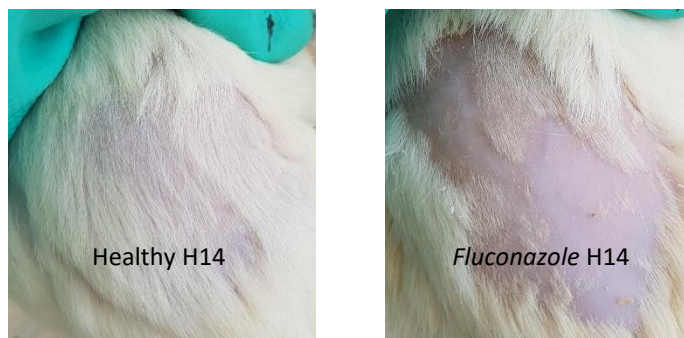
**Macroscopic Validation and Histopathological Staining of HE**

**Macroscopic Overview of Alopecia-like Rat Skin**

The results of macroscopic observation on the skin of *alopecia-like rats* on day 14 after *administration of fluconazole* showed a slowdown in hair growth in rats when compared to the group of healthy mice, as shown in figure 4:



**Effect of Topical Gel Administration of Secretome Hypoxia Mesenchymal Stem Cells (SH-MSCs) on IL-10 and TNF-  $\alpha$  Gene Expression (In Vivo Experimental Study in Male Rats of Wistar Strains Model of Fluconazole-Induced Alopecia)**

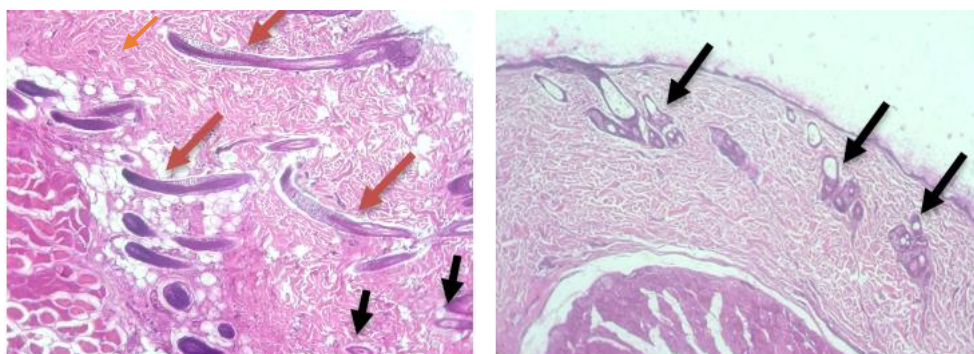


**Figure 1. Comparison of fur growth of healthy rats with rats given fluconazole**

The average percentage of baldness on day 14 in the healthy group obtained results of  $51.11 \pm 10.27$  while in the *alopecia like group* obtained an average result of  $68.26 \pm 7.96$ , macroscopic observation of the results of precondition experimental rats validated to have impaired hair growth by administering *Fluconazole* 35 mg / kg BB,

Results of HE staining of Skin Tissue of Alopecia-like Rats

The readings of histopathological preparations with *hematoxylin-eosin* (HE) staining showed that the group of rats induced with *Fluconazole* 35 mg for 14 days caused interference with the follicle anagen resulting in hair loss, HE preparations showed the results of no finding of the anagen follicle phase *in the treatment group compared to a group of healthy mice that were microscopically different from having phases anagen follicle* in the field of view. The results of the HE staining analysis are shown in figure 5.



**Figure 5. Validate hair follicles of healthy and alopecia-like mice using HE. Black arrows indicate telogen phase follicles, red arrows indicate anagen phase follicles**

**IL-10 and TNF- $\alpha$  gene expression in mouse models of alopecia-like by administration of SH-MSCs.**

Research with the RT-PCR method using Illumina' s *Eco Real-Time PCR tool*, *SH-MSCs* showed the results of increasing IL-10 levels in alopecia-like mice. Described in the following table:

**Table 2. IL-10 and TNF- $\alpha$  gene expression.**

Variable	Group			pvalue
	P2/K2 n=6 Mean $\pm$ SD	P3/K3 n=6 Mean $\pm$ SD	P4/K4 n=6 Mean $\pm$ SD	
Expressive has IL-10	0.79 $\pm$ 0.14	1.45 $\pm$ 0.11	2.61 $\pm$ 0.23	
<i>Saphiro wilk</i>	0,64	0,06	0,23	
<i>Levene's Test</i>				0,05
<i>One way Anova</i>				0,00
TNF- $\alpha$ gene expression	2.54 $\pm$ 2.0	1.40 $\pm$ 0.10	0.63 $\pm$ 0.20	
<i>Saphiro wilk</i>	0,26	0,47	0,38	
<i>Levene's Test</i>				0,77
<i>One way Anova</i>				0,00

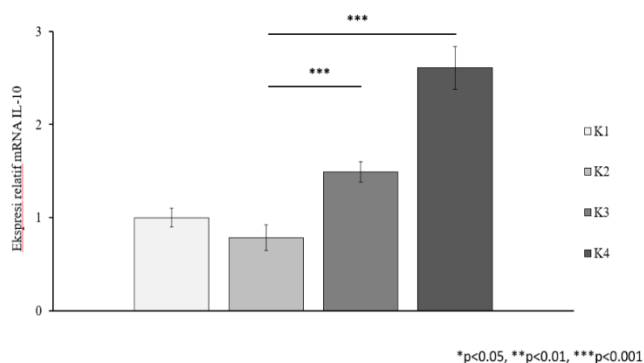
Information:

- *Saphiro Wilk test* ( $p > 0.05$  = normal)
- *Levene's Test* ( $p > 0,05$  = homogen)
- *One way Anova* ( $p < 0.05$ ) = significant difference)

## Effect of Topical Gel Administration of Secretome Hypoxia Mesenchymal Stem Cells (SH-MSCs) on IL-10 and TNF- $\alpha$ Gene Expression (In Vivo Experimental Study in Male Rats of Wistar Strains Model of Fluconazole-Induced Alopecia)

Based on table 2, the average IL-10 gene expression results in the negative control group (P2) were  $0.79 \pm 0.14$ , the mean SH-MSCs gel group dose  $20 \mu\text{L}$  (P3) was  $1.45 \pm 0.11$ , and the mean value in the SH-MSCs gel group dose  $40 \mu\text{L}$  (P4) was  $2.61 \pm 0.23$ . Statistical analysis for normality and homogeneity of IL-10 gene expression obtained normal distributed data results with the *Saphiro Wilk* test ( $p > 0.05$ ), and homogeneity data obtained from *Levene's Test* test values of  $0.05$  ( $p > 0.05$ ).

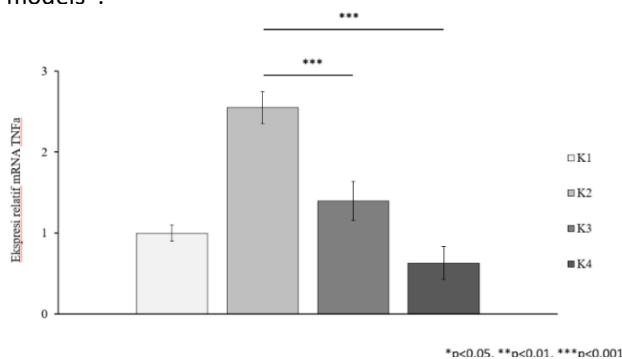
It can be concluded that the results of IL-10 gene expression data are normally distributed and homogeneous, followed by the One way Anova test with a value of  $0.00$  ( $p < 0.05$ ) so that significant differences in IL-10 gene expression between groups can be known in mice with alopecia-like models.



**Figure 2. IL-10 gene expression graph per group**

Based on table 2, the average results of TNF- $\alpha$  gene expression in the negative control group (P2) were  $2.54 \pm 2.0$ , the average SH-MSCs gel group dose  $20 \mu\text{L}$  (P3) was  $1.40 \pm 0.10$ , and the mean value in the SH-MSCs gel group dose  $40 \mu\text{L}$  (P4) was  $0.63 \pm 0.20$ . Statistical analysis for normality and homogeneity of TNF- $\alpha$  gene expression obtained normal distributed data results with the *Saphiro Wilk* test ( $p > 0.05$ ), and homogeneity data obtained from *the Levene's Test* test value of  $0.77$  ( $p > 0.05$ ).

It can be concluded that the results of TNF- $\alpha$  gene expression data are normally distributed and homogeneous, followed by the One way Anova test with a value of  $0.00$  ( $p < 0.05$ ) so that significant differences in TNF- $\alpha$  gene expression between groups can be known in mice with alopecia-like models .



**Figure 3. TNF- $\alpha$  gene expression graph for each group**

Based on graph 6, the average IL-10 gene expression result was the highest value in the SH-MSCs group dose of  $40 \mu\text{L}$  (P4) and decreased TNF- $\alpha$  gene expression with the lowest value in the SH-MSCs group dose of  $40 \mu\text{L}$  (P4). It was concluded that in the SH-MSCs group, doses of  $40 \mu\text{L}$  increased IL-10 gene expression and decreased TNF- $\alpha$  gene expression in Wistar mice with *fluconazole-induced* alopecia-like models.

### Comparison of IL-10 gene expression between groups in alopecia-like mice with SH-MSCs gel.

Based on statistical tests, normally distributed and homogeneous data, a *One way Anova* statistical test was carried out followed by a *Post Hoc LSD* parametric test to determine the SH-MSCs topical gel dose group that had the most effect on increasing IL-10 gene expression in each group. Significant differences were obtained between all P2, P3, and P4 groups with a significance of  $p:0.000$  ( $P < 0.05$ ).

## Effect of Topical Gel Administration of Secretome Hypoxia Mesenchymal Stem Cells (SH-MSCs) on IL-10 and TNF- $\alpha$ Gene Expression (In Vivo Experimental Study in Male Rats of Wistar Strains Model of Fluconazole-Induced Alopecia)

**Table 3. Comparison of IL-10 gene expression between groups with Post Hoc LSD assay**

Group	Comparison Group	Significance	Confidence Interval 95%	
			Border Below	Border Above
P2	P3*	0,00	-0,90	-0,49
	P4*	0,00	-2,04	-1,62
P3	P2*	0,00	0,49	0,91
	P4*	0,00	-1,34	-0,92
P4	P2*	0,00	1,62	2,04
	P3*	0,00	0,92	1,33

LSD Test: \* mean difference significant P <0.05

### Comparison of TNF- $\alpha$ gene expression between groups in mouse models of alopecia-like with administration of SH-MSCs.

Based on statistical tests, normally distributed and homogeneous data, a statistical test of *One way Anova* was carried out followed by a *Post Hoc LSD* parametric test to determine the SH-MSCs topical gel dose group that had the most effect on decreasing TNF- $\alpha$  gene expression in each group. Significant differences were obtained between all P2, P3, and P4 groups with a significance of p:0.000 (P <0.05).

**Table 4. Comparison of TNF- $\alpha$  gene expression between groups with Post Hoc LSD assay**

Group	Comparison Group	Significance	Confidence Interval 95%	
			Border Below	Border Above
P2	P3*	0,00	0,88	1,41
	P4*	0,00	1,65	2,17
P3	P2*	0,00	-1,41	-0,88
	P4*	0,00	0,50	1,03
P4	P2*	0,00	-2,18	-1,65
	P3*	0,00	-1,03	-0,50

LSD Test: \* mean difference significant P <0.05

## IV. DISCUSSION

Alopecia is a dermatological disorder caused by bacterial or fungal infections, inflammation, or immune dysregulation.<sup>1</sup> The disorder is characterized by a shorter anagen phase and a longer telogen phase in the hair cycle.<sup>1</sup> The integrity of the ends of the hair is related to cortical hair, the texture and gloss of the hair is related to the quality of its surface.<sup>23</sup> Normally hair will detach from the scalp up to approximately 100 strands per day, it is considered abnormal if more hair falls out than 120 strands daily, diffuse and local hair loss may both occur unifocal or multifocal hair.<sup>24</sup>

This study aimed to determine the effect of topical gel administration of SH-MSCs on IL-10 and TNF- $\alpha$  gene expression in *Wistar rats with fluconazole-induced alopecia-like models*. A mouse model of fluconazole-induced alopecia, describing the type of hair loss in the telogen effluvium phase, the molecular mechanisms of development from anagen to catagen/telogen, and telogen effluvium deposition, changes in retinoic acid metabolism and retinoic acid accumulation as major contributors to the cause need to be analyzed further.<sup>25</sup>

Application of stem cells to engineered tissue to reconstitute damaged tissue and develop regenerative therapies for the skin.<sup>16</sup> Developments in stem cell research using MSCs in restoring and saving ischemic tissue through angiogenesis.<sup>26</sup> MSC secretomes induce angiogenesis *in vitro* and *in vivo*, angiogenic factors expressed namely PDGF, BFGF, VEGF, TGF- $\beta$ , Angiopoietin-1 (ANG-1), Placental Growth Factor (PIGF), IL-6, and MCP-1.<sup>27</sup> MSCs contribute to angiogenesis through direct differentiation, interaction of cell-contact with endothelial cell lines, and paracrine release of pro-angiogenic molecules. Paracrine factor can increase the blood supply of damaged tissues through the activation and recruitment of stem cells and progenitor cells.<sup>28</sup>

The results of the IL-10 gene expression study experienced the highest increase in the SH-MSCs gel group dose of 40  $\mu$ L (P4) of  $2.61 \pm 0.23$  compared to the other groups P2, and P3, showing that molecularly SH-MSCs gel significantly increased IL-10 gene expression. Intravenously injected MSCs can prevent skin graft-induced AA, possibly through inhibition of IFN $\gamma$ , CXCL9, and CXCL10

## Effect of Topical Gel Administration of Secretome Hypoxia Mesenchymal Stem Cells (SH-MSCs) on IL-10 and TNF- $\alpha$ Gene Expression (In Vivo Experimental Study in Male Rats of Wistar Strains Model of Fluconazole-Induced Alopecia)

production and CD3 and CD8+NKG2D+ T cell infiltration, suggesting that MSC-mediated IFN $\gamma$  inhibition and CD3 and CD8+NKG2D+ T cell infiltration protect against hair follicle collapse.<sup>29</sup> By secreting TGF $\beta$ 1, IL10, and PGE2, MSCs have the capacity to make iTreg cells and have immunomodulatory abilities that modulate the inflammatory environment.<sup>17</sup> In line with the research of Byun *et al*, (2016) Increased expression of proinflammatory Th1 cytokines, such as IFN $\gamma$ , and CD8+NKG2D+ T cells, acting as cytotoxic effectors, responsible for autoimmune attacks on HF in AA pathogenesis. IFN $\gamma$  expression is abnormally elevated in AA lesions through a Th1-mediated response. In addition, IFN $\gamma$  produced from CD8+ T cells causes HF loss and promotes type I cellular autoimmunity. MSC-mediated immunosuppression requires early activation of immune cells through the secretion of proinflammatory cytokines, e.g. as IFN $\gamma$ . Inflammatory diseases associated with cytokines have an advantage in successful treatment with MSCs.<sup>25</sup>

Pathological T cells express IFN-C and IL-17 early in the disease, with a significant increase in the production of cytokines IL-4 and IL-10.<sup>30</sup> Th1 and Th17 cytokines trigger attacks on hair follicles resulting in premature cessation of the hair growth cycle and induction of alopecia phenotype and further lead to disease occurrence, while Th2 pathways may play a role in the inhibition of cell-mediated immune attacks to delay disease progression.<sup>31</sup> Treg cells play an important role in inducing and maintaining tolerance to self-antigens and prevention of autoimmunity, producing anti-inflammatory cytokines (TGF- $\beta$  and IL-10) and regulating the function of pro-inflammatory cytokines.<sup>32</sup> IL-10 has a regulatory effect rather than a stimulating effect on the immune process, inhibiting the production of activated T cell cytokines. Elevated IL-10 levels in alopecia areata compared to healthy controls, the role of IL-10 is difficult to present due to the separate form of Th2 and Treg pathways.<sup>32</sup>

The results of the study of the lowest TNF- $\alpha$  gene expression in the SH-MSCs gel group dose of 40  $\mu$ L (P4) were  $0.63 \pm 0.20$  compared to the other groups P2, and P3. showed that gel SH-MSCs significantly decreased TNF- $\alpha$  gene expression. Proinflammatory cytokines such as *tumor necrosis factor- $\alpha$*  (TNF- $\alpha$ ) coordinate cyclical hair growth in the pathogenesis of alopecia.<sup>2,3</sup> AA patients had higher levels of IL-6 and TNF- $\alpha$ , IL-6 suppressed HFSC at rest through JAK STAT signaling (activating HFSC to renew damaged hair follicles). TNF- $\alpha$  has an important role in AA, suppression of TNF- $\alpha$  levels effectively treating *cases of alopecia Universalis* (severe stage AA) proves that suppression of TNF- $\alpha$  levels is effective in the treatment of AA. Decreased expression of IL-6 and TNF- $\alpha$  with HF-MSC affects hair follicles so that morphology remains intact.<sup>15</sup>

Research by Deng *et al*, (2021). showed that HF-MSCs promote hair follicle proliferation and reduce HF inflammation because CD8+ T cells are less observed in Vibrissa follicles treated with HF-MSC. What's more, in a mouse model of C3H/HeJ, HF-MSC injection suppresses AA and inhibits immune rights. Here we provide potential therapeutic methods for the treatment of AA, which are promising and beneficial for AA patients.<sup>15</sup> Stimulating factors can activate CD8+NKG2D+ T cells and produce IFN- $\gamma$  via the JAK1 and JAK3 pathways. IFN- $\gamma$  can increase IL-15 production in follicular epithelial cells through JAK1 and JAK2. IL-15 then binds to CD8+NKG2D+ T cells to produce more IFN- $\gamma$ , which amplifies the positive feedback loop. IFN- $\gamma$  promotes the collapse of hair follicle immune privilege, leading to the exposure of autoantigens to CD8+NKG2D+ T cells and facilitating autoimmune attacks on hair follicles. Meanwhile, other inflammatory cells, such as DC, CD4+T cells, NK T cells, mast cells, and eosinophils, accumulate around the hair bulbs.<sup>33</sup>

The stem cell therapy approach showed success, isolation of mononuclear cells derived from patients with *alopecia areata*, multipotent nature of stem cells derived from human cord blood and subsequently restored in the patient's circulation. Using this treatment, patients with severe *alopecia areata* experience improvements in hair growth and improved quality of life. The mechanisms are upregulation of cytokine T helper 2 (TH2) and restoration of balance of TH1, TH2 and TH3 cytokine production.<sup>67</sup> Side effects of many of these treatments are an important consideration, it is possible that combination with low doses and/or topical application will achieve results with an acceptable safety profile.<sup>34</sup>

### V. CONCLUSION

Topical administration of SH-MSCs gel significantly increased IL-10 gene expression at a dose of 40  $\mu$ L in *Wistar rats with fluconazole-induced alopecia-like models*. Topical administration of SH-MSCs gel significantly decreased TNF- $\alpha$  gene expression at a dose of 40  $\mu$ L in *Wistar mice with fluconazole-induced alopecia-like models*.

### ACKNOWLEDGEMENT

The authors declare no conflict of interest and no involvement of sponsors or funding for this research.

### REFERENCES

- 1) Li Y, Wang G, Wang Q, Zhang Y, Cui L, Huang X. Exosomes Secreted from Adipose-Derived Stem Cells Are a Potential Treatment Agent for Immune-Mediated Alopecia. *J Immunol Res.* 2022;2022. doi:10.1155/2022/7471246

## Effect of Topical Gel Administration of Secretome Hypoxia Mesenchymal Stem Cells (SH-MSCs) on IL-10 and TNF- $\alpha$ Gene Expression (In Vivo Experimental Study in Male Rats of Wistar Strains Model of Fluconazole-Induced Alopecia)

- 2) Dasanders Jbowen M. Effects of Interleukins, Colony-Stimulating Factor and Tumour Necrosis Factor on Human Hair Follicle Growth in Vitro: A Possible Role for Interleukin-1 and Tumour Necrosis Factor- $\alpha$  in Alopecia Areata. Vol 135.; 1996.
- 3) Ito T, Tokura Y. The role of cytokines and chemokines in the T-cell-mediated autoimmune process in alopecia areata. *Exp Dermatol*. 2014;23(11):787-791. doi:10.1111/exd.12489
- 4) Rossi A, Cantisani C, Melis L, Iorio A, Scali E, Calvieri S. Minoxidil Use in Dermatology, Side Effects and Recent Patents. Vol 6.; 2012.
- 5) Madrigal M, Rao KS, Riordan NH. A review of therapeutic effects of mesenchymal stem cell secretions and induction of secretory modification by different culture methods. *J Transl Med*. 2014;12(1). doi:10.1186/s12967-014-0260-8
- 6) Safavi KH, Muller SA, Suman VJ, Moshell AN, Melton LJ. Incidence of Alopecia Areata in Olmsted County, Minnesota, 1975 Through 1989. *Mayo Clin Proc*. 1995;70(7):628-633. doi:10.4065/70.7.628
- 7) Siiakma VK, Ol C, Dawn T, Kumar B. PROFILE OF ALOPECIA AREATA IN NORTHERN INDIA.
- 8) Putra A, Widyatmoko A, Ibrahim S, et al. Case series of the first three severe COVID-19 patients treated with the secretome of hypoxia-mesenchymal stem cells in Indonesia. *F1000Res*. 2021;10:228. doi:10.12688/f1000research.51191.1
- 9) Xue M, Zhang X, Chen J, et al. Mesenchymal Stem Cell-Secreted TGF- $\beta$  1 Restores Treg/Th17 Skewing Induced by Lipopolysaccharide and Hypoxia Challenge via miR-155 Suppression. *Stem Cells Int*. 2022;2022. doi:10.1155/2022/5522828
- 10) Lee YJ, Park SH, Park HR, Lee Y, Kang H, Kim JE. Mesenchymal stem cells antagonize ifn-induced proinflammatory changes and growth inhibition effects via wnt/ $\beta$ -catenin and jak/stat pathway in human outer root sheath cells and hair follicles. *Int J Mol Sci*. 2021;22(9). doi:10.3390/ijms22094581
- 11) Deng W, Zhang Y, Wang W, et al. Hair follicle-derived mesenchymal stem cells decrease alopecia areata mouse hair loss and reduce inflammation around the hair follicle. *Stem Cell Res Ther*. 2021;12(1). doi:10.1186/s13287-021-02614-0
- 12) Putra A, Ridwan FB, Putridewi AI, et al. The role of tnf- $\alpha$  induced mscs on suppressive inflammation by increasing tgf- $\beta$  and il-10. *Open Access Maced J Med Sci*. 2018;6(10):1779-1783. doi:10.3889/oamjms.2018.404
- 13) Ho CH, Lan CW, Liao CY, Hung SC, Li HY, Sung YJ. Mesenchymal stem cells and their conditioned medium can enhance the repair of uterine defects in a rat model. *Journal of the Chinese Medical Association*. 2018;81(3):268-276. doi:10.1016/j.jcma.2017.03.013
- 14) Kuntardjo N, Dharmana E, Chodidjah C, Nasihun TR, Putra A. TNF- $\alpha$ -Activated MSC-CM Topical Gel Effective in Increasing PDGF Level, Fibroblast Density, and Wound Healing Process Compared to Subcutaneous Injection Combination. *Majalah Kedokteran Bandung*. 2019;51(1):1-6. doi:10.15395/mkb.v51n1.1479
- 15) Deng W, Zhang Y, Wang W, et al. Hair follicle-derived mesenchymal stem cells decrease alopecia areata mouse hair loss and reduce inflammation around the hair follicle. *Stem Cell Res Ther*. 2021;12(1). doi:10.1186/s13287-021-02614-0
- 16) Martinez-Lopez A, Montero-Vilchez T, Sierra-Sánchez Á, Molina-Leyva A, Arias-Santiago S. Advanced medical therapies in the management of non-scarring alopecia: Areata and androgenic alopecia. *Int J Mol Sci*. 2020;21(21):1-28. doi:10.3390/ijms21218390
- 17) Darlan DM, Munir D, Putra A, Jusuf NK. MSCs-released TGF $\beta$ 1 generate CD4+CD25+Foxp3+ in T-reg cells of human SLE PBMC. *Journal of the Formosan Medical Association*. 2021;120(1):602-608. doi:10.1016/j.jfma.2020.06.028
- 18) Zhao J, Hu L, Liu J, Gong N, Chen L. The effects of cytokines in adipose stem cell-conditioned medium on the migration and proliferation of skin fibroblasts in vitro. *Biomed Res Int*. 2013;2013. doi:10.1155/2013/578479
- 19) Chen L, Tredget EE, Wu PYG, Wu Y, Wu Y. Paracrine factors of mesenchymal stem cells recruit macrophages and endothelial lineage cells and enhance wound healing. *PLoS One*. 2008;3(4). doi:10.1371/journal.pone.0001886
- 20) Roddy GW, Oh JY, Lee RH, et al. Action at a distance: Systemically administered adult stem/progenitor cells (MSCs) reduce inflammatory damage to the cornea without engraftment and primarily by secretion of TNF- $\alpha$  stimulated gene/protein 6. *Stem Cells*. 2011;29(10):1572-1579. doi:10.1002/stem.708
- 21) Jorgensen C. Mesenchymal stem cells immunosuppressive properties: Is it specific to bone marrow-derived cells? *Stem Cell Res Ther*. 2010;1(2). doi:10.1186/scrt15
- 22) Németh K, Leelahavanichkul A, Yuen PST, et al. Bone marrow stromal cells attenuate sepsis via prostaglandin E 2-dependent reprogramming of host macrophages to increase their interleukin-10 production. *Nat Med*. 2009;15(1):42-49. doi:10.1038/nm.1905
- 23) Sinclair RD. Healthy hair: What is it? In: *Journal of Investigative Dermatology Symposium Proceedings*. Vol 12. Nature Publishing Group; 2007:2-5. doi:10.1038/sj.jidsymp.5650046

## Effect of Topical Gel Administration of Secretome Hypoxia Mesenchymal Stem Cells (SH-MSCs) on IL-10 and TNF- $\alpha$ Gene Expression (In Vivo Experimental Study in Male Rats of Wistar Strains Model of Fluconazole-Induced Alopecia)

- 24) Kristiningrum E. CONTINUING PROFESSIONAL DEVELOPMENT Akreditasi PP IAI-2 SKP Suplemen Untuk Rambut Sehat. Vol 45.; 2018.
- 25) Thompson Iii GR, Krois CR, Affolter VK, et al. Examination of Fluconazole-Induced Alopecia in an Animal Model and Human Cohort. Published online 2019. doi:10.1128/AAC
- 26) Matluobi D, Araghi A, Maragheh BFA, et al. Carvacrol promotes angiogenic paracrine potential and endothelial differentiation of human mesenchymal stem cells at low concentrations. *Microvasc Res.* 2018;115:20-27. doi:10.1016/j.mvr.2017.08.003
- 27) Kehl D, Generali M, Mallone A, et al. Proteomic analysis of human mesenchymal stromal cell secretomes: a systematic comparison of the angiogenic potential. *NPJ Regen Med.* 2019;4(1). doi:10.1038/s41536-019-0070-y
- 28) Putra A, Pertiwi D, Milla MN, et al. Hypoxia-preconditioned MSCs have superior effect in ameliorating renal function on acute renal failure animal model. *Open Access Maced J Med Sci.* 2019;7(3):305-310. doi:10.3889/oamjms.2019.04
- 29) Byun JW, Kim HJ, Na K, et al. Bone marrow-derived mesenchymal stem cells prevent alopecia areata development through the inhibition of NKG2D expression: A pilot study. *Exp Dermatol.* 2017;26(6):532-535. doi:10.1111/exd.13255
- 30) Ito T, Tokura Y. The role of cytokines and chemokines in the T-cell-mediated autoimmune process in alopecia areata. *Exp Dermatol.* 2014;23(11):787-791. doi:10.1111/exd.12489
- 31) Tembhe MK, Sharma VK. T-helper and regulatory T-cell cytokines in the peripheral blood of patients with active alopecia areata. *British Journal of Dermatology.* 2013;169(3):543-548. doi:10.1111/bjd.12396
- 32) Gautam RK, Singh Y, Gupta A, Arora P, Khurana A, Chitkara A. The profile of cytokines (IL-2, IFN- $\gamma$ , IL-4, IL-10, IL-17A, and IL-23) in active alopecia areata. *J Cosmet Dermatol.* 2020;19(1):234-240. doi:10.1111/jocd.12970
- 33) Zhou C, Li X, Wang C, Zhang J. Alopecia Areata: an Update on Etiopathogenesis, Diagnosis, and Management. *Clin Rev Allergy Immunol.* 2021;61(3):403-423. doi:10.1007/s12016-021-08883-0
- 34) Pratt CH, King LE, Messenger AG, Christiano AM, Sundberg JP. Alopecia areata. *Nat Rev Dis Primers.* 2017;3. doi:10.1038/nrdp.2017.11



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Effect of Gel Secretome Hypoxia Mesenchymal Stem Cell on Expression of TGF- $\beta$ and IL-6 (In Vivo Experimental Study in Male Rats of Wistar Strains Model Hyperglycemic Wounds)



Yudhi Tities Kusuma<sup>1</sup>, Prasetyowati Subchan<sup>2</sup>, Agung Putra<sup>3</sup>

<sup>1</sup>Postgraduate student of Biomedical Sciences, Faculty of Medicine, Universitas Islam Sultan Agung, Jl Kaligawe KM 4 Semarang 50012

<sup>2,3</sup>Department of Biomedical Sciences, Faculty of Medicine, Universitas Islam Sultan Agung, Jl Kaligawe KM 4 Semarang 50012

**ABSTRACT:** Wounds disrupt normal skin structure, function, and shape. The healing process is hampered by hyperglycemia or high blood glucose levels resulting in wounds healing longer, resulting in an extension of the healing phase. The aim of this study was to determine the effect of administering hypoxic MSC secretome gel on the expression of the TGF- $\beta$  and IL-6 genes in male white Wistar rats with a hyperglycemic injury model. True experimental in vivo research with a Post Test Only Control Group design. Consisting of 5 groups, namely the healthy mice group (K1), the base gel treated mice group (K2), the standard intervention treatment group (positive control) with gentamicin (K3), the secretome treatment and intervention group with a dose of 100  $\mu$ L (K4) and a dose of 200  $\mu$ L (K5). The research sample consisted of 30 male Wistar rats. Mouse skin tissue was analyzed on day 46 after termination to see the expression of the TGF- $\beta$  and IL-6 genes using the quantitative RTq-PCR method. There was a significant difference in TGF- $\beta$  gene expression between treatment groups using the One-way Anova test 0.024 ( $p < 0.05$ ), various doses of MSC hypoxic secretome gel had an effect on increasing TGF- $\beta$  gene expression using Tamhane's Post Hoc test ( $p < 0.05$ ) showed the highest increase at a dose of 200  $\mu$ L compared to the others, while IL-6 gene expression had a significant difference with the Kruskal-Wallis test 0.001 ( $p < 0.05$ ), using MSC hypoxia secretome gel had an effect on decreasing IL-6 gene expression with results lowest at a dose of 200  $\mu$ L. MSC hypoxic secretome gel at a dose of 200  $\mu$ L/BW effectively increased TGF- $\beta$  gene expression and decreased IL-6 gene expression in male white Wistar rats with a hyperglycemic injury model.

**KEYWORDS:** Hyperglycemic wounds, MSC hypoxic secretome gel, TGF- $\beta$ , IL-6

### I. INTRODUCTION

Wounds are disorders of the structure, function, and normal shape of the skin that can be distinguished according to the healing time of acute wounds and chronic wounds. The integrity of the skin and the architecture of skin tissue are disturbed in its form and function.<sup>1</sup> Several conditions, including hyperglycemia hamper the healing process. Wounds heal more slowly than usual when blood glucose levels are high, in this condition there is an extension of the healing phase.<sup>2</sup> Disruption of the wound healing process is associated with regulatory cytokines, growth factors, and cell signaling molecules, increased oxidative stress, epithelialization delay, collagen synthesis, angiogenesis, and impaired endothelial function. Impaired production of transforming growth factor- $\beta$  (TGF- $\beta$ ) and vascular endothelial growth factor (VEGF), impairing wound healing in hyperglycemic conditions.<sup>3</sup> Hyperglycemia is closely related to the pathogenesis of diabetes mellitus, increased free fatty acids, and insulin resistance that can cause endothelial damage.<sup>4</sup> Susceptibility to wound infection and inflammation cannot be pathologically separated from elevated levels of pro-inflammatory cytokines such as TNF- $\alpha$  and IL-6, often.<sup>5</sup> being a serious complication leads to ischemic conditions or even amputation. Advances and technological developments in the health sector also gave rise to various alternative treatments, one of which was treatment using secretomes of hypoxic mesenchymal stem cells (MSC).

The incidence of injuries every year is increasing, both acute and chronic wounds. According to American studies, 3.50 patients out of every 1000 people have injuries. Surgical or traumatic injuries account for the majority of injuries in the world's population (48.00%), followed by foot ulcers (28.0%) and pressure sores (21.0%).<sup>6</sup> An American Wound Association called MedMarket Diligence conducted research on the incidence of injuries in the world based on the etiology of disease. According to surgical

## Effect of Gel Secretome Hypoxia Mesenchymal Stem Cell on Expression of TGF- $\beta$ and IL-6 (In Vivo Experimental Study in Male Rats of Wistar Strains Model Hyperglycemic Wounds)

wound data, there are 110.30 million cases of injuries worldwide. Trauma injuries 1.60 million cases, there are 20.40 million cases of abrasions, 10 million cases of burns, 8.50 million cases of decubitus ulcers, 12.50 million cases of venous ulcers, 13.50 million cases of diabetic ulcers, 0.20 million amputations per year, 0.60 million cases of carcinoma, 0.10 million cases of melanoma, and complications of skin cancer up to 0.10 million cases.<sup>6</sup>

Hyperglycemia is one of the early symptoms of metabolic disorders.<sup>2</sup> Impaired recovery due to physiological conditions leads to the occurrence of chronic injuries.<sup>1</sup> Increased oxidative stress, delayed collagen synthesis, decreased angiogenesis, impaired epithelialization and glucose metabolism, fibroblasts, and endothelial cell dysfunction have been reported as vital pathophysiological factors in delaying the wound healing process.<sup>7</sup> Coordination between various cells, the release of local growth factors and cytokines affect the rate of wound repair whereas disruption in this cycle leads to delayed wound healing.<sup>8</sup> MSC secretomes produce and release cytokines that stimulate angiogenesis, extracellular matrix remodeling, cell recruitment, immunomodulation, extracellular matrix remodeling, and nerve regeneration which all aid wound healing.<sup>9</sup> Hypoxic preconditioning increases cytoprotective impact, maintains multipotency, increases proliferation, and the capacity of MSC hypoxic secretomes to survive in environments that are difficult to locate damaged tissues.<sup>10</sup>

TGF- $\beta$  is the most important growth factor for the improvement of collagen synthesis, and plays an important role in wound healing by activating fibroblasts, which promotes healing and contributes to the formation of scar repair.<sup>11</sup> Hyperglycemic wounds are more susceptible to infection and hyper-inflammation, causing an increase in the pro-inflammatory cytokines TNF- $\alpha$  and IL-6. IL-6 is thought to play an important role in wound repair, including keratinocyte stimulation and fibroblast proliferation, synthesis and breakdown of extracellular matrix proteins, fibroblast chemotaxis, and regulation of immune responses.<sup>12</sup>

Research by Kuntardjo et al, 2019 reported that topical administration of MSC-CM gel doses of 100  $\mu$ L and 200  $\mu$ L was more effective compared to combination subcutaneous injection.<sup>13</sup> Administration of MSC secretome can improve wound condition in mice by inhibiting inflammatory response through decreasing levels of IL-6, IL-1 $\beta$ , TNF- $\alpha$ , and IL-4, increasing the anti-inflammatory cytokine TGF- $\beta$ .<sup>14</sup> Utilization of various precondition techniques to increase the regenerating ability of cell secretion using MSC secretomes, hypoxic conditions are strategies to increase growth factor secretion, protect tissues, and accelerate cell regeneration in wound healing.<sup>15</sup> However, administration of MSC hypoxic secretome gel against TGF- $\beta$  and IL-6 gene expression in hyperglycemic wound model mice has never been reported. Based on this background, research is needed to determine the effect of MSC hypoxic secretome gel on TGF- $\beta$  and IL-6 gene expression in male Wistar rat hyperglycemic wound models.

## II. MATERIAL AND METHOD

### Study Design and Experimental Animals

This research is a true experimental in vivo research with Post Test Only Control Group Design. The study subjects used male Wistar white rats aged 2-3 months with a weight ranging from 200-250 grams that fit the inclusion and inclusion criteria, acclimatized for 7 days. This study used 5 treatment groups, a group of healthy rats (K1), a group of mice treated with base gel (K2), a treatment group that received standard intervention (positive control) with gentamicin (K3), a treatment group, and secretome intervention dose of 100  $\mu$ L/kgBW (K4), and a treatment group and secretome intervention dose of 200  $\mu$ L/kgBW (K5).

### Research Materials

The study material used rat umbilical cord, Streptozotocin, citrate buffer, water-based gel, Ketamine, Xylazine, dinitrophenyl-bovine serum albumin (DNP-BSA), aluminum hydroxide gel (Al(OH)), 2,4-Dinitrochlorobenzene 1.5% (DNCB), acetone-olive oil NaCl 0.9%, PBS, DMEM, FBS, fungizone, and penstrep.

### Research Equipment

This research uses equipment consisting of a Biosafety Cabinet (BSC), micropipette, CO2 incubator, Disecting kit, Flask 75T, Hypoxic chamber, oxygen meter, beaker glass, stirring rod, 1 cc injection syringe, balance sheet, Gluco test easy touch, tweezers, surgical scissors, handscoon, and sterile swab.

### MSC Isolation from Umbilical Cord

Work on biosafety cabinet class 2, equipment used and work carried out in sterile conditions, the steps are as follows: **(1)** The umbilical cord is cut from the rat fetus and the blood vessels are removed. **(2)** An Umbilical cord is collected and placed in a sterile container containing 0.9% NaCl. **(3)** Using tweezers, the umbilical cord is placed on a petri dish, and the umbilical cord is washed thoroughly with PBS. **(4)** The umbilical cord is finely chopped and inserted in flask 25T then flattened and allowed to stand for 3 minutes until the tissue sticks to the surface of the flask. **(5)** The complete medium consisting of DMEM, fungizon, penstrep, and FBS is added slowly until it covers the network. **(6)** The explant is then incubated in an incubator at 37°C and 5% CO<sub>2</sub>. **(7)** Cells



## **Effect of Gel Secretome Hypoxia Mesenchymal Stem Cell on Expression of TGF- $\beta$ and IL-6 (In Vivo Experimental Study in Male Rats of Wistar Strains Model Hyperglycemic Wounds)**

appear about 14 days after the start of the culture process. **(8)** Media is replaced every 3 days by removing half of the media and replacing it completely with new media. **(9)** Cell maintenance is carried out so that the cell obtains 80% contingency.

### **Hypoxia and Tangential Flow Filtration Manufacturing Process**

**(1)** MSC that has obtained 80% consensus is then added complete medium of up to 10 mL. **(2)** Then the flask containing MSC is inserted into the hypoxic chamber. **(3)** Nitrogen gas is flowed through the inlet valve and an oxygen meter is placed in the sensor hole to measure the oxygen concentration in the chamber. **(4)** Nitrogen is then added until the indicator needle shows an oxygen concentration of 5%. **(5)** After 24 hours, the culture media will be removed and then filtered using Tangential Flow Filtration to obtain SH-MSC and then it will be matched with K4 and K5.

### **Gel Preparatory Manufacturing Process**

**(1)** SH-MSC gel preparation is made by mixing SH-MSCs with gel to obtain a concentration of 250  $\mu$ L/g. SH-MSC 200 mg gel preparation contains SH-MSCs at doses of 100  $\mu$ L/kgBW (K4) and 200  $\mu$ L/kgBW secretome (K5). **(2)** The mixing process is carried out aseptically until a homogeneous mixture is formed based on the physical properties observed using a microscope.

### **Treatment of Hyperglycemic Mouse Model**

**(1)** Rats are adapted for 7 days, then after 7 days are satisfied for 8-12 hours. Rats were injected once intraperitoneally with streptozotocin 65 mg/kgBW. Validation of the blood glucose test is carried out on the 36th day after initiation. Hyperglycemia was established when the rats' blood glucose was >200 mg/dl. **(2)** After 30 days of Streptozotocin injection, the rats were anesthetized with a mixture of ketamine (60 mg/kgBW) and Xylazine (20 mg/kgBW), and the back of the rats were shaved. **(3)** Using sterile and aseptic techniques, a circular incision with a diameter of 6 mm and a depth of 2 mm was made on the skin of the rat's back with a disposable incision tool. Then the wound is closed using tegaderm for 6 days.

### **Validation of Microscopic Examination of Hyperglycemic Wounds**

Hyperglycemic lesions are viewed macroscopically using photographs of the specimen and microscopically with HE staining. Skin samples were taken to make histological preparations by paraffin wax method and hematoxylin-eosin (HE) staining. The steps are as follows: **(1)** Skin samples of mice of all groups were taken and fixed in a 10% NBF solution. **(2)** Rinse the skin sample with 70% alcohol until it is free of fixative residue. **(3)** Skin samples were soaked in 70%, 80%, 90%, 96% alcohol, and absolute alcohol for 30 minutes respectively for the dehydration process. **(4)** Soak the skin sample in toluol until clear or transparent for 1 hour. **(5)** Paraffin infiltration is carried out in an oven at 56-60°C by placing skin samples in a mixture of toluol and paraffin in a ratio of 3:1, 1:1, and 1:3 for 30 minutes each. Skin samples were placed on pure paraffin I, pure paraffin II, and pure paraffin III for 30 minutes at each treatment. **(6)** In Embedding, a sample of pure paraffin peel is implanted into a mold of a paraffin block that contains liquid paraffin and waits for the paraffin to harden. **(7)** Skin samples in paraffin blocks are cut into 6  $\mu$ m thick pieces using microtomes. **(8)** Next, the tissue sample slices are attached to the glass by applying Mayer's albumin and then given a little aqueous droplet and then heated on a hot plate until the slices stick firmly. **(9)** The histological preparation is deparaffined by placing it on xylol for 24 hours. **(10)** The staining process is carried out by hematoxylin-eosin staining. The xylol content is taken with filter paper, then added in alcohol 96%, 90%, 80%, 70%, 60%, 50%, 40%, 30%, and aqueous is done for 1-2 minutes. The preparation is placed on Hematoxylin dye for 5-10 seconds, then rinsed under running water for 10 minutes. The next process is to soak the preparation in 30%, 40%, 50%, 60%, and 70% alcohol for 3-5 minutes. The preparation is laid out in eosin for 5-10 minutes each, then soaked in 70%, 80%, 90%, and 96% alcohol for 3-5 minutes, and then dried with filter paper. The preparation is put into xylol for 15 minutes, then the histological preparation is given drops of canada balsam. **(11)** The preparation is covered with a cover glass, named, and stored in a supply box.

### **Hyperglycemic Wound Care**

Then on the sixth day after the formation of hyperglycemic wounds, rats were treated for 10 days with topical gel administration every day, with SH-MSC gel composition dose 100  $\mu$ L/kgBW in 200 mg gel (K4) and dose 200  $\mu$ L/kgBW in 200 mg gel (K5). The positive control mice (K2) received standard antibiotic therapy and the negative control mice received the base gel treatment (K3). After 10 days of wound treatment, the mice were terminated using the cervical dislocation method, and skin samples were taken for parameter analysis.

### **RNA Extraction Process and cDNA Synthesis**

**(1)** A total of 50-100 mg of skin samples are cut into small pieces and inserted in a tube containing 0.5 mL of Iso Plus RNA. The pieces of skin are smoothed with micro pastels and DNA RNase free, then added RNAiso Plus as much as 0.5 ml and stored at room temperature for 5 minutes. **(2)** Then add 0.2 mL chloroform and vortex until the solution until it becomes milky white.

## Effect of Gel Secretome Hypoxia Mesenchymal Stem Cell on Expression of TGF- $\beta$ and IL-6 (In Vivo Experimental Study in Male Rats of Wistar Strains Model Hyperglycemic Wounds)

Incubation for 5 minutes at room temperature and centrifugation for 15 minutes at 4°C at a rate of 15,000 xg-force until solution in a three-layer tube. (3) The topmost layer containing mRNA is transferred into a 2 mL microtube, with the same ratio of isopropanol added. (4) Shake the 2 mL microtube tube until a white thread appears, then centrifuge at 4°C at a speed of 12,000 xg-force for 10 minutes. The supernatant is removed until white pellets appear at the bottom of the tube. (5) After drying, add 100  $\mu$ L of 75% ethanol to the solution (Diethyl pyrocarbonate) DEPC then turned back several times then centrifuged again at 40C, speed 15,000 xg-force for 5 minutes. (6) Supernatants are removed and DEPC is added as much as 50-100  $\mu$ L at -80°C or can be used in further research. (7) Then as many as 2  $\mu$ L of RNA samples were quantified using NanoDrop with a wavelength of 260 nm. The quantification result will be calculated to make 3000 ng. (8) cDNA synthesis process by mixing the previously calculated RNA sample with 1  $\mu$ L of OligoDT and PCR water to a volume of 10  $\mu$ L, then the mixture is put into a thermal cyclor and incubated for 5 minutes at a temperature of 700C. (9) Then added 5X buffer 4  $\mu$ L, DEPC-Treated H<sub>2</sub>O 5  $\mu$ L, ReverTraAce 1  $\mu$ L. (10) The mixture is then incubated at a temperature of 45-500C for 30 minutes.

### Diagnosis of TGF- $\beta$ and IL-6 gene expression RTq-PCR method

(1) Analysis of TGF- $\beta$  and IL 6 expression using RTq-PCR, a mixture of 1  $\mu$ L cDNA sample, KAPPA SYBR FAST qPCR master mix as much as 10  $\mu$ L, specific forward and reverse primers in each target gene as much as 1  $\mu$ L and Nuclease Free Water as much as 7  $\mu$ L. (2) PCR products are then analyzed using RTq-PCR illumine with predaturation temperature at 950C for 2 minutes, then denaturation 950C with a time of 5 seconds, then aneling 55-600C for 20 seconds. With a total number of cycles 40 times. The primary sequences of GADPH used are: F: 5'-GCG ACA GTC AAG GCT GAG AATG -3' and R: 5'-TCT CGC TCC TGG AAG ATG GTGA -3'. (3) The primary sequence of TGF- $\beta$  used is F: 5'-TAC CAT GCC AAC TTC TGT CTG GGA-3' and R: 5'-ATG TTG GAC AAC TGC TCC ACC TTG-3'. (4) The primary sequences of IL-6 used are F: 5'-TCC TAC CCC AAC TTC CAA TGC TC-3' and R: 5'-TTG GAT GGT CTT GGT CCT TAG CC-3'. (5) Increased gene expression was analyzed in the ratio of improvement to gene housekeeping using EcoStudy software.

## III. RESULT

### Isolation of the Hypoxia Secretome of MSCs

The MSC hypoxic secretome used in this study was the result of filtration of MSC culture medium under 5% hypoxic conditions for 24 hours using Tangential flow filtration (TFF). MSCs were isolated from Umbilical Cord rats aged 19 days and cultured on a flask using a specific culture medium. MSC validation is performed after the 4th phase. The results of morphological analysis showed that MSCs have spindle-like morphology similar to fibroblast cells. The results of membrane marker analysis using flow cytometry showed that MSC expressed membrane proteins CD90 (97.6%), CD29 (96.4%), and slightly expressed CD45, (1.7%) and CD31 (3.9%). Analysis of the differentiation potential of MSCs into el adipocytes and osteocytes was carried out using Oil Red O and Alizarin Red Staining painting. MSC shows the ability to differentiate into osteocytes and adipocytes indicated by calcium and fat deposits in the form of red color.

MSC hypoxic secretomes were performed using morphological analysis, cell surface markers, and differentiation potential, morphological analysis using inverted microscopy, cell surface marker analysis using flow cytometry, and adipogenic and osteogenic differentiation analysis using Oil Red O and Alizarin Red Staining. The validated cells were then cultured and incubated under hypoxic conditions (5% O<sub>2</sub>). The culture medium is collected and filtered by the Tangential Flow Filtration (TFF) method.

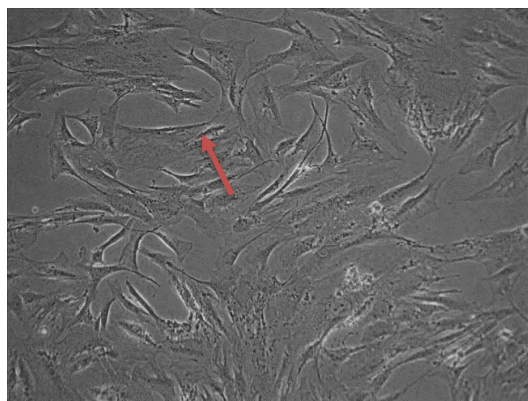


Figure 1. Isolation of MSC with spindle-like cells at 100x magnification.

## Effect of Gel Secretome Hypoxia Mesenchymal Stem Cell on Expression of TGF- $\beta$ and IL-6 (In Vivo Experimental Study in Male Rats of Wistar Strains Model Hyperglycemic Wounds)

The results of the isolation of MSC hypoxic secretomes were validated by flow cytometry to demonstrate MSC's ability to express various special surface markers. Figure 2 shows that MSCs express CD90 (97.6%), CD29 (96.4%) and express CD45 (1.7%) and CD31 (3.9%)

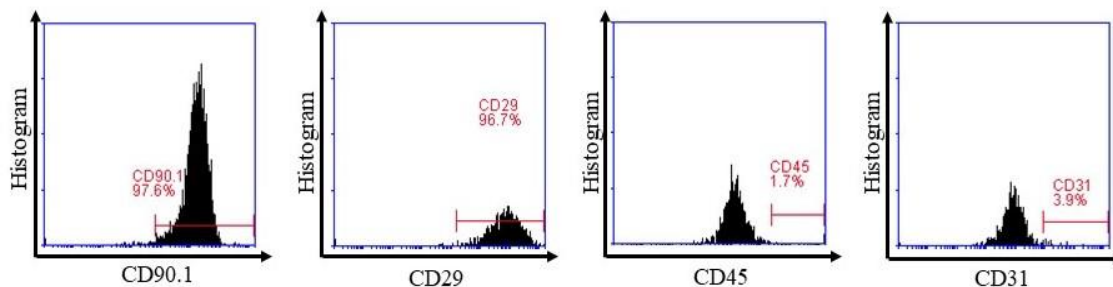


Figure 2. Flow cytometry analysis of CD90, CD29, CD45 and CD31 expression

Analysis of MSC's ability to differentiate into a wide variety of mature cells. MSCs are given special media to differentiate into osteophytes and adipocytes. red coloring using Alizarin Red staining and oil Red dye on osteogenic and adipogenic cultures at 100x magnification, respectively, seen in Figure 3 and Figure 4:

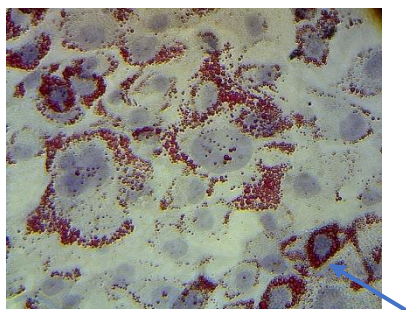


Figure 3. MSC differentiated into adipocytes

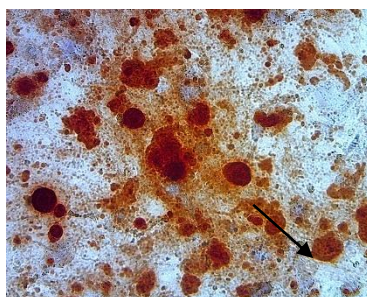


Figure 3. MSCs differentiate into osteocytes

MSC cultures containing secretomes were collected and screened using the Tangential flow filtration (TFF) method based on molecular weight measuring 10-50 kDa containing cytokines IL-10 and TGF- $\beta$ .<sup>60</sup> TGF- $\beta$  is a dimeric growth factor molecule with a molecular weight of 25 kDa that helps reduce the duration of the inflammatory response.<sup>60</sup>

In this study, the isolation of growth factors contained in MSC hypoxic secretomes was carried out to obtain pure MSC hypoxic secretomes. Researchers used TFF media to isolate molecules using filter tapes of 10-50 kDa 50%, 50-100 kDa 25%, and 100-300 kDa 25%. After screening, measurement of growth factor content in MSC hypoxic secretomes was carried out using the ELISA test. MSC hypoxic secretomes are known to produce TGF- $\beta$  levels of  $372.53 \pm 9.18$  pg/mL, this value is higher than the TGF- $\beta$  concentration in normoxic MSC secretomes which range from 10-100 pg/mL.

### IL-10 and TNF- $\alpha$ gene expression in mouse models of alopecia-like by administration of SH-MSCs

The results of TGF- $\beta$  gene expression analysis using the RTq-PCR method using the Illumina Eco Real-Time PCR tool obtained the following results:

## Effect of Gel Secretome Hypoxia Mesenchymal Stem Cell on Expression of TGF- $\beta$ and IL-6 (In Vivo Experimental Study in Male Rats of Wistar Strains Model Hyperglycemic Wounds)

Table 1. Average levels, normality, and homogeneity of TGF- $\beta$  gene expression between treatment groups

Group	Base gel (K2)	Gentamicin (K3)	Sec 100 $\mu$ L (K4)	Sec 200 $\mu$ L (K5)
Tikus 1	0,72	0,45	0,85	1,34
Tikus 2	0,78	0,89	0,93	1,85
Tikus 3	0,51	0,81	1,53	2,00
Tikus 4	0,40	0,95	0,59	1,72
Tikus 5	0,36	0,63	0,61	0,61
Tikus 6	0,97	0,62	0,66	0,54
Mean	0,62	0,72	0,86	1,34
SD	0,24	0,19	0,35	0,64
Shapiro wilk	0,64*	0,71*	0,06*	0,21*

Information:

\*Saphiro-Wilk test ( $p > 0,05$  = normal)

\*\* Levene's Test ( $p > 0,05$  = homogeneous)

Based on the results shown in Table 3 and Figure 6 graph, the average expression of TGF- $\beta$  genes in the base gel group (K2) was  $0.62 \pm 0.24$ , the average gentamicin group was  $0.72 \pm 0.19$ , the average secretome group 100  $\mu$ L (K4)  $0.86 \pm 0.35$  and the average secretome group 200  $\mu$ L (P2)  $1.34 \pm 0.64$ . TGF- $\beta$  gene expression data of the four groups were normally distributed with Shapiro-Wilk test values with  $p > 0.05$  values and had homogeneous data variants with Levene's Test test results with  $p$  values = 0.02 ( $p > 0.05$ ). It was concluded that the distribution and variant of TGF- $\beta$  gene expression data were normal and inhomogeneous.

Statistical analysis with the One Way Anova test obtained a value of  $p = 0.024$  ( $p < 0.05$ ) so it was concluded that there was a significant difference in the average expression of the TGF- $\beta$  gene between the four groups. One-Way Anova test results followed by Post Hoc Tamhane test to determine the most influential dose group, shown in Table 2.

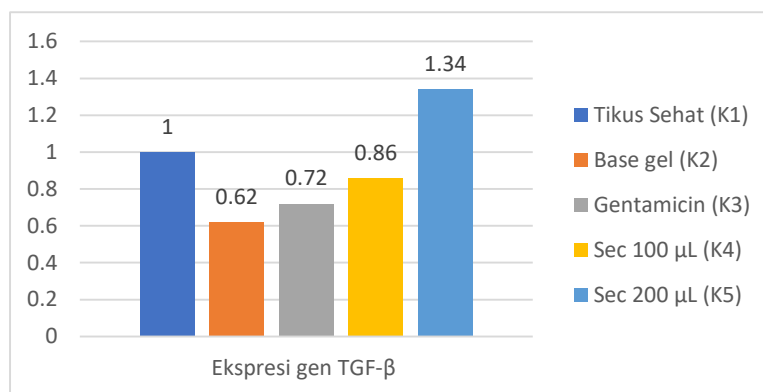


Figure 4. Average levels of TGF- $\beta$  gene expression between treatment groups

Table 2. Post Hoc Tamhane test of TGF- $\beta$  gene expression in each group

Group	Comparison Group	Sig.	95% confidence interval	
			Lower Limit	Upper Limit
Gel Base	Gentamicin	0.66	-0.5765	0.3732
	Secretom100	0.308	-0.7132	0.2365
	Secretom200	0.005*	-1.1948	-0.2452
Gentamicin	Gel Base	0.66	-0.3732	0.5765
	Secretom100	0.555	-0.6115	0.3382

**Effect of Gel Secretome Hypoxia Mesenchymal Stem Cell on Expression of TGF-  $\beta$  and IL-6 (In Vivo Experimental Study in Male Rats of Wistar Strains Model Hyperglycemic Wounds)**

	Secretom200	0.013*	-1.0932	-0.1435
Secretom100	Gel Base	0.308	-0.2365	0.7132
	Gentamicin	0.555	-0.3382	0.6115
	Secretom200	0.047*	-0.9565	-0.0068
Secretom200	Gel Base	0.005*	0.2452	1.1948
	Gentamicin	0.013*	0.1435	1.0932
	Secretom100	0.047*	0.0068	0.9565

The \* indicates a significantly different group

Based on the data of Table 4 above, the average comparison of the base gel group (K2) with the gentamicin group (K3) 0.66 and secretome group 100 (K4) 0.308 was not significantly different, while the group (K2) with secretome group 200 (K5) was significantly different with a value of 0.005 ( $p < 0.05$ ). Group (K3) compared with group (K2) and group (K4) were not significantly different while group (K3) compared with group (K5) was significantly different with a value of 0.013 ( $p < 0.05$ ).

Group (K4) compared to group (K2) and group (K3) were not significantly different while group (K4) compared to group (K5) was significantly different with a value of 0.047 ( $p < 0.05$ ). Group (K5) compared to group (K2) was significantly different with a value of 0.005, Group (K5) compared to group (K3) was significantly different with a value of 0.013, and group (K5) compared to group (K4) significantly different with a value of 0.047 ( $p < 0.05$ ).

Tamhane's Post Hoc test results on TGF- $\beta$  gene expression results showed that administration of MSC 200 $\mu$ L/kgBW hypoxic secretome gel can increase TGF- $\beta$  gene expression in male Wistar rat hyperglycemic wound models.

**Effect of MSC hypoxic secretome gel administration on IL-6 gene expression.**

**Table 3. Mean levels, normality, and homogeneity of IL-6 gene expression between treatment groups**

Group	Base gel (K2)	Gentamicin (K3)	Sec 100 $\mu$ L (K4)	Sec 200 $\mu$ L (K5)
Rat 1	1,13	1,95	0,80	0,31
Rat 2	1,75	0,86	1,16	0,91
Rat 3	1,65	0,95	0,28	0,63
Mouse 4	1,96	1,95	0,91	0,63
Rat 5	1,48	0,90	1,01	0,91
Rat 6	1,13	0,95	0,28	0,63
Mean	1,52	1,26	0,74	0,67
SD	0,34	0,53	0,37	0,22
Shapiro wilk	0,49*	0,005	0,20*	0,20*
Levene test	0,036			

Information:

\*Saphiro Wilk test ( $p > 0.05$  = normal)

\*\* Levene's Test ( $p > 0,05$  = homogeneous)

The results of the study based on Table 5 average expression of the IL-6 gene in the base gel group (K2) of  $1.52 \pm 0.34$ , the average gentamicin group of  $1.26 \pm 0.53$ , the average secretome group of 100  $\mu$ L (K3) of  $0.74 \pm 0.37$  and the average secretome group of 200  $\mu$ L (K5) of  $0.67 \pm 0.22$ . IL-6 gene expression data of the four groups were not distributed with Shapiro Wilk test values in the

## Effect of Gel Secretome Hypoxia Mesenchymal Stem Cell on Expression of TGF- $\beta$ and IL-6 (In Vivo Experimental Study in Male Rats of Wistar Strains Model Hyperglycemic Wounds)

gentamicin group (K3) of  $p = 0.005$  ( $p < 0.05$ ) and had inhomogeneous data variants with the results of the Levene's Test test with a value of  $p = 0.036$  ( $p < 0.05$ ). It was concluded that the distribution and variant of IL-6 gene expression data were abnormally distributed and inhomogeneous.

The Kruskal-Wallis non-parametric test obtained results  $p = 0.001$  ( $p < 0.05$ ) so it was concluded that there were significant differences between treatment groups for IL-6 gene expression

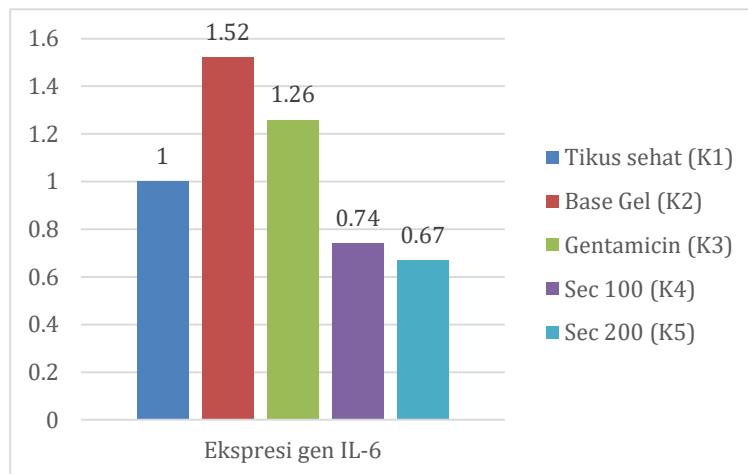


Figure 5. The average of the IL-6 gene expression between treatment groups

### Comparison of TNF- $\alpha$ gene expression between groups in mouse models of alopecia-like with administration of SH-MSCs

#### Validation of Blood Sugar Levels

Blood glucose examination is carried out gradually on day 0, day 30, and day 36, following the results of the glucose level examination in Table 4.

Table 4. The results of glucose level

Group	Healthy H36	THE H36
Rat 1	102	388
Rat 2	112	314
Rat 3	96	346
Mouse 4	99	456
Rat 5	105	498
Rat 6	110	327
Mean	104	388.2
SD	6.23	74.41

Based on Table 4, the average glucose level in the day 36 hyperglycemia treatment group showed a significant increase from normal at  $104 \pm 6.23$ , and the average glucose level in the day 36 hyperglycemic treatment group showed a significant increase from normal at  $388.2 \pm 74.41$ . The results of glucose levels showed a significant increase so hyperglycemic conditions were declared valid for hyperglycemic wound mouse models.

#### Histopathological Validation of HE Staining

The results of observations of hematoxylin-eosin (HE) staining histopathological preparations in a group of healthy rats with hyperglycemia treatment are as follows:

## Effect of Gel Secretome Hypoxia Mesenchymal Stem Cell on Expression of TGF- $\beta$ and IL-6 (In Vivo Experimental Study in Male Rats of Wistar Strains Model Hyperglycemic Wounds)

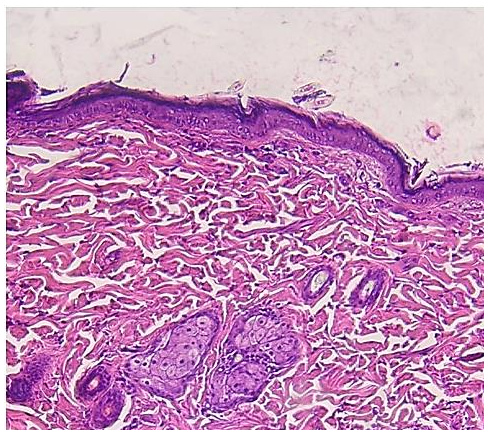


Figure 7. HE staining on healthy rat group

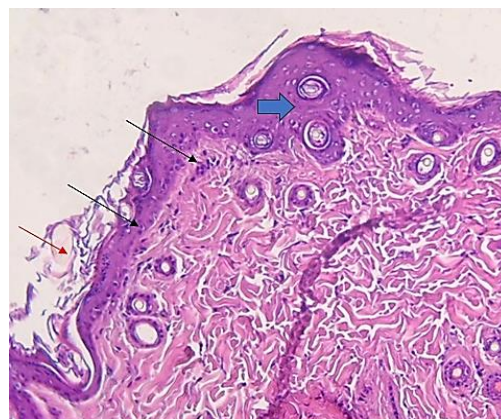


Figure 8. HE staining on hyperglycemia rat group

Based on Figure 8, HE staining in the hyperglycemic group showed thickening of the epithelial wall shown in the blue arrow, while the black arrow showed inflammation in immune cells and the red arrow necrosis in epithelial cells.

### Macroscopic Picture of Hyperglycemic Wounds

Based on Figure 6, macroscopic results of hyperglycemic wounds were observed on day 36, day 43, and day 46. The results showed the acceleration of wound repair using secretomes of 200  $\mu$ L on day 43 experienced the smallest macroscopic healing and day 46 wounds had healed.

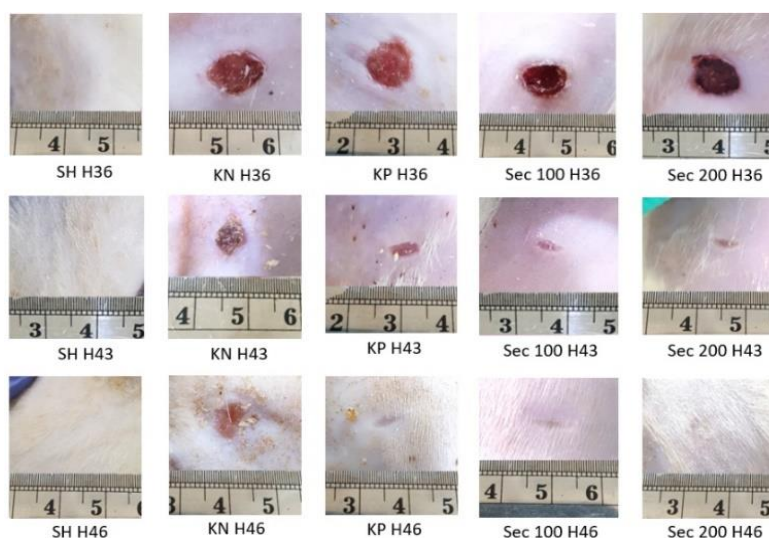


Figure 9. Macroscopic picture of hyperglycemic wounds

### IV. DISCUSSION

Impaired wound healing due to hyperglycemia causes changes in endothelial cell function and vascular dysfunction in wounds resulting in infection and in many cases amputation. Delayed wound healing results from changes in several endogenous factors that contribute to wound healing, including decreased production of growth factors such as PDGF and TGF- $\beta$ , mediators involved in angiogenic response, macrophage function, collagen synthesis, keratinocyte migration, and unstoppable inflammatory fibroblast proliferation.<sup>42</sup>

Recent developments in stem cell research, particularly involving MSCs to stop prolonged inflammatory processes as well as the recovery and repair of damaged tissues.<sup>61</sup> Growth factors that can trigger damage tissue repair include Basic Fibroblast Growth Factor (BFGF), Vascular Endothelial Growth Factor (VEGF), Transforming Growth Factor beta (TGF- $\beta$ ), Platelet-Derived Growth Factor (PDGF), Angiopoietin-1 (ANG-1), Placental Growth Factor (PIGF), and Monocyte Chemoattractant Protein 1 (MCP-1).<sup>62</sup>

Wound healing depends on the growth and migration of keratinocytes in the epidermis and the formation of granulation tissue in

## Effect of Gel Secretome Hypoxia Mesenchymal Stem Cell on Expression of TGF- $\beta$ and IL-6 (In Vivo Experimental Study in Male Rats of Wistar Strains Model Hyperglycemic Wounds)

the dermis. This tissue growth will not occur before the inflammatory process is complete. Inflammation that occurs results in tissue death which triggers the release of DAMP and causes macrophages (M1) to secrete proinflammatory cytokines, namely IL-6. With the involvement of T cells that also secrete IFN- $\gamma$  M1 will continue to secrete IL-6 and cause local and systemic inflammation.<sup>40,63</sup>

The results showed that the highest IL-6 gene expression was found in the base gel group (K1) of  $1.52 \pm 0.34$ , and the average of the lowest IL-6 gene expression group was found in the secretome group of 200  $\mu$ L (K5) of  $0.67 \pm 0.22$ . It showed that administration of MSC hypoxic secretome gel in the 200  $\mu$ L (K5) secretome group had the most significant effect on decreasing IL-6 gene expression. Other studies have shown that damaged cells cause inflammation, which promotes the production of inflammatory mediators including IL-6. Decreased IL-6 levels cause MSCs to actively migrate towards damaged areas.<sup>64</sup> MSC cells that migrate in the wound area will secrete anti-inflammatory cytokines such as IL-10 and growth factors such as PDGF which play an important role in the wound healing process.<sup>65</sup>

Previous research has found that IL-10 can suppress inflammation by inhibiting nF-kB activity, which leads to the decline of pro-inflammatory cytokines such as IL-6. In addition, IL-10 is able to trigger polarization of M1 and M2, so macrophages are anti-inflammatory. Secretomes containing IL-10 can also play a similar role in suppressing inflammation in the wound area.

Another study by Pan et al. 2017, using UC-SH MSCs showed a significant reduction in serum IL-6 and TNF- $\alpha$  levels after UC-MSCs treatment in DM mice and improved insulin resistance.<sup>66</sup> In another study by Cevey et al. 2019, showed a decrease in inflammation through the IL-10 and STAT3 pathways, inducing phosphorylation of STAT3, IL-10 binds to IL-10R, activating JAK 1. The STAT3 protein enters the nucleus and activates the SOSC3 mRNA sequence which is then expressed intracellularly and inhibits proinflammatory signaling pathways, specifically NF-kB. Production of proinflammatory cytokines, including IL-6, is reduced when the NF-kB pathway is suppressed.<sup>67</sup>

This study aims to reveal the role of the secretome in IL-6 and TGF $\beta$  expression in hyperglycemic wounds. The results showed that TGF- $\beta$  gene expression increased significantly in the secretome group of 200  $\mu$ L (P2) with an average of  $1.34 \pm 0.62$ . The results of the analysis using the Post Hoc Temhane test found that K5 was significantly different compared to the base gel group (K2), gentamicin group (K3), and secretome group 100 (K4). In line with the 2019 study of Beserra et al., using lupeol in wound healing in streptozotocin-induced hyperglycemic rats, found that TGF- $\beta$  expression increased in mice that experienced improved and accelerated wound healing. Elevated levels of IL-10 were also known to occur in the lupeol-treated group compared to the control group.<sup>42</sup>

In another study by Ormazabal et al. 2022, the hMSC-EC secretome promotes wound healing in hyperglycemic mice. hMSC-EC, being a therapeutic alternative, administration of hMSC-EC generated under tightly controlled conditions could represent a new therapeutic approach for treating chronic wounds in diabetic patients.<sup>16</sup> In wound healing, the role of TGF- $\beta$  is important in the activation of fibroblast cells, leading to the production of ECM which acts as a scaffold for MSC cells. TGF- $\beta$  is mostly released by type 2 macrophages which are anti-inflammatory cells.<sup>68</sup> Therefore an increase in TGF- $\beta$  correlates with wound healing.

### V. CONCLUSION

Administration of MSC hypoxic secretome gel at a dose of 200  $\mu$ L/kgBW was shown to significantly increase TGF- $\beta$  gene expression in male Wistar rat hyperglycemic wound models. Administration of MSC hypoxic secretome gel at a dose of 200  $\mu$ L/kgBW was shown to significantly affect the decrease in IL-6 gene expression in male Wistar rat hyperglycemic wound models.

### ACKNOWLEDGEMENT

The authors declare no conflict of interest and no involvement of sponsors or funding for this research.

### REFERENCES

- 1) Purnama H, Ratnawulan S. Review Sistematis: Proses Penyembuhan Dan Perawatan Luka. *Farmaka*. 2017;15(2):251-6.
- 2) Kewuta MNN, Dada IKA, Jayawardhita AAG. Based On Signs Of Inflammation and The Presence Of Scabs Leaf Extract Of *Muntingia Calaburata* The Healing Of Incisions Wound In Hyperglycemic Mice. *Indonesia Medicus Veterinus*. 2021;10(1):30-40. doi:10.19087/imv.2021.10.1.30
- 3) Mao X, Li Z, Li B, Wang H. Baicalin regulates mRNA expression of VEGF-c, Ang-1/Tie2, TGF- $\beta$  and Smad2/3 to inhibit wound healing in streptozotocin-induced diabetic foot ulcer rats. *J Biochem Mol Toxicol*. 2021;35(11). doi:10.1002/jbt.22893



## Effect of Gel Secretome Hypoxia Mesenchymal Stem Cell on Expression of TGF- $\beta$ and IL-6 (In Vivo Experimental Study in Male Rats of Wistar Strains Model Hyperglycemic Wounds)

- 4) Mintyatus Hazad E, Wibisono N, Sri Damayanti D. Efek Kombinasi Ekstrak Infusa Sambiloto, Salam, Kayu Manis , Dan Temulawak Terhadap Kadar Nitrit Oksida Jaringan Arteri Ekor Tikus Wistar Jantan Model Hiperglikemia.; 2019.
- 5) Yazdanpanah L, Shahbazian H, Nazari I, et al. Incidence and risk factors of diabetic foot ulcer: A population-based diabetic foot cohort (ADFC study)-two-year follow-up study. *Int J Endocrinol.* 2018;2018. doi:10.1155/2018/7631659
- 6) Huda N, Febriyanti E, Laura D De. Edukasi Berbasis Nutrisi dan Budaya pada Penderita Luka Kronis. *Jurnal Pendidikan Keperawatan Indonesia* . 2018;4(1):1. doi:10.17509/jpki.v4i1.12307
- 7) Adil M, Khan RA, Kalam A, et al. Effect of anti-diabetic drugs on bone metabolism: Evidence from preclinical and clinical studies. *Pharmacological Reports.* 2017;69(6):1328-1340. doi:10.1016/j.pharep.2017.05.008
- 8) Goswami S, Kandhare A, Zanwar AA, et al. Oral L-glutamine administration attenuated cutaneous wound healing in Wistar rats. *Int Wound J.* 2016;13(1):116-124. doi:10.1111/iwj.12246
- 9) Regmi S, Pathak S, Kim JO, Yong CS, Jeong JH. Mesenchymal stem cell therapy for the treatment of inflammatory diseases: Challenges, opportunities, and future perspectives. *Eur J Cell Biol.* 2019;98(5-8). doi:10.1016/j.ejcb.2019.04.002
- 10) Fui LW, Lok MPW, Govindasamy V, Yong TK, Lek TK, Das AK. Understanding the multifaceted mechanisms of diabetic wound healing and therapeutic application of stem cells conditioned medium in the healing process. *J Tissue Eng Regen Med.* 2019;13(12):2218-2233. doi:10.1002/term.2966
- 11) Wulandari P, Hutagalung MR, Perdanakusuma DS. Deteksi Kadar Transforming Growth Factor (Tgf-B) Pada Luka Akut.; 2021.
- 12) Refiani E, Maliza R, Fitri H, Lestari P. Therapeutic Effects of Medicinal Plants on Diabetic Foot Ulcers: A Systematic Review. *Journal of Agromedicine and Medical Sciences.* 2021;7(3):167. doi:10.19184/ams.v7i3.24244
- 13) Kuntardjo N, Dharmana E, Chodidjah C, Nasihun TR, Putra A. TNF- $\alpha$ -Activated MSC-CM Topical Gel Effective in Increasing PDGF Level, Fibroblast Density, and Wound Healing Process Compared to Subcutaneous Injection Combination. *Majalah Kedokteran Bandung.* 2019;51(1):1-6. doi:10.15395/mkb.v51n1.1479
- 14) Jung H, Son GM, Lee JJ, Park HS. Therapeutic effects of tonsil-derived mesenchymal stem cells in an atopic dermatitis mouse model. *In Vivo (Brooklyn).* 2021;35(2):845-857. doi:10.21873/INVIVO.12325
- 15) Bormann D, Gugerell A, Ankersmit HJ, Mildner M. Therapeutic Application of Cell Secretomes in Cutaneous Wound Healing. *Journal of Investigative Dermatology.* 2023;143(6):893-912. doi:10.1016/j.jid.2023.02.019
- 16) Ormazabal V, Nova-Lampeti E, Rojas D, et al. Secretome from Human Mesenchymal Stem Cells-Derived Endothelial Cells Promotes Wound Healing in a Type-2 Diabetes Mouse Model. *Int J Mol Sci.* 2022;23(2). doi:10.3390/ijms23020941
- 17) Lee EG, Luckett-Chastain LR, Calhoun KN, Frempham B, Bastian A, Gallucci RM. Interleukin 6 function in the skin and isolated keratinocytes is modulated by hyperglycemia. *J Immunol Res.* 2019;2019. doi:10.1155/2019/5087847
- 18) Fromer MW, Chang S, Hagaman ALR, et al. The endothelial cell secretome as a novel treatment to prime adipose-derived stem cells for improved wound healing in diabetes. *J Vasc Surg.* 2018;68(1):234-244. doi:10.1016/j.jvs.2017.05.094
- 19) Park SR, Kim JW, Jun HS, Roh JY, Lee HY, Hong IS. Stem Cell Secretome and Its Effect on Cellular Mechanisms Relevant to Wound Healing. *Molecular Therapy.* 2018;26(2):606-617. doi:10.1016/j.ymthe.2017.09.023
- 20) Waters R, Subham S, Pacelli S, Modaresi S, Chakravarti AR, Paul A. Development of MicroRNA-146a-Enriched Stem Cell Secretome for Wound-Healing Applications. *Mol Pharm.* 2019;16(10):4302-4312. doi:10.1021/acs.molpharmaceut.9b00639
- 21) Meng XM, Tang PMK, Li J, Lan HY. TGF- $\beta$ /Smad signaling in renal fibrosis. *Front Physiol.* 2015;6(MAR). doi:10.3389/fphys.2015.00082
- 22) Zhang YE. Non-Smad signaling pathways of the TGF- $\beta$  family. *Cold Spring Harb Perspect Biol.* 2017;9(2). doi:10.1101/cshperspect.a022129
- 23) Wang L, Wang HL, Liu TT, Lan HY. TGF-beta as a master regulator of diabetic nephropathy. *Int J Mol Sci.* 2021;22(15). doi:10.3390/ijms22157881
- 24) Kang S, Kishimoto T. Interplay between interleukin-6 signaling and the vascular endothelium in cytokine storms. *Exp Mol Med.* 2021;53(7):1116-1123. doi:10.1038/s12276-021-00649-0
- 25) Shen TNY, Kanazawa S, Kado M, et al. Interleukin-6 stimulates Akt and p38 MAPK phosphorylation and fibroblast migration in non-diabetic but not diabetic mice. *PLoS One.* 2017;12(5). doi:10.1371/journal.pone.0178232
- 26) Wright HL, Cross AL, Edwards SW, Moots RJ. Effects of IL-6 and IL-6 blockade on neutrophil function in vitro and in vivo. *Rheumatology (United Kingdom).* 2014;53(7):1321-1331. doi:10.1093/rheumatology/keu035
- 27) Das LM, Rosenjack J, Au L, et al. Hyper-inflammation and skin destruction mediated by rosiglitazone activation of macrophages in IL-6 deficiency. *Journal of Investigative Dermatology.* 2015;135(2):389-399. doi:10.1038/jid.2014.375

## Effect of Gel Secretome Hypoxia Mesenchymal Stem Cell on Expression of TGF- $\beta$ and IL-6 (In Vivo Experimental Study in Male Rats of Wistar Strains Model Hyperglycemic Wounds)

- 28) Cox AA, Sagot Y, Hedou G, et al. Low-dose pulsatile interleukin-6 as a treatment option for diabetic peripheral neuropathy. *Front Endocrinol (Lausanne)*. 2017;8(MAY). doi:10.3389/fendo.2017.00089
- 29) Kong M, Xie K, Lv M, et al. Anti-inflammatory phytochemicals for the treatment of diabetes and its complications: Lessons learned and future promise. *Biomedicine and Pharmacotherapy*. 2021;133. doi:10.1016/j.biopha.2020.110975
- 30) Punca S, Karakteristik :, Dan P, et al. *Tinjauan Pustaka*. Vol 22.; 2016.
- 31) Widowati W, Rahma D, Widyanto M. *Sel Punca Sebagai Transformasi Alternatif Terapi.*; 2013.
- 32) Madrigal M, Rao KS, Riordan NH. A review of therapeutic effects of mesenchymal stem cell secretions and induction of secretory modification by different culture methods. *J Transl Med*. 2014;12(1). doi:10.1186/s12967-014-0260-8
- 33) Zhang S, Chu WC, Lai RC, Lim SK, Hui JHP, Toh WS. Exosomes derived from human embryonic mesenchymal stem cells promote osteochondral regeneration. *Osteoarthritis Cartilage*. 2016;24(12):2135-2140. doi:10.1016/j.joca.2016.06.022
- 34) Ahangar P, Mills SJ, Cowin AJ. Mesenchymal stem cell secretome as an emerging cell-free alternative for improving wound repair. *Int J Mol Sci*. 2020;21(19):1-15. doi:10.3390/ijms21197038
- 35) Weiss ARR, Dahlke MH. Immunomodulation by Mesenchymal Stem Cells (MSCs): Mechanisms of action of living, apoptotic, and dead MSCs. *Front Immunol*. 2019;10(JUN). doi:10.3389/fimmu.2019.01191
- 36) Ezhilarasu H, Vishalli D, Dheen ST, Bay BH, Kumar Srinivasan D. Nanoparticle-based therapeutic approach for diabetic wound healing. *Nanomaterials*. 2020;10(6):1-29. doi:10.3390/nano10061234
- 37) Jhamb S, Vangaveti VN, Malabu UH. Genetic and molecular basis of diabetic foot ulcers: Clinical review. *J Tissue Viability*. 2016;25(4):229-236. doi:10.1016/j.jtv.2016.06.005
- 38) Mouritzen M V., Petkovic M, Qvist K, et al. Improved diabetic wound healing by LFCinB is associated with relevant changes in the skin immune response and microbiota. *Mol Ther Methods Clin Dev*. 2021;20:726-739. doi:10.1016/j.omtm.2021.02.008
- 39) Jung SW, Moon JY. The role of inflammation in diabetic kidney disease. *Korean Journal of Internal Medicine*. 2021;36(4):753-766. doi:10.3904/kjim.2021.174
- 40) MacLeod AS, Mansbridge JN. The Innate Immune System in Acute and Chronic Wounds. *Adv Wound Care (New Rochelle)*. 2016;5(2):65-78. doi:10.1089/wound.2014.0608
- 41) Landén NX, Li D, Ståhle M. Transition from inflammation to proliferation: a critical step during wound healing. *Cellular and Molecular Life Sciences*. 2016;73(20):3861-3885. doi:10.1007/s00018-016-2268-0
- 42) Beserra FP, Vieira AJ, Gushiken LFS, et al. Lupeol, a dietary triterpene, enhances wound healing in streptozotocin-induced hyperglycemic rats with modulatory effects on inflammation, oxidative stress, and angiogenesis. *Oxid Med Cell Longev*. 2019;2019. doi:10.1155/2019/3182627
- 43) Wechsler ME, Rao V V., Borelli AN, Anseth KS. Engineering the MSC Secretome: A Hydrogel Focused Approach. *Adv Healthc Mater*. 2021;10(7). doi:10.1002/adhm.202001948
- 44) Ferreira JR, Teixeira GQ, Santos SG, Barbosa MA, Almeida-Porada G, Gonçalves RM. Mesenchymal stromal cell secretome: Influencing therapeutic potential by cellular pre-conditioning. *Front Immunol*. 2018;9. doi:10.3389/fimmu.2018.02837
- 45) Liu T, Zhang L, Joo D, Sun SC. NF- $\kappa$ B signaling in inflammation. *Signal Transduct Target Ther*. 2017;2. doi:10.1038/sigtrans.2017.23
- 46) Putra A, Alif I, Nazar MA, et al. IL-6 and IL-8 Suppression by Bacteria-adhered Mesenchymal Stem Cells Co-cultured with PBMCs under TNF- $\alpha$  Exposure. In: *Scitepress*; 2021:311-317. doi:10.5220/0010491903110317
- 47) Johnson BZ, Stevenson AW, Prêle CM, Fear MW, Wood FM. The role of IL-6 in skin fibrosis and cutaneous wound healing. *Biomedicine*. 2020;8(5). doi:10.3390/BIOMEDICINES8050101
- 48) Porro C, Cianciulli A, Panaro MA. The regulatory role of IL-10 in neurodegenerative diseases. *Biomolecules*. 2020;10(7):1-15. doi:10.3390/biom10071017
- 49) Shi GJ, Shi GR, Zhou J yin, et al. Involvement of growth factors in diabetes mellitus and its complications: A general review. *Biomedicine and Pharmacotherapy*. 2018;101:510-527. doi:10.1016/j.biopha.2018.02.105
- 50) García de Vinuesa A, Abdelilah-Seyfried S, Knaus P, Zwijsen A, Bailly S. BMP signaling in vascular biology and dysfunction. *Cytokine Growth Factor Rev*. 2016;27:65-79. doi:10.1016/j.cytogfr.2015.12.005
- 51) Liu Y, Liu Y, Deng J, Li W, Nie X. Fibroblast Growth Factor in Diabetic Foot Ulcer: Progress and Therapeutic Prospects. *Front Endocrinol (Lausanne)*. 2021;12. doi:10.3389/fendo.2021.744868
- 52) Peng J, Zhao H, Tu C, et al. In situ hydrogel dressing loaded with heparin and basic fibroblast growth factor for accelerating wound healing in rat. *Materials Science and Engineering C*. 2020;116. doi:10.1016/j.msec.2020.111169

## Effect of Gel Secretome Hypoxia Mesenchymal Stem Cell on Expression of TGF- $\beta$ and IL-6 (In Vivo Experimental Study in Male Rats of Wistar Strains Model Hyperglycemic Wounds)

- 53) Kartika RW, Alwi I, Suyatna FD, et al. The Role Of Vegf, Pdgf And Il-6 On Diabetic Foot Ulcer After Platelet Rich Fibrin P Hyaluronic Therapy. *Heliyon*. 2021;7(9). doi:10.1016/j.heliyon.2021.e07934
- 54) Kowluru A. Oxidative stress in cytokine-induced dysfunction of the pancreatic beta cell: Known knowns and known unknowns. *Metabolites*. 2020;10(12):1-17. doi:10.3390/metabo10120480
- 55) Jiang CM, Liu J, Zhao JY, et al. Effects of hypoxia on the immunomodulatory properties of human gingiva-derived mesenchymal stem cells. *J Dent Res*. 2015;94(1):69-77. doi:10.1177/0022034514557671
- 56) Liang X, Lin F, Ding Y, et al. Conditioned medium from induced pluripotent stem cell-derived mesenchymal stem cells accelerates cutaneous wound healing through enhanced angiogenesis. *Stem Cell Res Ther*. 2021;12(1). doi:10.1186/s13287-021-02366-x
- 57) Ormazabal V, Nova-Lampeti E, Rojas D, et al. Secretome from Human Mesenchymal Stem Cells-Derived Endothelial Cells Promotes Wound Healing in a Type-2 Diabetes Mouse Model. *Int J Mol Sci*. 2022;23(2). doi:10.3390/ijms23020941
- 58) Li D, Wu N. Mechanism and application of exosomes in the wound healing process in diabetes mellitus. *Diabetes Res Clin Pract*. 2022;187. doi:10.1016/j.diabres.2022.109882
- 59) Wang-Fischer Y, Garyantes T. Improving the reliability and utility of streptozotocin-induced rat diabetic model. *J Diabetes Res*. 2018;2018. doi:10.1155/2018/8054073
- 60) Widyaningsih W. Pengaruh Pemberian Sekretom Sel Punca Mesenkimal Hipoksia Terhadap Kadar C-Peptide, IL-6, Dan Polarisasi Makrofag Tipe-2 (Studi Eksperimental in Vivo Pada Tikus Obesitas Diabetes Melitus Tipe 2) (Doctoral Dissertation, Universitas Islam Sultan Agung (Indonesia)).; 2022.
- 61) Matluobi D, Araghi A, Maragheh BFA, et al. Carvacrol promotes angiogenic paracrine potential and endothelial differentiation of human mesenchymal stem cells at low concentrations. *Microvasc Res*. 2018;115:20-27. doi:10.1016/j.mvr.2017.08.003
- 62) Kehl D, Generali M, Mallone A, et al. Proteomic analysis of human mesenchymal stromal cell secretomes: a systematic comparison of the angiogenic potential. *NPJ Regen Med*. 2019;4(1). doi:10.1038/s41536-019-0070-y
- 63) Longo M, Zatterale F, Naderi J, et al. Adipose tissue dysfunction as determinant of obesity-associated metabolic complications. *Int J Mol Sci*. 2019;20(9). doi:10.3390/ijms20092358
- 64) Baratawidjaja KG, Rengganis I. *Imunologi dasar edisi ke-10*. Jakarta: Fakultas Kedokteran Universitas Indonesia. Published online 2014.
- 65) Golan K, Kumari A, Kollet O, et al. Daily Onset of Light and Darkness Differentially Controls Hematopoietic Stem Cell Differentiation and Maintenance. *Cell Stem Cell*. 2018;23(4):572-585.e7. doi:10.1016/j.stem.2018.08.002
- 66) Pan XH, Huang X, Ruan GP, et al. Umbilical cord mesenchymal stem cells are able to undergo differentiation into functional islet-like cells in type 2 diabetic tree shrews. *Mol Cell Probes*. 2017;34:1-12. doi:10.1016/j.mcp.2017.04.002
- 67) Cevey AC, Penas FN, Alba Soto CD, Mirkin GA, Goren NB. IL-10/STAT3/SOCS3 axis is involved in the anti-inflammatory effect of benznidazole. *Front Immunol*. 2019;10(JUN). doi:10.3389/fimmu.2019.01267
- 68) Yolanda MM. Adult Stem Cell Therapy in Chronic Wound Healing. *J Stem Cell Res Ther*. 2014;04(01). doi:10.4172/2157-7633.1000162



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## The Effect of Secretome Hypoxia Mesenchymal Stem Cells on PDGF and IL-1b Gene Expression (Experimental Study on Wistar Rats Hyperglycemic Wound Models)



Nensi Rianti<sup>1</sup>, Agung Putra<sup>2</sup>, Prasetyowati Subchan<sup>3</sup>

<sup>1</sup> Postgraduate student of Biomedical Sciences, Faculty of Medicine, Universitas Islam Sultan Agung, Jl Kaligawe KM 4 Semarang 50012

<sup>2,3</sup> Department of Biomedical Sciences, Faculty of Medicine, Universitas Islam Sultan Agung, Jl Kaligawe KM 4 Semarang 50012

**ABSTRACT:** Hyperglycemic wounds take longer to heal, and high glucose results in an increase in inflammatory cells, a decrease in the angiogenesis process, and the production of growth factors. Antibiotic treatment, surgery, or debridement can increase the risk of amputation. This study aimed to determine the effect of administering gel secretome hypoxia mesenchymal stem cells (SH-MSCs) on the expression of PDGF and IL-1b in Wistar rats with a hyperglycemic wound model. In vivo laboratory experimental research with a Post Test Only Control Group Design. The samples consisted of 30 Wistar rats, divided into 5 groups, namely healthy rats (P1), negative control (P2), positive control with gentamicin (P3), gel secretome dose of 20  $\mu$ L/rat (P4), and gel secretome dose of 40  $\mu$ L/rat (P5). MSC secretome hypoxia gel treatment for 10 days, then skin tissue samples were examined using the RTq-PCR method to analyze PDGF and IL-1b gene expression. Analysis of PDGF gene expression showed significant differences between treatment groups using the Kruskal-Wallis test with a result of 0.018 ( $p < 0.05$ ), but there were no significant differences between groups using the Mann-Whitney test ( $p < 0.05$ ). Analysis of IL-1b gene expression showed significant differences between treatment groups using the Kruskal Wallis test with a result of 0.001 ( $p < 0.05$ ), various doses of secretome gel affected reducing IL-1b gene expression using the Mann Whitney test with a result of 0.004 ( $p < 0, 05$ ). The most significant decrease was at a secretome dose of 40  $\mu$ L/mouse. MSC secretome hypoxia gel at a dose of 40  $\mu$ L/rat effectively reduces IL-1b gene expression in Wistar rats with a hyperglycemic wound model. However, various doses of MSC secretome hypoxia gel do not significantly increase PDGF gene expression.

**KEYWORDS:** PDGF, IL-1b, SH-MSCs, hyperglycemic wounds

### I. INTRODUCTION

Poor glycemic control in the long term negatively affects wound recovery.<sup>1</sup> Hyperglycemic wound conditions take longer to heal.<sup>2</sup> The difficulty of wound healing is caused by high glucose in the microenvironment and various biological factors. Wounds are easily damaged, difficult to heal, and eventually develop into chronic wounds.<sup>1</sup> Wound healing becomes inhibited due to an increase in inflammatory cells, a decrease in the process of angiogenesis, and a decrease in growth factor production.<sup>3</sup> Hyperglycemia is known to induce the expression of interleukin 1b (IL-1b) in several different cell types in each injury event. The IL-1b pathway can be part of a positive feedback loop that maintains inflammation in chronic wounds and contributes to impaired healing.<sup>4</sup> Platelet-derived growth factor (PDGF) is a growth factor that regulates cell growth and division, PDGF promotes wound healing by strengthening chemotactic migration, mitosis, and proliferation of inflammatory cells and fibroblasts to promote the formation of granulation tissue in wounds.<sup>5</sup>

Treatment of hyperglycemic wounds with antibiotics, surgical or debridement, can still increase the risk of amputation with frequent recurrences.<sup>6</sup> Growth factor therapy is an interesting strategy to accelerate wound closure, MSCs are multipotent stromal cells that can regenerate tissue damage.<sup>7</sup> Therefore, an effective and safe adjunct therapeutic approach is needed for wounds, one of which is mesenchymal stem cells (MSC) secretome hypoxia that can polarize into anti-inflammatory cytokines in a hypoxic environment and produce various anti-inflammatory cytokines and growth factors.<sup>8</sup>

## **The Effect of Secretome Hypoxia Mesenchymal Stem Cells on PDGF and IL-1b Gene Expression (Experimental Study on Wistar Rats Hyperglycemic Wound Models)**

Wound healing is disrupted due to complications of the disease that reduce physical activity and cause chronic wounds up to amputation.<sup>9</sup> Hyperglycemia in patients with diabetes, vascular disease, and neuropathy is a condition that hinders the wound healing process.<sup>4</sup> Wound conditions in hyperglycemia are linked to complications of diabetes mellitus, affecting 439 million people globally by 2030 (aged 20 to 79 years), potentially causing chronic ulcers and increasing the risk of amputation 17 to 40 times higher.<sup>10</sup>

Research shows that MSC secretome hypoxia secretes various mediators and growth factors that promote skin regeneration, namely PDGF, Hepatocyte growth factor (HGF), Vascular endothelial growth factor (VEGF), Fibroblast growth factor (FGF) and Transforming growth factor- $\beta$  1 (TGF- $\beta$ 1). The hypoxia secretome has anti-inflammatory potential and has the ability to detect the presence of injury signaling molecules, migrate to the injury area and accelerate wound healing.<sup>11</sup> In Vitro research shows that MSC secretome activates the Phosphatidylinositol 3-kinase (PI3K/Akt) signaling cascade or Focal adhesion kinase mediated signaling (FAK)/ Extracellular regulated kinase (ERK1/2) and further increases the proliferation and migration ability of various skin cell types, such as fibroblasts, keratinocytes, and vascular epithelial cells thereby accelerating contraction wound, inhibition of this signaling pathway resulting in beneficial effects induced by secretions on various skin cells.<sup>12</sup> Other preclinical studies reported routine antioxidant and anti-inflammatory effects on wound healing in streptozotocin-induced hyperglycemic rats. Rutin increases the production of antioxidant enzymes induced by nuclear erythroid related factor 2 (NRF2), inhibits the expression of matrix metalloproteinases (MMPs) regulated by NF- $\kappa$ B, and decreases the expression of vascular endothelial growth factor (VEGF), reduces oxidative stress and inflammatory response in hyperglycemic rats thereby improving wound healing and further reducing the risk of ulcer development.<sup>1</sup>

PDGF at a concentration of 20-200 pmol accelerates the infiltration of inflammatory cells and fibroblasts, extracellular matrix deposition, and collagen formation in wounds, resulting in a rapid healing process compared to untreated models.<sup>13</sup> In Vivo studies report that several factors may influence the phenotype of macrophages expressed in chronic wounds, having the potential to maintain proinflammatory environment. Macrophages in chronic wounds express high levels of proinflammatory molecules IL-1b, matrix metalloproteinase 9 (MMP-9), tumor necrosis factor-alpha (TNF- $\alpha$ ), and decreased expression of nonhealing markers insulin-like growth factor 1 (IGF-1), transforming growth factor beta (TGF- $\beta$ ), and interleukin 10 (IL-10). In hyperglycemic conditions known to induce IL-1b interleukin expression in a number of different cells, the IL-1 pathway $\beta$  being part of a positive feedback loop that sustains inflammation in chronic wounds and contributes to impaired healing.<sup>4</sup>

MSC secretome hypoxia can suppress the secretion of pro-inflammatory cytokines thereby lowering levels of IL-6, IL-1b, TNF- $\alpha$ , IL-4 and accelerating the improvement of wound conditions in mice.<sup>14</sup> Research reveals MSC secretome hypoxia secretes growth factors that support skin regeneration, such as PDGF regulates cellular activity in the wound healing process, detects the presence of injured signal molecules, migrates to the injured area and accelerates wound healing.<sup>3,11</sup> Various studies report the potential of the precondition MSC secretome in repairing wound tissue, enhancing regenerative properties in cell secretion. MSC secretome hypoxia as a source of tissue protective and regenerative secretions in wound healing.<sup>15</sup> However, the potential of MSC secretome hypoxia gel in regenerating hyperglycemic wounds has never been done. Based on this background, it is necessary to conduct research to determine the effect of MSC secretome hypoxia gel on the expression of PDGF and IL-1b genes in male Wistar rat hyperglycemic wound models.

## **II. MATERIAL AND METHOD**

### **Study Design and Experimental Animals**

This research is a true research of laboratory experiments in vivo with the design of Post Test Only Control Group Design. The study subjects used male white rats of the Wistar strain, ranging in age from 2-3 months with a weight between 200-250gr which met the criteria of inclusion and inclusion, acclimatized for 7 days. This study used 5 treatment groups, a group of healthy mice (P1), a group of negative control rats of hyperglycemic wound model with base gel administration (P2), a positive control group of hyperglycemic wound rat models with standard therapy using gentamicin antibiotics (P3), a group of hyperglycemic wound rat model with administration of MSC secretome hypoxia gel dose of 20  $\mu$ L / rat (P4), and a group of hyperglycemic wound model with MSC gel administration secretome hypoxia dose of 40  $\mu$ L/rat (P5).

### **Research Materials**

This research uses equipment consisting of 1 cc injection syringe, balance sheet, handsoon, gluco test easy touch, stemple mold wound 2x2 cm tweezers, Handsoon surgical scissors, sterile swab, biosafety Cabinet (BSC), Oxygen meter, beaker glass, stirring rod, micropipette, CO2 incubator, Dissecting kit, Flask 75T, Hypoxic chamber.

# **The Effect of Secretome Hypoxia Mesenchymal Stem Cells on PDGF and IL-1b Gene Expression (Experimental Study on Wistar Rats Hyperglycemic Wound Models)**

## **Research Equipment**

This research uses equipment consisting of a Biosafety Cabinet (BSC), micropipette, CO<sub>2</sub> incubator, Dissecting kit, Flask 75T, Hypoxic chamber, oxygen meter, beaker glass, stirring rod, 1 cc injection syringe, balance sheet, Gluco test easy touch, tweezers, surgical scissors, handscoon, and sterile swab.

## **MSC Isolation from Umbilical Cord**

The isolation stage is carried out in biosafety cabinet class 2, with aseptic and sterile-conditioned tools. The steps are as follows: (1) Collect the Umbilical cord then place it in a sterile container containing 0.9% NaCl. (2) The Umbilical cord is placed on a petri dish, and then washed thoroughly with PBS using tweezers. (3) Cut the umbilical cord, separate it from the rat fetus, and remove the blood vessels. (4) Finally chop the umbilical cord, insert it into the 25T flask then flatten, and let stand for 3 minutes until the tissue sticks to the surface of the flask. (5) Complete media (DMEM, fungizone, penstrep, and FBS) are added slowly until the network is covered with media. (6) Incubation with an incubator at 37°C and 5% CO<sub>2</sub>. (7) Cell growth is detected about 14 days after the culture process, then add media every 3 days by removing half of the media and completely replacing it with new media. (8) The addition of cells is repeated so that the cells reach 80% confluence.

## **Hypoxia and TFF Manufacturing**

(1) MSC that has reached 80% confluence plus complete media up to 10 mL (2) Flask containing MSC is inserted into the hypoxic chamber. (3) Nitrogen gas is flowed through the inlet valve and the oxygen meter is placed in the sensor hole to determine the oxygen concentration. (4) Nitrogen is then added until the oxygen concentration is 5%. (5) After 24 hours, culture media will be removed and screened using TFF to obtain hypoxia MSC secretome and then will be used on P4 and P5.

## **Preparation Manufacturing Gel MSC Secretome Hypoxia**

(1) MSC secretome hypoxia gel preparation is prepared by mixing 20 µL secretome added 20 µL in 200mg gel so as to obtain a concentration of 20 µL/rat (P4). The MSC secretome hypoxia gel preparation for (P5) was prepared by mixing 40 µL of secretome with 20 µL added in 200 mg of gel to obtain a concentration of 40 µL/rat. (2) Aseptically mix until homogeneous based on physical properties observed using a microscope.

## **Hyperglycemic Mouse Model Making**

(1) Rats were acclimatized for 7 days, then satisfied for 8-12 hours, then anesthetized with a mixture of ketamine (60 mg/kgBW) and xylazine (20 mg/kgBW) and given intraperitoneal doses using streptozotocin 65 mg/kgBW/day dissolved in 0.1 M citrate buffer pH 4.0 for 30 days. A blood glucose test is performed on day 7 after initiation. The diagnosis of hyperglycemia is established when blood glucose levels >200 mg/dl. (2) After 30 days of Streptozotocin injection, rat hair was shaved on the back. Making wounds using a circular biopsy punch diameter of 6 mm with a depth of 2 mm.<sup>59</sup>

## **Validation of Hyperglycemic Wound Examination**

Microscopically, skin samples were taken from all groups to make histopathological preparations with hematoxylin-eosin (HE) staining. (1) Skin samples of mice of all groups were taken and fixed in 10% NBF solution, Rinse with 70% alcohol until free of fixative residue. (2) Skin samples were dehydrated with 70%, 80%, 90%, 96% alcohol, and absolute alcohol for 30 minutes each. (3) The sample is soaked with toluol for 1 hour until clear or transparent. (4) In the oven, the paraffin infiltration process is carried out at a temperature of 56-60°C by placing the skin sample in a mixture of toluol and paraffin with a ratio of 3: 1, 1: 1 and 1: 3 for 30 minutes. Skin samples were placed on pure paraffin I, pure paraffin II, and pure paraffin III for 30 minutes at each treatment. (5) Embedding process, a sample of pure paraffin skin is implanted into a paraffin block mold containing liquid paraffin and wait for it to harden, and then the paraffin block is cut to a thickness of 6 µm with microtomes. (6) Slices of skin tissue samples are attached to a glass object by applying Mayer's albumin and then dripped with a little distilled water and then heated using a hot plate until the slices stick firmly. (7) The histological preparation is deparafinisation by placing it on xylol for 24 hours. (8) Continue with HE staining. The xylol content is taken with filter paper, then added in alcohol 96%, 90%, 80%, 70%, 60%, 50%, 40%, 30%, and aqueous is done for 1-2 minutes. The preparation is placed on the HE dye for 5-10 seconds, then rinse under running water for 10 minutes. The next process is to soak the preparation using 30%, 40%, 50%, 60%, and 70% alcohol for 3-5 minutes. The preparation is placed in eosin for 5-10 minutes, then soaked in 70%, 80%, 90%, and 96% alcohol for 3-5 minutes, and dried with filter paper. The preparation is put into xylol for 15 minutes, then the histological preparation is given drops of Canada balsam. (9) The preparation is covered with a cover glass, given etiquette, and stored in the preparation box.<sup>60</sup>

# The Effect of Secretome Hypoxia Mesenchymal Stem Cells on PDGF and IL-1b Gene Expression (Experimental Study on Wistar Rats Hyperglycemic Wound Models)

## Hyperglycemic Wound Care

Hyperglycemic wounds formed on the sixth day, then rats were treated for 10 days with daily administration of MSC secretome hypoxia gel, with a composition of MSC secretome hypoxia gel dose 20  $\mu\text{L}/\text{rat}$  (P4) and dose 40  $\mu\text{L}/\text{rat}$  (P5). The positive control mice (P3) received standard antibiotic therapy gentamicin, and the negative control mice received base gel treatment (P2).

## RNA Isolation Process and cDNA Synthesis

(1) A 100 mg skin tissue sample is cut into small pieces and inserted in a tube containing 0.5 mL of Iso Plus RNA. (2) Skin sample pieces were smoothed with micropestle with RNase free DNA added 0.5 mL of Iso Plus RNA and then stored at room temperature for 5 minutes. Add 2 mL of chloroform and stir the solution until milky white using a vortex mixer. (3) Incubation for 2-3 minutes at room temperature and centrifugation for 15 minutes at 4°C at a speed of 15,000 rpm until three layers are obtained. (4) The topmost layer containing mRNA is transferred into the microtube and isopropanol is added in equal proportions. (5) Shake the microtube until white fibers appear, then centrifuge at 4°C at 15,000 rpm for 10 minutes. The supernatant is discarded and the remaining white pellets appear at the bottom of the tube. After drying, add 100  $\mu\text{L}$  of 70% ethanol to the DEPC (Diethyl pyrocarbonate) solution flip back several times then centrifuge again at 4°C, 15,000 rpm for 5 minutes. (6) Remove the supernatant and add DEPC 30-50  $\mu\text{L}$ , then as much as 5  $\mu\text{L}$  of RNA sample is quantified using Nanodrop with a wavelength of 260 nm. The quantification result will be calculated to make 3000 ng. (7) The process of cDNA synthesis by mixing as much as 1  $\mu\text{L}$  of RNA samples that have been calculated previously with 1  $\mu\text{L}$  of OligoDT and Nuclease Free Water (NFW) primers until reaching a volume of 10  $\mu\text{L}$ , then inserted in a thermal cycler for 5 minutes at a temperature of 70°C. (8) Add 5X buffer 4  $\mu\text{L}$ , DEPC-Treated  $\text{H}_2\text{O}$  5  $\mu\text{L}$ , ReverTraAce 1  $\mu\text{L}$ . (9) The mixture is incubated at 45-50°C for 30 min.<sup>61</sup>

## Diagnosis of PDGF and IL-1b Gene Expression RTq-PCR method

(1) PDGF and IL-1b gene expression were analyzed using RTq-PCR with a mixture of 1  $\mu\text{L}$  cDNA sample each, KAPA SYBR FAST qPCR Master Mix as much as 10  $\mu\text{L}$ , primer forward and reverse as much as 1  $\mu\text{L}$  each, and nuclease-free water up to a total of 20  $\mu\text{L}$ . (2) PCR gene expression was analyzed using qRT-PCR illumine with a predenaturation temperature profile of 95°C for 2 minutes, denaturation of 95°C for 30 seconds, then aneling for 20 seconds at a temperature of 61°C with a cycle of 50 times. (3) Increased gene expression was analyzed in the ratio of improvement to gene housekeeping using EcoStudy software.<sup>62</sup>

## III. RESULT

### Isolation of MSC Secretome from Umbilical Cord

The hypoxia MSC secretome used in this study was the result of filtration of MSC culture medium under 5% hypoxia conditions using Tangential Flow Filtration (TFF) for 24 hours then MSC was isolated from the umbilical cord of Wistar rats in a 19-day bunting state, the addition of media consisting of DMEM (Dulbeccos's modified eagle medium), fungizone, penstrep, and FBS, the results of isolation was then cultured in a plastic flap. MSC validation is performed after the 4th phase. Microscopic examination of MSC

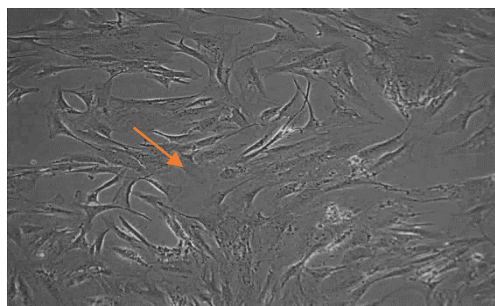


Figure 1. MSC isolation with spindle-like cells

culture results at 80% confluenc

e showed cells attached to the base of the flask with spindle-like cell shapes (Figure 1).

Examination of the capacity of MSCs to differentiate into osteogenic and adipogenic cells serves to validate the results of MSC cell isolation procedures. Oil red O staining is used in adipogenic differentiation assays to show the formation of red lipid droplets (Figure 2.a). The osteogenic differentiation assay of Alizarin red staining shows the production of calcium disposition, which is seen in red (Figure 2.b).

# The Effect of Secretome Hypoxia Mesenchymal Stem Cells on PDGF and IL-1b Gene Expression (Experimental Study on Wistar Rats Hyperglycemic Wound Models)

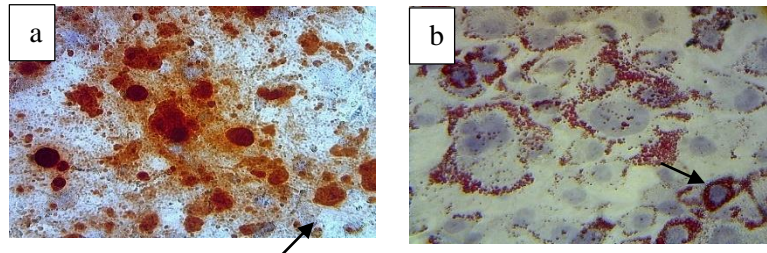


Figure 2. (a) MSCs differentiate into osteocytes and (b) MSCs differentiate into Adipocytes

Validation with flow cytometry, the results of MSC secretome hypoxia isolation show the capacity to express various special surface markers (surface markers). MSC expresses CD90 (97.6%), CD29 (96.4%) and expresses CD45 (1.7%), and CD31 (3.9%), the results of flow cytometry analysis are shown in Figure 3:

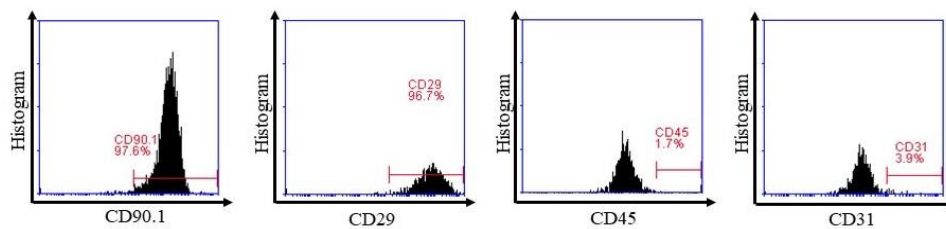


Figure 3. Flow cytometry analysis of CD90, CD29, CD45 and CD31 expression

MSC secretome hypoxia is suspected to contain anti-inflammatory cytokines and growth factors, therefore, after the filtration process is carried out analysis of the content of anti-inflammatory cytokines and growth factors, measurement of growth factor content in MSC secretome hypoxia is carried out using the ELISA test. MSC secretome hypoxia is known to produce PDGF levels of  $947.26 \pm 34.93$  pg/mL, VEGF levels of  $1137.56 \pm 37.51$  pg/mL, bFGF levels of  $1175.54 \pm 38.82$  pg/mL, IL-10 levels of  $525.12 \pm 10.24$  pg/mL, and TGF- $\beta$  levels of  $372.53 \pm 9.18$  pg/mL.

## Validation of Blood Sugar Levels in Hyperglycemic Model Rats

Validation examination of glucose levels in research subjects on day 30, 36, and 46, to ensure the condition of hyperglycemia in each study subject according to the inclusion criteria for hyperglycemic wound models. The results of the glucose level examination are described in Table 1.

Table 1. Results of glucose level validation in hyperglycemic group rats

Group	P1 H0	P1 H30	P1 H36	P1 H 46	P3 46	P4	P5
Mean	105.7	419.3	388.2	382	311.8	304	294
SD	6.19	90.28	74.41	57.48	45.2	29.19	51.11

Average glucose levels in the 30th-day hyperglycemic treatment group showed a significant increase in the results of the healthy group of  $105.7 \pm 6.19$  increased significantly to  $419.3 \pm 90.28$ , the average level of the 36th-day hyperglycemia group obtained results of  $388.2 \pm 74.41$ , the average levels in the 46th day hyperglycemic group obtained results of  $382 \pm 57.48$ , compared to the gentamicin group  $311.8 \pm 45.2$ , secretome group 20  $\mu$ L  $304 \pm 29.2$  and secretome group 40  $\mu$ L  $294 \pm 51.1$ .



# The Effect of Secretome Hypoxia Mesenchymal Stem Cells on PDGF and IL-1b Gene Expression (Experimental Study on Wistar Rats Hyperglycemic Wound Models)

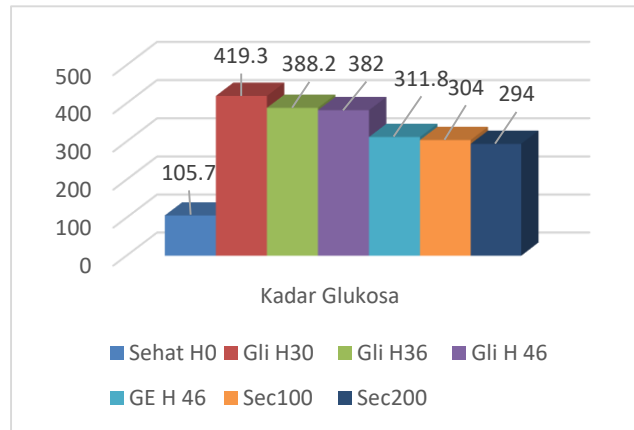


Figure 4. Results of glucose level validation in treatment group rats

The results of glucose levels showed a significant increase in the hyperglycemic group on day 30, 36, and 46 so this hyperglycemic condition can be modeled as hyperglycemic wounds.

## Macroscopic Picture of Hyperglycemic Wounds

The results of macroscopic observational studies on hyperglycemic wounds on day 36, 43, and 46, showed accelerated wound healing using secretome. Using the 40 µL/rat secretome most macroscopically significant, on day 46 wound healing was visibly camouflaged and covered with growing hair, indicating that the use of secretome is effective in accelerating wound healing, the results of macroscopic wound closure analysis are shown in Figure 5.

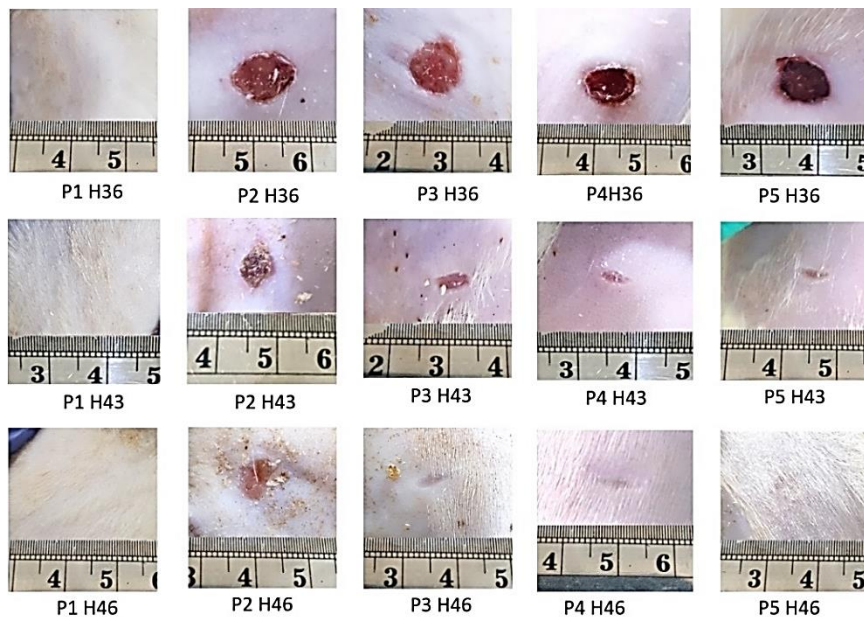
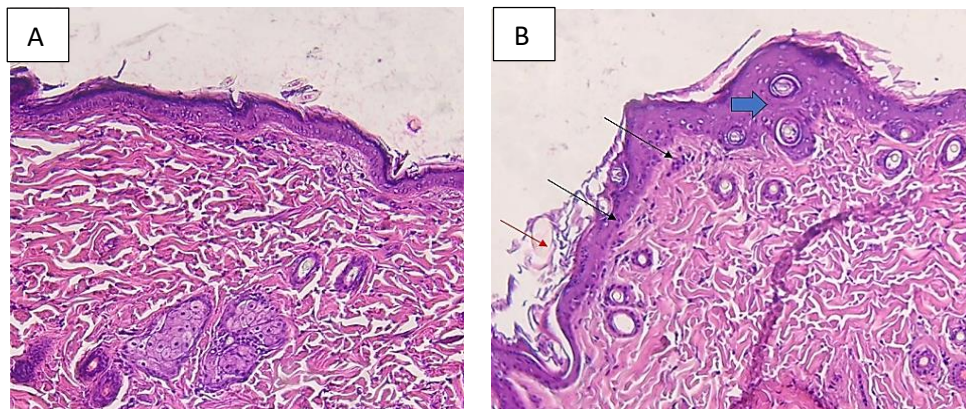


Figure 5. Macroscopic hyperglycemic wounds

# The Effect of Secretome Hypoxia Mesenchymal Stem Cells on PDGF and IL-1b Gene Expression (Experimental Study on Wistar Rats Hyperglycemic Wound Models)

## Histopathological Results of HE Staining

The readings of histopathological preparations with hematoxylin-eosin (HE) staining showed that the STZ-induced rat group of 65 mg / kgBW had thickened in the epithelium, necrosis in epithelial cells and inflammation in immune cells compared to the group of healthy mice. The results of the analysis of HE histopathological preparations are shown in Figure 6.



**Figure 6. HE Staining Histopathology**

### Information

A = Group of healthy mice

B = Group of hyperglycemic rats

HE staining in the hyperglycemic group showed thickening of the epithelium (blue arrow), inflammation of immune cells (black arrow), and necrosis of epithelial cells (red arrow).

## Effects of MSC Secretome Hypoxia Administration on PDGF Gene Expression

In this study, it was found that MSC secretome hypoxia was able to increase PDGF gene expression in hyperglycemic wound model mice. The results of PDGF gene expression analysis using the RTq-PCR method using the Illumina Eco Real-Time PCR tool are described in Table 2.

**Table 2. Mean expression, normality and homogeneity of PDGF between treatment groups**

Group	Base gel (P2)	Gentamicin (P3)	Sec 20 μL (P4)	Sec 40 μL (P5)	p value
Rat 1	0,35	0,18	0,66	0,79	
Rat 2	0,25	0,27	0,34	0,27	
Rat 3	0,40	0,12	0,26	0,77	
Rat 4	0,30	0,21	0,66	0,69	
Rat 5	0,25	0,42	0,34	0,35	
Rat 6	0,43	0,13	0,26	0,77	
Mean	0,33	0,22	0,42	0,61	
SD	0,08	0,11	0,19	0,23	
Shapiro wilk	0,42*	0,29*	0,03	0,03	
Levene test	0,007				
Kruskal Wallis	*0,018				

### Information:

\*Saphiro Wilk test ( $p > 0.05$  = normal)

\* Levene's Test ( $p > 0,05$  = homogenous)

Kruskal Wallis ( $p < 0.05$ ) = significant difference)

## The Effect of Secretome Hypoxia Mesenchymal Stem Cells on PDGF and IL-1b Gene Expression (Experimental Study on Wistar Rats Hyperglycemic Wound Models)

Based on Table 2 above, the average results of PDGF gene expression in the base gel group (P2) were  $0.33 \pm 0.08$ , the mean gentamicin group (P3)  $0.22 \pm 0.11$ , the mean secretome group 20  $\mu\text{L}$  (P4)  $0.42 \pm 0.19$  and the mean secretome group 40  $\mu\text{L}$  (P5)  $0.61 \pm 0.23$  (Figure 6). The average results of PDGF gene expression were normally distributed with Shapiro Wilk test values in the P2=0.42 and P3=0.29 ( $p > 0.05$  groups), while normal undistributed data were obtained in the P4=0.03 and P5=0.03 groups with normal values of  $p > 0.05$  and inhomogeneous data variants with Levene's Test test results with  $p = 0.007$  values with homogeneous values ( $p > 0.05$ ). It was concluded that the data resulting from the expression of PDGF gene groups P4 and P5 were not normally distributed and were not homogeneous.

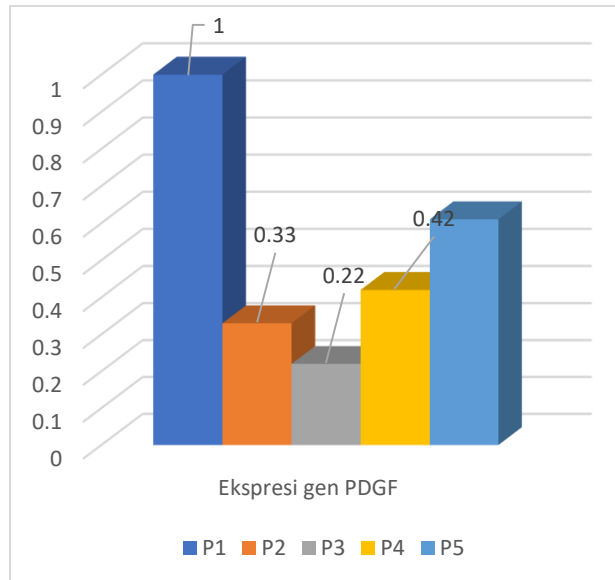


Figure 7. Average PDGF gene expression between treatment groups

Non-parametric statistical analysis using the Kruskal-Wallis test obtained results of 0.018 ( $p < 0.05$ ), it was concluded that there were significant differences between treatment groups on PDGF expression.

### Effects of MSC Secretome Hypoxia Administration on IL-1b Gene Expression

The results showed that MSC secretome hypoxia was able to reduce IL-1b gene expression in hyperglycemic wound model mice. The results of IL-1b gene expression analysis using the RTq-PCR method using Illumina's Eco Real-Time PCR tool are described in Table 3.

Table 3. Mean expression, normality, and homogeneity of IL-1b gene expression between treatment groups

Group	Base gel (P2)	Gentamicin (P3)	Sec 20 $\mu\text{L}$ (P4)	Sec 40 $\mu\text{L}$ (P5)	p value
Rat 1	2,14	0,26	0,25	0,34	
Rat 2	1,72	0,41	0,20	0,29	
Rat 3	3,66	0,55	0,26	0,18	
Rat 4	1,39	0,23	0,25	0,10	
Rat 5	2,14	0,41	0,20	0,14	
Rat 6	3,92	0,51	0,26	0,30	
Mean	2,49	0,39	0,24	0,22	
SD	1,04	0,13	0,03	0,09	
Shapiro wilk	0,20*	0,47*	0,17	0,44*	
Levene test	0,000				
Kruskal	*0,001				
Wallis					
Mann					
Whitney	*0,004				

Information:

\*Saphiro Wilk test ( $p > 0.05$  = normal)

\*\* Levene's Test ( $p > 0,05$  = homogenous)

## The Effect of Secretome Hypoxia Mesenchymal Stem Cells on PDGF and IL-1b Gene Expression (Experimental Study on Wistar Rats Hyperglycemic Wound Models)

\*Kruskal Wallis ( $p < 0.05$ ) = significant difference)

\*Mann Whitney ( $p < 0,05$ ) = different meaning)

Based on Table 3, the average IL-1b gene expression results in the base gel group (P2) were  $2.49 \pm 1.04$ , the average gentamicin group (P3) was  $0.39 \pm 0.13$ , the average secretome group was 20  $\mu\text{L}$  (P4) was  $0.24 \pm 0.03$  and the average secretome group was 40  $\mu\text{L}$  (P5) was  $0.22 \pm 0.09$ .

IL-1b gene expression was highest in the base gel (P2) group and lowest in the 40  $\mu\text{L}$  secretome group, showing that the 40  $\mu\text{L}$  secretome was effective in reducing IL-1b gene expression in mice with hyperglycemic wound models.

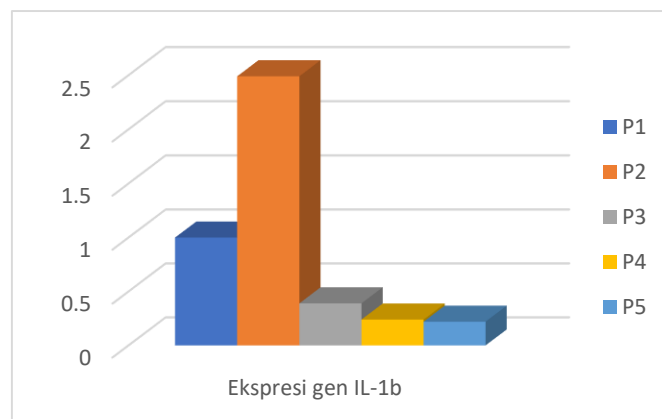


Figure 8. Mean expression, gen IL-1b gene expression between treatment groups

IL-1b gene expression data were normally distributed with Shapiro Wilk test values in the P2=0.20, P3=0.47, and P5=0.44 groups, while in the P4 group, the data were not normally distributed with values of  $p = 0.03$  ( $p > 0.05$ ) and had inhomogeneous data variants with Levene's Test test results with  $p = 0.000$  ( $p > 0.05$ ). It was concluded that the distribution and variant of IL-1b gene expression data are not normally distributed and are not homogeneous. The Kruskal-Wallis non-parametric test obtained results  $p = 0.001$  ( $p < 0.05$ ), followed by the Mann-Whitney test obtained results of 0.004 ( $p < 0.05$ ) so that it was concluded that there were significant differences between treatment groups of IL-1b gene expression in mice with hyperglycemic wound models.

### IV. DISCUSSION

Inflammation is a local response to various inflammatory cells to eliminate, cleanse, build, and maintain the integrity of the tissue homeostasis system. The inflammatory process is initiated by inflammatory cells due to the stimulation of danger signal molecules produced when pathogenic bacteria damage certain tissues or substances.<sup>63</sup> Impaired wound healing due to hyperglycemia alters endothelial cell activity and causes vascular dysfunction in wounds, increasing the risk of infection up to amputation. Changes in a number of endogenous factors, including decreased growth factor production, angiogenic response mediators, macrophage activity, collagen synthesis, keratinocyte migration, and fibroblast proliferation lead to delayed wound healing.<sup>59</sup> Ormazabal et al, 2022 study using MSC-EC hypoxic secretome or specific protein combination enriched in MSC-EC hypoxic secretome improves the wound healing process in hyperglycemic conditions.<sup>57</sup> The group that received secretome treatment showed rapid wound healing and less scarring. In addition, further research using the human fibroblast secretome serves as a human protein control. When wounds are treated with stem cell secretion, epidermal and dermal thickness increases markedly faster.<sup>17</sup>

MSCs actively contribute to angiogenesis through direct differentiation, interaction of cell contact with endothelial cell derivatives, and paracrine release of pro-angiogenic molecules. Paracrine factor can increase the blood supply of damaged tissues through the activation and recruitment of stem cells and progenitor cells.<sup>66</sup>

The results of the PDGF gene expression study in the base gel group (P2) were  $0.33 \pm 0.08$ , showed an increase in the average gentamicin group (P3)  $0.22 \pm 0.11$ , the average secretome group 20  $\mu\text{L}$  (P4)  $0.42 \pm 0.19$  showed an increase from the P3 group and the average secretome group of 40  $\mu\text{L}$  (P5) showed the highest increase of  $0.61 \pm 0.23$ , It can be concluded that the administration of MSC secretome hypoxia gel a dose of 40  $\mu\text{L}/\text{rat}$  was significant for increased expression of the PDGF gene in male white rats of the Wistar strain model of hyperglycemic wounds. In line with research by Chen et al, 2020 routine use can increase the production of antioxidant enzymes induced by nuclear factor erythroid 2-related factor 2 (NRF2), inhibit the expression of matrix metalloproteinases (MMPs) regulated by NF- $\kappa\text{B}$ , and decrease the expression of vascular endothelial growth factor (VEGF). It also promotes the expression of the associated neurogenic protein (UCH-L1) reduces oxidative stress and

## The Effect of Secretome Hypoxia Mesenchymal Stem Cells on PDGF and IL-1b Gene Expression (Experimental Study on Wistar Rats Hyperglycemic Wound Models)

inflammatory response in hyperglycemic rats, promotes wound healing, and reduces the risk of ulcers.<sup>1</sup> PDGF acts as one of the growth and division factors, especially during the angiogenesis phase and the formation of blood vessels from the previous vascular network. MSC mechanism in the wound area through the process of differentiation, and vascularization by involving the release of PDGF.<sup>61</sup>

Another study by Das et al, 2016. reported a significant increase in wound healing activity with co-administration of PDGF-BB with syndecan-4 proteoliposomes (S4PL). significant translational potential in enhancing the effects of PDGF-BB for diabetic wound healing. The addition of syndecan-4 co-treatment may improve keratinocyte migration and wound closure in the context of diabetes S4PL has an immunomodulatory effect on wound macrophages, reduces inflammation, and improves phenotypic markers of M2 macrophages.<sup>51</sup>

The results of the IL-1b gene expression in the base gel group (P2) of  $2.49 \pm 1.04$ , experienced an average decrease in the gentamicin group (P3) of  $0.39 \pm 0.13$ , the average in the secretome group of 20  $\mu\text{L}$  (P4) decreased from the P3 group to  $0.24 \pm 0.03$  and the lowest average expression of the IL-1b gene in the secretome group of 40  $\mu\text{L}$  (P5) of  $0.22 \pm 0.09$ . Showed that administration of MSC secretome hypoxia gel dose 40  $\mu\text{L}/\text{rat}$  effectively decreased IL-1b gene expression in mice with hyperglycemic wound models. In line with research by Shiddiqi et al, 2017. IL-1 and Caspase-1 expression can be lowered in mice with pristane-induced lupus with MSC secretome administration. This is indicated by the fact that IL-1 $\beta$  and Caspase-1 are expressed to a lesser extent in the pristane + secretome group compared to the pristane group.<sup>67</sup>

The decrease in caspase-1 and IL-1b expression is caused by inhibition of NLRP3 inflammasome activation so that caspase-1 activation does not occur which causes IL-1b not to form. Inhibition of NLRP3 inflammasome activation is caused because the MSC secretome contains stanniocalcin-1 (STC-1) which also plays a role in inhibiting ROS production.<sup>68</sup> Administration of MSC secretome inhibits NLRP3 inflammasome by lowering ROS levels in mitochondria. ROS plays an important role in activating the NLRP3 inflammasome. NLRP3 inflammasome activates caspase-1 which converts pro IL-1b into active IL-1b which plays a role in inflammatory mechanisms.<sup>67</sup> Peripheral blood angiocrine MSCs can stimulate endothelial functional characteristics by activating the VEGF-A signaling pathway through a number of factors, including endothelin-1, IL-8, platelet-derived growth factor-AA (PDGF-AA), and IGF-2. MSC hypoxia expresses much higher levels of Heat Shock Protein (HSP) molecules than normoxic, capable of folding proteins that lead to optimal intracellular protein function, such as VEGF and PDGF. Hypoxic MSCs are more effective in regenerating damaged tissue than normoxic MSCs.<sup>66</sup>

### V. CONCLUSION

MSC secretome hypoxia gel administration significantly affected PDGF and IL-1b gene expression in male white rats of Wistar strain model hyperglycemic wound.

### ACKNOWLEDGEMENT

The authors declare no conflict of interest and no involvement of sponsors or funding for this research.

### REFERENCES

- 1) Chen LY, Huang CN, Liao CK, et al. Effects of rutin on wound healing in hyperglycemic rats. *Antioxidants*. 2020;9(11):1-13. doi:10.3390/antiox9111122
- 2) Rahmadani S. Aplikasi Topikal Ekstrak Etanol Daun Sirsak (*Annona Muricata* L.) Pada Luka Tikus Hiperglikemia Setelah Diberi Pakan Lemak Tinggi. <http://etd.repository.ugm.ac.id/>
- 3) Wang L, Wang HL, Liu TT, Lan HY. TGF-beta as a master regulator of diabetic nephropathy. *Int J Mol Sci*. 2021;22(15). doi:10.3390/ijms22157881
- 4) Mirza RE, Fang MM, Ennis WJ, Kohl TJ. Blocking interleukin-1 $\beta$  induces a healing-associated wound macrophage phenotype and improves healing in type 2 diabetes. *Diabetes*. 2013;62(7):2579-2587. doi:10.2337/db12-1450
- 5) Shen S, Wang F, Fernandez A, Hu W. Role of platelet-derived growth factor in type II diabetes mellitus and its complications. *Diab Vasc Dis Res*. 2020;17(7). doi:10.1177/1479164120942119
- 6) Dan P, Diabetes P, Tipe M. *Perkumpulan Endokrinologi Indonesia*.; 2011.
- 7) Kuntardjo N, Dharmana E, Chodidjah C, Nasihun TR, Putra A. TNF- $\alpha$ -Activated MSC-CM Topical Gel Effective in Increasing PDGF Level, Fibroblast Density, and Wound Healing Process Compared to Subcutaneous Injection Combination. *Majalah Kedokteran Bandung*. 2019;51(1):1-6. doi:10.15395/mkb.v51n1.1479
- 8) HS Z, Putra A. Peran Mesenchymal Stem Cells dalam Regulasi PDGF dan Sel Islet pada Diabetes. *Jurnal Kedokteran Brawijaya*. 2018;30(2):98-102. doi:10.21776/ub.jkb.2018.030.02.4

## The Effect of Secretome Hypoxia Mesenchymal Stem Cells on PDGF and IL-1b Gene Expression (Experimental Study on Wistar Rats Hyperglycemic Wound Models)

- 9) Badr G, Badr BM, Mahmoud MH, Mohany M, Rabah DM, Garraud O. Treatment of diabetic mice with undenatured whey protein accelerates the wound healing process by enhancing the expression of MIP-1 $\alpha$ , MIP-2, KC, CX3CL1 and TGF- $\beta$  in wounded tissue. *BMC Immunol.* 2012;13. doi:10.1186/1471-2172-13-32
- 10) Kulkarni M, O'Loughlin A, Vazquez R, et al. Use of a fibrin-based system for enhancing angiogenesis and modulating inflammation in the treatment of hyperglycemic wounds. *Biomaterials.* 2014;35(6):2001-2010. doi:10.1016/j.biomaterials.2013.11.003
- 11) Regmi S, Pathak S, Kim JO, Yong CS, Jeong JH. Mesenchymal stem cell therapy for the treatment of inflammatory diseases: Challenges, opportunities, and future perspectives. *Eur J Cell Biol.* 2019;98(5-8). doi:10.1016/j.ejcb.2019.04.002
- 12) Park SR, Kim JW, Jun HS, Roh JY, Lee HY, Hong IS. Stem Cell Secretome and Its Effect on Cellular Mechanisms Relevant to Wound Healing. *Molecular Therapy.* 2018;26(2):606-617. doi:10.1016/j.ymthe.2017.09.023
- 13) Vaidyanathan L. Growth factors in wound healing ↓ a review. *Biomedical and Pharmacology Journal.* 2021;14(3):1469-1480. doi:10.13005/bpj/2249
- 14) Jung H, Son GM, Lee JJ, Park HS. Therapeutic effects of tonsil-derived mesenchymal stem cells in an atopic dermatitis mouse model. *In Vivo (Brooklyn).* 2021;35(2):845-857. doi:10.21873/INVIVO.12325
- 15) Bormann D, Gugerell A, Ankersmit HJ, Mildner M. Therapeutic Application of Cell Secretomes in Cutaneous Wound Healing. *Journal of Investigative Dermatology.* 2023;143(6):893-912. doi:10.1016/j.jid.2023.02.019
- 16) Karuniawan A, Andrie M, Riza H, Studi Farmasi P, Kedokteran F, Tanjungpura Pontianak U. Uji Efek Penyembuhan Luka Sayat Salep Ekstrak Ikan Toman (*Channa Micropeltes*) Secara Topikal Pada Tikus Yang Diinduksi Streptozotocin.; 2016.
- 17) Park SR, Kim JW, Jun HS, Roh JY, Lee HY, Hong IS. Stem Cell Secretome and Its Effect on Cellular Mechanisms Relevant to Wound Healing. *Molecular Therapy.* 2018;26(2):606-617. doi:10.1016/j.ymthe.2017.09.023
- 18) Ahmadi H, Amini A, Fadaei Fathabady F, et al. Transplantation of photobiomodulation-preconditioned diabetic stem cells accelerates ischemic wound healing in diabetic rats. *Stem Cell Res Ther.* 2020;11(1). doi:10.1186/s13287-020-01967-2
- 19) Hu W, Zhang Y, Wang L, et al. Bone morphogenetic protein 4-smad-induced upregulation of platelet-derived growth factor AA impairs endothelial function. *Arterioscler Thromb Vasc Biol.* 2016;36(3):553-560. doi:10.1161/ATVBAHA.115.306302
- 20) Mulholland EJ. Electrospun Biomaterials in the Treatment and Prevention of Scars in Skin Wound Healing. *Front Bioeng Biotechnol.* 2020;8. doi:10.3389/fbioe.2020.00481
- 21) Manzat Saplacan RM, Balacescu L, Gherman C, et al. The Role of PDGFs and PDGFRs in Colorectal Cancer. *Mediators Inflamm.* 2017;2017. doi:10.1155/2017/4708076
- 22) Farooqi AA, Siddik ZH. Platelet-derived growth factor (PDGF) signalling in cancer: Rapidly emerging signalling landscape. *Cell Biochem Funct.* 2015;33(5):257-265. doi:10.1002/cbf.3120
- 23) Folestad E, Kunath A, Wågsäter D. PDGF-C and PDGF-D signaling in vascular diseases and animal models. *Mol Aspects Med.* 2018;62:1-11. doi:10.1016/j.mam.2018.01.005
- 24) Tan JL, Lash B, Karami R, et al. Restoration of the healing microenvironment in diabetic wounds with matrix-binding IL-1 receptor antagonist. *Commun Biol.* 2021;4(1). doi:10.1038/s42003-021-01913-9
- 25) Larouche J, Sheoran S, Maruyama K, Martino MM. Immune regulation of skin wound healing: Mechanisms and novel therapeutic targets. *Adv Wound Care (New Rochelle).* 2018;7(7):209-231. doi:10.1089/wound.2017.0761
- 26) Rea IM, Gibson DS, McGilligan V, McNerlan SE, Denis Alexander H, Ross OA. Age and age-related diseases: Role of inflammation triggers and cytokines. *Front Immunol.* 2018;9(APR). doi:10.3389/fimmu.2018.00586
- 27) Zhang X, Dai J, Li L, Chen H, Chai Y. NLRP3 Inflammasome Expression and Signaling in Human Diabetic Wounds and in High Glucose Induced Macrophages. *J Diabetes Res.* 2017;2017. doi:10.1155/2017/5281358
- 28) Dai J, Shen J, Chai Y, Chen H. IL-1  $\beta$  Impaired Diabetic Wound Healing by Regulating MMP-2 and MMP-9 through the p38 Pathway. *Mediators Inflamm.* 2021;2021. doi:10.1155/2021/6645766
- 29) Mirza RE, Fang MM, Weinheimer-Haus EM, Ennis WJ, Koh TJ. Sustained inflammasome activity in macrophages impairs wound healing in type 2 diabetic humans and mice. *Diabetes.* 2014;63(3):1103-1114. doi:10.2337/db13-0927
- 30) Liu Y, Liu Y, Deng J, Li W, Nie X. Fibroblast Growth Factor in Diabetic Foot Ulcer: Progress and Therapeutic Prospects. *Front Endocrinol (Lausanne).* 2021;12. doi:10.3389/fendo.2021.744868
- 31) Boniakowski AE, Kimball AS, Joshi A, et al. Murine macrophage chemokine receptor CCR2 plays a crucial role in macrophage recruitment and regulated inflammation in wound healing. *Eur J Immunol.* 2018;48(9):1445-1455. doi:10.1002/eji.201747400
- 32) Liu D, Yang P, Gao M, et al. NLRP3 activation induced by neutrophil extracellular traps sustains inflammatory response in the diabetic wound. *Clin Sci.* 2019;133(4):565-582. doi:10.1042/CS20180600

## The Effect of Secretome Hypoxia Mesenchymal Stem Cells on PDGF and IL-1b Gene Expression (Experimental Study on Wistar Rats Hyperglycemic Wound Models)

- 33) Putra A, Pertiwi D, Milla MN, et al. Hypoxia-preconditioned MSCs have superior effect in ameliorating renal function on acute renal failure animal model. *Open Access Maced J Med Sci.* 2019;7(3):305-310. doi:10.3889/oamjms.2019.049
- 34) Vasanthan J, Gurusamy N, Rajasingh S, et al. Role of human mesenchymal stem cells in regenerative therapy. *Cells.* 2021;10(1):1-14. doi:10.3390/cells10010054
- 35) Zakrzewski W, Dobrzyński M, Szymonowicz M, Rybak Z. Stem cells: Past, present, and future. *Stem Cell Res Ther.* 2019;10(1). doi:10.1186/s13287-019-1165-5
- 36) Putra A, Ridwan FB, Putridewi AI, et al. The role of tnf- $\alpha$  induced mscs on suppressive inflammation by increasing tgf- $\beta$  and il-10. *Open Access Maced J Med Sci.* 2018;6(10):1779-1783. doi:10.3889/oamjms.2018.404
- 37) Ullah M, Liu DD, Thakor AS. Mesenchymal Stromal Cell Homing: Mechanisms and Strategies for Improvement. doi:10.1016/j.isci
- 38) Ghaneialvar H, Soltani L, Rahmani HR, Lotfi AS, Soleimani M. Characterization and Classification of Mesenchymal Stem Cells in Several Species Using Surface Markers for Cell Therapy Purposes. *Indian Journal of Clinical Biochemistry.* 2018;33(1):46-52. doi:10.1007/s12291-017-0641-x
- 39) Lotfinia M, Lak S, Ghahhari NM, et al. Full Length Iranian Hypoxia Pre-Conditioned Embryonic Mesenchymal Stem Cell Secretome Reduces IL-10 Production by Peripheral Blood Mononuclear Cells. *Biomed J.* 2017;21(1):24-31. doi:10.6091/.21.1.24
- 40) Madrigal M, Rao KS, Riordan NH. A review of therapeutic effects of mesenchymal stem cell secretions and induction of secretory modification by different culture methods. *J Transl Med.* 2014;12(1). doi:10.1186/s12967-014-0260-8
- 41) Drawina P, Putra A, Nasihun T, Prajoko YW, Dirja BT, Amalina ND. Increased serial levels of platelet-derived growth factor using hypoxic mesenchymal stem cell-conditioned medium to promote closure acceleration in a full-thickness wound. *Indones J Biotechnol.* 2022;27(1):36-42. doi:10.22146/ijbiotech.64021
- 42) Meng X, Grötsch B, Luo Y, et al. Hypoxia-inducible factor-1 $\alpha$  is a critical transcription factor for IL-10-producing B cells in autoimmune disease. *Nat Commun.* 2018;9(1). doi:10.1038/s41467-017-02683-x
- 43) Syafril S. Pathophysiology diabetic foot ulcer. In: *IOP Conference Series: Earth and Environmental Science.* Vol 125. Institute of Physics Publishing; 2018. doi:10.1088/1755-1315/125/1/012161
- 44) Alavi A, Sibbald RG, Mayer D, et al. Diabetic foot ulcers: Part I. Pathophysiology and prevention. *J Am Acad Dermatol.* 2014;70(1):1.e1-1.e18. doi:10.1016/j.jaad.2013.06.055
- 45) Aumiller WD, Dollahite HA. Pathogenesis and management of diabetic foot ulcers. *J Am Acad Physician Assist.* 2015;28(5):28-34. doi:10.1097/01.JAA.0000464276.44117.b1
- 46) Noor S, Zubair M, Ahmad J. Diabetic foot ulcer - A review on pathophysiology, classification and microbial etiology. *Diabetes and Metabolic Syndrome: Clinical Research and Reviews.* 2015;9(3):192-199. doi:10.1016/j.dsx.2015.04.007
- 47) Chantelau EA. Nociception at the diabetic foot, an uncharted territory. *World J Diabetes.* 2015;6(3):391. doi:10.4239/wjd.v6.i3.391
- 48) Jhamb S, Vangaveti VN, Malabu UH. Genetic and molecular basis of diabetic foot ulcers: Clinical review. *J Tissue Viability.* 2016;25(4):229-236. doi:10.1016/j.jtv.2016.06.005
- 49) Wang CJ, Ko JY, Kuo YR, Yang YJ. Molecular changes in diabetic foot ulcers. *Diabetes Res Clin Pract.* 2011;94(1):105-110. doi:10.1016/j.diabres.2011.06.016
- 50) Blakytyn R, Jude EB. Altered molecular mechanisms of diabetic foot ulcers. *International Journal of Lower Extremity Wounds.* 2009;8(2):95-104. doi:10.1177/1534734609337151
- 51) Das S, Majid M, Baker AB. Syndecan-4 enhances PDGF-BB activity in diabetic wound healing. *Acta Biomater.* 2016;42:56-65. doi:10.1016/j.actbio.2016.07.001
- 52) Wang L, Wang F, Zhao L, et al. Mesenchymal stem cells coated by the extracellular matrix promote wound healing in diabetic rats. *Stem Cells Int.* 2019;2019. doi:10.1155/2019/9564869
- 53) Okonkwo UA, Dipietro LA. Diabetes and wound angiogenesis. *Int J Mol Sci.* 2017;18(7). doi:10.3390/ijms18071419
- 54) Kartika RW, Alwi I, Suyatna FD, et al. The Role Of Vegf, Pdgf And Il-6 On Diabetic Foot Ulcer After Platelet Rich Fibrin P Hyaluronic Therapy. *Heliyon.* 2021;7(9). doi:10.1016/j.heliyon.2021.e07934
- 55) MacLeod AS, Mansbridge JN. The Innate Immune System in Acute and Chronic Wounds. *Adv Wound Care (New Rochelle).* 2016;5(2):65-78. doi:10.1089/wound.2014.0608
- 56) Raziyeva K, Kim Y, Zharkinbekov Z, Kassymbek K, Jimi S, Saparov A. Immunology of acute and chronic wound healing. *Biomolecules.* 2021;11(5). doi:10.3390/biom11050700

## The Effect of Secretome Hypoxia Mesenchymal Stem Cells on PDGF and IL-1b Gene Expression (Experimental Study on Wistar Rats Hyperglycemic Wound Models)

- 57) Ormazabal V, Nova-Lampeti E, Rojas D, et al. Secretome from Human Mesenchymal Stem Cells-Derived Endothelial Cells Promotes Wound Healing in a Type-2 Diabetes Mouse Model. *Int J Mol Sci.* 2022;23(2). doi:10.3390/ijms23020941
- 58) Federer WT. *Experimental Design Theory And Application*, Third Edition,. Oxford and IBH Publishing Co, New Delhi Bombay Calcuta. Published online 1977.
- 59) Beserra FP, Vieira AJ, Gushiken LFS, et al. Lupeol, a dietary triterpene, enhances wound healing in streptozotocin-induced hyperglycemic rats with modulatory effects on inflammation, oxidative stress, and angiogenesis. *Oxid Med Cell Longev.* 2019;2019. doi:10.1155/2019/3182627
- 60) Widyaningsih W. Pengaruh Pemberian Sekretom Sel Punca Mesenkimal Hipoksia Terhadap Kadar C-Peptide, IL-6, Dan Polarisasi Makrofag Tipe-2 (Studi Eksperimental in Vivo Pada Tikus Obesitas Diabetes Melitus Tipe 2) (Doctoral Dissertation, Universitas Islam Sultan Agung (Indonesia)).; 2022.
- 61) HS Z, Putra A. Peran Mesenchymal Stem Cells dalam Regulasi PDGF dan Sel Islet pada Diabetes. *Jurnal Kedokteran Brawijaya.* 2018;30(2):98-102. doi:10.21776/ub.jkb.2018.030.02.4
- 62) Muhar AM, Putra A, Warli SM, Munir D. Hypoxia-mesenchymal stem cells inhibit intra-peritoneal adhesions formation by upregulation of the il-10 expression. *Open Access Maced J Med Sci.* 2019;7(23):3937-3943. doi:10.3889/oamjms.2019.713
- 63) Putra A. *Basic Molecular Stem Cell* Semarang: Unisulla Press.; 2019.
- 64) Matluobi D, Araghi A, Maragheh BFA, et al. Carvacrol promotes angiogenic paracrine potential and endothelial differentiation of human mesenchymal stem cells at low concentrations. *Microvasc Res.* 2018;115:20-27. doi:10.1016/j.mvr.2017.08.003
- 65) Kehl D, Generali M, Mallone A, et al. Proteomic analysis of human mesenchymal stromal cell secretomes: a systematic comparison of the angiogenic potential. *NPJ Regen Med.* 2019;4(1). doi:10.1038/s41536-019-0070-y



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.



## Digital Transformation and Smes: A Systematic Literature Review Using Bibliometric Analysis



Dang Khoa Vu

Ph.D. student at Economic Business University, Vietnam National University

Address: 144 Xuan Thuy Street, Cau Giay District, Hanoi Province, Vietnam

**ABSTRACT:** This article uses bibliometric analysis to integrate, synthesize, and expand the knowledge regarding digital transformation and small and medium enterprises. The author examined the Web of Science (WOS) core collection database for articles between 2021 and 2023, October. For a complete record, information is collected on the publication year, keywords, document type, journal, author, affiliations, country, abstracts, and the number of citations. The co-citation, co-occurrence, and publication patterns were analyzed using VOSviewer 1.6.19. The study comprised 64 papers (N = 64), of which 94% were original research articles and just 6% were review articles. The study adopted the bibliometric approach in mapping out the research focus on digital transformation and small and medium enterprises which has been given considerable attention recently. The article concludes by identifying the gaps in the literature and proposing future study possibilities.

**KEYWORDS:** digital transformation, bibliometrics, SMEs, systematic literature review, web of science, VOS viewer

### 1. INTRODUCTION

Digital transformation brings many benefits to businesses. When applying digital transformation, the information linkage among departments within a business is connected on a unified technological platform, enabling the resolution of issues that arise in the enterprise immediately and ensuring smooth operations without negative impacts such as delayed customer service or decreased sales volume (Hinings, Gegenhuber, et al. 2018). Participating in the digital transformation process allows managers to proactively and easily access business activity reports (Nguyen Đình Quyet, 2021). Therefore, as an innovative approach, digital transformation enables businesses to optimize production and business in an environment where resources are becoming increasingly scarce, enhancing global competitiveness.

Small and medium-sized enterprises (SMEs) account for nearly 97% of the total businesses in Vietnam, operating under various constraints. Although digital transformation brings many benefits to businesses regarding cost savings, changing production and business methods, improving the quality of goods and services, and enhancing business management effectiveness, not all businesses can afford to invest. The majority of small and medium-sized enterprises face difficulties in digital transformation.

### 2. DATA SOURCE AND METHODOLOGY

Web of Science (WoS) database was the only source for the study's data collection. WoS is the most critical database for scientific research and the top scientific citation search and analytical information platform globally (Li, Rollins, & Yan, 2018). It is utilized as a research tool supporting various scientific activities across multiple knowledge fields and as a data collection for large-scale, data-intensive studies. WoS contains more than 53 million records, 1.18 billion referenced references, and coverage of over 34,000 publications, and it has been utilized in thousands of published academic research over the past 20 years. It is also Eugene Garfield's most incredible enduring commercial legacy (Li et al., 2018). The Journal Impact Factor (JIF) is a crucial Web of Science component. The "impact factor" is the metric used in the InCites Journal Citation Reports (JCR) for SCI and SSCI, as is extensively documented elsewhere (Garfield, 2007; Meho & Yang, 2007).

The selection of journal articles was based on the idea that journal articles are viewed as more credible sources of information and are briefer and more thorough than other sources of information (Ramos-Rodríguez & Ruíz-Navarro, 2004; Zhang et al., 2016). The chosen key search terms were "digital transformation" AND "SMEs". It was determined which publications had these search terms in their titles, abstracts, and keywords. This study's time range included twenty years, from 2021 to 2023.

Throughout 64 chosen papers, the institutes of corresponding authors are gathered and examined.

3. ANALYZE THE RESULTS

Country

China was represented by the first of the 10 nations included in this list with 10 research. Italy has the second-highest number of articles, behind the United States, with a total of eight, followed by Spain and Czech, each with six and seven articles. With just seven articles, Spain has a fantastic citation high citations per article, despite having a comparatively low number of articles. There are three nations in Asia with a high rate of article production. China has the most significant proportion of articles (10), followed by Vietnam, and South Korea. China had the highest number of citations, while Vietnam had a higher citation rate per item.

Table 1. Top 10 ranking of countries by article, citations

Selected	Country	Documents	Citations	Total link strength
<input checked="" type="checkbox"/>	peoples r china	7	65	289
<input checked="" type="checkbox"/>	italy	5	165	171
<input checked="" type="checkbox"/>	south korea	4	21	167
<input checked="" type="checkbox"/>	czech republic	5	4	142
<input checked="" type="checkbox"/>	spain	2	20	118
<input checked="" type="checkbox"/>	canada	4	42	108
<input checked="" type="checkbox"/>	germany	2	1	58
<input checked="" type="checkbox"/>	vietnam	2	11	12
<input checked="" type="checkbox"/>	greece	3	15	11

Source: Author’s analysis of the WOS database.

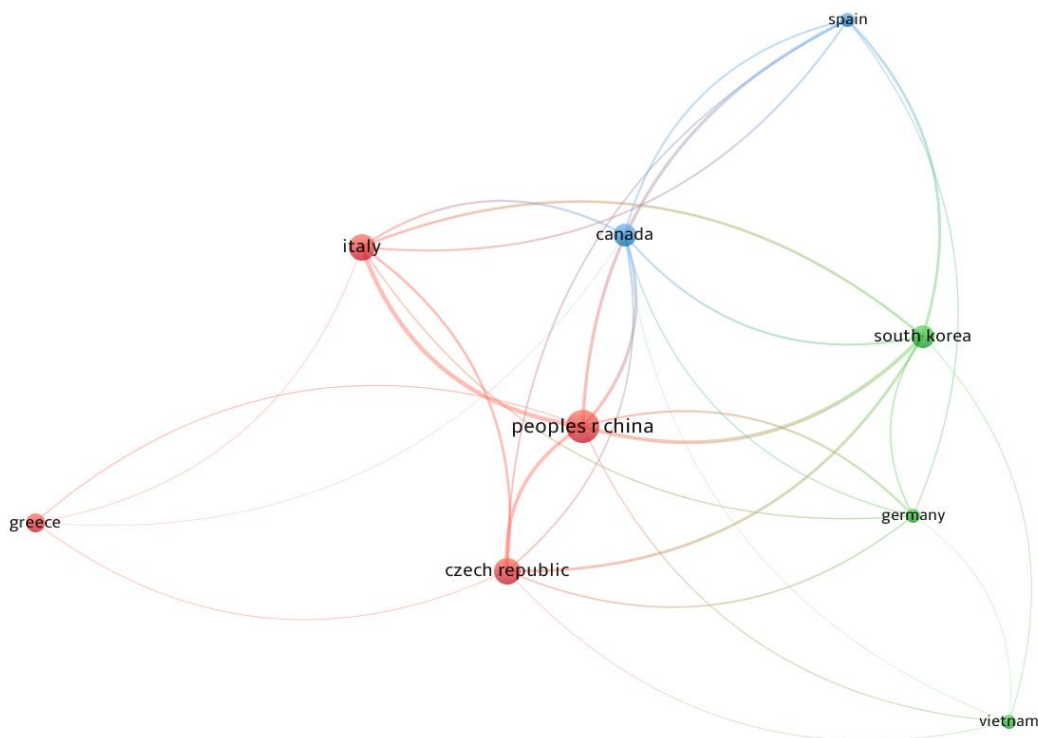


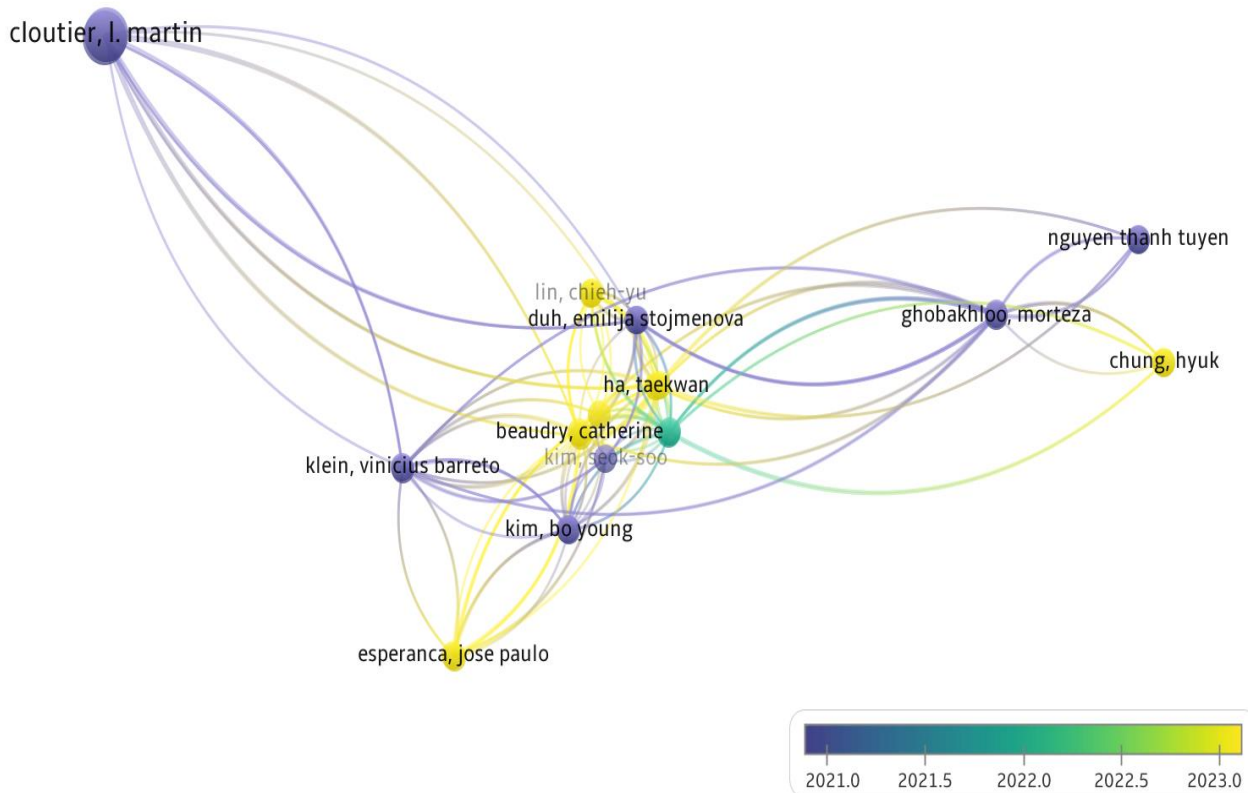
Figure 1. Network visualization map of the country

Source: Author’s analysis of the WOS database

# Digital Transformation and Smes: A Systematic Literature Review Using Bibliometric Analysis

## Authors

The overlay visualization co-authorship network depicts eleven co-authorship clusters. As shown above, in the co-authorship networks, the color of the linkages (such as blue, green, yellow, and purple) corresponds to the color coding of the different time spans inside a 5-year slice. In addition, the network established several research communities composed of the communities' chief writers and other authors to allow collaborative collaborations and fieldwork. Klein, Cloutier, and Emilija were the first writers to publish in their respective fields. These co-authorships, seen in deep purple and blue on the map, existed between 2021 and 2023.



**Figure 2. Overlay visualization co-authorship network**

**Source:** Author's analysis of the WOS database.

## KEYWORDS

Su and Lee (2010) indicated that keywords might be employed to offer a clear and succinct summary of the study topic during keyword analysis. Moreover, as N. Van Eck and Waltman (2010) mentioned, a network of keywords may be utilized to illustrate the knowledge between their link and the conceptual organization of the study issue. Many study subjects and themes have merged and evolved in the field of automation research throughout the years, representing the tendencies and boundaries of the discipline. The evaluation of bibliographic record data to create a network of co-occurring keywords and subject categories in labor market research. Co-word analysis is one of the most often utilized bibliometric approaches (Callon, Courtial, & Laville, 1991). It is defined as the number of publications in which two keywords appear together (Whittaker, 1989). Co-word analysis successfully analyzes the visual interactions between frequently used terms, allowing authors to determine trends within a particular field. The keywords employed by the writers of the research study provide light on the most important research topics in the field (N. J. Van Eck & Waltman, 2014). So, the current study examines the co-occurrence of keywords, which may be derived from the title, abstract, or authors. Figure 3 depicts the overlay visualization network map for co-occurring terms throughout publishing years. From 2021 to 2023, it was noticed that there were at least four instances of study concentrating on digital transformation and SMEs, such as innovation, dynamic capabilities, business, management, performance, strategy ...

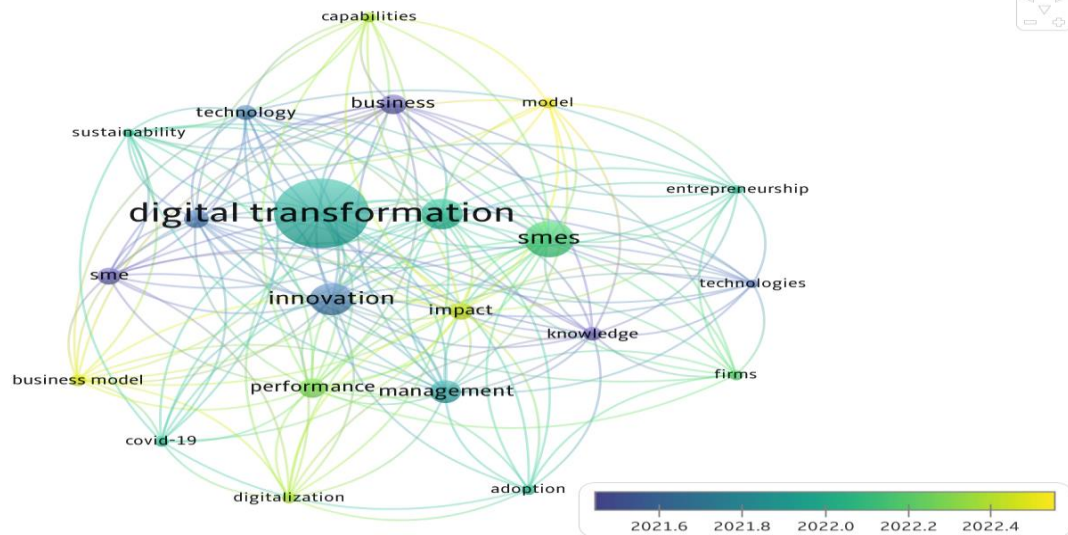


Figure 3. Overlay visualization map for co-occurring keywords

Source: Author’s analysis of the WOS database.

#### 4. DISCUSSION AND CONCLUSION

The concept of digital transformation has been discussed and studied for many years, but up to now, there is still no unified definition. At each stage and from different perspectives, authors present different definitions. From a business perspective, authors generally agree that digital transformation involves the application of new technologies to optimize resources, operational processes, and better meet customer needs. According to (Stolterman and Fors 2004), digital transformation is defined as using technology to significantly improve business performance or access range. (McDonald Mark and Rowsell-Jones 2012) suggest that digital transformation is not just about digitizing resources but creating business value based on digital assets. In line with this viewpoint, (Fitzgerald, Kruschwitz et al. 2013) defines digital transformation in businesses as the use of new digital technologies, such as social media, smart mobile devices, new analytic techniques, or automated linking systems, to bring about significant changes in business operations, such as enhancing customer experience, optimizing activities, and creating new business models. (Hess T, Matt C et al. 2016) believe that digital transformation encompasses changes that digital technology can bring about in a business model, leading to changes in products, organizational structure, or automation of business processes. Therefore, digital transformation in enterprises is not merely about digitizing statistical data, operational processes, or organizational information; rather, it is more important to apply technology to analyze the digitized data and then change the way value is created for the business. The digital transformation capability of an enterprise is its ability to apply new digital technologies in its organization, operations, and management, while creating valuable assets from digital technology applications to optimize resources, better meet market needs, and generate added value for the business. According to (Hinchcliffe D. 2016), the process of digital transformation in enterprises involves three aspects.

Firstly, it is the transformation of operational processes. Building and utilizing electronic data exchange systems will greatly save time and increase efficiency for businesses.

Secondly, it is the transformation of operating models, meaning changing the way operations are carried out to create value for the business.

Lastly, it is the change in customer experience. This results from the interaction between customers and the business, which the customers experience and perceive.

#### REFERENCES

- 1) Bennis W (2013). "Leadership in a digital world: embracing transparency and adaptive capacity." MIS Q 37: 635–636.
- 2) Berman SJ (2012). "Digital transformation: opportunities to create new business models." Strategy Leadersh 40: 16-24.
- 3) Besson P and Rowe F (2012). "Strategizing information systems-enabled organizational transformation: a transdisciplinary review and new directions." J Strateg Inf Syst 21: 103-124.
- 4) Bharadwaj A, et al. (2013). "Digital business strategy: toward a next generation of insights." MIS Q 37: 471–482.
- 5) Cha KJ, et al. (2015). "An integrative model of IT-enabled organizational transformation: a multiple case study." Manag Decis 53: 1755–1770.

## Digital Transformation and Smes: A Systematic Literature Review Using Bibliometric Analysis

- 6) Chatterjee D, et al. (2002). "Shaping up for e-commerce: institutional enablers of the organizational assimilation of web technologies." *MIS Q* 26: 65–89.
- 7) Daniel EM and Wilson HN (2003). "The role of dynamic capabilities in e-business transformation." *Eur J Inf Syst* 12: 282–296.
- 8) Dremel C, et al. (2017). "How AUDI AG established big data analytics in its digital transformation." *MIS Q Exec* 16 (2): 81–100.
- 9) El Sawy OA, et al. (2016). "How LEGO built the foundations and enterprise capabilities for digital leadership." *MIS Q Exec* 15 (2): 141–166.
- 10) Fitzgerald, M., et al. (2013). "Embracing digital technology: a new strategic imperative." *MIT sloan management review* 55(1).
- 11) Gerth AB and Peppard J (2016). "The dynamics of CIO derailment: how CIOs come undone and how to avoid it." *Bus Horiz* 59(1): 61–70.
- 12) Granados N and Gupta A (2013). "Transparency strategy: competing with information in a digital world." *MIS Q* 37(2): 637–641.
- 13) Hai Phong Statistics Office (2023). *Niên giám thống kê 2023*. Hanoi, NXB Thống Kê.
- 14) Hansen R and Sia SK (2015). "Hummel's digital transformation toward omnichannel retailing: key lessons learned." *MIS Q Exec* 14(2): 51–66.
- 15) Hess T, et al. (2016). "Options for formulating a digital transformation strategy." *MIS Q Exec* 15(2): 123–139.
- 16) Hinchcliffe D. (2016). *The Hardest Lesson of Digital Transformation: Designing for Loss of Control*.
- 17) Hinings, B., et al. (2018). "Digital innovation and transformation: An institutional perspective." *Information and Organization* 28(1): 52–61.
- 18) Hu H, et al. (2016). "The role of institutional entrepreneurship in building digital ecosystem: a case study of Red Collar Group (RCG)." *Int J Inf Manag* 36(3): 496–499.
- 19) Ireland RD, et al. (2009). "Conceptualizing corporate entrepreneurship strategy." *Entrepreneursh Theory Practice* 33(1): 19–46.
- 20) Karimi J and Walter Z (2015). "The role of dynamic capabilities in responding to digital disruption: a factorbased study of the newspaper industry." *J Manag Inf Syst* 32(1): 39–81.
- 21) Kohli R and Johnson S (2011). "Digital transformation in latecomer industries: CIO and CEO Leadership Lessons from Encana Oil and Gas (USA) Inc." *MIS Q Exec* 10(4): 141–156.
- 22) Kohli R and Melville NP (2019). "Digital innovation: a review and synthesis." *Inf Syst J* 29(1): 200–223.
- 23) Liu DY, et al. (2011). "Resource fit in digital transformation: lessons learned from the CBC Bank global e-banking project." *Manag Decis* 49(10): 1728–1742.
- 24) Llopis J, et al. (2004). "Transforming the firm for the digital era: an organizational effort towards an E-culture." *Hum Syst Manag* 23(4): 213–225.
- 25) Loebbecke C and Picot A (2015). "Reflections on societal and business model transformation arising from digitization and big data analytics: a research agenda." *J Strateg Inf Syst* 24(3): 149–157.
- 26) Mazzei MJ and Noble D (2017). "Big data dreams: a framework for corporate strategy." *Bus Horiz* 60(3): 405–414.
- 27) McDonald Mark, P. and A. Rowsell-Jones (2012). *The Digital Edge. Exploiting Information and Technology for Business Advantage*.
- 28) Nguyen Đình Quyet (2021). "Chuyển đổi số trong doanh nghiệp ở Việt Nam hiện nay: Những khó khăn cần tháo gỡ." *Tạp chí Cộng sản*.
- 29) Peltola S (2012). "Can an old firm learn new tricks? A corporate entrepreneurship approach to organizational renewal." *Bus Horiz* 55(1): 43–51.
- 30) Ranganathan C, et al. (2004). "Bringing professionals on board: lessons on executing IT-enabled organizational transformation." *MIS Q Exec* 3(3): 151–160
- 31) Rigby DK, et al. (2016). "Embracing agile." *Harv Bus Rev* 94(5): 40–50.
- 32) Rindova VP and Kotha S (2001). "Continuous "morphing": competing through dynamic capabilities, form, and function." *Acad Manag* 44(6): 1263–1280.
- 33) Sandström CG (2016). "The non-disruptive emergence of an ecosystem for 3D Printing—insights from the hearing aid industry's transition 1989–2008." *Technol Forecast Soc Change* 102: 160–168.
- 34) Schuchmann D and Seufert S (2015). "Corporate learning in times of digital transformation: a conceptual framework and service portfolio for the learning function in banking organisations." *Int J Adv Corp Learn* 8(1): 31–39.
- 35) Sebastian IM, et al. (2017). "How big old companies navigate digital transformation." *MIS Q Exec* 16(3): 197–213.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## The Knife-Plane Configuration Model of CCP equipment from plasma corona discharge case



Asep Yoyo Wardaya<sup>1</sup>, Zaenul Muhlisin<sup>2</sup>, Isnain Gunadi<sup>3</sup>, Pandji Triadyaksa<sup>4</sup>

<sup>1,2,3,4</sup>Department of Physics, Faculty of Science and Mathematics, Diponegoro University, Semarang Indonesia

**ABSTRACT:** This research discusses the concept of analytical calculations of current-voltage (I-V) characteristics in the case of corona discharges using an asymmetric electrode model (with a DC source), which is often called capacitively coupled plasma (CCP) equipment. This CCP equipment, which is almost similar in shape to capacitor equipment in conventional electrical equipment, has the characteristic of having an active electrode in an upright position above the position of a passive electrode (in a lying position) in the air. Another characteristic is that the lowest end of the active electrode has a sharp surface so that a large corona current flows out of the sharp surface towards the passive electrode. The (I-V) characteristic calculation method can be calculated using a geometric concept (based on the sharp surface at the tip of the active electrode) using a modified capacitance concept. For the case of an asymmetric model with an arrangement of active and passive electrodes perpendicular to each other, the capacitance calculation can use the knife-plane electrode configuration model.

**KEYWORDS:** CCP, asymmetric electrode model, (I-V) characteristics, corona discharge, geometric concept, knife-plane

### I. INTRODUCTION

The use of plasma technology in various human lives has become commonplace, such as plasma applications in the Medical Field (Kim, & Kim, 2021), Agriculture and Biomedicine (Stryczewska, & Boiko, 2022), Plasma Fusion (Makar, 2020), etc. One of the plasma technologies used is electrode equipment, which is similar to a capacitor and is called capacitively coupled plasma (CCP). This CCP equipment is divided into three categories, namely the electric asymmetric CCP, the direct current CCP, and the dual-frequency CCP (Liu, et al. 2012).

There is an interesting thing in the discussion of plasma discharges, namely the discussion of the characteristics of current-voltage (I-V) that appear when using CCP equipment in the electric asymmetric and direct current categories. There is an oddity in the current-voltage (I-V) characteristics in the case of plasma discharges, which is not found in the case of (I-V) characteristics in ordinary conventional electric currents. This oddity can occur because the plasma discharge process is caused by several physical events such as electrodynamics (Guan, et al. 2018), convective heat transfer (Robinson, 1970), electric wind (Robinson, 1961), Etc. The solution for calculating the (I-V) characteristics is quite difficult to do because the calculations that have been carried out with physical solutions (using the concept of Maxwell's equations) only match part of the initial discharge curve. Although it is only suitable in the case of an initial discharge curve, there is a (I-V) characteristic model of the cylindrical CCP model that incorporates the concept of capacitance, which turns out to be suitable for symmetric discharge currents, as expressed by the equation (Robinson, 1967),

$$i = \frac{10^6}{l} \frac{4b_0 C_A}{\sigma R^2} V(V - V_i), \quad (1)$$

where  $i$  is corona current  $I$ /length  $l$  (A/m). The quantities  $R$  and  $l$  are the outer radius and length of the Coaxial Cylinders, respectively. The  $C_A$  quantity is the formulation of the capacitance of a cylindrical coaxial electrode (Halliday, et al. 2013), which can be written as

$$C_A = \frac{2\pi\epsilon l}{\ln(R/r)}, \quad (2)$$

where  $r$  adalah radius dalam dari Coaxial silinder (thin wire). If you look at equation (1) above, the (I-V) characteristics apart from being determined by the capacitance value  $C_A$ , are also determined by a multiplier factor of  $10^6$ , in addition to the outer radius

## The Knife-Plane Configuration Model of CCP equipment from plasma corona discharge case

R. The appearance of the  $R$  factor in equation (1), identifies the symmetrical plasma flow from the inner cylinder to the outer cylinder, while the multiplier factor indicates the strength value of the plasma electric current which is much greater when compared to the electric current originating from an ordinary conventional circuit. Now, we will apply the capacitance model to the case of asymmetric CCP equipment using a DC source. For this case, of course, the plasma current that comes out is not symmetrical in shape from the active electrode to the passive electrode. This event can occur because the most dominant plasma discharge output (not evenly distributed to each electrode surface) will come out from the lowest end of the active electrode area with a tapered surface towards the passive electrode, in accordance with the experiment Dobranszky, et al. (2008). However, the capacitance concept can still be used, although the calculation must be modified according to the discharge conditions of the experiment Dobranszky, et al. (2008). This capacitance model is referred to as a modified capacitance model by adding a multiplier  $k$  from the sharpest area of the integration boundary of the capacitance calculation, as done by Wardaya et al. (2022,2022A).

### II. KNIFE-PLANE ELECTRODE CONFIGURATION

To calculate capacitance with the active electrode in an upright position above the passive electrode (in a lying position below the active electrode), we need a knife-plane electrode configuration model illustrated in Figure 1 below

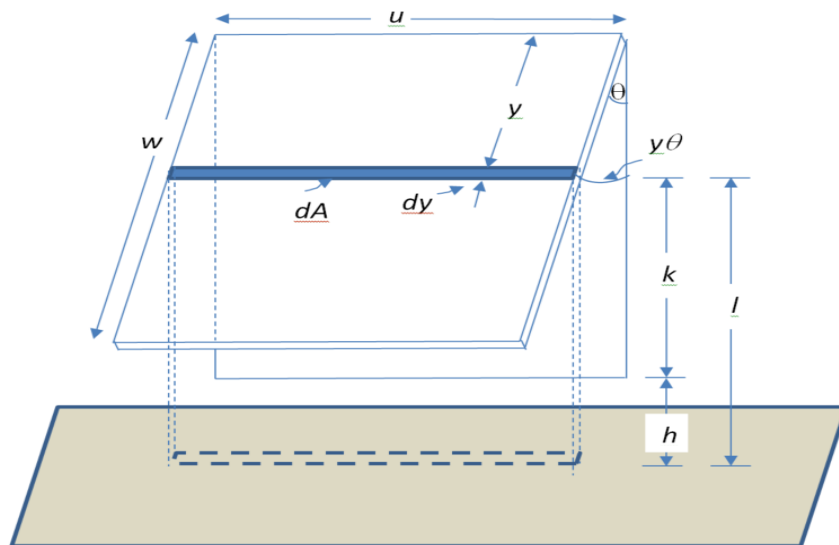


Figure 1. Sketch of the knife-plane electrode configuration model.

The picture above shows a sketch of the CCP equipment with a knife-plane electrode configuration model. The model begins with an active electrode (upper plate) inclined  $\theta$  to the vertical plane. The active electrode has a length  $u$  and a width  $w$ , where if it is positioned perpendicularly in the air, it will have a  $h$  distance from the passive electrode (in a horizontal position below the active electrode). Now consider an area element  $dA$  (located at the active electrode) with a length  $u$  and a width  $dy$ . The distance of the area element to the top end of the active electrode is  $y$ , while the space of the area element to the passive electrode is  $l = k + h$ . If the area element represents the active electrode element, then the size of the capacitance element can be written as

$$dC = \varepsilon_0 \frac{dA}{l} = \varepsilon_0 \frac{u dy}{k + h} \quad (3)$$

For the case of the active electrode perpendicular to the passive electrode ( $y\theta \cong 0$ ), which is called the knife-plane configuration model, the relationship  $k = w - y$  is obtained so that for the plane knife configuration model, equation (3) can be written as

$$dC = -\varepsilon_0 \frac{u dy}{(y - w - h)} \quad (4)$$

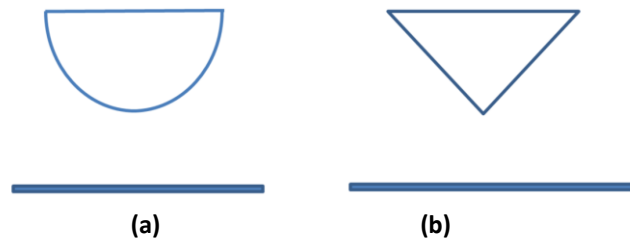
The solution of the capacitance value from the plane blade configuration model, from equation (4), by considering the boundary conditions  $0 \leq y \leq w$ , will produce the equation.

$$C_h = -\varepsilon_0 u \int_{y=0}^w \frac{dy}{(y - w - h)} = \varepsilon_0 u \ln \left| \frac{w}{h} + 1 \right| \quad (5)$$

## The Knife-Plane Configuration Model of CCP equipment from plasma corona discharge case

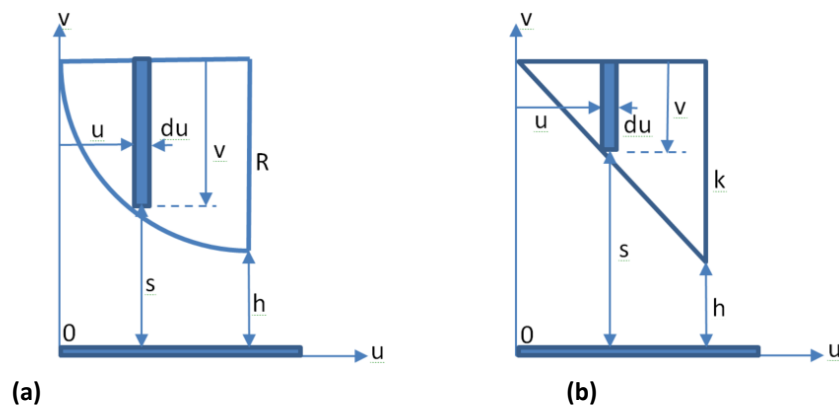
### III. APPLICATION ON CCP EQUIPMENT

For the case of various CCP equipment with the active electrode in the form of a thin plate and with the plate positioned perpendicularly in the air, while the passive electrode is in the form of a wide rectangular plate and its position lies horizontally below the active electrode, the capacitance calculation can be calculated using equation (5) above. For example, we will look at 2 electrode configuration models of CCP equipment as illustrated in Figure 2 below,



**Figure 2. Sketch view of 2 electrode configuration models of CCP equipment. (a). The active electrode is a semicircle, and (b) The active electrode is an isosceles triangle. All passive electrodes are rectangular plates that lie horizontally below the active electrode.**

To calculate the capacitance of the two models above, the first thing to look at is the symmetry of the active electrode, so the capacitance value is calculated using Figure 3 below.



**Figure 3. Example of a capacitance value calculation model. (a). The active electrode is a semicircle, and (b) The active electrode is an isosceles triangle.**

Calculating the capacitance value from Figure 2 can use the principle of symmetry where the shape of the active electrode in Figure (2) only takes up half of it, which is seen in Figure (3). From Figure (3), we can calculate the capacitance element through the formula

$$dC_k = \epsilon_0 \int_u^v du \ln \left| \frac{v}{s} + 1 \right|. \quad (6)$$

From equation (6), we can calculate the capacitance value of the electrode configuration system in figure (2), with the total capacitance value being  $C_{tot} = 2C_k$  because it uses the symmetry principle. In Figure (3), there is also a length relationship that connects the size of the electrode element with the actual electrode, such as:

$s + v = R + h$  (in picture (3a)) and  $s + v = k + h$  (in picture (3b)). (7) There is an additional concept for the modified capacitance model, namely the emergence of a current multiplication factor  $k$  at the integration boundary of the sharp, active electrode area, thus producing a modified capacitance value  $C_{tot}$ . In Figure 3, the position of the site with a tapered shape is the position of the bottom electrode tip, which is a distance  $h$  from the passive electrode. For the (I-V) characteristic formulation, we can use the formulation introduced by Wardaya et al. (2022,2022A) as

$$I = -\frac{\mu_0}{\epsilon_0^2} \left[ \frac{\{C_{tot}\}^3}{(\text{Gauss area})^2} \right] (V - V_i)^2. \quad (8)$$

### IV. DISCUSSION



## The Knife-Plane Configuration Model of CCP equipment from plasma corona discharge case

Problems that arise from calculating the current-voltage (I-V) characteristics of corona discharge cases in CCP equipment can be solved using physical calculations (using Maxwell's equations) or geometrically (using a modified capacitance approach). For geometric calculations in the case of asymmetric CCP and DC source, the modified capacitance calculation using a knife-plane model approach applies to the condition that the active electrode is made of a thin plate and has a perpendicular position in the air with the passive electrode below the active electrode in a horizontal position.

### V. CONCLUSIONS

This research uses a geometric approach to calculate the knife-plane configuration model for modified capacitance calculations in calculating the (I-V) characteristics of the plasma discharge case. The physical or geometric approach method only represents the initial discharge curve part of the (I-V) characteristic graph, where the continuation curve of the (I-V) characteristic is quite difficult to predict because of the complexity of the physical problems that occur in corona discharge events. Using a modified capacitance model by introducing a  $k$  factor as a fitting curve is a relatively straightforward approach to calculating (I-V) characteristics compared to the physical solution approach using Maxwell's equations.

### REFERENCES

- 1) Kim, S., & Kim, C. (2021). Applications of Plasma-Activated Liquid in the Medical Field. *Biomedicines*, 9(11), 1700. <https://doi.org/10.3390/biomedicines9111700>.
- 2) Stryczewska, H.D., & Boiko, O. (2022). Applications of Plasma Produced with Electrical Discharges in Gases for Agriculture and Biomedicine. *Applied Sciences*, 12(9), 4405. <https://doi.org/10.3390/app12094405>.
- 3) Makar, A.K. (2020). An Audit of Occurrence of Dust in Tokamak and Stability of Fusion Plasma. *Plasma and Fusion Research*, 15, 1405019.1-1405019.8. <https://doi.org/10.1585/pfr.15.1405019>.
- 4) Liu, Y-X., Jiang, W., Li, X-S., Lu, W-Q., & Wang, Y-N. (2012). An overview of diagnostic methods of low-pressure capacitively coupled plasmas. *Thin Solid Films*, 521, 141-145. <https://doi.org/10.1016/j.tsf.2012.02.016>.
- 5) Guan, Y., Vaddi, R.S., Aliseda, A., & Novosselov, I. (2018). Analytical model of electrohydrodynamic flow in corona discharge. *Physics of Plasmas*, 25(8), 083507. <https://doi.org/10.1063/1.5029403>.
- 6) Robinson, M. (1970). Convective Heat Transfer at The Surface of A Corona Electrode. *International Journal of Heat and Mass Transfer*, 13,263-274.
- 7) Robinson, M. (1961). Movement of Air in the Electric Wind of the Corona Discharge. *Transactions of the American Institute of Electrical Engineers*, 80, 143-150. <https://doi.org/10.1109/TCE.1961.6373091>.
- 8) Robinson, M. (1967). The Corona Threshold for Coaxial Cylinders in Air at High Pressures. *IEEE Transactions on Power Apparatus and Systems*, 86(2),185-189.
- 9) Halliday, D., Resnick, R., & Walker, J. (2013). *Fundamentals of Physics* (10<sup>th</sup> ed.). John Wiley & Sons.
- 10) Dobranszky, J., Bernath, A., & Marton, H.Z. (2008). Characterisation of the plasma shape of the TIG welding arc. *International Journal of Microstructure and Materials Properties*, 3(1), 126-140. <https://doi.org/10.1504/IJMMP.2008.016949>.
- 11) Wardaya, A.Y., Muhlisin, Z., Suseno, J.E., Soesanto, Q.M.B., Azam, M., Setiawati, E., & Hadi, S. (2022). The electrode model of corona plasma discharge theory for current–voltage characteristics case in air. *The European Physical Journal Applied Physics*, 97, 22. <https://doi.org/10.1051/epjap/2022210252>.
- 12) Wardaya, A.Y., Muhlisin, Z., Suseno, J.E., Nur, M., Triadyaksa, P., Khumaeni, A., Sarwoko, E.A., Windarta, J., & Hadi, S. (2022A). The Current-Voltage Characteristics for Electrode Geometry Model of Positive DC Corona Discharge in Air. *Gazi University Journal of Science*, 35, 1140-1150. <https://doi.org/10.35378/gujs.885345>.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Testing the Mediation Effect of Employee Engagement on Internal Branding Practice-Job Satisfaction Relationship of Hospitality Industry Employees



Lohana Juariyah<sup>1</sup>, Syihabudhin<sup>2</sup>, Afwan Hariri Agus Prohimi<sup>3</sup>, I Nyoman Riki Widyastawan<sup>4</sup>

<sup>1,2,3,4</sup> Management Department, Universitas Negeri Malang, Indonesia

**ABSTRACT:** This research explains (1) the conditions of internal branding, employee engagement, and employees' job satisfaction; and (2) the existence of a positive and significant relationship between internal branding, employee engagement, and job satisfaction among hospitality industry employees especially in hotel industry in Malang Raya. The researchers took the four-star hotel with non-chain hotel to make sure independent internal branding practices. The hotels consisted of six hotels as the research objects. The researchers took the sample from the population of six hotels with proportionate random sampling technique and obtained 163 respondents. The data analysis technique applied descriptive statistics and partial least square analyses. From the descriptive analysis result, it shows that hotel applied good internal branding practices, employees have high employee engagement and job satisfaction. The coefficient path between internal branding and employee engagement had the highest value. Thus, the researchers expected the hospitality service institution, especially hotel to implement internal branding for their employees.

**KEYWORDS:** Internal branding, employee engagement, job satisfaction, hospitality industry

Establishing strong branding in the hospital service industry is important because of competitive industrial competition from the previous situation. An industry or a corporation must keep the meaning of the attached brand (Pinar, Trapp, Girard & E. Boyt, 2014). Powell (2014) explains the solution of keeping and improving the commitment of a brand requires relevant internal branding management between the superordinate and the subordinates or the internal actors of an organization, the employees. Internal branding, based on the primes that employees represent the brand quality, in which the branding is achievable by supporting the employees to understand and comprehend the brand meaning; and gaining the relevant skills and techniques to meet the brand promises (Lee, Kim & Kim, 2014). The descriptions of internal branding as a focused branding toward internal consumers include the recognition of the employees by the employees. The objectives of internal branding are to ensure the employees deliver the branding promises for the external consumers (Foster, Punjaisri, & Cheng, 2010). Dryl (2017) defines internal branding as the implementation of internal communication and training programs to educate employees about the branding promises.

Hospitality industries apply internal branding practices as the parts of service industries with high employee-consumer interaction. The roles of employees in the hospitality industry are vital. The roles determine the satisfaction of the corporate services. Employees become the differentiators and competitive means within the hospitality industrial competition. Employees with excellent performance are irreplaceable by the competitors at least for the short term (Punjaisri, Evanchitzky, & Wilson, 2009). In the short term, internal branding brings employee engagement to inspire and bind the employees; and to associate the employees and the organization (Grossman, 2008).

The definition of employee engagement, by Right Management (2006), is - every individual in an organization who comprehends and is committed to succeed in the business strategy, combines the commitment aspect, and shares the pride of the product and the organizational brand. The success of internal branding supports engagement due to employee motivation by encouraging the employees to understand the corporate visions and strategies from personal perspectives. Some studies found the influence of internal branding on employee engagement. Slatten & Mehmetoglu (2011) found the information provision about mission or organizational direction improved employee engagement while working. King (2010) found that employees with excellent brand understanding could relieve the confusion about jobs and facilitate employee engagement to promote brand-

## Testing the Mediation Effect of Employee Engagement on Internal Branding Practice-Job Satisfaction Relationship of Hospitality Industry Employees

support behavior. Employee engagement refers to an organizational result due to excellent employee treatment as the internal customers.

Employee engagement refers to the attachment between the employees and the organization. This engagement is beyond physical and cognitive attachments, such as emotional attachment to the performed jobs. Any engaged employees with the spirit and capability of feeling the relationship with the corporations could encourage future innovation and organizational advancement. Saks (2006) explains that employee engagement directs various things to be positive, such as performance satisfaction.

Job satisfaction refers to joyful and positive situations as the results of the performance assessment and individual performance experience. The conceptualization of the notion of job satisfaction includes the emotional state from the employee evaluation of their jobs. The other definition of job satisfaction is the individual attitude toward the promoted job as a global measurement with various dimensions (Kelly and Hise, 1980). Any employee with excellent satisfaction could reach a high-performance level (Kelly and Hise, 1980). Du Preez and Bendixen (2015) and Hwang & Der-Jang (2005) observed that internal branding contributed to performance satisfaction. Tang, Siu, & Cheung (2014) explain that job satisfaction influences employee behaviors then the whole organizational performance. Employees who perceive the superordinate or the employer provides career development support, the employees will have the organizational commitment and spend more time serving the clients (King, 2010). Internal branding maximizes the agreement between the values, the employees, and the organizational values to improve employee satisfaction and decrease the turnover increment (Du Prezz & Bendixen, 2015). In this research, the researchers discuss the correlation between internal branding and job satisfaction moderated by employee engagement. The concept of internal branding is interesting to investigate because hospitality service provides a brand image. The determination of the image relies on the employee service quality (Lee, Kim & Kim, 2014). Many parties assume that the branding concept only applies in marketing. In fact, before the implementation of external marketing to the community, a corporation must do the internal marketing inside the corporation. Internal branding aims and focuses on the corporate internal matters to make the employees comprehend their working places and their joy to work in the places. Thus, they will find the corporations the greatest places to work. Lee et al (2014) researched 12 employees of a hotel in South Korea. They found that internal branding was important to develop employee engagement while working and organizing. The effects included improved job satisfaction. Itam & Singh (2017) also found that the achieved employee management required the corporate focus to apply internal branding practices and to pay attention to the positive correlation toward job satisfaction. However, Lee et al (2014) and Itam & Singh (2017) found a direct and insignificant correlation between internal branding and job satisfaction. The correlation between internal branding and job satisfaction receives the full mediation by employee engagement. Thus, the researchers were interested in proving the truth of the direct correlation between internal branding and job satisfaction and examining the mediating effect of employee engagement. In this research, the researchers investigated the employees of hotels in Malang Raya. Malang Raya is a great region consisting of Malang Regency, Malang Municipality, and Batu Municipality. These areas are tourist resort areas that support the hospitality industry's growth. The rationality of selecting the hotel employees as the research objects included the direct correlation between the hotel employees and the customers. Thus, the interpretation of the employees toward the corporation is realized in the behaviors and the performances of the employees. These matters significantly influence the customers' perceptions of the corporations. Thus, internal branding is an absolute action to promote in the hospitality industry to establish excellent client perceptions toward the corporations. The selected objects in this research include the hospitality resort category with independent ownership. The researchers selected the four-starred hotels and resorts because these hotels and resorts had high and complex service levels as a hospitality business. Four-starred hotels also apply a high-standard employee management based on the requirement. On the other hand, the researchers did not select any five-starred hotels because the number of hotels with this star was limited in Malang. Most five-star hotels in Malang had special networks. Thus, the researchers assumed there would be various hindrances to collect the data. The researchers chose hotels with independent ownership since many previous researches about hospitality services had the features of chained or franchised hotels. Thus, heretofore, independent hotels are less exposed. By considering various reasons related to the hotel selections, the researchers eventually chose 6 hotels as the research object. They were: Bunga Butik Resort Club, Kusuma Agrowisata Resort & Convention Hotel, Amarta Hills Hotel and Resort, The Onsen Hot Spring, Zam-Zam Hotel and Resort, and Lembah Metro Resort

Based on the background, the formulated research hypotheses are:

H1: Internal branding has significant impact on the employee engagement.

H2: Internal branding has significant impact toward job satisfaction.

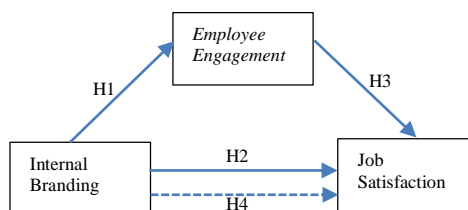
H3: Employee engagement significantly impact job satisfaction.

H4: Internal branding indirectly influences job satisfaction as mediated by employee engagement.

# Testing the Mediation Effect of Employee Engagement on Internal Branding Practice-Job Satisfaction Relationship of Hospitality Industry Employees

## METHOD

This quantitative research described and explained the data. Thus, the nature of the research is descriptive and explanatory research. The population consisted of employees of six-four-starred hotels with independent ownership. The researchers took the samples with a proportional random sampling technique. The researchers found the sample size consisted of 163 respondents. The applied instrument was a five-point Likert scale, from extremely disagree to agree. The researchers obtained the data by distributing the questionnaire and analyzed the obtained data through descriptive statistics and by applying Partial Least Square (PLS).



**Figure 1. the Research Design**  
Source: The Processed Data (2023)

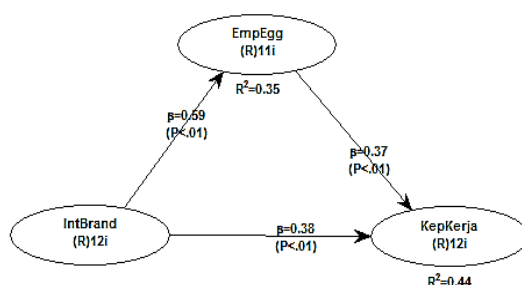
Remarks:

- : Direct influence
- - -→ : Indirect influence

## RESULTS

The researchers grouped the respondent descriptions based on sex type, age, educational level, and occupation status. The researchers concluded that most respondents were males (75%) aged between 20 and 29 years old (56%) with an educational level of Senior High School (65%) and contract-occupational status (74%).

The descriptive analysis of this research covers the variable descriptions of the respondents while answering each question item related to the variables of internal branding, employee engagement, and performance satisfaction. The descriptive results of the internal branding showed that whole items obtained a mean score of 4.10, indicating an excellent implementation of internal branding practices by the hotel. The descriptive analysis results of employee engagement showed that the whole items obtained a mean score of 3.95, indicating high employee engagement toward the given jobs at the corporation. Then, the descriptive analysis result of job satisfaction showed that the whole items obtained a means core of 3.96, indicating excellent satisfaction of the employees of the corporation.



**Figure 2. the Path Diagram**  
Source: The Processed Data (2023)

The applied partial least square analysis was useful to determine the influence of internal branding on employee engagement, the influence of internal branding toward job satisfaction, the influence of employee engagement toward job satisfaction, and the influence of internal branding toward job satisfaction as moderated with employee engagement.

In this research, the researchers applied two assessment analyses with partial least squares by evaluating the outer model to validate and ensure the reliability of the establishing indicators of the latent variables. Then, the researchers evaluated the structural model or the inner model to determine the correlation among variables.

## Testing the Mediation Effect of Employee Engagement on Internal Branding Practice-Job Satisfaction Relationship of Hospitality Industry Employees

In the outer model evaluation, the researchers validated the data with convergent and discriminant validity tests. Then, the researchers grouped the convergent test into the loading-factor-based convergent test and the average variance extracted test (AVE).

Cdcd

**Table 1. the Convergent Validity (Loading Factor)**

Variable	Item	Loading Factor	Remarks
<i>Internal Branding (IB)</i>	X1	0,586	Valid
	X2	0,620	Valid
	X3	0,709	Valid
	X4	0,695	Valid
	X5	0,642	Valid
	X6	0,665	Valid
	X7	0,644	Valid
	X8	0,704	Valid
	X9	0,679	Valid
	X10	0,701	Valid
	X11	0,671	Valid
	X12	0,593	Valid
<i>Employee Engagement (EE)</i>	Z1	0,656	Valid
	Z2	0,588	Valid
	Z3	0,699	Valid
	Z4	0,682	Valid
	Z5	0,665	Valid
	Z6	0,671	Valid
	Z7	0,619	Valid
	Z8	0,608	Valid
	Z9	0,473	Valid
	Z10	0,533	Valid
	Z11	0,494	Valid
<i>Job satisfaction (JS)</i>	Y1	0,534	Valid
	Y2	0,492	Valid
	Y3	0,577	Valid
	Y4	0,740	Valid
	Y5	0,691	Valid
	Y6	0,739	Valid
	Y7	0,761	Valid
	Y8	0,784	Valid
	Y9	0,741	Valid
	Y10	0,594	Valid
	Y11	0,678	Valid
	Y12	0,535	Valid

**Source:** the processed data (2023)

Table 1 shows the whole items of internal branding (X1-X12), employee engagement (Z1-Z11), and job satisfaction (Y1-Y12) are valid to measure the latent variables since the loading values are higher than 0.7. Thus, the values are considerable to be between 0.4 and 0.6 (Solihin & Ratmono, 2013).

**Table 2. The Convergent Validity (Average Variance Extracted (AVE))**

Variable	AVE	Remarks
<i>Internal Branding</i>	0,436	Valid
<i>Employee Engagement</i>	0,375	Valid
<i>Job Satisfaction</i>	0,439	Valid

**Source:** the processed data (2023)

## Testing the Mediation Effect of Employee Engagement on Internal Branding Practice-Job Satisfaction Relationship of Hospitality Industry Employees

Table 2 shows all variables, such as internal branding, employee engagement, and job satisfaction have AVE values lower than 0.5, the suggested value. Fornell & Larcker (1981) explain that the average variance extracted (AVE) could be the conservative estimation from the outer model. Based on the composite reliability, the researchers concluded that the convergent validity based on the construct is adequate although the value is higher than 50% of the variance due to the error. Thus, the researchers conclude the result meets the criteria because the reliability values of the internal branding, employee engagement, and job satisfaction are higher than 0.6. All indicators of the variables are valid.

**Table 3 the Discriminant Validity**

Variable	IB	EE	KK	Remarks
IB	(0,660)	0,585	0,550	Valid
EE	0,585	(0,613)	0,572	Valid
KK	0,550	0,572	(0,663)	Valid

**Source:** the processed data (2023)

The variables of internal branding, employee engagement, and job satisfaction lead to the greater AVE root-square than the other AVE root-square of other variables. Therefore, the variables of internal branding, employee engagement, and job satisfaction are valid. This result also indicated that the respondents had no difficulties while answering the questions.

Then, the researchers examined the instrument reliability with composite reliability value. The applied criteria of examination are: composite reliability values higher than 0.6 indicate excellent reliability (Fornell & Larcker, 1981).

**Table 4. The Composite Reliability**

Variable	Composite Reliability	Remarks
Internal Branding	0,902	Reliable
Employee Engagement	0,867	Reliable
Job Satisfaction	0,902	Reliable

**Source:** the processed data (2023)

Table 4 shows that the composite reliability of all variables is higher than 0.6. Thus, based on the composite reliability calculation, all indicators of measuring the variables are valid.

Then, the researchers promoted an inner model evaluation and found some assessments. Here are the assessments.

**Table 5. The Adjusted R-Square**

The Endogenous Variable	Adjusted R-Squared
Employee Engagement	0,344
Job Satisfaction	0,431

**Source:** the processed data (2023)

Table 5 shows the value of the adjusted r-square of employee engagement is 0.344 (34.4%). The value indicates that internal branding could explain employee engagement for a percentage of 34.4%, moderate category. Then, the adjusted r-square value of the job satisfaction is 0.431 (44.2%). The result indicates that internal branding and employee engagement could explain the variance in job satisfaction with a percentage of 44.2%, a moderate category.

**Table 6. The Effect Size**

Variable	Effect Size
Internal Branding – Employee Engagement	0,348
Internal Branding – Job Satisfaction	0,224
Employee Engagement - Job Satisfaction	0,214

**Source:** the processed data (2023)

Table 6 shows the effect size of internal branding on employee engagement with a size of 0.348, lower than 0.35. The value indicates a moderate category. The effect size value of the internal branding toward job satisfaction is 0.224 lower than 0.35, indicating moderate category. The effect size of employee engagement toward job satisfaction is 0.214, lower than 0.35. The value indicates a moderate category.

# Testing the Mediation Effect of Employee Engagement on Internal Branding Practice-Job Satisfaction Relationship of Hospitality Industry Employees

Table 7. Q2 Predictive Relevance

Variable	Q-squared
Employee Engagement	0,359
Job Satisfaction	0,447

Source: the processed data (2023)

Table 7 shows the Q2 predictive relevance of employee engagement is 0.359, indicating the predictive relevance of the model with the Q-square value of the endogenous variable, employee management, higher than 0. Then, the Q2 predictive relevance of the job satisfaction variable is 0.447. The value indicates that the model has predictive relevance because the Q-squared of the endogenous variable is higher than 0.

Then, the last step was promoting a hypothetical test and concluding the results.

H1: Internal branding positively and significantly influences employee engagement with a path coefficient of 0.590 and a p-value lower than 0.001. The result accepts H1. Internal branding significantly and positively influences employee engagement.

Thus, high internal branding increases employee engagement.

H2: Internal branding positively and significantly influences job satisfaction with a path coefficient value of 0.383 and a p-value lower than 0.001. The result accepts H2. Internal branding positively and significantly influences job satisfaction. Thus, high internal branding tends to improve job satisfaction.

H3: Employee engagement positively and significantly influences job satisfaction with a path coefficient of 0.371 and a p-value lower than 0.001. The result accepts H3. Employee engagement positively and significantly influences job satisfaction. Thus, high employee engagement tends to improve job satisfaction.

H4: Internal branding indirectly influences job satisfaction moderated with employee engagement. The obtained indirect coefficient of internal branding toward job satisfaction as mediated by employee engagement is 0.219 with a p-value lower than 0.001. The result accepts H4. Internal branding positively and significantly influences job satisfaction as moderated with employee engagement. The result indicates high employee engagement occurs due to high internal branding that improves job satisfaction.

## DISCUSSION

### *Internal Branding*

All hotels as the research objects had excellent internal branding. An excellent practice is observable from excellent response indications toward the implementation of hospitality training, communication during the group meeting and briefing, and the reward provision.

The employees promoted and respondents all related indicators with the internal branding practices. This situation led to improved performance potency. Employees become important components in the hospitality industry. The employees' capabilities to deliver the values of the hospitality product include the success of industrial performance.

Adequate internal branding of a corporation could transform the corporate values for the employees that may reach the customers. The internal branding process would be effective with training, group meetings, briefing, and reward provisions for the employees.

### *Employee Engagement*

The measurement of employee engagement applied two indicators: job engagement and organizational engagement. This research found the fact that the engagement level of respondents had a high category. The result indicates that employee engagement in the jobs and the corporation is high, indicated by the enthusiasm of the employee performance.

Saks (2006) argues that workers will develop their corporate attachment and responses upon the organizational resources. In this context, the organizational resource includes the internal branding process, consisting of the given training, internal communication, and reward provision. This matter proves that a corporation with maximum internal branding practices could encourage employees to improve their engagement with the organization.

### *Job Satisfaction*

This research found that employees had high job satisfaction. The indicators of job satisfaction include salary satisfaction, supervision satisfaction, and peer-working satisfaction. The satisfaction may occur due to various factors. In this research context, it happened due to internal branding practices and high employee engagement. Du Prez & Bendixen (2015) explain that internal branding could maximize the agreements between the values of employees and organizations to improve employee satisfaction

## **Testing the Mediation Effect of Employee Engagement on Internal Branding Practice-Job Satisfaction Relationship of Hospitality Industry Employees**

Saks (2006) also states that employee engagement is directed to positive matters, such as job satisfaction.

### **The Influence of Internal Branding on Employee Engagement**

Based on the partial least square analysis results, internal branding positively and significantly influences employee engagement. This research empirically proved that internal branding practices, by combining training, internal communication such as group meetings and briefings, and rewards could positively influence employee engagement.

Lee et al (2014) and Itam & Singh (2017) found that employee engagement had to focus on internal branding by applying an internal communication system, training, and reward provision. Thus, the employees had relevant skills and incentives to perform. Slatten & Mehmetoglu (2011) found that the provision of information about organizational mission and direction for employees would make the employees engaged in their jobs. King (2010) found that employees with excellent brand understanding could relieve the confusion about jobs and facilitate employee engagement to promote brand-support behavior. Employee engagement is an organizational product that treats the employees as internal customers.

### **The Influence of Internal Branding toward Job Satisfaction**

Based on the path coefficient values, internal branding has a greater value (0.392) toward job satisfaction than employee engagement (0.369). Besides that, the size effect value between internal branding and job satisfaction is 0.233 higher than the correlation between employee engagement and job satisfaction, 0.216. This matter indicates that internal branding excellently influences job satisfaction improvement than employee engagement.

Du Prezz & Bendiven (2015) also found that internal branding greatly contributed the job satisfaction, brand commitment, and employee intention to stay. Internal branding could maximize employee values and organizational values along with improved employee satisfaction. Internal branding could decrease the turnover level. Eid et al. (2019) found the internal branding increment with the moderation of employee orientation. The increment had a positive and significant effect on job satisfaction. The results denied the findings of Lee et al. (2014) and Itam & Singh (2017). The researchers found the direct effect between internal branding and job satisfaction insignificantly. The correlation between internal branding and job satisfaction receives the full mediation by employee engagement.

### **The Influence of Employee Engagement Toward Job Satisfaction**

Based on the partial least square analysis result, the researchers found employee engagement positively and significantly influenced job satisfaction. This study supported the previous result about engaged employees and the tendency to improve the job satisfaction level.

Kristianti et al. (2015) and Setiawan Widjaja (2018) also found that employee engagement positively and significantly influenced the job satisfaction of the employees at Swiss-Belinn and Shangri-La hotels in Surabaya. Excellent focus on employee performance and participation led to high engagement. Thus, corporations must find various strategies to bind employees with their jobs and to improve their job satisfaction. Excellently engaged employees would have positive perceptions of the corporation and organization. Alarcon & Edwards (2010) concluded that employee engagement significantly predicted job satisfaction. Employee engagement is important for corporations to establish an excellent working culture and expected consequences in terms of job satisfaction.

### **The Influence of Internal Branding toward Job Satisfaction with Employee Engagement as Mediator**

The analysis results found the path coefficient results of each variable had a positive and significant influence. Internal branding had both a direct influence on job satisfaction and an indirect influence on job satisfaction with the moderation of employee engagement. The influence of internal branding toward job satisfaction with the mediation of employee engagement proves that employee engagement is the mediating variable. In this case, the mediating effect of employee engagement has a partial feature because internal branding could significantly influence job satisfaction without the moderation of employee engagement.

Lee et al. (2014) and Itam & Singh (2017) found that internal branding positively influenced job satisfaction with the mediation of employee engagement. However, the researchers noticed some differences. The results of Lee et al (2014) and Itam & Singh (2017) found the mediating effect of complete employee engagement. It happened because no direct correlation between internal branding and job satisfaction. Besides that, employee engagement, as a mediating variable, could moderate the correlation between organizational performance conditions and the related results, such as job satisfaction and job commitment (Maslach et al., 2001).



# Testing the Mediation Effect of Employee Engagement on Internal Branding Practice-Job Satisfaction Relationship of Hospitality Industry Employees

## CONCLUSION

Based on the results about the influence of internal branding on job satisfaction with the mediation of employee engagement, the measurements of all variables, the researchers concluded:

1. The employees had an excellent perception of the internal branding of the corporation. The reflection of the internal branding was observable in the hospitality training, group meeting and briefing communication, and reward provision. The employees had excellent engagement toward the job and the corporation. The evidence was the enthusiasm and high working spirit. The employees found the job satisfying especially related to the aspects of task, salary, supervision, and peer-worker.
2. The researchers found a direct, positive, and significant impact of internal branding, employee engagement, and job satisfaction. Thus, the results accepted H1, H2, and H3.
3. The researchers also found an indirect, positive, and significant correlation between internal branding and job satisfaction with the partial moderation of employee engagement. Thus, the result accepted H4.
4. The measurement of the outer model found the convergent validity on the item with a loading value lower than 0.7. Thus, the average variance extracted (AVE) of internal branding, employee engagement, and job satisfaction is lower than 0.5. However, the results did not become problems since the composite reliability value of the three variables was excellent, higher than the recommended value of 0.6.
5. The measurement of the inner model showed the r-square value of employee engagement and job satisfaction was in the moderate category. Then, the size effect value of the correlation among the variables: internal branding, employee engagement, and job satisfaction, was in the moderate category. The q-squared result showed that employee engagement and job satisfaction had predictive relevance.
6. The results of goodness of fit, GoF, found that the model was categorized at large category and indicated high or strong predictive power.
7. The highest coefficient value of the internal branding and employee engagement correlation was at 0.590. Internal branding could better improve job satisfaction than employee engagement based on the path coefficient value and effect size value. These values are higher than the inter-variable correlation.

## SUGGESTION

Based on the results, the researchers share suggestions and considerations. Here are the suggestions:

1. For the hotel

The path coefficient and the size effect values of internal branding and employee engagement correlation were higher than the other variable correlations. Thus, the hotel must improve and develop internal branding practices. The evidence of the employee engagement improvement would direct to the positive attitudes and behaviors. Therefore, the corporation must realize the training practices, internal communication, and reward provisions to improve employee engagement. High employee engagement improves job satisfaction.
2. For future researchers
  - a. The researchers suggest separating the job engagement and organizational engagement concepts from the original concept of employee engagement. The first two concepts are different constructs. This finding supports the theory of Saks that job engagement and organizational engagement are different concepts. Thus, future researchers should review the influential variables based on the two types of employee engagement and the influence on the outcome variables (job and organizational variables). This matter facilitates the understanding of inter-variable correlation.
  - b. The researchers also suggest future researchers take different hotels and compare the results from various hotels.

## ACKNOWLEDGEMENT

The authors would like to thank the Faculty of Economics and Business, Universitas Negeri Malang (FEB UM) for funding this research in the 2023 research grant competition. The authors also thank to Hotel Manager who are willing to cooperate, support and help this research, especially to management of these hotels: Klub Bunga Butik Resort, Kusuma Agrowisata Resort & Convention Hotel, Amarta Hills Hotel and Resort, The Onsen Hot Spring, Zam-Zam Hotel and Resort, and Lembah Metro Resort.

## REFERENCES

- 1) Alarcon, G. M., & Edwards, J. M. 2011. The relationship of engagement, job satisfaction, and turnover intentions. *Stress and Health*, 27(3), e294-e298.

## Testing the Mediation Effect of Employee Engagement on Internal Branding Practice-Job Satisfaction Relationship of Hospitality Industry Employees

- 2) Dryl, T. 2017. Internal branding in the organization in the context of internal corporate communication. *Handel Wewnętrzny*, 367(2), 56-68.
- 3) Du Preez, R., & Bendixen, M. T. 2015. The impact of internal brand management on employee job satisfaction, brand commitment, and intention to stay. *International Journal of Bank Marketing*, 33(1), 78-91.
- 4) Eid, R., Al Zaabi, A., Alzahmi, R., & Elsantil, Y. (2019). Integrating internal branding antecedents, customer and job satisfaction in the public sector. *International Journal of Organizational Analysis*.
- 5) Fornell, C., & Larcker, D. F. 1981. Evaluating structural equation models with unobservable variables and measurement error. *Journal of marketing research*, 18(1), 39-50.
- 6) Foster, C., Punjaisri, K., & Cheng, R. 2010. Exploring the relationship between corporate, internal, and employer branding. *Journal of Product & Brand Management*, 19(6), 401-409.
- 7) Grossman, D. 2008. The inside marketing from within creates ambassadors for your hospital's brand. *Marketing health services*, 28(3), 10.
- 8) Hwang, S., & Der-Jang, C. 2005. Relationships among internal marketing, employee job satisfaction, and international hotel performance: An empirical study. *International Journal of Management*, 22(2), 285.
- 9) Itam, U., & Singh, S. 2017. Examining the mediation effect of employee engagement on internal brand practices and outcome variables in the organized retail sector. *International Business Management*, 11(3), 673-682.
- 10) Kelly, J. P., & Hise, R. T. 1980. Role conflict, role clarity, job tension, and job satisfaction in the brand manager position. *Journal of the Academy of Marketing Science*, 8(2), 120-137.
- 11) King, C. 2010. " One size doesn't fit all": Tourism and hospitality employees' response to internal brand management. *International Journal of Contemporary Hospitality Management*, 22(4), 517-534.
- 12) Kristanti, S. E., Purnamasari, M., & Widjaja, D. C. 2015. The Impact of Employee Engagement Toward Job Satisfaction and Turnover Intention at Swiss Belinn Surabaya. *Jurnal Hospitality dan Manajemen Jasa*, 3(1), 141-152.
- 13) Lee, Y. K., Kim, S., & Kim, S. Y. 2014. The impact of internal branding on employee engagement and outcome variables in the hotel industry. *Asia Pacific Journal of Tourism Research*, 19(12), 1359-1380.
- 14) Pinar, M., Trapp, P., Girard, T., & Boyt, T. E. 2014. University brand equity: an empirical investigation of its dimensions. *International Journal of Educational Management*.
- 15) Powell, S. M. 2014. Twenty-one years of the journal of brand management: A commemorative review. *Journal of Brand Management*, 21(9), 689-701.
- 16) Punjaisri, K., Evanschitzky, H., & Wilson, A. 2009. Internal branding: an enabler of employees' brand-supporting behaviors. *Journal of Service Management*, 20(2), 209-226.
- 17) Right Management. 2006. *Measuring true employee engagement*. Philadelphia: Right Management.
- 18) Saks, A. M. 2006. Antecedents and consequences of employee engagement. *Journal of managerial psychology*, 21(7), 600-619.
- 19) Setiawan, O. D., & Widjaja, D. C. 2018. Analisa Pengaruh Employee Engagement Terhadap Kinerja Karyawan dengan Kepuasan Kerja Sebagai Variabel Intervening di Shangri-La Hotel Surabaya. *Jurnal Hospitality dan Manajemen Jasa*, 6(2).
- 20) Slåtten, T., & Mehmetoglu, M. 2011. Antecedents and effects of engaged frontline employees: A study from the hospitality industry. *Managing Service Quality: An International Journal*, 21(1), 88-107.
- 21) Solihin, M., Ratmono D. 2013. *Analisis SEM-PLS dengan WarpPLS 3.0*. Yogyakarta: Andi
- 22) Tang, S. W., Siu, O. L., & Cheung, F. 2014. A study of work-family enrichment among Chinese employees: The mediating role between work support and job satisfaction. *Applied Psychology*, 63(1), 130-150.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Employee Performance in Aviation Industry Based on Koopman's Individual Work Performance Questionnaire (IWPQ)



Lohana Juariyah<sup>1</sup>, Dimas Syah Putra<sup>2</sup>, Syihabudhin<sup>3</sup>

<sup>1,3</sup>Management Department, Universitas Negeri Malang, Indonesia

<sup>2</sup>PT. Cahaya Baja Indonesia, Jakarta, Indonesia

**ABSTRACT: Introduction/Main Objectives:** The purpose of this study was to analyze the employee performance conditions of PT. Garuda Indonesia (Persero) Tbk after the Covid-19 pandemic

**Background Problems:** Performance is one of the important variables for the company, including Garuda Indonesia. As an air transportation service company with excellent service, Garuda Indonesia must always maintain the company's performance through its employees in order to achieve the company's vision and mission, especially after the Covid-19 pandemic which suppresses the business conditions of airline companies.

**Novelty:** Employee performance evaluation so far using general instrument of evaluation rather than individual (personal evaluation). Therefore, this research try to analyse employee performance through individual work performance questioner develop by Koopman.

**Research Methods:** This research is descriptive quantitative research by using the IWPQ (Individual Work Performance Questioner) performance assessment instrument found by Koopman which consists of three assessment indicators: Task Performance, Contextual Performance, and Counterproductive Behavior. Researchers' analyzed then report the condition of each indicator of Garuda Indonesia's employee performance

**Finding/Results:** The results of the study show that the performance of Garuda Indonesia employees is very good even though the employees are in a condition after the Covid-19 pandemic

**Conclusion:** It means that Garuda Indonesia still has employee capital at play, so it is expected to be able to survive and recover in the current new normal era eventhough Garuda Indonesia is still in crisis condition.

**KEYWORDS:** Individual Work Performance Questioner, Employee Performance, Post Pandemic, Garuda Indonesia.

### INTRODUCTION

Air transportation services are services that are currently needed by the community because the level of community mobility is very high, considering the geographical location of Indonesia which is an archipelagic country. The growth in the number of air transportation service users in Indonesia from 2015-2018 increased by around 42% (Directorate General of Civil Aviation, <http://hubud.dephub.go.id> accessed 19 June 2020) indicating that air transportation services are experiencing growth and have a good impact for the Indonesian economy. The same is true during the Covid-19 pandemic. Air transportation is still a mainstay for the community to support their activities, even though the frequency of its use is currently decreasing drastically, even become the worst in the history of the aviation industry (PT Garuda Indonesia (Persero) Tbk, 2021). The decline in the number of airline users due to the Covid-19 pandemic, of course, has an impact on the performance of airlines and also their employees. Garuda Indonesia is no exception. This airline is well-known as the best national airline and is one of the 5-star airlines in the world who received the Skytrax award, an independent global aviation rating agency based in the UK (PT Garuda Indonesia (Persero) Tbk, 2018, 2019). Even during the Covid-19 pandemic, the airline was still able to excel and get an award as "One of the Global Airline with the Best Health and Safest Protocol Standards in the World" from the Safe Travel Barometer in 2020 and was able to maintain a level on time performance. Thus getting an award as "The Most Punctual Airline in The World" from the Official Airline Guide (OAG) Flight View (PT Garuda Indonesia (Persero) Tbk, 2021). However, research findings from (Yulianto and Riyanto, 2021), stated that the current competitive strategy of Garuda is no longer competitive enough. This indicates that Garuda Indonesia is starting to experience a decline in its competitive ability, including its performance. In order for Garuda Indonesia to be able to maintain its achievements, of course they must pay attention to employees as important entities for the services and trust they provide to

## Employee Performance in Aviation Industry Based on Koopman’s Individual Work Performance Questionnaire (IWPQ)

customers. Companies must pay attention to employee performance to be able to compete with competitors so that company goals are achieved, especially in this New Normal era. It is no secret that Garuda Indonesia is a well-known company which caring for its employees and their families. Not just plane tickets and free vacations that are given to support their employees, but there are many educational programs and scholarships that are given to support the work of their employees. However, in the current new normal, and also in the midst of the problems faced by Garuda Indonesia and its board of directors, especially what happened in 2019 (the decline in the value of Garuda shares, allegations of money laundering, smuggling of Harley Motorcycles and Brompton Bikes by its former president director, and the chaotic acquisition of PT Garuda Indonesia through Citilink, its subsidiary, against Sriwijaya Air, etc.) made employees feel anxious and somewhat shaky in their trust in the proud airline they work for. Not only that, the current difficult economic conditions due to the pandemic can make the support programs for employees that have been provided by the company begin to decrease. So the possibility of employees will also be affected by their performance. The measurement of employee performance so far has used instruments that are general in nature and have not specifically measured objective individual performance and are supported by qualified psychometric properties (Alim and Hidayat, 2018). If you use a specific performance measurement in the context of work, then the problem of generalizing the instrument and research results also cannot be done. In addition, research related to performance will also involve various types of work whose performance measures are certainly different (Widyastuti and Hidayat, 2018). Therefore, an employee performance measurement instrument is needed that is general in nature, able to measure individual performance appropriately, and can be used to measure performance globally without taking into account the individual's work background. The Individual Work Performance Questioner (IWPQ) developed by Koopmans *et al.*, (2012), Koopmans *et al.*, (2012), Koopmans, Bernaards, *et al.*, (2014), dan Koopmans, Coffeng, *et al.*, (2014) tries to accommodate the need for instruments. individual performance measurement that is universal or can be applied in a variety of jobs, regardless of the individual's work background. This study aims to explore how the performance conditions of employees of PT. Garuda Indonesia, the pride of the country, is in a state of the Covid-19 pandemic and at the same time is experiencing a crisis of confidence and an economic crisis that has hit the company. By using the individual performance measurement instrument (IWPQ) which has been adapted into Indonesian, this study also wants to see the consistency (reliability) of the adapted employee performance instrument developed by (Widyastuti and Hidayat, 2018).

### METHOD, DATA, AND ANALYSIS

This research is a quantitative research that aims to analyze the condition of the performance of employees of PT. Garuda Indonesia (Persero), Tbk descriptively. Respondents in this study were permanent employees of PT. Garuda Indonesia has experienced work from home (WFH) and also work from office (WFO) because it is already in the new normal period. Data collection in this study was conducted using on-line and off-line questionnaires given to 318 Garuda Indonesia employees. Of the 318 questionnaires given to employees, 290 answered/filled out the questionnaire (91% response rate). However, from 290 responses, only 282 responses could be analyzed further due to incomplete answers. Performance measurement uses an individual performance measurement instrument (IWPQ) which has been adapted into Indonesian by Widyastuti and Hidayat (2018), which consists of three indicators, namely: Task Performance (PT), Contextual Performance (PK), and Counterproductive Work Behavior (PKK). ). The total number of individual performance measurement instruments is 18 items (5 PT items, 8 PK items, and 5 PKK items). The instrument measurement scale uses a 0-4 scale. For PT and PK, the response format (range of scale) is from rarely – sometimes – often – very often – always. Meanwhile, the response range for PKK is from never – rarely – sometimes – often – very often. Therefore, to calculate the total individual performance, the calculation formula is used:  $PT + PK + (4 - PKK)$ . While the average total value of individual performance will be in the range of 0 (lowest) to 12 (highest). After being analyzed using validity and reliability tests, it appears that all individual performance measurement items are valid and reliable, as shown in Table 1 below:

**Table 1. Validity and Reliability Value of IWPQ Instruments**

No Item	Corrected Item-Total Correlation	Description	Reliability Value
1	0,530	Valid	
2	0,687	Valid	
3	0,476	Valid	
4	0,613	Valid	
5	0,486	Valid	

## Employee Performance in Aviation Industry Based on Koopman's Individual Work Performance Questionnaire (IWPQ)

6	0,536	Valid	
7	0,664	Valid	
8	0,636	Valid	
9	0,702	Valid	0,916 (Reliable)
10	0,559	Valid	
11	0,665	Valid	
12	0,811	Valid	
13	0,603	Valid	
14	0,665	Valid	
15	0,638	Valid	
16	0,470	Valid	
17	0,488	Valid	
18	0,477	Valid	

(Sources: Data processed by researchers, 2023)

### RESULT AND DISCUSSION

From the 282 data submitted by respondents, almost 60% were male and the remaining 40.8% were female. The average age of workers is in the age range of 24 to 51 years. Almost 75% of respondents are in the age range of 31-51 years or mature age. Meanwhile, the majority of respondents' last education was bachelor degree with 87.9%, the remaining 5.3% were masters and 6.7% were diplomas. Then when viewed from the length of work, more than 1/3 of the respondents, or 33.7% to be precise, have worked for more than 20 years. While those who work between 19-20 years are 23%. Only a few, less than 2% of employees who became respondents in the study were employees who worked less than 2 years. This means that the selection of respondents/data collected is quite representative. While descriptively, it can be seen that the average of total value individual performance of Garuda employees is 9,575 which is in the good performance range. Meanwhile, from the three sub-indicators of performance measurement, it appears that the average score for task performance (PT) is 3.18. While the average value of contextual performance is 3.166 and counterproductive work behavior (PKK), the average value is 0.769. By using a measurement scale of 0-4, it can be seen that the average value of PT is in the high category. Likewise, the value of contextual performance is also included in the high category. As for the PKK, the value of 0.769 is included in the low criteria. The complete value of the instrument average, standard deviation, median, minimum and maximum values can be seen in Table 2. Meanwhile, the total conversion value of performance and the descriptive meaning of the instrument's mean value can be seen in Table 3 and Table 4 below.

**Table 2. Descriptive Results (Mean, Median, Deviation Standard, Minimum and Maximum Value)**

	Item	Minimum	Maximum	Mean	Median	Deviation Standard
Total Performance	18	0	12	9.575	9.4	1.2344261
Task Performance (TP)	5	0,0	4	3.17801	3.2	0.42478
Contextual Performance (CP)	8	0,0	4	3.16578	3.125	0.477821
Counter Productive Behaviour (CPB)	5	0,0	4	0.768794	0.8	0.604271

(Sources: Data processed by researchers, 2023)

## Employee Performance in Aviation Industry Based on Koopman's Individual Work Performance Questionnaire (IWPQ)

**Table 3. Individual Total Performance Value Conversion**

Interval	Criteria
0 – 2,40	Poor performed
2,41 – 4,80	Underperformed
4,81 – 7,20	High enough
7,21 – 9,60	High/Good
9,61 – 12,0	Well Performed

(Sources: Data processed by researchers, 2023)

**Table 4. Conversion of the Mean Value for each Indicator**

Interval	Criteria
0 – 0.8	Poor performed
0.81 – 1.6	Less performed
1,61 – 2,4	High enough
2,41 – 3,2	Good
3,21 – 4,0	Very High/Very Good

(Sources: Data processed by researchers, 2023)

From the research data presented, it can be seen that in general the average of total performance value of Garuda Indonesia employees is in a good range ( $M = 9.575$ ;  $SD = 1.23442611$ ), even this average value is in the range of performance which is almost towards the very good performance. Even when compared to the median value, the average value of employee performance does appear to be above the median value. This further shows that Garuda Indonesia employees are performing well, despite the pandemic and economic crisis they are experiencing. The findings of this study are certainly quite surprising considering the condition of Garuda which is being hit by a crisis of trust by the public and quite affects the identity and performance of Garuda Indonesia employees themselves. Considering the scheme of applying "temporarily laid off" work alternately for employees, especially professional pilots and also cutting salaries at all levels up to 50% until early retirement is enforced for 1,691 employees starting in 2020 (<https://investasi.kontan.co.id/news/bisnis-terguncang-1691-karyawan-garuda-indonesia-giaa-pensiun-dini>, accessed Friday 20 August 2023). A little explanation why Garuda Indonesia employees who are still staying, still show good performance, is because of the goodwill of the company. (Saxton, 1998) states that the company's reputation is an invaluable asset. These assets must be carefully maintained and managed both in times of crisis and prosperity. Garuda Indonesia has the status as a flag carrier (national airline) where more than 60.54% of the shares/ownership are held by the state (<https://money.kompas.com/read/2021/07/15/092342426/hampir-bangkrut-serikat-karyawan-garuda-surati-jokowi?page=all>, 15 July 2023). Employees still have hope that the company they work for will still be saved by the state as the majority shareholder. This is shown by the surviving employees, to be exact, 7,184 employees, out of a total of 7,600 permanent employees who are currently still surviving, they are willing to cut their salaries by up to 50%. This shows the dedication and willingness of employees to feel the same conditions experienced by the company. Garuda Indonesia's reputation seems to be quite good in the eyes of their employees. And according to Walker Information, a consulting firm in America, the companies that are most successful in managing their reputations are those where the CEO sees them as reputation stewards and instils the need to protect the company's reputation in all employees (Saxton, 1998). From this definition it can be seen that Garuda Indonesia has been able to arouse the need to maintain the good name of the company in employees, but unfortunately some Garuda Indonesia CEOs have forgotten their duties as stewards of the company's reputation. Furthermore, Walker Information also found in their survey that the main sources of company reputation are market leadership, product/service quality, and brand image. Meanwhile, management/financial performance is a secondary driver (Saxton, 1998). If it is related to the current condition of Garuda Indonesia, the financial crisis and debt entanglements are the two drivers of the company's reputation. This means that the company's reputation can still survive well even though it is experiencing a management and financial crisis, because managerial/financial performance is not the main determinant of Garuda Indonesia's reputation. Of course, this can be an

## Employee Performance in Aviation Industry Based on Koopman's Individual Work Performance Questionnaire (IWPQ)

important note for the management and the government as the majority shareholder, to consider future decisions for Garuda Indonesia's fate. When viewed from the realm of human resources, of course this is an important basic capital for Garuda Indonesia to stay afloat and continue to be optimistic through the crisis. Especially if it is related to the company's reputation which is still quite good, of course these two things can be the company's strength for recovery. Of course, the CEO's role is very important and it is necessary to return to its initial role as a servant and guardian of the company's reputation if it is to survive, not as a connoisseur of reputational benefits as was the case in the past. Of course, it would be a shame if the airline, the pride of this nation, disappeared, was pawned.

### CONCLUSION AND SUGGESTION

From the results and discussion of research findings, it can be seen that the performance conditions of Garuda's employees are at a good level, even though the company is in a crisis position and is in danger of going bankrupt. One of the things that makes employees willing to survive and perform well is the reputation of the company Garuda Indonesia as a national airline (flag carrier) which is quite popular and has been the market leader for many years in Indonesia. Suggestions for the management of Garuda Indonesia is to use the findings of the good performance of Garuda Indonesia employees as capital to survive and rise from the crisis. Moreover, it is seen that employees are also willing to survive and become fighters for the company's reputation. In terms of company reputation, financial and managerial crises are not the main factors driving the company's reputation. So, there is still hope to survive and rise from the crisis caused by the Covid-19 pandemic and the financial crisis. It is hoped that the government as the majority owner of Garuda Indonesia shares will also take into account this finding, so that it will not be easy to "sell" the airline that is the pride of the country.

### ACKNOWLEDGEMENT

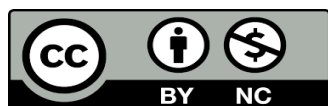
The authors would like to thank the Faculty of Economics, Universitas Negeri Malang for funding this research in the 2023 research grant competition. The authors also thank PT Garuda Indonesia (Persero), Tbk for being willing to be the subject of research despite the crisis.

### REFERENCES

- 1) Alim, S. and Hidayat, R. (2018) 'Psychometric Properties of Performance Appraisal Instrument : Individual Work Performance Questionnaire ( IWPQ ) Studi Properti Psikometri Alat Ukur Performance Appraisal : Individual Work Performance Questionnaire ( IWPQ )', pp. 1–2.
- 2) Direktorat Jendral Perhubungan Udara, <http://hubud.dephub.go.id>. Pertumbuhan jumlah pengguna jasa transportasi udara di Indonesia dari tahun 2015-2018.
- 3) Investasi.kontan.co.id. Bisnis Terguncang, 1691 Karyawan Garuda Indonesia (GIAA) Pensiun Dini. <https://investasi.kontan.co.id/news/bisnis-terguncang-1691-karyawan-garuda-indonesia-giaa-pensiun-dini>, diakses Jumat 20 Agustus 2023
- 4) Kompas.com. Hampir Bangkrut, Serikat Karyawan Garuda Surati Jokowi. <https://money.kompas.com/read/2021/07/15/092342426/hampir-bangkrut-serikat-karyawan-garuda-surati-jokowi?page=all>, diakses 15 Juli 2023
- 5) Koopmans, L. et al. (2012) 'Development of an individual work performance questionnaire', *International Journal of Productivity and Performance Management*, 62(1), pp. 6–28. doi: 10.1108/17410401311285273.
- 6) Koopmans, L., Bernaards, C. M., et al. (2014) 'Measuring individual work performance: Identifying and selecting indicators', *Work*, 48(2), pp. 229–238. doi: 10.3233/WOR-131659.
- 7) Koopmans, L., Coffeng, J. K., et al. (2014) 'Responsiveness of the individual work performance questionnaire', *BMC Public Health*, 14(1), pp. 1–11. doi: 10.1186/1471-2458-14-513.
- 8) PT Garuda Indonesia (Persero) Tbk (2018) 'Annual Report 2018 - One Family Nation Garuda Indonesia', pp. 1–633. Available at: [www.garuda-indonesia.com](http://www.garuda-indonesia.com).
- 9) PT Garuda Indonesia (Persero) Tbk (2019) 'Standing Strong into the Future (Laporan Tahunan 2019 Annual Report)', pp. 1–740. Available at: <https://www.garuda-indonesia.com/content/dam/garuda/files/pdf/investor-relations/report/AR2019.pdf>.
- 10) PT Garuda Indonesia (Persero) Tbk (2021) 'GARUDA INDONESIA The Airline of Indonesia Annual Report 2020', pp. 24–96.
- 11) Saxton, M. K. (1998) 'Where do Reputations Come From?', *Corporate Reputation Review*, 1(4), pp. 393–399. doi: 10.1057/palgrave.crr.1540060.

## Employee Performance in Aviation Industry Based on Koopman's Individual Work Performance Questionnaire (IWPQ)

- 12) Widyastuti, T. and Hidayat, R. (2018) 'Adaptation of Individual Work Performance Questionnaire (IWPQ) into Bahasa Indonesia', *International Journal of Research Studies in Psychology*, 7(2). doi: 10.5861/ijrsp.2018.3020.
- 13) Yulianto, L. and Riyanto, B. (2021) *Analisis Strategi Bersaing PT Garuda Indonesia Dalam Industri Penerbangan*. Available at: <http://etd.repository.ugm.ac.id/penelitian/detail/194598>.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.



## The Influence of Salak Skin Ethanol Extract on the Lipid Profile, IL-6 and MDA Serum (Experimental Study on Male Rats of Wistar Strains Induced by High-Fat Diet)



Hanny Fuzi Lestari<sup>1</sup>, Setyo Trisnadi<sup>2</sup>, Danis Pertiwi<sup>3</sup>, Wahyudi<sup>4</sup>

<sup>1,4</sup> Postgraduate student of Biomedical Sciences, Faculty of Medicine, Universitas Islam Sultan Agung, Jl Kaligawe KM 4 Semarang 50012

<sup>2,3</sup> Department of Biomedical Sciences, Faculty of Medicine, Universitas Islam Sultan Agung, Jl Kaligawe KM 4 Semarang 50012

**ABSTRACT:** Dyslipidemia is characterized by an increase in total cholesterol, triglycerides, LDL and a decrease in HDL. One of the consequences of endothelial dysfunction as a precursor to cardiovascular disease is induced by oxidative stress and inflammation, so this condition must be controlled. Dyslipidemia causes an increase in pro-inflammatory cytokines which play a role in oxidative stress and inflammatory processes. The aim of this study was to determine the effect of administering snake fruit ethanol extract on serum lipid profile, IL-6 and MDA levels in Wistar rats induced by a high-fat diet. The type of research is experimental with a Post Test Only Control Group Design research design. The research subjects used 36 Wistar rats, divided into 6 treatment groups, namely healthy control group (KS), negative control (K-), positive control with simvastatin (K+), 60 mg dose EEKS group (P1), 120 mg dose EEKS group (P2), and EEKS group dose 240 mg (P3). Examination on day 36 used blood serum ELISA method to analyze levels of lipid profile, IL-6 and MDA. There was a significant difference using the t test ( $p < 0.05$ ) in the average decrease in total cholesterol, LDL, triglyceride levels and increase in HDL levels. The results of IL-6 levels showed significant differences between groups using the one way anova test ( $p < 0.05$ ), the 120 mg dose had the lowest results but was not significantly different when compared to the K+ group using the post hoc LSD test ( $p < 0, 05$ ), while the results of MDA levels were significantly different using the Kruskal Wallis test ( $p < 0.05$ ), showing that the 240 mg dose had the same results as the simvastatin group using the Mann-Whitney test ( $p < 0.05$ ). Snake bark ethanol extract (EEKS) at a dose of 240 mg has the same effect as simvastatin by reducing total cholesterol, LDL, triglyceride levels and increasing HDL. EEKS reduces IL-6 and MDA levels in dyslipidemia conditions.

**KEYWORDS:** Salak bark extract, lipid profile, IL-6, MDA

### I. INTRODUCTION

Dyslipidemia is characterized by an increase in total cholesterol, triglycerides, LDL and a decrease in HDL. One of the consequences of dyslipidemia is endothelial dysfunction as a precursor to cardiovascular disease induced by oxidative stress and inflammation, so the condition must be controlled. Dyslipidemia causes an increase in pro-inflammatory cytokines that play a role in oxidative stress and inflammatory processes.<sup>1</sup> Oxidative stress occurs when ROS is more than antioxidants so that the amount of ROS increases and results in tissue damage. Interleukin-6 (IL-6) is a proinflammatory cytokine used as a marker of tissue inflammatory processes. Oxidative stress causes an increase in ROS in the body leading to lipid peroxidation. An organic compound that is a marker of lipid peroxidation is MDA (*malondyaldehyde*).

World Health Organization (WHO) data shows the prevalence of dyslipidemia in 2008 at 37% in the male population and 40% in the female population and is considered responsible for 2.6 million deaths and causes another 29.7 million lives to experience helplessness each year<sup>4</sup>. In Indonesia, data released by RISKESDAS in 2013 shows that 35.9% of the Indonesian population aged 15  $\geq$  years has dyslipidemia where women are more than men and urban residents are more than rural areas. RISKESDAS data in 2013 also showed that 15.9% of the population aged  $\geq$  15 years had a proportion of LDL  $\geq$  190 mg/dl, 22.9% HDL levels  $\leq$  40 mg/dl, and 11.9% had triglyceride levels of 500  $\geq$  mg/dl<sup>5</sup>. Data from PAPDI in 2011 found that in Indonesia only 31.3% of dyslipidemia patients achieved the desired therapeutic target<sup>6</sup>. The use of statin drugs as gold standard has a good effect on the overall lipid profile. Statins are drugs that lower total cholesterol, triglycerides and LDL that are very effective in preventing

## The Influence of Salak Skin Ethanol Extract on the Lipid Profile, IL-6 and MDA Serum (Experimental Study on Male Rats of Wistar Strains Induced by High-Fat Diet)

cardiovascular risk. Although statins are effective in reducing lipid profiles, long-term use of statins has the side effect of increasing liver enzyme levels in the first 5 months of therapy, especially in hepatitis B and C patients, in addition to 5% of statin users experiencing myopathy and kidney failure so statin use must be monitored.

Nuranti., *et al* (2015), in his research found that ethanol extract of salak fruit peel dose 210 and 840 mg / kg weight of mice was proven to reduce total cholesterol levels of mouse blood with the largest decrease of 23.72% (dose 840 mg / kgbb mice), but the activity was still smaller than simvastatin with a percentage reduction in total cholesterol levels of 42.08%. Therefore, studies with higher EEKS doses of 200, 400, 600 mg / 200 grams of rat weights are expected to prove a decrease in lipid profile levels, lowering IL 6 levels and MDA blood serum of male rats *wistar strains*.

Research on ethanol extract of salak fruit peel as an antioxidant is still very limited. Research conducted by Handayani., *et al* (2021) found that ethanol extract of salak fruit peel contains alkaloids 7.61 % w/w; flavonoids 0.041%w/w; tannins 1.18 %w/w; and saponins 2 %w/w. Ethanol extract of salak fruit peel dose 140 mg / kg body weight in rats has the effect of reducing blood glucose levels and ureal and creatinine. Kanon., *et al* (2012) found that ethanol extract of salak fruit peel 150 mg / Kg BB can reduce blood sugar levels of male white rats (*Rattus norvegicus*) induced sucrose. Putri's research (2020), showed that ethanol extract of salak fruit peel dose 0.075-0.225 g/200 g BB can reduce blood sugar levels of male white rats (*Rattus norvegicus*) induced alloxan. Valentino., *et al* (2021) in their research found that EEKS can reduce blood sugar levels of alloxan-injected rats with a p value of < 0.05, and the best dose is 600 mg / KgBB. Meanwhile, to reduce the body weight of rats who have been injected with alloxane, less significant results  $p > 0.05$ .

Datu., *et al* (2022) who conducted a study on the effect of giving salak juice (*Salacca zalacca*) on lipid profiles and body weight of hyperlipidemia and obesity model rats concluded that giving salak juice affects lipid profiles by reducing total cholesterol, triglyceride levels, LDL levels. Giving salak juice can also reduce the weight of obese rats and reduce blood glucose levels.

Antioxidants are an option in efforts to control dyslipidemia. Treatment and prevention of diseases with antioxidants is one of the therapeutic modalities that is not inferior to pharmacological or lifestyle approaches. Potent antioxidants are proven to overcome several diseases and even degenerative diseases that are not easy to handle.<sup>8</sup> Nature has provided ingredients that humans can consume to inhibit free radicals.

Indonesian people have traditionally used plants for health maintenance and disease treatment. One plant that has health benefits is salak (*Salacca zalacca*). Salak plants are known to contain beneficial secondary metabolite compounds, one of which has an effect as an antioxidant that can reduce the negative impact of free radicals.<sup>37</sup>

Secondary metabolites are a group of compounds synthesized by living things and used to support life. Secondary metabolites in the pharmaceutical field are specifically used as drug candidates, namely the structure of compounds that have biological activity in the form of therapeutic effects with minimal toxicity.<sup>36</sup> The results showed that only about 30% of subjects with dyslipidemia achieved the target of dyslipidemia treatment. It is necessary to make efforts to reduce lipid profile levels with natural substances. One effort that can be done is the use of statins but long-term use is reported to have side effects in the form of myopathy and kidney failure, so the use of this drug must still be monitored.<sup>8</sup> So that alternative therapies are needed that are comfortable, cheap and acceptable such as by using medicinal efficacious materials that are around. Fruits are the best source of antioxidants for humans. Recent epidemiological studies have shown a positive correlation between the consumption of fruits rich in natural antioxidants and a reduced incidence of non-communicable diseases including cancer, cardiovascular disorders and diabetes<sup>37</sup>. One plant that can be used is salak. Salak is one of the horticultural commodities that has the potential to be developed commercially. Salak is a source of vitamins, minerals, fiber and bioactive components such as antioxidants. Salak is found in many tropical countries including in Indonesia. Salak peel contains several chemical compounds including polyphenols, flavanols, flavonoids, ascorbic acid and tannins that have activity as antioxidants.<sup>3</sup>

Salak fruit has been shown to have antioxidant effects, while research on the effects of salak fruit skin is still limited. People use salak in their fruit flesh, while other parts such as fruit skins are underused and even just thrown away and become useless waste. Though basically all parts of the plant such as fruit skin that are often overlooked, may have benefits. Existing studies on the effects of salak [*Salacca zalacca* (Gaertner) Voss] are more directed towards the flesh of the fruit. According to the results of research in salak fruit contains total polyphenols of  $217.1 \pm 13.2$  mg GAE (gallic acid equivalent) / 100 g fresh weight<sup>38</sup>. Salak fruit has antioxidant activity measured by DPPH and ABTS methods of  $110.4 \pm 7.9$  and  $1507.5 \pm 70.1$   $\mu$ M TE (micromolar trolox equivalent) / 100 g fresh weight, respectively. Ethyl acetate extract of salak var. Hunchback has antioxidant activity with IC50 1.6  $\mu$ g/mL and methyl-pyrrole-2,4-dicarboxylic acid compounds are new compounds in the var salak plant. Hunchback that has antioxidant activity with IC50 3.27  $\mu$ g/mL. While research on salak fruit skin is still little reported. According to research by Deng (2012), salak fruit peel has antioxidant activity with FRAP (Ferric-Reducing Antioxidant Power) value of  $0.74 \pm 0.10$   $\mu$ mol Fe(II) / g, TEAC (Trolox Equivalent Antioxidant Capacity) value of  $4.50 \pm 0.22$   $\mu$ mol Trolox / g fruit skin (Deng, et.al., 2012). Research conducted by Fitri

# The Influence of Salak Skin Ethanol Extract on the Lipid Profile, IL-6 and MDA Serum (Experimental Study on Male Rats of Wistar Strains Induced by High-Fat Diet)

(2014) EEKS dose has antioxidant activity with IC50 value of  $229.27 \pm 6.35$  ( $\mu\text{g} / \text{mL}$ ). So far research explaining the effect of salak bark ethanol extract in rats on lipid profile levels, IL-6 and MDA is still limited. Therefore, research is still very relevant for further research.

The use of experimental male rats of *the wistar* strain because of genetics, physiology, and metabolism similar to humans. In addition, male rats of *the wistar* strain have a relatively short life cycle, a large number of offspring per birth, and ease of handling<sup>9</sup>.

## II. MATERIAL AND METHOD

### Study Design and Experimental Animals

This research is a *true* research of *laboratory experiments in vivo* with the design of *Post Test Only Control Group Design*. The study subjects used 36 male rats of the 8-week-old Wistar strain weighing between 150-200 grams that met the inclusion and inclusion criteria, adapted for 7 days. This study used 6 treatment groups, a healthy control group with standard feed diet + aquabidest (K S), a negative control group with a high-fat feed diet without standard drug intervention + aquabidest (K -), a positive control group with a high-fat feed diet intervened with simvastatin dose 0.18 mg / day orally + aquabides for 14 days (K +), treatment group with high-fat feed diet for 14 days and administration of salak skin ethanol extract dose of 60 mg / 200 grams of rat body weight + aquabidest for 14 days (P1), and treatment with high feed diet for 14 days and administration of salak skin ethanol extract dose of 120 mg / 200 grams of rat body weight + aquabidest for 14 days (P2). The treatment group was given a high-feed diet for 14 days and ethanol extract of salak peel at a dose of 240 mg / 200 grams of rat body weight + aquabidest for 14 days (P3). On day 36, male wistar rats had their blood drawn to check lipid profile, IL-6 and serum MDA levels.

### Research Materials

This research uses equipment consisting of Salak Skin Ethanol Extract doses of 60, 120, and 240 mg/200 grams of rat weight, rat serum, *Automatic Analyze Shimatzu brand*, 0.37% TBA solution in 0.25 N HCl, 15% TCA solution, and IL-6 kit reagent.

### Research Equipment

This research uses equipment consisting of rat cage with feed holder with size L: 40 cm, W: 30 cm, H: 30 cm, rat scales "Nigushi Scale", small scissors, razor blade, oral sonde, gloves, cotton counter, drip pipette, *Eppendorf* tube, cuvet, *waterbath* with temperature 950C, spectrophotometer, centrifuge, micropipette, ELISA reader, and digital camera.

### Salak Skin Ethanol Extract

Making salak peel extract using a re-maceration technique, where the salak skin that has been belnder, is weighed first for 150 gr and then extracted with 900 ml of 70% ethanol solution using a soaking technique of approximately 5 days. The extract is then filtered using filter paper (the results of the first filter) and the rest is extracted again in 2 days using 70% ethanol as much as 600 ml and then filtered again (the results of the second filter). Furthermore, the results of the first and second filters in the form of solution are collected and evaporated using a vacuum evaporator with a temperature of 700C until the volume becomes a quarter of the initial volume and continued again by drying it in the oven at 400C until it is a thick extract. Obtained 4.86 grams of thick extract and then divided into 3 concentrations: 200mg / kgbb, 400 mg / kgbb and 600 mg / kgbb.

### Induction of Dyslipidemia

A high-fat feed diet is given standard feed and gastric swabs. The composition of high-fat feed consists of standard feed: egg yolk is carried out on the 8-21st day of treatment.

### How to Sample Experimental Animals

(1) After 35 days of treatment, rat blood collection was carried out through puncture of the optalmica vein in the retro-orbitalis. (2) Blood is collected into the *collect tube*. The blood in the *collect tube* is allowed to stand first for 20 minutes, then centrifuge at a speed of 3000 rpm for 10 minutes until serum is formed, which is a clear liquid in the supernatant. The serum is taken and transferred to a test tube for analysis.

### Lipid Profile Rate Measurement Procedure

(1) Prepare blanks, standards and samples of rat blood serum. (2) Put 1000  $\mu\text{l}$  of total cholesterol, HDL, LDL, triglyceride test reagents into the tube (1000 $\mu\text{l}$  each three tubes). (3) Put a standard sample of total cholesterol, HDL, LDL, triglycerides as much as 10  $\mu\text{l}$  into a tube containing 1000  $\mu\text{l}$  of total cholesterol reagents, HDL, LDL, triglycerides. (4) Put a serum sample of 10  $\mu\text{l}$  into total cholesterol, HDL, LDL, triglyceride reagents. (5) Incubation for 10 minutes at 370 C. (6) After 60 minutes, read using a spectrophotometer with a wavelength of 546 nm.

# The Influence of Salak Skin Ethanol Extract on the Lipid Profile, IL-6 and MDA Serum (Experimental Study on Male Rats of Wistar Strains Induced by High-Fat Diet)

## How to Measure IL-6 Rate

(1) Prepare reagents, samples and standard solutions. Try to be at room temperature +/- 30 minutes before the solution is used. (2) Take plates and strips containing wells as needed, for unused strips can be stored in coolers with a temperature of 2-80C. (3) Put 50 µl of standard solution into the contribution, note: there is no need to add antibody, because in standard solution already contains antibody. (4) Put 40 µl of sample into the well and add 10 µl of anti-IL-6 antibody into the well containing the sample, then add 50 µl of streptavidin-HRP into the standard well and sample (except control negative), mix the solution and cover with a sealer then incubate in an incubator at 370C for 1 hour. (5) Open the sealer and wash the wells for 5x with a washing buffer of 0.35 ml each well until the well is full, and absorb it using a tissue to dry. (6) Put 50 µl of substrate A solution and 50 µl of substrate B into the drain, cover the plate using a sealer, then incubate into the incubator with a temperature of 370C with closed conditions (dark) for 10 minutes (until the solution changes from clear to blue). (7) Remove the plate containing the well, add 50 µl of stop solution to the sump, the solution will change from blue color to kining, then insert the plate into the elisa reader to read the color absorbance with a reading wavelength of 450 nm (valid result if the reading is done under 10 minutes).

## How to Measure MDA Rate

(1) Blood of male wistar rats is taken as much as 1 ml through the orbital sinuses. (2) Blood samples are centrifuge at a speed of 3000 rpm for 30 minutes, then a supernatant of 200 µl is taken into the centrifuge tube. Added 15% TCA solution as much as 2000 µl and 0.37% TBA solution in 0.25N HCl as much as 2000 µl. (3) Heated through a *waterbath* with a temperature of 950C for 60 minutes. (4) Cooled to a temperature of 300C and put into the column Sep-Park C18. (5) Before use, the column is washed first using 5 ml *methanol* and water and then discarded. (6) The sample mixture is put into the column and discarded. (7) TBA is diluted from the column by adding 4 ml of methanol and then accommodated in a cuvet. (8) Color density is read using spectrophotometry at a wavelength of 532 nm.

## III. RESULT

### Lipid Profile Level Validation

Examination of lipid profiles of rat serum was carried out after administration of a high-fat diet (as validation) on day 21 of the study. The lipid profile levels examined were total cholesterol, LDL (*Low-density lipoprotein*), TG (Triglyceride), and HDL (*High-Density Lipoprotein*).

**Table 1. Comparison of mean lipid profile levels of the non-suspension group with the high-fat diet interperse group**

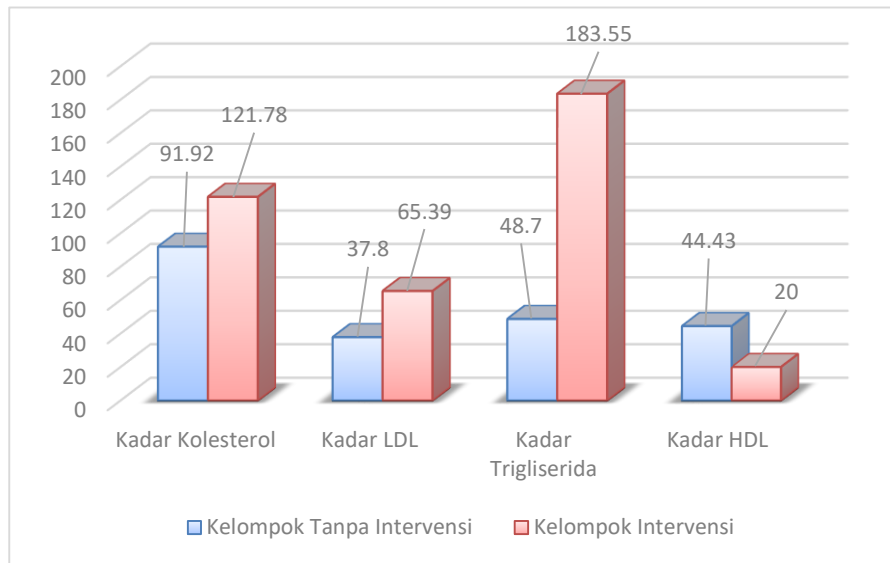
Group	Up to (mg/dL)	Cholesterol (mg/dL)	Up to (mg/dL)	LDL Triglyceride up to (mg/dL)	Up to HDL (mg/dL)
<b>Group without interruption</b>					
Mean ± SD	91.92 ± 16.92		37.8 ± 8.84	48.7 ± 20.7	44.43 ± 10.42
<i>Shapiro-Wilk</i>	0.69*		0.22*	0.9*	0.49*
<b>Suspension group</b>					
Mean ± SD	121.78 ± 16.33		65.39 ± 8.72	183.55 ± 25.41	20.00 ± 4.74
<i>Shapiro-Wilk</i>	0.69*		0.22*	0.90*	0.49*
<i>Leuvene Test</i>	0,95+		0,83+	0,25+	0,08+
<i>the test</i>	0,01^		0,00^	0,00^	0,00^

**Description:** The \* sign indicates the result of normal data distribution ( $p > 0.05$ ). The + sign indicates homogeneous data with the Levene test ( $p > 0.05$ ). The ^ mark indicates a significant result for the *One Way Anova test* ( $p < 0.05$ )

A total of 6 group rats without interference (healthy group) and 6 group mice with high-fat diet interference were taken blood on day 21 to check lipid profile levels. The average total cholesterol yield in the group without interference was 91.92 mg / dL, compared to the intervention group increased by an average of 121.78 mg / dL. LDL levels in the group without interference 37.8 mg / dL, increased in the interperse group 65.39 mg / dL. Average triglyceride levels in the group without interference 48.7 mg / dL, increased in the interperse group with an average of 183.55 mg / dl, and decreased the average HDL levels from the group without interference 44.43 mg / dL, decreased in the interperse group to 20.00 mg / dL in the interperse group.

## The Influence of Salak Skin Ethanol Extract on the Lipid Profile, IL-6 and MDA Serum (Experimental Study on Male Rats of Wistar Strains Induced by High-Fat Diet)

Analysis using the *Shapiro-Wilk* test is known to all normally distributed groups with values ( $p > 0.05$ ), and has homogeneous data variance with Leuvene Test results ( $p > 0.05$ ). Analysis of the t-test test obtained results ( $p < 0.05$ ) in the group with the suspension



**Figure.1. Graph of differences in lipid profile levels of the non-interference group with the high-fat diet interperse group**

known to be significantly different for the four groups. Cholesterol, LDL and triglyceride levels increased after a high-fat diet and decreased HDL levels. Thus it can be concluded that the induction treatment of a high-fat diet is successful (there is a difference).

### Results of lipid profile examination, IL-6 and MDA after EEX administration

Examination of lipid profiles, IL-6 and MDA from mouse serum was carried out after EEKS administration on day 36 of the study for 14 days. The lipid profile levels examined after EEKS administration were total cholesterol, LDL, Triglyceride, and HDL, then IL-6 and MDA parameters.

**Table 2. Results of analysis of average lipid profiles, IL-6 and MDA**

Variable	Group	Group						P value
		KS	Towards-	K+	P1	P2	P3	
Total Cholesterol Up (mg/dL)	Mean ± SD	38.52 ± 25.48	46.35 ± 19.94	64.58 ± 6.63	71.02 ± 8.68	44.52 ± 9.35	67.83 ± 4.38	
	<i>Shapiro-Wilk</i>	0,17*	0,74*	0,85*	0,25*	0,97*	0,36*	
	<i>Leuvene Test</i>							0,003+
	<i>One way Anova</i>							0,019^
Up to LDL (mg/dL)	Mean ± SD	3.73 ± 0.92	6.72 ± 1.28	6.91 ± 2.15	7.98 ± 0.84	7.47 ± 2.33	8.97 ± 0.66	
	<i>Shapiro-Wilk</i>	0.08*	0.06*	0.60*	0.09*	0.34*	0.1*	
	<i>Leuvene Test</i>							0.04+
	<i>One way anova</i>							0,003^
Triglyceride up to (mg/dL)	Mean ± SD	55.12 ± 20.84	125.89 ± 31.12	68.75 ± 19.56	103.45 ± 8.36	44.61 ± 9.86	41.03 ± 4.00	
	<i>Shapiro-Wilk</i>	0.08*	0.06*	0.60*	0.09*	0.34*	0.10*	
	<i>Leuvene Test</i>							0.02
	<i>One way anova</i>							0,00^
Up to HDL (mg/dL)	Mean ± SD	23.77 ± 17.25	14.45 ± 0.89	43.92 ± 12.71	42.35 ± 5.46	28.13 ± 5.96	50.65 ± 7.97	
	<i>Shapiro-Wilk</i>	0.30*	0.65*	0.81*	0.99*	0.46*	0.36*	
	<i>Leuvene Test</i>							0.03
	<i>One way anova</i>							0,00^
Up to IL-6 (ng/L)	Mean	3.07 ± 1.01	4.02 ± 0.9	3.35 ± 0.93	4.36 ± 0.87	2.9 ± 0.55	3.8 ± 0.59	

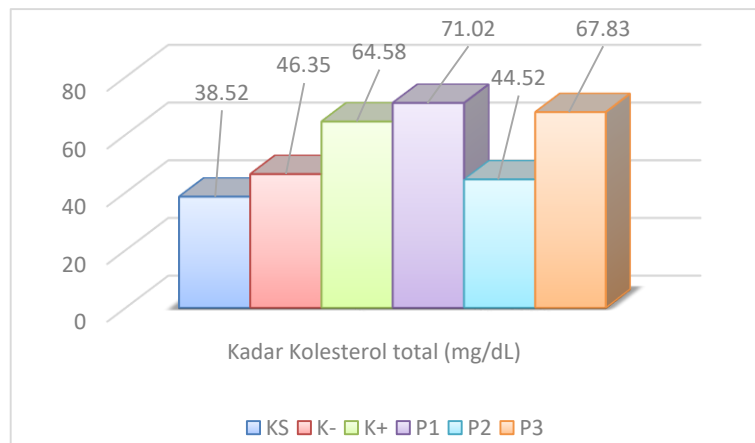
**The Influence of Salak Skin Ethanol Extract on the Lipid Profile, II-6 and MDA Serum (Experimental Study on Male Rats of Wistar Strains Induced by High-Fat Diet)**

	<i>Shapiro-Wilk</i>	0.5*	0,78*	0.93*	0,27*	0,89*	0,45*	
	<i>Leuvene Test</i>							0.68+
	<i>One way Anova</i>							0.032^
Up to MDA (mg/mL)	Mean	0.13 ± 0.04	0.07 ± 0.01	0.08 ± 0.01	0.11 ± 0.02	0.09 ± 0.02	0.08 ± 0.01	
	<i>Shapiro-Wilk</i>	*0.12	*0.55	*0.42	0.01	0.01	*0.10	
	<i>Leuvene Test</i>							0.03
	<i>Kruskal Wallis</i>							0.01"

Description: the \* sign indicates the result of normal data distribution ( $p > 0.05$ ). The + sign indicates homogeneous data with the Levene test ( $p > 0.05$ ). The ^ mark indicates a significant result for the *One Way Anova test* ( $p < 0.05$ ), The " mark indicates a significant result for the *Kruskal Wallis test* ( $p < 0.05$ ).

**A. Results of total cholesterol level examination after EEX administration**

The average results of checking total cholesterol levels in the group after EEKS administration obtained results, namely in the KS group 38.52 mg / dL, K- 46.35 mg / dL, K + 64.58 mg / dL, P1 44.52 mg / dL, P2 67.83 mg / dL and P3 43.44 mg / dL. Total cholesterol levels were highest in the P1 group and the lowest group was the KS group. Descriptive analysis using the Shapiro-Wilk test is known to all normally distributed groups with a value of ( $p > 0.05$ ), but has inhomogeneous data variance with the results of the Leuvene Test ( $p > 0.05$ ) obtained results of 0.00. A graph of the average total cholesterol levels between groups is presented in Figure 2 below:



**Figure 2. Average total cholesterol levels between groups after EEKS administration**

Total cholesterol levels after EEX administration with a high-fat diet in the treatment group lowered total cholesterol levels. The group after EEKS was given the *One way Anova test* obtained results of 0.019 ( $p < 0.05$ ) showing significant differences in each group after EEKS administration. Results can be seen in table 3.

**Table 2. Differences in average total cholesterol levels of each group after EEKS administration with *Post Hoc Tamhane test***

Group	Towards-	K+	P1	P2	P3
KS	1.00	0,87	0,70	1,00	0,80
Towards-		0,93	0,73	1,00	0,84
K+			0,99	0,20	1,00
P1				*0,08	0,13
P2					0,31

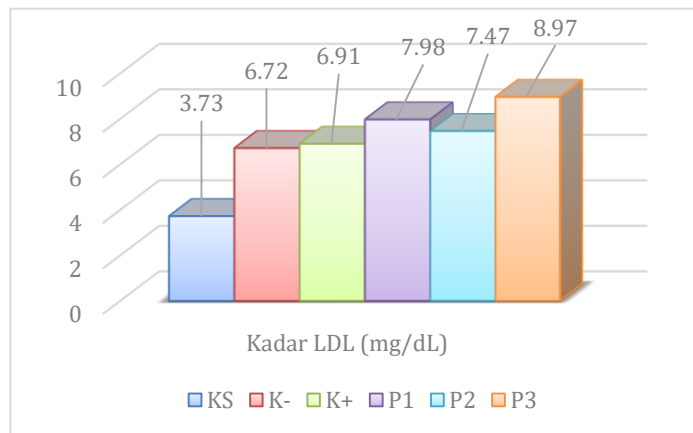
Description: \* Means  $p < 0.05$

Analysis of the difference in average cholesterol levels was carried out *Post hoc Tamhane test* to determine the most influential EEKS dose. The results showed a significant difference in the P1 group compared to the P2 group with a result of 0.08 ( $p < 0.05$ ), It can be concluded that the P2 group with a dose of 120 mg EEKS most affected total cholesterol levels in male rats *Wistar* strain induced by a high-fat diet.

## The Influence of Salak Skin Ethanol Extract on the Lipid Profile, II-6 and MDA Serum (Experimental Study on Male Rats of Wistar Strains Induced by High-Fat Diet)

### B. Results of LDL level examination after EEKS administration

The average results of LDL levels in the group after EEKS administration obtained results in the KS group 3.73 mg / dL, K- 6.72 mg / dL, K + 6.91 mg / dL, P1 7.98 mg / dL, P2 7.47 mg / dL and P3 8.97 mg / dL. LDL levels were highest in the P3 group and the lowest group was the KS group. Descriptive analysis using the *Shapiro-Wilk test* is known to all normally distributed groups with a value of ( $p > 0.05$ ), but has inhomogeneous data variants with Leuvene Test results ( $p > 0.05$ ) obtained results of 0.04 , as in graph 3.



**Figure 2. Average LDL levels between groups after EEKS administration**

Analysis of the difference in average LDL levels carried out by Tamhane Post hoc test showed that there was a significant difference in the KS group with P1 0.007 ( $p < 0.05$ ), the KS group was significantly different from the P3 group with a value of 0.002 ( $p < 0.05$ ), It can be concluded that the P3 group with a dose of 240 mg EEKS most affected LDL levels in male rats of the wistar strain induced by a high-fat diet. Attached to table 4 follows:

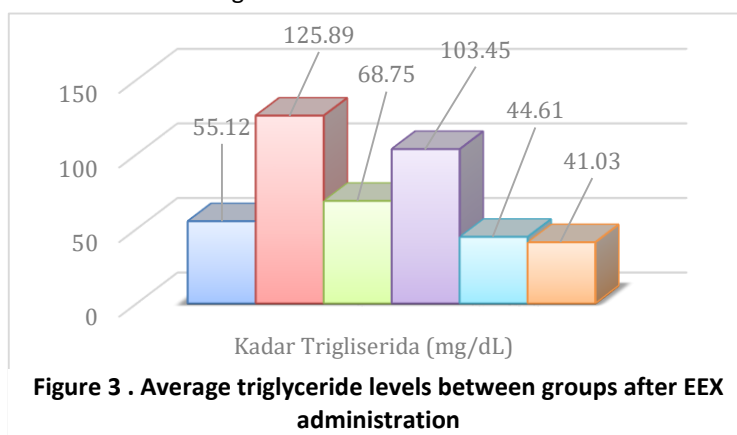
**Table 3. Differences in average LDL levels in each group after EEKS administration with Posh Hoc Tamhane test**

Group	Towards-	K+	P1	P2	P3
KS	0,15	0,55	*0,007	0,47	*0,002
Towards-		1,00	0,93	1,00	0,37
K+			1,00	1,00	0,91
P1				1,00	0,84
P2					0,99

Keterangan: \* Bermakna  $p < 0,05$

### C. Results of triglyceride level examination after EEX administration

The average results of triglyceride levels in the group after EEKS administration obtained results, namely in the KS group 55.12 mg / dL, K- 125.89 mg / dL, K + 68.75 mg / dL, P1 103.45 mg / dL, P2 44.61 mg / dL and P3 41.03 mg / dL. Triglyceride levels were highest in the K+ group and the lowest group was the P3 group. Descriptive analysis using the Shapiro-Wilk test is known to all normally distributed groups with a value of ( $p > 0.05$ ), but has inhomogeneous data variants with the results of the Leuvene Test ( $p > 0.05$ ) obtained results of 0.02. as in the following chart 4:



**Figure 3 . Average triglyceride levels between groups after EEX administration**

## The Influence of Salak Skin Ethanol Extract on the Lipid Profile, Il-6 and MDA Serum (Experimental Study on Male Rats of Wistar Strains Induced by High-Fat Diet)

Descriptive analysis using the Shapiro-Wilk test is known to all normally distributed groups with a value of ( $p > 0.05$ ), but has inhomogeneous data variants with the results of the Leuvene Test ( $p > 0.05$ ) obtained results of 0.02.

Analysis of the average difference in triglyceride levels carried out by Tamhane Post hoc test showed that there were significant differences in the KS group with  $K+ 0.003$ ,  $K+ with P2 0.003$ ,  $K+ with P3 0.010$ ,  $P1 with P2 0.002$ ,  $P1 with P3 0.002$  ( $p < 0.05$ ), It can be concluded that the P2 group with a dose of 120 mg and P3 with a dose of 240 mg EEKS most affected triglyceride levels in male rats of the Wistar strain induced high-fat diet with the same level of meaning. Attached to table 5 follows:

**Table 4. Differences in average LDL levels in each group after EEKS administration with *Posh Hoc Tamhane test***

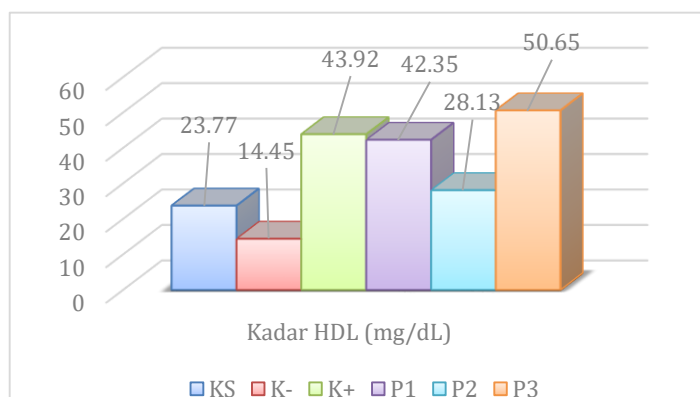
Group	Towards-	K+	P1	P2	P3
KS	0,16	*0,003	0,18	1,00	0,99
Towards-		0,64	0,99	0,14	0,16
K+			0,05	*0,003	0,010
P1				*0,002	*0,002
P2					1,00

Description: \* Means  $p < 0.05$

### D. Results of HDL level examination after EEKS administration

The results of the average examination of HDL levels in the group after EEKS administration obtained results, namely in the KS group 23.77 mg / dL, K- 14.45 mg / dL, K+ 43.92 mg / dL, P1 42.35 mg / dL, P2 28.13 mg / dL and P3 50.65 mg / dL. HDL levels were highest in the P3 group and the lowest group was the K- group. Descriptive analysis using *the Shapiro-Wilk test* is known to all normally distributed groups with a value of ( $p > 0.05$ ), but has inhomogeneous data variants with Leuvene Test results ( $p > 0.05$ ) obtained results of 0.03, as in the following graph 5:

Analysis of the difference in average HDL levels carried out by *Tamhane Post hoc* test showed that there were significant



**Figure 4. Average HDL levels between groups after EEKS administration**

differences in the K- group with  $K+ 0.026$ ,  $K- with P1 0.009$ ,  $K- with P3 0.023$ ,  $K+ with P2 0.031$  ( $p < 0.05$ ), It can be concluded that the P3 group with a dose of 240 mg EEKS most affected HDL levels in male rats of *the Wistar strain* induced by a high-fat diet with a significance level of 0.023. Attached to table 6 follows:

**Table 5. Differences in average HDL levels in each group after EEKS administration with *Posh Hoc Tamhane test***

Group	Towards-	K+	P1	P2	P3
KS	0,45	0,22	1,00	0,99	0,98
Towards-		*0,026	*0,009	0,08	*0,002
K+			0,18	*0,031	0,30
P1				0,06	0,99
P2					0,07

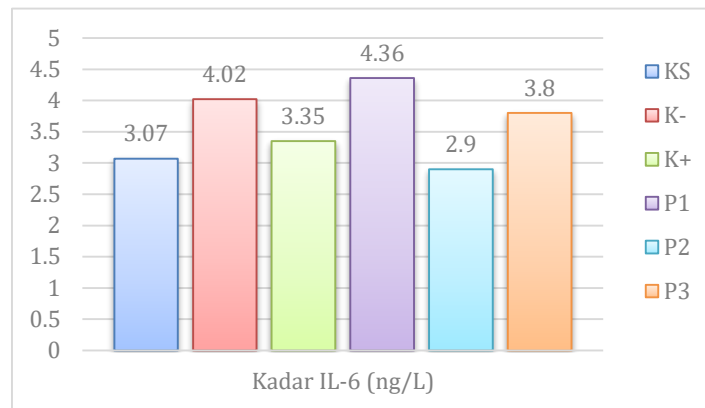
Description: \* Means  $p < 0.05$



# The Influence of Salak Skin Ethanol Extract on the Lipid Profile, IL-6 and MDA Serum (Experimental Study on Male Rats of Wistar Strains Induced by High-Fat Diet)

## IL-6 Rate Analysis Results

The average results of the IL-6 level examination were obtained in the KS group 3.07 ng / L, K- 4.02 ng / L, K + 3.35, P1 4.36 ng / L, P2 2.90 ng / L and P3 3.80 ng / L. The highest IL-6 levels in the P1 group and the lowest group were the P2 group. Descriptive analysis using the Shapiro-Wilk test is known to all normally distributed groups with a value of ( $p > 0.05$ ), and has a homogeneous data variance with the results of the Leuvene Test ( $p > 0.05$ ) obtained results of 0.068. It was concluded that the average data of IL-6 levels were normally distributed and homogeneous so that they qualified for a One way anova test to determine differences between groups.



**Figure.5. Graph of the average value of IL6 levels after EEKS administration in each group**

The results of the one-way anova test obtained results of 0.032 ( $p < 0.05$ ) showed there were significant differences between treatment groups, Group P2 with EEKS dose 120 mg for 14 days decreased significantly when compared to the positive group (K +) given simvastatin dose 0.18 mg / day orally, as illustrated in graph 6.

Analysis of differences in mean IL-6 levels was carried out Post hoc LSD test to determine the dose group that most affected rats with a high-fat diet intervened with EEKS, attached to the following table:

**Table 6. Differences in average IL-6 levels per group after EEKS administration**

Group	Towards-	K+	P1	P2	P3
KS	*0,056	0,561	*0,011	0,722	0,134
Towards-		0,171	0,485	0,26	0,654
K+			*0,043	0,351	0,350
P1				*0,005	0,256
P2					0,068

Description: \* Means  $p < 0.05$

IL-6 levels of the KS group with the *LSD post hoc* test were significantly different compared to the K- group, the KS group was significantly different than the P1 group, the K+ group was significantly different than the P1 group, and the P1 group was significantly different than the P2 group. The comparison of each group with the most significant value is the P2 group of 0.005 ( $p < 0.05$ ) it can be concluded that the P2 group with a dose of 120 mg has the best effect in reducing IL-6 levels.

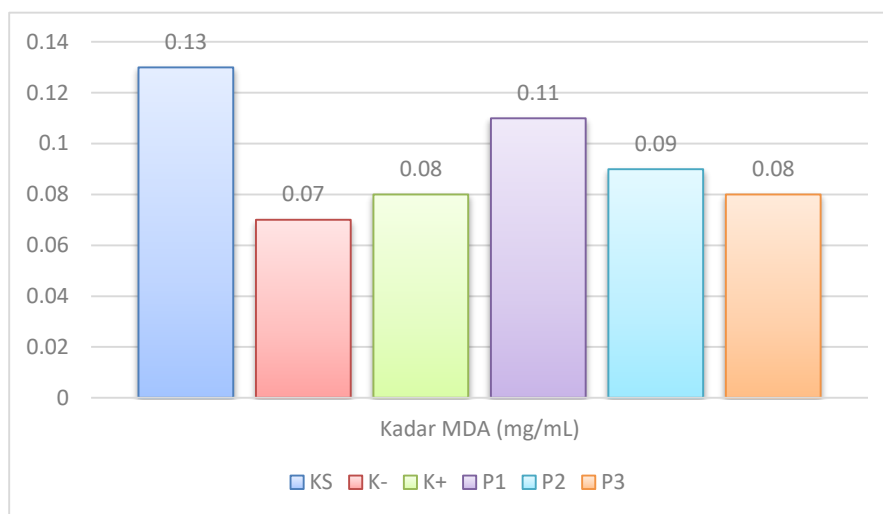
## MDA Rate Analysis Results

The average results of MDA levels were obtained in the KS group 0.13 mg / mL, K- 0.07 mg / mL, K + 0.08 mg / mL, P1 0.11 mg / mL, P2 0.09 mg / mL and P3 0.08 mg / mL. MDA levels were highest in the P1 group and the lowest group was the K- group. Descriptive analysis using the *Shapiro-Wilk* test found abnormally distributed data in the P1 group of 0.01 mg / ml and P2 0.01 mg / ml ( $p > 0.05$ ), and had inhomogeneous data variants with *Leuvene Test results* ( $p > 0.05$ ) obtained results of 0.03. It was concluded that the average data of MDA levels were abnormally distributed and not homogeneous so that Kruskal Wallis's non-parametric test was carried out to determine differences between groups.

The results of the Kruskal Wallis test obtained results of 0.01 ( $p < 0.05$ ) showed there were significant differences between treatment groups, Group K – give n a high-fat diet without interference had the lowest value, group K + with simvastatin dose 0.18

## The Influence of Salak Skin Ethanol Extract on the Lipid Profile, Il-6 and MDA Serum (Experimental Study on Male Rats of Wistar Strains Induced by High-Fat Diet)

mg / day orally with group P3 with EEKS dose 240 mg for 14 days had the same average MDA value, as illustrated in the following graph 7:



**Figure 6. Graph of the average value of MDA levels after EEKS administration in each group**

Analysis of differences in average MDA levels was carried out by *the Mann-Whitney* test to determine the dose group that had the most effect on rats with a high-fat diet that was intervened with salak bark extract.

The MDA levels of the KS group with the *Mann-Whitney* test were significantly different compared to the K- group with a value of 0.005 ( $p < 0.05$ ), the KS group was significantly different compared to the K+ group with a value of 0.002, the KS group was not significantly different compared to the P1 group with a value of 0.226, the KS group was significantly different compared to the P2 group with a value of 0.023, and the KS group was significantly different compared to the P3 group with a value of 0.003. It was concluded that MDA levels with the administration of salak bark ethanol extract dose of 240 mg for 14 days were most effective compared to others, as in the following table:

**Table 8. Differences in mean MDA levels after EEX administration of each group with *the Mann-Whitney* test**

Group	Checklists	Say
KS	Towards-	*0,005
	K+	*0,005
	P1	0,189
	P2	*0,023
	P3	*0,003

Description: \* Means  $p < 0.05$

## IV. DISCUSSION

Dyslipidemia is defined as a disorder of lipid metabolism characterized by an increase or decrease in lipid fraction levels in plasma. The main lipid fraction abnormalities are an increase in total cholesterol (K-Total), LDL cholesterol, and/or triglycerides (TG) levels and a decrease in HDL cholesterol.<sup>14,15</sup> Dyslipidemia that modulates the function and activity of myeloid cells, and an increase in oxidative metabolism with increased production of reactive oxygen species (ROS). As a defense mechanism, cells produce antioxidants (AOs) to prevent or limit oxidative tissue injury. Excessive ROS production can cause an imbalance between ROS and AOS leading to oxidative stress and damage, contributing to tissue injury through several mechanisms, including DNA damage, membrane lipid peroxidation, enzyme oxidation and stimulation of proinflammatory cytokines.<sup>40</sup> Dyslipidemia is a leading cause of heart attacks, strokes, and peripheral vascular disease. Chronic inflammation that is triggered and disrupted by the accumulation of lipids. accumulation of cells containing excess lipids within artery walls, increased formation of intracellular reactive oxygen species (ROS) play an important role in chronic inflammatory response.<sup>25</sup>

Dyslipidemia is a condition in which there is an increase or decrease in the fraction of lipids in the blood due to an abnormality in the metabolism of the lipid itself. The lipid fraction that experiences abnormalities is usually an increase in total cholesterol, TG, LDL levels and a decrease in HDL cholesterol.<sup>41</sup> In this study showed the effect of salak bark extract can reduce cholesterol, LDL,

## The Influence of Salak Skin Ethanol Extract on the Lipid Profile, II-6 and MDA Serum (Experimental Study on Male Rats of Wistar Strains Induced by High-Fat Diet)

TG levels and increase HDL levels in rats given a high-fat diet feed for 14 days. In line with research by Datu., *et al* (2022) with the provision of salak fruit juice (*Salacca zalacca*) the administration of salak fruit juice affects lipid profiles by reducing total cholesterol, triglyceride levels, and LDL levels. Giving salak juice can also reduce the weight of obese rats and reduce blood glucose levels. Research by Nuranti., *et al* (2015), reported that ethanol extract of salak fruit peel doses of 210 and 840 mg / kg of mouse weight was shown to reduce total cholesterol levels of mouse blood with the largest decrease of 23.72% (dose 840 mg / kgbb mice), but the activity was still smaller than simvastatin with a percentage reduction in total cholesterol levels of 42.08%. Unlike this study where at a dose of 120 mg EEKS given for 14 after diet treatment High fat, decreased total cholesterol levels lower than in the simvastatin group, but at a dose of 240 mg was found not lower than the simvastatin group. These results show that the optimal dose of 120 mg is better than simvastatin which needs more in-depth research.

Clinically, the most important plasma lipids are triglycerides and cholesterol. Apart from cholesterol's central role in cellular regulation and stability, it serves as a building block for steroid hormones, vitamin D, oxieol, and bile acids. Its insolubility in plasma requires its transport in spherical macromolecules called lipoproteins, which consist of a hydrophobic core, containing mainly cholesterol esters and triglycerides, and a hydrophilic layer composed of phospholipids, free cholesterol, and apolipoproteins. The main cholesterol-carrying lipoproteins are low-density lipoprotein (LDL) and high-density lipoprotein (HDL). Imbalances in cholesterol homeostasis are triggered by increased food intake or by genetic factors resulting in the removal of cholesterol in peripheral tissues. Damage to the endothelium that causes migration of monocytes into the intima and differentiation into macrophages. Macrophage scavenger receptors mediate excessive endocytosis of modified LDL, which lacks negative feedback regulation and results in the formation of macrophage foam cells. Excessive absorption of modified LDL leads to apoptosis and cholesterol-induced inflammation. Cytokines produced by macrophages and endothelial cells stimulate smooth muscle cell proliferation. Unresolved inflammation eventually leads to plaque expansion, destabilization, and rupture.<sup>24</sup>

Excess intracellular cholesterol can be toxic and lead to foam cell formation and cell hardening, which in turn affects blood vessel integrity and cell signaling. Maintain a strict balance between the synthesis, absorption, and export of cholesterol, since cholesterol itself cannot be degraded in higher organisms. For cellular cholesterol depletion, cholesterol is transferred to HDL particles, which receive excess cholesterol mainly from peripheral cells and tissues to be transported back to the liver to be removed together into bile. This pathway is called reverse cholesterol transport (RCT). In contrast, circulating LDL particles, which are formed from triglyceride-rich lipoproteins after remodeling in plasma and liver, complete the transport of cholesterol to cells that require lipids. In this case, cells express higher levels of LDL-receptor (LDLR), a protein that mediates uptake of LDL particles through the classical receptor-mediated endocytosis pathway. In case of excess total body cholesterol, cholesterol will eventually accumulate in LDL particles, leading to prolonged circulation in the bloodstream. This imbalance is consequently followed by oxidation of the particle itself, leading to an increase in atherosclerotic potential and rigidity of the cell membrane. Oxidized LDL particles have been shown to induce endothelial stiffness. Atherogenic processes alter other transport processes, such as HDL transcytosis over endothelial cells, which are essential for lipid clearance in the intima. Over time, cholesterol and other lipids are deposited on the walls of blood vessels, causing plaque formation. However, the whole phenomenon begins at the cellular level when cells are faced with an excess of cholesterol.<sup>26</sup>

ROS, produced during mitochondrial physiological or physiopathological oxidative metabolism, reacts with various biomolecules, including lipids, carbohydrates, proteins, nucleic acids, and connective tissue macromolecules, thereby disrupting cell function. Under normal physiological conditions, there is a critical balance in the formation of oxygen free radicals and the antioxidant defense system. A decrease in oxidant/antioxidant balance triggers a situation of oxidative stress and generally results from ROS hyperproduction. Oxidative stress is known to be a component of molecular and cellular tissue damage mechanisms in a broad spectrum of human diseases. Many oxygenated compounds, especially aldehydes such as malondialdehyde (MDA) and conjugated dienes, are produced during the attack of free radicals into membrane lipoproteins and polyunsaturated fatty acids. Many studies have found that serum MDA is higher in subjects with hyperlipidemia and decreases after dietary supplementation with antioxidants<sup>11</sup>.

Dyslipidemia causes an increase in pro-inflammatory cytokines that play a role in oxidative stress and inflammatory processes.<sup>1</sup> Antioxidants are an option in efforts to control dyslipidemia. The antioxidant content in salak bark extract was able to reduce MDA levels in the results of the study showed that the dose group of 240 mg EEKS was the same as the group with simvastatin dose 0.18 mg, showed the effect of EEKS that reduced inflammation so as to reduce MDA levels equaled the results of the simvastatin group, proving the antioxidant content can be an alternative choice in the treatment of dyslipidemia. Treatment and prevention of diseases with antioxidants is one of the therapeutic modalities that is not inferior to the pharmacological approach. Potent antioxidants are proven to overcome several diseases and even degenerative diseases that are not easy to handle.<sup>8</sup>

Lipid metabolism and peroxidation are important in the development of inflammation, which increases with some of the

## The Influence of Salak Skin Ethanol Extract on the Lipid Profile, IL-6 and MDA Serum (Experimental Study on Male Rats of Wistar Strains Induced by High-Fat Diet)

complications associated with dyslipidemia.<sup>40</sup> IL-6 has a major role in the relationship between inflammation, obesity and cardiovascular disease. Several other findings suggest elevated interleukin (IL)-6 is used as a marker of systemic inflammation and a diagnostic marker of atherosclerotic events.<sup>41</sup>

### V. CONCLUSION

1. Administration of salak bark ethanol extract had an effect on reducing IL-6 levels in male rats of wistar strains induced by a high-fat diet.
2. Administration of salak bark ethanol extract had an effect on reducing MDA levels in male rats of wistar strains induced by a high-fat diet.

### ACKNOWLEDGEMENT

The authors declare no conflict of interest and no involvement of sponsors or funding for this research.

### REFERENCES

- 1) Najiao Hong et.al. 2022. The relationship between dyslipidemia and inflammation among adults in east coast China: A cross-sectional study. doi: 10.3389/fimmu.2022.937201.
- 2) Kiki Ikrima et.al. 2019. Peran Spesies Oksigen Reaktif Pada Inflamasi Serta Antioksidan Alami Sebagai Fitoterapi. <https://jurnal.unpad.ac.id/farmaka/article/view/22010>.
- 3) Puryono, Rahayedra Ivory et al. 2015. Uji Aktivitas Antioksidan dari Berbagai Varietas Ekstrak Buah Salak (*Salacca zalacca* (Gaertn.) Voss) dengan Metode DPPH (1,1-Difenil-2-Pikrilhidrazil) (Antioxidant Assay of Some *Salacca zalacca* (Gaertn.) Voss Varieties using DPPH (1,1 - Diphenyl - 2 - Picrylhydrazyl) Method).
- 4) World health Organization ( WHO ). Global Health Observatory ( GHO ) data. Available from : <http://www.who.int/gho/ned/risk factors/cholesterol text/en/>. Accessed February 16.2023.
- 5) Badan Penelitian dan Pengembangan Kesehatan Kementerian Kesehatan RI tahun 2013. Laporan Nasional Riset Kesehatan Daerah ( RISKESDAS)2013.2014.
- 6) Lin CF, Chang YH, Chien SC, Lin YH. Epidemiology dyslipidemia in Asia Pacific Region. *Int J Geront* 2018; 12:2-6
- 7) Park EJ, Chiang C, Munawar M et.al. Lipid Lowering Treatment in Hiperkolesterolaemia Patients; The CEPHEUS Pan-Asians Survey. *Eur J Cardiovasc Prev Rehab*, 2011;19(4):781-794
- 8) Lin CF, Chang YH, Chien SC, Lin YH. Epidemiology of dyslipidemia in Asia Pasific Region. *Int J Geront* 2020;12;2-6
- 9) Mutiarahmi CN, Hartady T, Lesmana R. Use Of Mice A Experimental Animals In Laboratories That Refer To The Principles Of Animal Welfare: A Literature review. *Indones Med Veterinus*. 2021 jan 31; 10(1):134-45.
- 10) Laufs U, Parhofer KG, Ginsberg Hn, Hegele RA. Clinical Review On Trigiliderides. *Eur Heart J*.2020 Jan 1;41 (1);99-109c.
- 11) Yang, Rui-Li; Shi, Yong-Hui; Hao, Gang; Li,Wu; Le, Guo-Wei (2018). Increasing Oxidative Stress with Progressive Hyperlipidemia in Human; Relation between Malondyaldehyde and Atherogenic Index. *Journal of Clinical Biochemistry and Nutrition*, 43(3),154-158. Doi:10.3164/jcbrn.2018044.
- 12) Delpech, Bernard. (2019). The Alkaloids Chemistry and Biology Vol 73 II The Saraine Alkaloid. 223-329. Doi:10.1016/B978-0-12-411565-1.00004-4
- 13) Fikri Fatoni.2014. Studi Potensi Biji salak sebagai sumber alternatif monosakarida dengan cara hidrolisis menggunakan asam sulfat. (skripsi). FTP UGM; Yogyakarta
- 14) Soebardi s, Purnamasari D, Oemardi M, Soewondo P, Waspaji S, Soegondo S. Dyslipidemia in newly diagnosis diabetis mellitus. The Jakarta surveillance 2006. *Acta Med Indones*, 41 (4);186-190,2009
- 15) Eckel RH, Cornier MA. Update on NCEP ATP-III emerging cardiometabolic risk factors. *BMC Med* 2014;12;115
- 16) Soegondo S. Aterogenic dyslipidemia and the metabolic syndrome. *Acta.Med Indones* 2015; 37(3);177-183
- 17) Jacobson AT, Ito KM, Maki CK et al. National Lipid Association (NLA ) rekomendasi for patient-entered management of dyslipidemia;part I (full report).*J Clin Lipid* 2015;9;129-169
- 18) Chaudury B, Aggarwal A. Diabetic dyslipidemia:Current concepts in pathipisiology and management. *J Clin Diag Res* 2018;12 (1);6-9
- 19) Rader JD, Kheterpal AS. Lipoprotein physiology in;Dyslipidemias pathopisiology, evaluation and management, Garg A (ed). Humana Press;1-12,2015
- 20) Grundy SM, Becker D, Clark LT. Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults.2019.
- 21) Cabazeas CM.Burggraaf B,Klop B. Dyslipidemia in clinical pratice. *Clin Chim Act*, 2018;487;117-125

## The Influence of Salak Skin Ethanol Extract on the Lipid Profile, IL-6 and MDA Serum (Experimental Study on Male Rats of Wistar Strains Induced by High-Fat Diet)

- 22) Kopin L, Lowenstein JC. In the clinic. Dyslipidemia. *Ann Intern Med.* ACP 2017;ITC 81-ITC95
- 23) American Diabetes Association (ADA). Cardiovascular disease and risk management; Standards of medical care in diabetes. *Diab Care* 2018;41(1);S86-S104.
- 24) Fransiska I, Indahyani DE, Handayani ATW. Kadar Kolesterol pada Mencit (Mus-Musculus) Diabetes Setelah Konsumsi Ekstrak Rumpun Laut Coklat (Phaeophyta). 2020;8;6.
- 25) Hafianie A, Genest J. High Density Lipoproteins; Measurement techniques and High HDL-Cholesterol Level Always Beneficial? *Biomedicines.* 2021. Aug 25;9(9);1083.
- 26) Zhang A, Yao Y, Xue Z, Guo X, Dou J, Lv Y, et al. A Study on the Factors Influencing Triglyceride Levels among Adults in Northeast China. *Sci Rep.* 2018 Dec;8 (1);6388
- 27) Agrawal M, Spencer HJ, Faas FH. The Method of LDL Cholesterol Measurement Influences Classification of LDL Cholesterol to Treatment Goals; 2014;14.
- 28) Connelly MA, Shalurova I, Otvus JD. High-density lipoprotein and inflammation in cardiovascular disease. *Transl Res.* 2016 Jul; 173;7-18
- 29) Laufs U, Parhofer KG, Ginsberg HN, Hegele RA. Clinical Review on triglyceride. *Eur Heart J.* 2020 Jan 1;41(1);99-109c.
- 30) Franczyk B, Rysz J, Lawinski J, Rysz-Gorzyrska M, Gluba-Brzozka A. Is a High HDL-Cholesterol Level Always Beneficial? *Biomedicines.* 2021 Aug 25;9(9);1083
- 31) Zheng S. Crocetin attenuates atherosclerosis in hyperlipidemic rabbits through inhibition of LDL oxidation. *J. Cardiovasc. Pharmacol.* 2006;47:70–76. [PubMed] [Google Scholar]
- 32) Kurnia H, Permatasari N, Subandi, Pengaruh Ekstrak Jintan Hitam terhadap MDA dan sel spermatogonium tikus yang dipapar asap rokok kretek subakut. *J Kedokteran Brawijaya.* 2014.03.07
- 33) Harum Iriyanti, Susanto H, Rosidi A. 2017. Pemberian Tempe Menurunkan Kadar MDA dan Meningkatkan Aktifitas Enzim SOD pada tikus dengan aktifitas fisik tinggi. *Jurnal Gizi Pangan Universitas Diponegoro Semarang.*
- 34) Chen L, Deng H, Cui H, Fang J, Deng J, Li Y, Wang X, Zhao L. 2018. Inflammatory Responses and Inflammation – Association Disease in Organs, oncotarget, 9(96);7204-7218.
- 35) Setiati S, Alwi I, Sudoyo AW, Setyohadi B, Syam AF. *Panduan Pengelolaan Dislipidemia.* Jakarta: PAPDI. 2019
- 36) Handayani, TW., Widodo, A., Yanti, R., Prasetyo, E., Zulfaidah., dan Tandi, J. (2021). Analisis Metabolit Sekunder dan Aktivitas Ekstrak Etanol Kulit Buah Salak (*Salacca zalacca* (Gaertn.) Voss) Terhadap Kadar Glukosa dan Ureum Kreatinin Tikus Putih Jantan (*Rattus norvegicus*). *KOVALEN: Jurnal Riset Kimia*, 7(3): 161-168.
- 37) Adjeng, A. N. T., Hairah, S., Herman, S., Ruslin, R., Fitrawan, L. O. M., Sartinah, A., Ali, N. F. M., & Sabarudin, S. (2020). Skrining Fitokimia dan Evaluasi Sediaan Sabun Cair Ekstrak Etanol 96% Kulit Buah Salak Pondoh (*Salacca zalacca* (Gaertn.) Voss.) Sebagai Antioksidan. *Pharmauho: Jurnal Farmasi, Sains, Dan Kesehatan*, 5(2), 21–24. <https://doi.org/10.33772/pharmauho.v5i2.10170>
- 38) Afrianti, L.H., E.Y. Sukandar, S. Ibrahim, I.K. Adnyana (2010). Senyawa asam-2- metilester-1-H-pirol-4-karboksilat dalam ekstrak etil asetat buah salak varietas Bongkok sebagai antioksidan dan antihyperuricemia, *J.Teknol. dan Industri Pangan*, Vol.XXI No.1 Th.2010, 66-72.
- 39) Arikunto, S. (2010). *Prosedur penelitian: suatu pendekatan praktik.* Edisi Revisi Cetakan ke-14. Jakarta: Rineka Cipta.
- 40) De Souza Bastos A, Graves DT, de Melo Loureiro AP, Júnior CR, Corbi SC, Frizzera F, Scarel-Caminaga RM, Câmara NO, Andriankaja OM, Hiyane MI, Orrico SR. Diabetes and increased lipid peroxidation are associated with systemic inflammation even in well-controlled patients. *Journal of Diabetes and its Complications.* 2016 Nov 1;30(8):1593-9.
- 41) Sarbijani HM, Khoshnia M, Marjani A. The association between Metabolic Syndrome and serum levels of lipid peroxidation and interleukin-6 in Gorgan. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews.* 2016 Jan 1;10(1):S86-9.
- 42) Heriwijaya IP, Jawi IM, Satriyasa BK. Uji efektivitas ekstrak air daun ubi jalar ungu (*Ipomoea batatas*) terhadap profil lipid tikus putih jantan galur wistar yang diinduksi pakan dislipidemia. *Intisari Sains Medis.* 2020 Aug 1;11(2):452-6.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Simulated Design and Evaluation of Centralized off Grid Street Light Solar Power System with Backup Generator



Ekpa Kenneth Andikan<sup>1</sup>, Joshua Odion<sup>2</sup>, Akpan Nsikak Uduak<sup>3</sup>

<sup>1,3</sup>Department of Electrical/Electronic Engineering Technology, Akwa Ibom State Polytechnic, Ikot Osurua, Nigeria.

<sup>2</sup>Department of Instrumentation and Control, Total Energies Limited, Port Harcourt, Nigeria.

**ABSTRACT:** In this paper, simulated design and evaluation of centralized off grid street light solar power system with backup generator is presented. The design of the street light solar power system takes into consideration the desired illumination level, the width of road, the coefficient of utilization, the maintenance factor, the desired distance between street light poles, the pole height, the pole space to pole height ratio and the total length of the street. The case study street light is located along IBB Avenue in Uyo, with latitude and longitude of 5.016982, 7.911769 respectively, path length of 2.2 km and daily energy demand of 125.8 kWh/day. The PVSyst simulation results show that the solar fraction is 0.993 which indicates that 99.3 % of the energy demand of the street light is supplied from the solar power while the remaining 0.7% of the energy demand is supplied from the backup generator. The total energy supplied by the generator is 375.7 kWh whereas the total annual energy generated from the PV array is 53739 kWh. The annual total of the energy demand is 46059 kWh while the annual total of the energy supplied to the street light from the solar power system is 46027 kWh. Also, the annual mean of the battery state of charge (SoC) is 80.3 %. Also, it is noted that the month of August alone has about 375.7 kWh energy supply from the backup generator with about 98 liters of fuel. Specifically, in a whole year, the backup generator will be used for only three days in August, namely, on the 13th, 14th and 15th of August, with the maximum supply of 239.8012 kWh occurring on the 14th day of August. Furthermore, the performance ratio (PR) of the system is 48.5%. In all, the results show that the solar power system is able to supply the required energy demand of the case study street light with only 0.7% deficit which is supplied from the backup generator.

**KEYWORDS:** Centralized solar power, Photovoltaic solar power, Loss of load, Off grid solar power, Solar fraction, Street light power system, Backup generator.

### I. INTRODUCTION

In the field of electric energy, the role of the electric network is crucial. Physical laws dictate how it functions. Different voltage levels make up the fixed structure of the electric network; the higher levels are used for transmission, while the lower levels are employed for distribution (Nkan, Okpo, Akuru, & Okoro, 2020; Natala, Nkan, Okoro, & Obi, 2023; Okpo, & Nkan, 2016; Nkan, Okpo, & Inyang, 2023). Presently, the Nigerian power industry is undergoing restructuring, especially in the generation and distribution systems (Nkan, Okpo, & Nseobong, 2023; Abunike, Umoh, Nkan, & Okoro, 2021) and the economic growth and development of any nation are intrinsically tied to the availability of energy (Okoro, Abunike, Akuru, Awah, Okpo, Nkan, Udenze, Innocent, & Mbunwe, 2022; Nkan, Okoro, Awah, & Akuru, 2019). Access to a reliable electricity supply plays a pivotal role in empowering individuals and facilitating personal and economic development. Performance evaluation of asynchronous motor was conducted in (Nkan, Okoro, Obi, Awah, & Akuru, 2019). With the ongoing expansions and growth of the electric utility industry, including deregulation in Nigeria, numerous changes characterized by additional generating stations, increase in transmission lines and loads are experienced thereby pushing the transmission systems closer to their stability and thermal limits (Nkan, Okpo, & Okoro, 2021; Edifon, Nkan, & Macaulay, 2016; Edifon, Nkan, & Ben, 2016). Interestingly, AKS has enormous solar potential but the use of solar power is very insignificant when compared to the use of fossil fuel-based power supply (Omorogiuwa & Okpo, 2015; Abunike, Umoh, Okpo, & Okoro, 2020). One reason for this is insufficient knowledge of the solar potential of the state and the cost implication of such systems (Okpo, Okoro, Awah, & Akuru, 2019; Awah, Okoro, Nkan, & Okpo, 2022).

# Simulated Design and Evaluation of Centralized off Grid Street Light Solar Power System with Backup Generator

In recent years Akwa Ibom State has witnessed rapid development in infrastructure and has also maintained relatively peaceful environment when compared with other Niger Delta States in Nigeria (Ufot-Akpabio, Ofem, & Ufot-Akpabio, 2022; Ufot-Akpabio & Ofem, 2019; Ukpog & George, 2012; Oyosoro & Okene, 2021). This factors has led to the influx of visitors and migration of people to Akwa Ibom State (Ibaba, 2011; Akpakpan & Uboegbulam, 2023; Obot, 2010). In order to enhance the security of the State and improve on the night life, the government of Akwa Ibom has steadily increase street light installations across that State. Presently, most of the street lights in the State are powered using diesel generators. However, due to the recent sharp rise in the cost of diesel, the running and maintenance cost of the street light is becoming a big burden to Ministry of works Uyo, the agency responsible for the street lights. Moreover, the need for clean, steady energy supply system is also another reason why it has become necessary for the adoption of solar photovoltaic (PV) power system for the street light in Akwa Ibom State (Babatunde, Akinbulire, Oluseyi, & Emezirinwune, 2019; Szakonyi & Urpelainen, 2015; Olatomiwa, Mekhilef, Huda, & Sanusi, 2015).

In this paper, a case study street light for the IBB Avenue in Uyo metropolis is considered. The design and evolution of the street light for the IBB Avenue is presented. The design and evaluation is carried out using PVSyst simulation software (Bagir & Channi, 2022; Salmi, Baci, Menni, Lorenzini, & Al-Douri, 2022). The design of the street light solar power system takes into consideration the desired illumination level, the width of road, the coefficient of utilization, the maintenance factor, the desired distance between street light poles, the pole height, the pole space to pole height ratio and the total length of the street (Akindipe, Olawale, & Bujko; Swathika, Karthikeyan, Subramaniam, Hemapala, & Bhaskar, 2022).

## II. METHODOLOGY

### A. Analytical Expressions for Determination of the Daily Load Demand of the Street Light

The design of the street light solar power system takes into consideration the desired illumination level (DILV), the width (WRD) of the case study road, the coefficient of utilization (CoU), the maintenance factor (Mf), as well as the desired distance between street light poles (DBP), pole height (PH), pole space to pole height ratio (STHR) and the total length of the street (PL). Based on these parameters, mean lumen of the lamp (ML) for the street light is given as:

$$ML = \frac{DILV(DBP)(WRD)}{C_0U(mf)} \quad (1)$$

Where

$$DBP = PH(STHR) \quad (2)$$

The wattage of the rating (WRL) for each of the street light is given as:

$$WRL = \frac{ML}{Leff} \quad (3)$$

Where  $Leff$  represents the luminous efficiency of the lamp. The number (NL) of required street lights poles to cover the street length is given as:

$$NL = \frac{PL+1000}{Dbtwpl} \quad (4)$$

Hence, the total power in watts (WTL) for the entire street lights and the daily energy demand (Eday) for Hday operating hours per day are given as:

$$WTL = WRL(NL) \quad (5)$$

$$Eday = WTL(hday) \quad (6)$$

### B. The Case Study Street Light and Meteorological datasets

Based on the analytical models presented in Equations 1 to 6, a case study street was considered and the solar power system design and evaluation was conducted using PVSyst software. Specifically, the case study street light is designed for IBB Avenue in Uyo (with latitude and longitude of 5.016982, 7.911769 respectively). The street is about 2.2 km based on Google map distance measurement tool, as shown in Figure 1. The daily load demand of the IBB Avenue street light is computed based on the dataset in Table 1 and the Equations 1 to 6 and the value of the daily energy demand is 125.8 kWh/day which is approximated to 126 kWh/day in the PVSyst software model of the daily energy demand profile, as shown in Figure 2.

The meteorological data for the IBB Avenue, as captured from National Aeronautics and Space Administration (NASA) portal using the PVSyst software is shown in Table 2. Also, the time evolution plot of the global solar radiation data on the horizontal plane and on the optimal tilted plane of the PV module are shown in Figure 3 while the time evolution plot of the ambient temperature is shown in Figure 4. The schematic diagram of the off grid solar power with backup generator is shown in Figure 5.

# Simulated Design and Evaluation of Centralized off Grid Street Light Solar Power System with Backup Generator

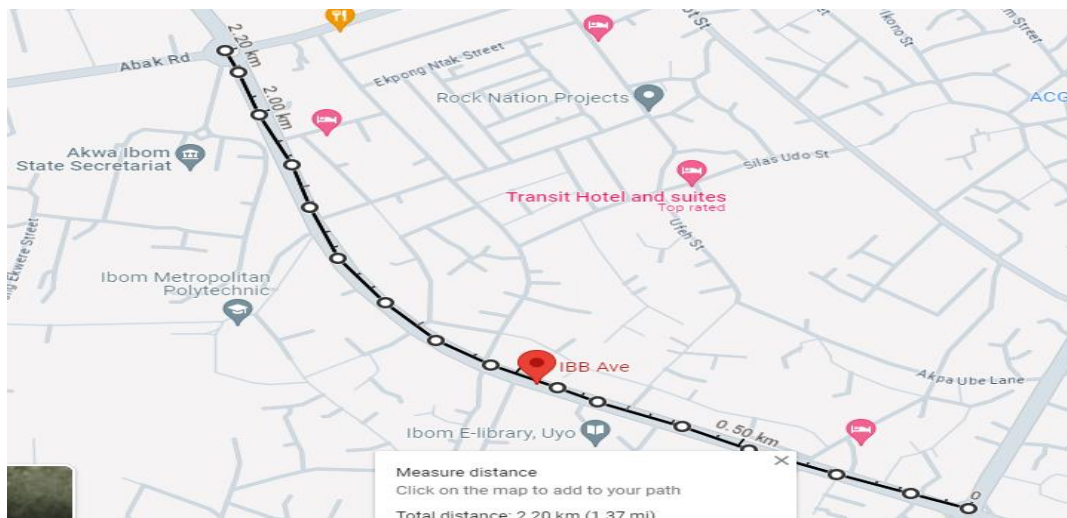


Figure 1. The Google map view of the case study IBB Avenue and path length of the street

Table 1 The case study IBB Avenue street light datasets

S/N	Parameter description	Parameter value
1	Luminous efficiency in lux/watt	124
2	Coefficient of utilization	0.77
3	Pole height in m	9
4	Required illumination lux level for the street in lux	42
5	Road width in m	8
6	Space to height ratio	2.5
7	Street light path length in km	2.2
8	Maintenance factor	0.8
9	Distance between the street light poles in m	22.5
10	Average required lumen of the lamp in lumens	12272.7
11	Wattage of each street light per pole in watts	99.0
12	Number of street light pole required	97.8
13	Total wattage of street light in kW	9.7
14	Number of operation hours per day	13.0
15	Daily energy demand of the street light in kWh	125.8

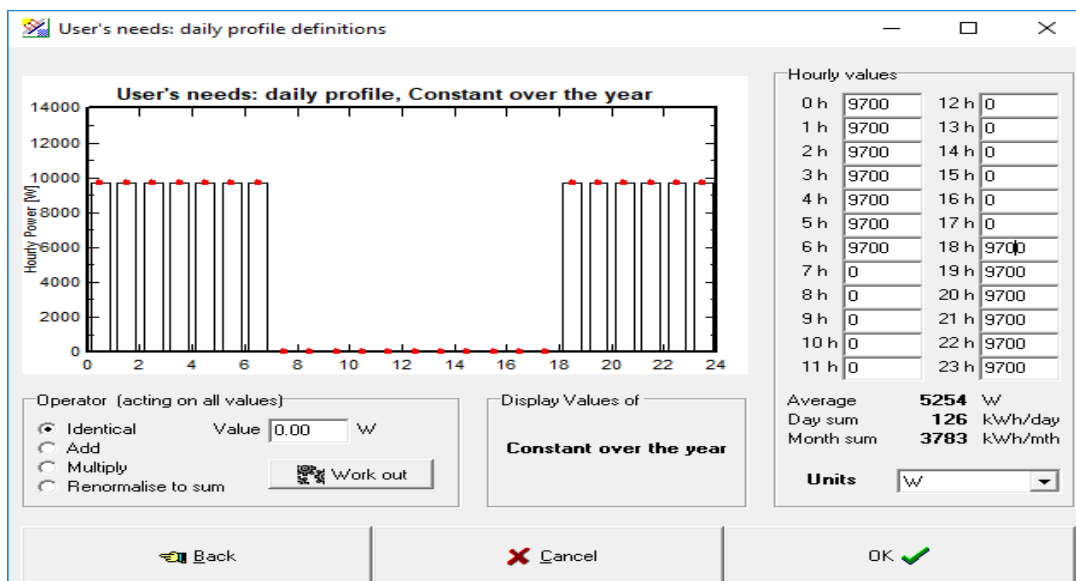


Figure 2. The PVSyst software model of the daily energy demand profile



# Simulated Design and Evaluation of Centralized off Grid Street Light Solar Power System with Backup Generator

Table 2. The meteorological data for the IBB Avenue

Meteo File NG_Ituk_Mbang_Uruan_SYN.MET, Monthly accumulations			
Meteo for Ituk Mbang Uruan, Synthetic data			
Plane: tilt 12°, azimuth 0°, Albedo 0.20			
Interval beginning	GlobHor kWh/m <sup>2</sup> .mth	GlobInc kWh/m <sup>2</sup> .mth	T Amb °C
January	170.5	183.7	25.10
February	159.6	166.8	25.40
March	154.1	154.4	25.40
April	138.6	134.7	25.50
May	133.9	126.7	25.40
June	108.0	101.8	24.60
July	98.9	95.0	23.80
August	96.4	93.5	23.60
September	97.8	96.8	23.80
October	112.5	113.7	24.10
November	128.7	134.8	24.50
December	159.3	173.7	24.80
Year	1558.3	1575.6	24.66

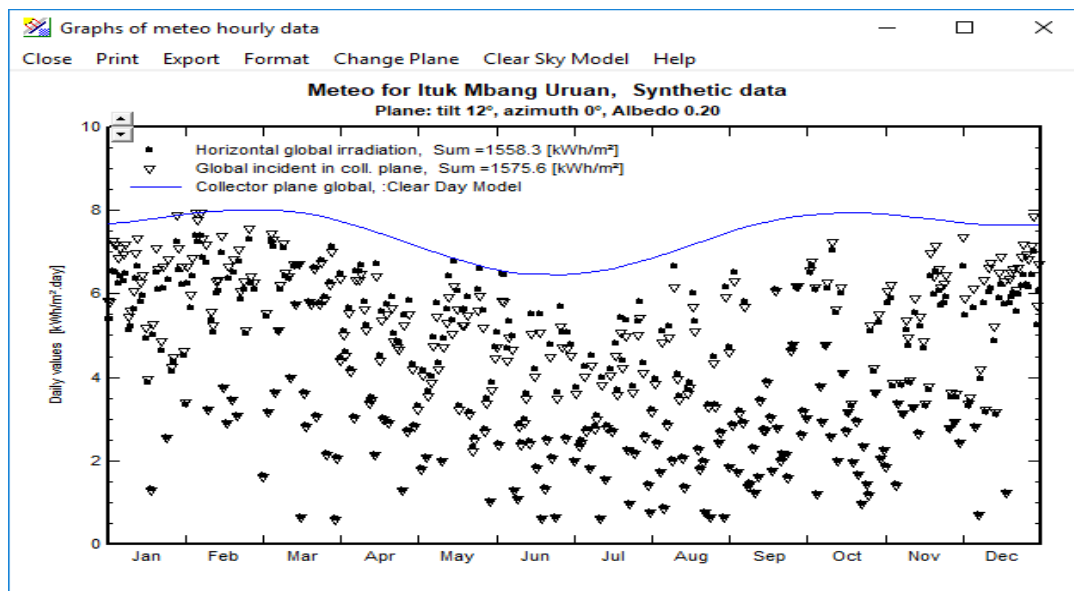


Figure 3. Time evolution plot of the global solar radiation data on the horizontal plane  
And on the optimaltilted plane of the PV module

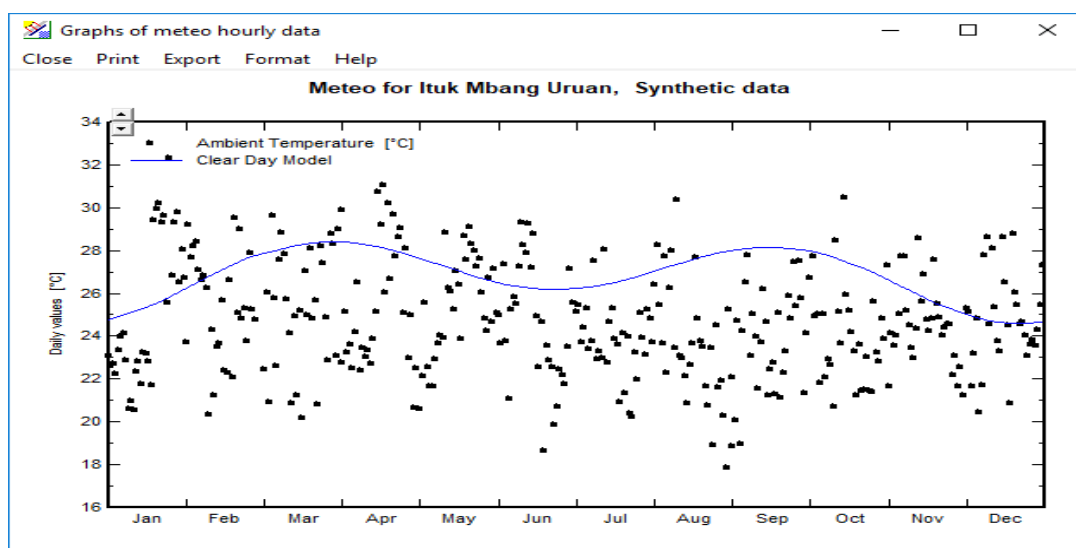


Figure 4 Time evolution plot of the ambient temperature

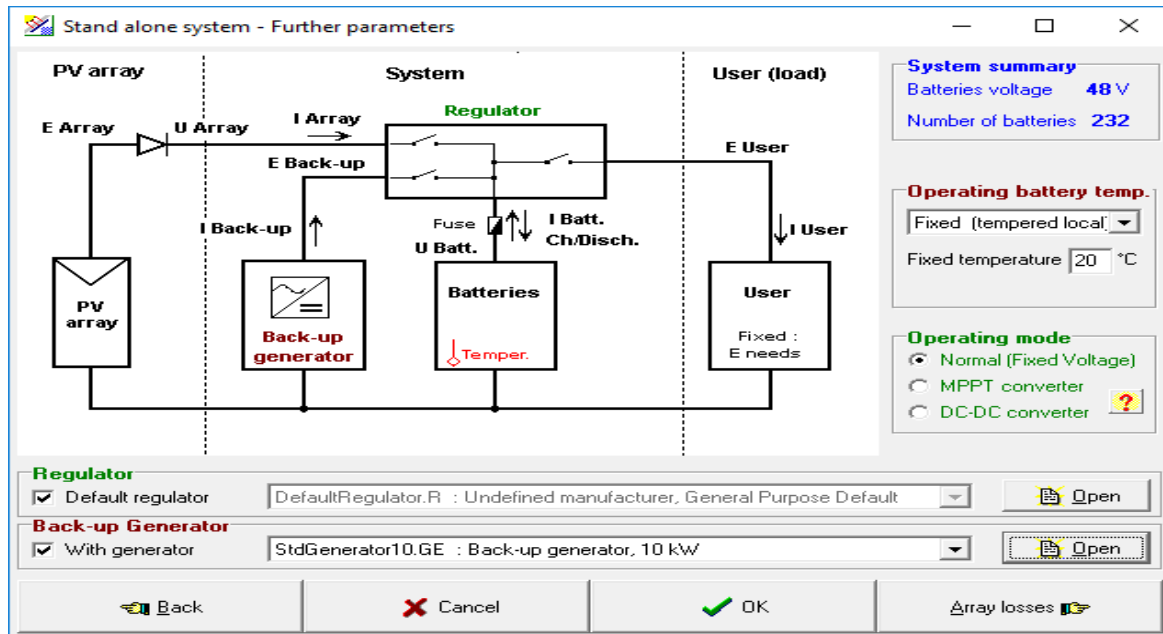


Figure 5. The schematic diagram of the off grid solar power with backup generator

### III. RESULTS AND DISCUSSION

The simulated configuration of the case study street light in PVSyst software is shown in Figure 6. The results on energy use and solar fraction are shown in Table 3. It shows that the solar fraction is 0.993 which indicates that 99.3 % of the energy demand of the street light is supplied from the solar power while the remaining 0.7% of the energy demand is supplied from the backup generator. The total energy supplied by the generator is 375.7 kWh whereas the total annual energy generated from the PV array is 53739 kWh. The annual total of the energy demand is 46059 kWh while the annual total of the energy supplied to the street light from the solar power system is 46027 kWh.

Figure 6. The simulated configuration of the case study street light in PVSyst software

## Simulated Design and Evaluation of Centralized off Grid Street Light Solar Power System with Backup Generator

**Table 3 The results on energy use and solar fraction**

	<b>EArray</b> kWh	<b>E Load</b> kWh	<b>E User</b> kWh	<b>E BkUp</b> kWh	<b>SolFrac</b>
<b>January</b>	4925	3909	3912	0.0	1.001
<b>February</b>	4287	3531	3533	0.0	1.001
<b>March</b>	4778	3909	3912	0.0	1.001
<b>April</b>	4419	3783	3786	0.0	1.001
<b>May</b>	4594	3909	3912	0.0	1.001
<b>June</b>	4275	3783	3786	0.0	1.001
<b>July</b>	4233	3909	3912	0.0	1.001
<b>August</b>	3996	3909	3912	375.7	0.905
<b>September</b>	4218	3783	3786	0.0	1.001
<b>October</b>	4522	3909	3912	0.0	1.001
<b>November</b>	4535	3783	3786	0.0	1.001
<b>December</b>	4959	3909	3912	0.0	1.001
Year	53739	46027	46059	375.7	0.993

**Table 4. The results on the monthly distribution of the mean battery state of charge, backup generator energy supply and system performance ratio**

	<b>SOCmean</b>	<b>T BkUp</b> Hour	<b>E BkUp</b> kWh	<b>FuelBU</b> liter	<b>Lur</b>	<b>PR</b>
<b>January</b>	0.816	0	0.0	0	0.010	0.388
<b>February</b>	0.828	0	0.0	0	0.007	0.396
<b>March</b>	0.839	0	0.0	0	0.013	0.433
<b>April</b>	0.818	0	0.0	0	0.009	0.470
<b>May</b>	0.810	0	0.0	0	0.026	0.522
<b>June</b>	0.819	0	0.0	0	0.013	0.575
<b>July</b>	0.702	0	0.0	0	0.021	0.634
<b>August</b>	0.686	37	375.7	98	0.029	0.573
<b>September</b>	0.793	0	0.0	0	0.023	0.594
<b>October</b>	0.837	0	0.0	0	0.030	0.534
<b>November</b>	0.845	0	0.0	0	0.032	0.453
<b>December</b>	0.848	0	0.0	0	0.009	0.402
Year	0.803	37	375.7	98	0.017	0.485

The results on the monthly distribution of the mean battery state of charge, backup generator energy supply and system performance ratio are shown in Table 4. The results show that the annual mean of the battery state of charge (SoC) is 80.3 %. Also, from the results in Table 4, it is noted that the month of August alone has about 375.7 kWh energy supply from the backup generator with about 98 liters of fuel. Furthermore, the performance ratio (PR) of the system is 48.5%. The results on the daily distribution of the backup generator energy supply in the month of August are shown in table 5 and Figure 7. The results show that backup generator is used for three days in August, namely, on the 13<sup>th</sup>, 14<sup>th</sup> and 15<sup>th</sup> of August, with the maximum supply of 239.8012 kWh occurring on the 14<sup>th</sup> day of August. On the other hand, the results on the daily distribution of unused energy in the month of August (shown in Table 6 and Figure 8) show that despite the low energy generation in August, there are still unused energy which are lost because the load is fully supplied, the battery is fully charged and still some excess energy is generated by the solar power which results in unused (lost) energy. In the month of August, the highest unused energy of 38.5122 kWh occurred on 17<sup>th</sup> of August (as shown in Table 6 and Figure 8). In all, the results show that the solar power system is able to supply the required energy demand of the case study street light with only 0.7% deficit which is supplied from the backup generator.

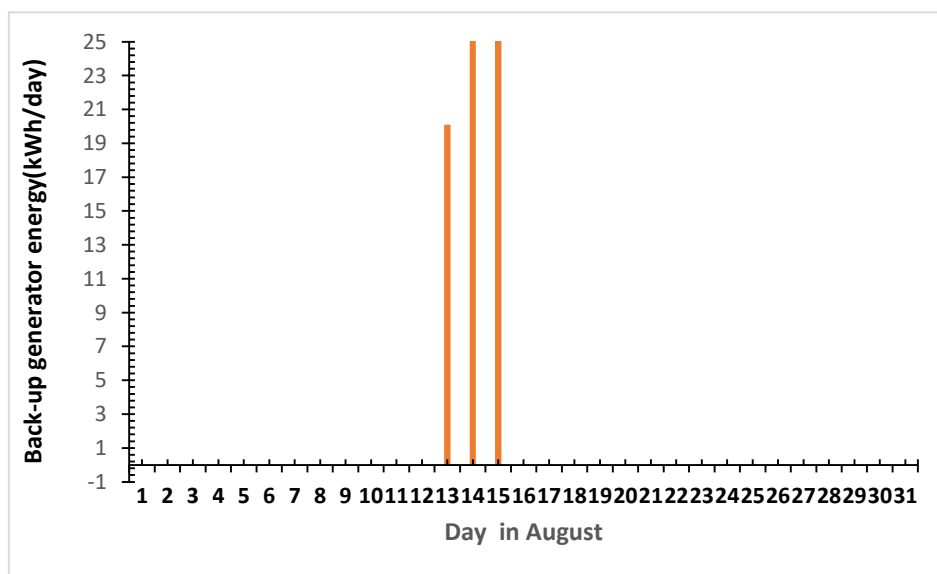
**Simulated Design and Evaluation of Centralized off Grid Street Light Solar Power System with Backup Generator**

**Table 5. Results on the daily distribution of the backup generator energy supply in the month of August**

Day in August	Backup generator energy (KWh/Day) with mean of 12.12 KWh/Day
1	0
2	0
3	0
4	0
5	0
6	0
7	0
8	0
9	0
10	0
11	0
12	0
13	20.0923
14	239.8012
15	115.7969
16	0
17	0
18	0
19	0
20	0
21	0
22	0
23	0
24	0
25	0
26	0
27	0
28	0
29	0
30	0
31	0

**Table 6 The results on the daily distribution of unused energy in the month of August**

Day in August	Unused energy (Full battery) loss (KWh/day) with mean of 7.781 KWh/day
1	0.3478
2	0
3	0
4	0.5783
5	0
6	0
7	0.3096
8	0
9	0.8609
10	0.4217
11	0
12	0.6418
13	0
14	0.4183
15	31.0398
16	27.9859
17	38.5122
18	38.1713
19	21.6266
20	13.8908
21	0.5635
22	0
23	0
24	0
25	0.2661
26	0
27	0
28	0
29	0
30	13.6664
31	51.9055



**Figure 7. The bar chart of the daily distribution of the backup generator energy supply in the month of August**

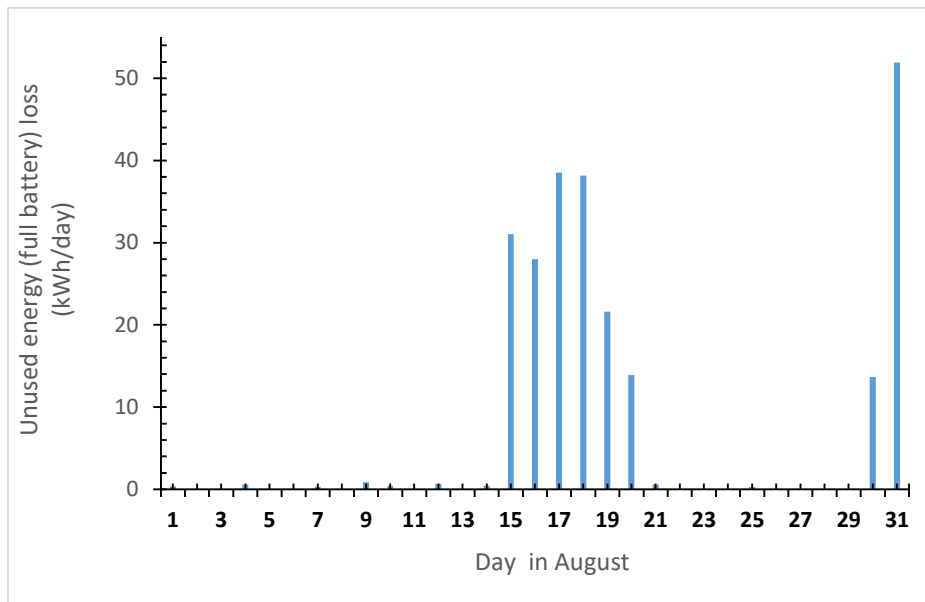


Figure 8. Bar chart of the daily distribution of unused energy in the month of August

#### IV. CONCLUSION

This paper presented the sizing of street light solar power system using PVsyst software and also the evaluation of key performance parameters of the solar power system. Some mathematical expressions for determining the daily energy demand of the street light are presented along with the case study streetlight design specifications. The PVsyst software simulation included backup generator to make up for loss of load incidence. The results showed that the solar power system was able to supply the load demand with over 99% solar fraction leaving only 0.7% of the power supply from the backup generator. Also, the month of August is the only month with power deficit from the solar power which prompted the use of the backup generator to makeup for the slight power supply deficit in August.

#### REFERENCES

- 1) Nkan, I. E., Okpo, E. E., Akuru, U. B., & Okoro, O. I. (2020). Contingency analysis for improved power system stability of the Nigerian 330 kV, 48-bus system using series FACTS controllers. *AIUE Congress 2020: International Conference on Use of Energy*.
- 2) Natala, H., Nkan, I. E., Okoro, O. I., & Obi, P. I. (2023). Investigation of the transfer capability of the Nigerian 330 kV, 58-bus power system network using FACTS devices. *ELEKTRIKA- Journal of Electrical Engineering*, 22(1), 53-62.
- 3) Okpo, E. E. & Nkan, I. E. (2016). Constructional Features and Performance Analysis of 3-Phase Linear Induction Motor. *International Journal of Scientific Innovations and Sustainable Development*, 6(1), 176-185.
- 4) Nkan, I. E., Okpo, E. E., & Inyang, A. B. (2023). Enhancement of Power Systems Transient Stability with TCSC: A Case Study of The Nigerian 330 kV, 48-Bus Network. *International Journal of Multidisciplinary Research and Analysis*, 6(10), 4828-4841.
- 5) Nkan, I. E., Okpo, E. E., & Nseobong, I. O. (2023). Optimum location of shunt FACTS devices for enhancement of power system loadability using continuation power flow. *International Multilingual Journal of Science and Technology (IMJST)*, 8(9), 6666-6674.
- 6) Abunike, E. C., Umoh, G. D., Nkan, I. E., & Okoro, O. I. (2021). Investigating the Magnetic Characteristics of 12/8 Switched Reluctance Motor for Enhanced Starting Torque. *Nigerian Journal of Technological Development*, 18(1), 70-75.
- 7) Okoro, O. I., Abunike, C. E., Akuru, U. B., Awah, C. C., Okpo, E. E., Nkan, I. E., Udenze, P. I., Innocent, U. O., & Mibunwe, M. J. (2022). A Review on the state-of-the-art optimization strategies and future trends of wound-field flux switching motors. *2022 IEEE PES/IAS PowerAfrica*, 1-5.
- 8) Nkan, I. E., Okoro, O. I., Awah, C. C., & Akuru, U. B. (2019). Investigating the dynamic stability of the Nigerian 48-bus systems for improved system performance using FACTS. *Proceedings of the 27th Domestic use of Energy Conference*.
- 9) Nkan, I. E., Okoro, O. I., Obi, P. I., Awah, C. C., & Akuru, U. B. (2019). Application of FACTS devices in a multi-machine power system for transient stability enhancement: A case study of the Nigerian 330 kV 48-bus system. *IEEE AFRICON*, Accra, Ghana, 1-9.

## Simulated Design and Evaluation of Centralized off Grid Street Light Solar Power System with Backup Generator

- 10) Nkan, I. E., Okpo, E. E., & Okoro, O. I. (2021). Multi-type FACTS controllers for power system compensation: A case study of the Nigerian 48-bus, 330 kV system. *Nigerian journal of Technological Development*, 18(1), 63-69.
- 11) Edifon, A. I., Nkan, I. E., & Macaulay, E. U. (2016). Comparative analysis of the performance of different photovoltaic (PV) technologies based on PVSyst thermal model. *Science Journal of Energy Engineering*, 4(6), 62-67.
- 12) Edifon, A. I., Nkan, I. E., & Ben, I. A. (2016). Estimation and ranking of the photovoltaic energy potential for local government areas in Akwa Ibom State, Nigeria. *Science Journal of Energy Engineering*, 4(6), 68-77.
- 13) Omorogiwa, E. & Okpo, E. E. (2015). PV-Diesel hybrid power system for a small village in Nigeria. *International Journal of Scientific Research Engineering Technology*, 1(4), ISSN (Online): 2395-566X.
- 14) Abunike, C. E., Umoh, G. D., Okpo, E. E., & Okoro, O. I. (2020). A comparative approach for the analysis of switched reluctance motors with modified rotor pole geometry. *Nigerian Journal of Engineering*, 27(3), 10-15.
- 15) Okpo, E. E., Okoro, O. I., Awah, C. C., & Akuru, U. B. (2019). Performance evaluation of 5.5 kW six-phase asynchronous motor. *2019 IEEE PES/IAS PowerAfrica, Abuja, Nigeria*, 639-644.
- 16) Awah, C. C., Okoro, O. I., Nkan, I. E., & Okpo, E. E. (2022). Impact of structural dimensions and poles on the torque performance of dual-stator permanent magnet machines. *Nigerian Journal of Technological Development*, 19(1), 68-79.
- 17) Ufot-Akpabio, A. M., Ofem, B. I., & Ufot-Akpabio, E. A. (2022). Sustainable urban development in Nigeria: Akwa Ibom State perspective. *Ethiopian Journal of Environmental Studies & Management*, 15(3).
- 18) Ufot-Akpabio, A. M., & Ofem, B. I. (2019). Urbanization and urban development in Nigeria: A perspective of Akwa Ibom State. *Journal of Agriculture, Environmental Resource and Management*, 4(2), 369-384.
- 19) Ukpong, D. E., & George, I. N. (2012). Socio-economic development of Nigeria and youth employment in 21st century: Implication for Akwa Ibom State. *Academic Research International*, 3(3), 288.
- 20) Oyosoro, F. I., & Okene, N. V. (2021). Insecurity in Akwa Ibom State: Issues, actors and solutions. *Insecurity in the Niger Delta*, 23.
- 21) Ibaba, S. I. (2011). Niger Delta: Interrogating the peace and development nexus. Department of Political Science, Niger Delta University, Monograph Series, (005), 35-37.
- 22) Akpakpan, I. R., & Uboegbulam, G. C. (2023). Cultural tourism impact on community development: A study of selected communities in Akwa Ibom State of Nigeria. *American Journal of Research in Humanities and Social Sciences*, 9, 109-118.
- 23) Obot, A. D. I. (2010). Redeeming the environmental plights of Nigerian cities: A case study of Uyo metropolis, Akwa Ibom State capital. *Ife Journal of Environmental Design and Management*, 4(1), 138.
- 24) Babatunde, M. O., Akinbulire, T. O., Oluseyi, P. O., & Emezirinwune, M. U. (2019). Techno-economic viability of off-grid standalone PV-powered LED street lighting system in Lagos, Nigeria. *African Journal of Science, Technology, Innovation and Development*, 11(7), 807-819.
- 25) Szakonyi, D., & Urpelainen, J. (2015). Energy poverty among urban street vendors in India: Evidence from Patna, Bihar. *Energy for Sustainable Development*, 24, 44-49.
- 26) Olatomiwa, L., Mekhilef, S., Huda, A. N., & Sanusi, K. (2015). Techno-economic analysis of hybrid PV–diesel–battery and PV–wind–diesel–battery power systems for mobile BTS: The way forward for rural development. *Energy Science & Engineering*, 3(4), 271-285.
- 27) Baqir, M., & Channi, H. K. (2022). Analysis and design of solar PV system using Pvsyst software. *Materials Today: Proceedings*, 48, 1332-1338.
- 28) Salmi, M., Baci, A. B., Inc, M., Menni, Y., Lorenzini, G., & Al-Douri, Y. (2022). Design and simulation of an autonomous 12.6 kW solar plant in the Algeria's M'sila region using PVSyst software. *Optik*, 262, 169294.
- 29) Akindipe, D., Olawale, O. W., & Bujko, R. (2022). Techno-economic and social aspects of smart street lighting for small cities—A case study. *Sustainable Cities and Society*, 84, 103989.
- 30) Swathika, O. G., Karthikeyan, K., Subramaniam, U., Hemapala, K. U., & Bhaskar, S. M. (2022). Energy efficient outdoor lighting system design: Case study of IT campus. In *IOP Conference Series: Earth and Environmental Science* (Vol. 1026, No. 1, p. 012029). IOP Publishing.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## The Role of Parents in Improving Early Childhood Literacy Skills



Partijem<sup>1</sup>, Ika Budi Maryatun<sup>2</sup>, Joko Pamungkas<sup>3</sup>

<sup>1,2,3</sup> Department of Early Childhood Education, Yogyakarta State University, Indonesia

**ABSTRACT:** This study aims to determine the role of parents in the development of early childhood literacy at State Kindergarten Pembina Bantul. The study population was parents of students in class A.4 at State Kindergarten Pembina Bantul, totalling 18 people. The sample was taken using total sampling technique. The instrument used was a closed questionnaire. The data analysis technique used percentage descriptive statistics. The results showed that the percentage of the role of parents in the development of early literacy in children aged 4-5 years at State Kindergarten Pembina Bantul was 62.36% (less). The description of each parent's role in early literacy development, Phonological Awareness of 65.83% is in the good category, Vocabulary Skill of 65.18 is in the good category, Print Motivation of 58.07% is in the less category, Print Awareness of 70.83% is in the good category, Letter Knowledge of 56.25% is in the less category, and Narrative Skills of 55.00% is in the less category.

**KEYWORDS:** parents' role, literacy, early childhood

### INTRODUCTION

Preparing superior resources to face the challenges of the disruption era requires innovation to develop better changes. In this case, education in Indonesia requires active cooperation to make education massive and useful. Early Childhood Education (ECE) is education provided to children from birth to six years old to ensure physically and mentally healthy growth and development (Harahap, 2021). The most important and fundamental early period throughout the growth and development span of human life is early childhood. In early childhood, all of a child's potential develops rapidly. This is when children experience a golden age, when they become sensitive or sensitised to various stimuli (Uce, 2017).

Ideal human resources are available for the urgency of education if provided early in life. To obtain optimal child development and growth, early childhood learning is essential to be delivered correctly. Reading and writing skills, which are needed during the preschool or basic literacy stage, are critical to a child's life, especially for academic success. Children who start learning to read at an early age and do not experience significant difficulties are more likely to become active readers than children who experience significant difficulties in learning to read. Children who have learnt to read early usually have parents who read to them frequently when they were young.

Every child has literacy skills that are important to have a good future. Literatus is the etymology of the word "literacy", which means "literate" (Silawati et al., 2018). Children's literacy skills are linked to language development. Children's language development consists of four aspects: speaking, reading, writing and listening (Hidayatussoalihah et al., 2022). Literacy is a child's ability to listen, understand spoken language, and communicate both orally and through pictures, all of which are shaped by interactions with their environment (Mardiyah, 2019). Literacy encompasses communication skills, reading, speaking, writing, listening, and critical and logical thinking, in addition to reading and writing skills (Prabowo et al., 2022). The important role of parents, teachers and the community as models is indispensable for literacy activities (Karima & Kurniawati, 2020).

Literacy is part of language development that needs to be stimulated from an early age. Literacy is a form of social collaborative interaction, which not only provides social functions to children, but also combines fun and satisfaction, which can increase children's desire to participate in various literacy activities. Literacy is part of language development that needs to be stimulated from an early age. Literacy is a form of social collaborative interaction, which not only provides a social function to the child, but also combines fun and satisfaction, which can increase the child's desire to participate in various literacy activities (Annisa & Eliza, 2021). Before children can read and write, they can have phonological awareness skills, letter knowledge, and master a variety of vocabulary. The introduction of literacy can be done in various ways with creativity and collaboration from educators and parents, such as role-playing, storytelling, painting and the like. However, the expected creativity and collaboration has not been well implemented. The National Institute of Child Health and Human Development explains that children must have six

## The Role of Parents in Improving Early Childhood Literacy Skills

early literacy skills in order to have good literacy skills (Burchinal, 2018). The six skills are Phonological Awareness, Vocabulary, Print Motivation, Print Awareness, Letter Knowledge, and Narrative Skills (Kurnia et al., 2022).

The phenomenon that exists in today's society where children before the age of five can read and the demands of education on children in formal education (primary school), there is a requirement to enter primary school that requires children to be able to read and write. That is why parents are competing to find their children schools with adequate quality in teaching reading and writing. Meanwhile, at home parents try to teach children to read in different ways. One of them is using storybooks as a medium used to stimulate children's abilities. With the development of technology today, children tend to spend time playing games and watching rather than reading. According to Kominfo, 60 million Indonesians own gadgets and rank fifth in the world in terms of gadget ownership. Ironically, the high number of gadget ownership is not able to be a solution to increase Indonesians' interest in reading, even though Indonesians can stare at gadget screens for about 9 hours a day (Arnita et al., 2022). Based on this data, it can be seen that Indonesian children spend more time in front of television and gadgets, and do activities that are not related to improving literacy skills. This phenomenon shows the importance of literacy for early childhood to develop children's ability to read and other skills from an early age.

One of the efforts in developing literacy in early childhood education is to provide activities related to literacy. The activity related to literacy is reading storybooks to children. As previous research has discussed a lot related to early childhood literacy development activities. The results of previous research illustrate that reading books to children can develop early childhood literacy. Reading books or telling stories is the provision of learning for children through reading books delivered by parents or adults to children orally (Rohman, 2017). A US Ministry of Education survey shows that children who are read to early in life learn quickly about books (Zati, 2018). Reading books is an activity that can be done by teachers at school and by parents at home. However, previous research states that parents' awareness in carrying out activities at home is still minimal. Early childhood literacy skills are only the responsibility of schools not for schools (Meliyanti et al., 2021), Therefore, there is a need for socialisation or assistance to parents in developing early childhood literacy.

Referring to previous research, the author feels the need to conduct research on literacy development carried out by parents to early childhood, so that children's literacy skills do not deteriorate due to the current state of technological development, knowledge about the importance of literacy is also not fully known by parents. The role of parents is very important in developing literacy skills from an early age. Based on this, the researcher intends to find out the role of parents in improving early childhood literacy at State Kindergarten Pembina Bantul.

### METHOD

The type of research used is descriptive quantitative with a survey method that describes the ability of parents to introduce early literacy to children. Quantitative descriptive research is research that describes variables as they are supported by data in the form of numbers generated from actual circumstances. The research was conducted in class A.4 of State Kindergarten Pembina Bantul. The population of this study were parents of students in class A.4 State Kindergarten Pembina Bantul, totalling 18 people. The sample was taken using total sampling technique.

The instrument used was a closed questionnaire. The questionnaire was developed based on early literacy theory and refers to previous studies. The questionnaire was developed based on the instrument grid, consisting of 35 statements with a score of 1-4. Reliability was tested with the Cronbach Alpha coefficient formula on SPSS 22 for windows software with a coefficient of 0.912. Early literacy indicators consisted of Phonological Awareness (awareness of sounds) (5 items), Vocabulary Skill (mastery of vocabulary) (7 items), Print Motivation (interest in print) (8 items), Print Awareness (sensitivity to writing) (5 items), Letter Knowledge (letter recognition skills) (5 items), and Narrative Skills (storytelling ability) (5 items) (Annisa & Eliza, 2021).

The data analysis technique uses percentage descriptive statistics. The results obtained are interpreted in the category, namely "very less" if 25-43%, "less" if 44-62%, "good" if 63-81%, and "very good" if 82-100%.

### RESULTS

The results of the analysis of parents' roles in early childhood literacy development at State Kindergarten Pembina Bantul are presented in Table 1.

**Table 1. The Role of Parents in Improving Early Childhood Literacy Skills at State Kindergarten Pembina Bantul**

No	Indicator	Percentage (%)	Category
1	<i>Phonological Awareness</i>	65,83	Good
2	<i>Vocabulary Skill</i>	68,15	Good
3	<i>Print Motivation</i>	58,07	Less



## The Role of Parents in Improving Early Childhood Literacy Skills

4	<i>Print Awareness</i>	70,83	Good
5	<i>Letter Knowledge</i>	56,25	Less
6	<i>Narative Skills</i>	55,00	Less
<b>Average</b>		<b>62,36</b>	<b>Less</b>

Table 1 above, the percentage of parents' role in early childhood literacy development at State Kindergarten Pembina Bantul is presented in the form of a graph as follows:

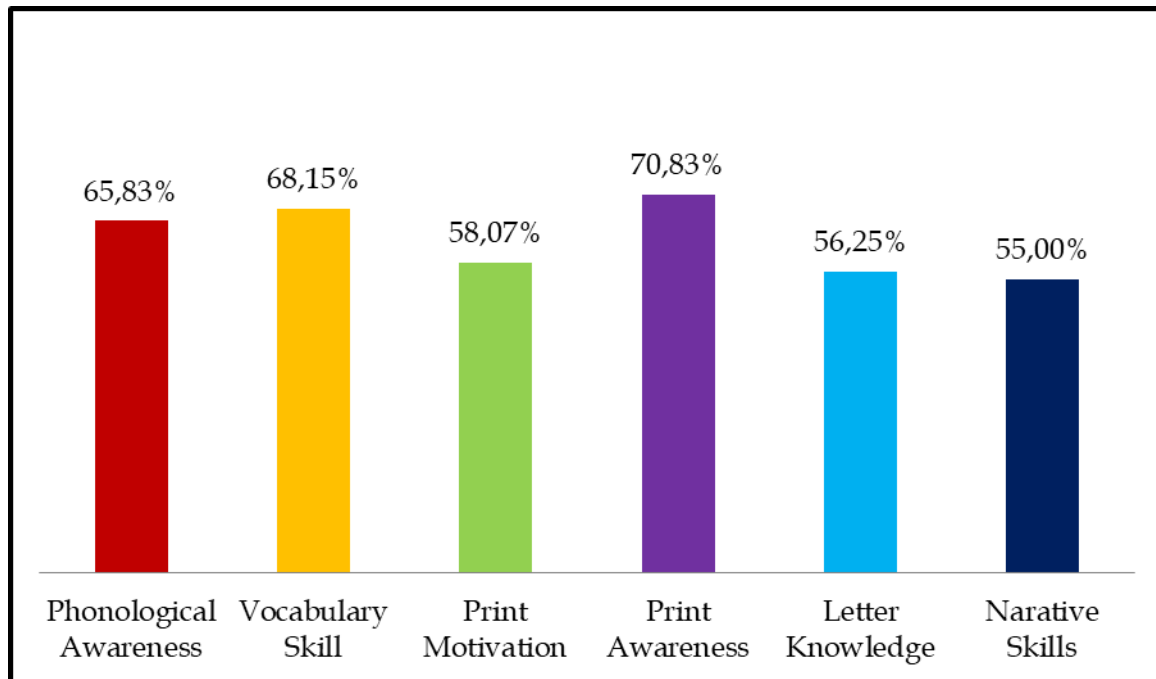


Figure 1: The Role of Parents in Improving Early Childhood Literacy Skills at State Kindergarten Pembina Bantul

Based on Table 1 and Figure 1, the percentage of parents' role in improving early childhood literacy at State Kindergarten Pembina Bantul is:

Based on the results of the overall analysis, it shows that the role of parents in developing early childhood literacy at State Kindergarten Pembina Bantul is 62.36% in the category of less. The formation of basic literacy skills in early childhood cannot occur in a short time, but the ability is also influenced by family role factors, especially mothers in developing these abilities to their children. Opinion (Widodo & Ruhaena, 2018) that children who receive good support and assistance from their parents will be able to learn and achieve better progress than children who do not receive support and assistance from their parents. The family is the main place for the formation and education of children. Families that realise the importance of literacy will provide stimulation to children through things such as providing various kinds of play media, such as storybooks, letter and number cards, inviting children to read stories together, and visiting the library.

Parents, especially mothers, are the primary madrasa for a child and parents play a significant role in every child's development, from character building to academic achievement. Parental involvement will stimulate children's development, as well as early literacy development. This is in line with the study (Ong'ayi et al., 2020) In Kenya, mothers reading books was associated with children's ability to read words, fathers reading books and playing together was associated with children's ability to identify letters and read words, and involvement of other household members in reading books was associated with children's ability to read words and recognise symbols. Early literacy skills are a must-have for children as they will open the gates for children to the next level of education.

The average percentage of parents' role in developing phonological awareness was 65.83%. This figure means that parents at State Kindergarten Pembina Bantul play a good role in developing children's phonological awareness. With this percentage, it can be seen that the children of State Kindergarten Pembina Bantul have a good ability to pronounce letters, spell, and recognise sounds, which will help children's academic achievement because it can be a determining factor in children's reading ability. Phonological awareness skill is the child's ability to recognise, distinguish, and manipulate sounds in language, voice, and one's speech. Phonological awareness skill is characterised by children's ability to hear, pronounce, play with sounds, and distinguish sounds. This ability is also a predictor of early reading ability in children (Barton-Hulsey et al., 2018). Based on the

## The Role of Parents in Improving Early Childhood Literacy Skills

theory and the results of the research, it is known that parents of children at State Kindergarten Pembina Bantul have been very instrumental in developing children's early literacy skills, especially phonological awareness. It can be predicted that children at State Kindergarten Pembina Bantul have phonological skills that will have a good impact on children's ability to read. Parents most often do singing and reciting the letters "a-z" with their children, while the least frequent activity done by parents is playing with sounds and voices.

The average percentage of the role of parents in developing children's vocabulary reached 68.15%, which means that parents at State Kindergarten Pembina Bantul have played a good role in developing children's vocabulary skills overall. From this figure, it can be seen that the early literacy skills of children at State Kindergarten Pembina Bantul in terms of vocabulary skills are well developed. Vocabulary skills are important in predicting children's reading development over time, because children's ability to master vocabulary is related to various aspects of reading (Hjetland et al., 2017). The most common role parents play is talking to their children. The least common role was reading books to the child. The clear growth of children's vocabulary is due to parents who have a lot of time to talk to their children. According to the theory and the results of the study, the researcher concluded that parents have done a good job of fulfilling their role as the main educational access in developing children's literacy, especially vocabulary skills. It is predicted that children at State Kindergarten Pembina Bantul have a good ability to understand and master vocabulary so that later it will be easier in the process of learning to read.

The average percentage of parents' role in developing children's interest in printed symbols/text reached 58.07%. This means that the parents of children at State Kindergarten Pembina Bantul play a lesser role and do not stimulate print motivation skills (children's interest in printed symbols/texts). Print motivation skill means that children have an interest in enjoying books. This skill will be well stimulated if it is supported by reading activities with children, providing time to tell stories, showing children the reading habits that parents have, and allowing children to choose books that they like. Children who are often given the stimulus to increase their interest in printed symbols or writing become more motivated to learn to read and have good academic achievement. Based on theory and research results, it can be seen that parents play a lesser role in developing children's print motivation skills. Therefore, the researcher argues that parents have not fully implemented their role as the main educational access in children's literacy development, especially print motivation skills. It can be concluded that children at State Kindergarten Pembina Bantul need to be given more stimulus in order to have motivation in learning to read, so that later the child does not find difficulties that cause the child to easily complain and give up when learning.

The average percentage of the role of parents in the development of print awareness skills reached 70.83%, this means that the parents of children at State Kindergarten Pembina Bantul play a good role in the development of skills to recognise printed symbols/text. With the percentage obtained, it can be predicted that the children of State Kindergarten Pembina Bantul have the ability to recognise, mark, and pay attention to the forms of symbols / writing in the environment. This figure shows that parents have played a role in developing children's print awareness skills. The most frequent role performed by parents is to invite children to write their names and the names of family members, and to interpret pictures. The least common role is to introduce letters and their shapes that can be written differently. Print awareness skill is a child's ability to recognise symbols such as letters, punctuation marks, logos, warning signs, and others (Bayraktar, 2018). This is consistent with the study (Brown et al., 2019) showed very positive results as evidenced by parent-child interactions. The findings also reveal that it is difficult to improve family literacy activities with busy parents, especially those who do not believe that reading aloud can improve children's reading. This means that family involvement, especially parents, in children's literacy development has a good impact on children's future literacy skills. Another definition of print awareness skill is the child's ability to point out words on the pages of a book, this awareness can be marked when the child is able to read words that exist anywhere, such as on shop labels, billboards, signboards, and includes learning to write. According to the theory and research results, it can be concluded that parents at State Kindergarten Pembina Bantul have carried out their role as the main educational access for children and play an important role in developing children's literacy, especially print awareness skills.

The average role of parents in developing children's letter knowledge is 56.25%. This figure means that parents at State Kindergarten Pembina Bantul are still less involved in developing letter knowledge. The most frequent role of parents is to write lowercase and uppercase letters from a-z. Meanwhile, the least frequent role of parents is to play letter games, such as stacking words and guessing letters. Letter knowledge is knowing that there are differences in each letter, some look similar, each has a name, and is associated with certain sounds. Learning to recognise letters is the first stage for children to achieve reading skills. Research results from (Chandra, 2017) shows that letter play activities can improve children's letter recognition skills. Based on the theory and the results of the study, it can be concluded that parents in the kindergarten of Pembina Bantul have not fulfilled their role as the main educational access for children in terms of literacy development, especially letter knowledge. So, it can be predicted that children in Bantul State Kindergarten do not have good enough skills to recognise or identify letters, and need to be given more stimulation to prepare them for reading.

## **The Role of Parents in Improving Early Childhood Literacy Skills**

The average percentage of the role of parents in developing children's storytelling skills reached 55.00%, which means that the role of parents at State Kindergarten Pembina Bantul is generally less involved in developing narrative skills in children. The role that parents do quite often is to be a listener for each child's story. While the least frequent form of role played by parents is role playing with children. Narrative is a universal tool used to inform, socialise, entertain and teach, in early childhood. Narrative skill means children's ability to retell, describe, and understand. Based on the theory and the results of the research, it can be concluded that the parents of children at State Kindergarten Pembina Bantul have not fulfilled their role as the main educational access for children in developing literacy, especially narrative skills. So, it can be concluded that children in Bantul State Kindergarten should get better stimulus so that they do not experience difficulties that will have an impact on children's reading ability later, where with this ability children can understand the reading material.

### **DISCUSSION**

The results above show that the role of parents in improving early literacy in children aged 4-5 years at State Kindergarten Pembina Bantul is still not optimal. Parents in literacy activities can be carried out including reading bedtime stories, giving examples of reading activities, singing, and introducing children's name writing. This is in accordance with the role of parents as literacy sources, literacy facilitators, and also as organizers of the implementation of literacy programs. The provision of early childhood literacy stimulation that is less appropriate needs to be addressed and for those that are appropriate, it needs to be more varied by adding play activities that suit children's needs. Some appropriate play activities for early childhood literacy stimulation are to invite children to talk and play related to letters and words, role play, introduce letters, writing, letter sounds, alphabet names, teach children to write, read storybooks and draw. These activities can be carried out with children at home, so as to provide maximum stimulation results for children.

The role of parents is very important for early childhood development because the learning that has been done at school can produce maximum abilities when parents repeat the learning that has been given at school (Wijayatiningsih et al., 2019). Early literacy education will have a positive impact on a child's academic performance. The practice of introducing early literacy by reading books to children has been proven to make children more successful in the academic field. This is because children who have been introduced to the world of literacy have better learning and communication skills than other children who have not received an introduction to literacy.

The increasingly sophisticated and modern conditions of the times require parents to be extra careful in protecting, guiding and paying attention to children's growth and development, so that they do not fall into the negative impact of the times. Parents must be observant of and follow technological developments in order to guide and direct their children. For this reason, parents should have broad insights in educating children that can be applied in the family. Parents can apply parenting that is wise, positive, effective, constructive, and transformative. There are many theories that explain parenting towards children in the family. In general, parenting in the family is divided into three categories: authoritarian, democratic, and permissive parenting (Indriani & Yemmarotillah, 2021).

Each parent does not have to use one type of parenting, but can combine certain types of parenting in educating and shaping children, so that good interactions occur. If the interaction between parents and children is well established, this can support physical, emotional, social, intellectual, and spiritual development from the time a child is in the womb until adulthood. Therefore, real parenting is an interaction that occurs between parents and their children in terms of fulfilling physical needs (eating, and drinking) and psychological needs (a sense of security, and affection), as well as socialising the norms that apply in society so that children can know and live in harmony, harmony and balance with their environment (Putro et al., 2020).

The role of parents in developing early childhood literacy skills should always provide positive things to children, including always praising children's learning progress, taking the time to accompany children in learning and buying children storybooks not only containing fairy tales but also science so that children can get used to reading. Literacy activities carried out are storytelling or reading stories. Reading storybooks to children can be done by teachers at school or parents at home. The selection of storybooks, namely the content of the story, is the right choice in reading books to children. The content of the story told directs children in receiving the knowledge conveyed by the story. In addition to the content of the book's story, the design of the book with children's pictures also has an appeal to children in listening to the story, which is no less important is the existence of the book itself. Parents can read storybooks to children at bedtime or certain times.

### **CONCLUSIONS**

Based on the results of data analysis and discussion, it can be concluded that the percentage of parents' role in improving early literacy in children aged 4-5 years at State Kindergarten Pembina Bantul is 62.36%. This percentage shows that parents in Pembina Bantul State Kindergarten still play a lesser role in developing early literacy in children. The description of each parent's

## The Role of Parents in Improving Early Childhood Literacy Skills

role in early literacy development, Phonological Awareness of 65.83% is in the good category, Vocabulary Skill of 65.18 is in the good category, Print Motivation of 58.07% is in the less category, Print Awareness of 70.83% is in the good category, Letter Knowledge of 56.25% is in the less category, and Narrative Skills of 55.00% is in the less category. Based on these results, parents are expected to understand the concept and importance of literacy to be stimulated in children, so that in the future parents are able to carry out various literacy activities with children at home. This will greatly help children to have broader literacy skills in the future.

### REFERENCES

- 1) Annisa, F., & Eliza, D. (2021). Peranan Orang Tua dalam Pengembangan Literasi Dini Selama Covid-19 pada Anak Usia 5-6 Tahun. *Cakrawala: Jurnal Pendidikan*, 15(1), 1–17.
- 2) Arnita, A., Febrian, D., Marpaung, F., Sinaga, M. S., & Yani, M. (2022). Peningkatan Kemampuan Literasi Anak Usia Sekolah Dasar dengan Funtastic Learning di Kelurahan Tegal Sari II Medan. *Jurnal Abdidas*, 3(3), 412–421.
- 3) Barton-Hulsey, A., Sevcik, R. A., & Ronski, M. (2018). The relationship between speech, language, and phonological awareness in preschool-age children with developmental disabilities. *American Journal of Speech-Language Pathology*, 27(2), 616–632.
- 4) Bayraktar, V. (2018). Investigating print awareness skills of preschool children in terms of child and parent variances. *EGITIM VE BILIM-EDUCATION AND SCIENCE*, 43(196).
- 5) Brown, C. L., Schell, R., Denton, R., & Knode, E. (2019). Family Literacy Coaching: Partnering with parents for reading success. *School Community Journal*, 29(1), 63–86.
- 6) Burchinal, M. (2018). Measuring early care and education quality. *Child Development Perspectives*, 12(1), 3–9.
- 7) Chandra, R. D. A. (2017). Pengembangan Media Visual Kartu Angka Efektif untuk Mengenalkan Huruf Vokal a, i, u, e, o pada Anak Usia Dini 3-4 Tahun PAUD Labschool Jember. *Jurnal INDRIA (Jurnal Ilmiah Pendidikan Prasekolah Dan Sekolah Awal)*, 2(1).
- 8) Harahap, A. Z. (2021). Pentingnya pendidikan karakter bagi anak usia dini. *Jurnal Usia Dini*, 7(2), 49–57.
- 9) Hidayatussoalihah, H., Karta, I. W., & Rachmayani, I. (2022). Deskripsi Kemampuan Literasi Anak Kelompok B di PAUD Negeri Kecamatan Palibelo Tahun 2022. *Jurnal Ilmiah Profesi Pendidikan*, 7(4), 2309–2316.
- 10) Hjetland, H. N., Brinchmann, E. I., Scherer, R., & Melby-Lervåg, M. (2017). Preschool predictors of later reading comprehension ability: A systematic review. *Campbell Systematic Reviews*, 13(1), 1–155.
- 11) Indriani, R., & Yemardotillah, M. (2021). Literasi Digital Bagi Keluarga Milenial Dalam Mendidik Anak Di Era Digital. *Continuous Education: Journal of Science and Research*, 2(2), 1–13.
- 12) Karima, R., & Kurniawati, F. (2020). Kegiatan Literasi Awal Orang Tua pada Anak Usia Dini. *Al-Athfal: Jurnal Pendidikan Anak*, 6(1), 69–80.
- 13) Kurnia, R., Ramdha, T., & Putra, Z. H. (2022). Implementation of Early Literacy Activities during COVID-19: A Parents Involvement Analysis. *International Journal of Instruction*, 15(2), 831–846.
- 14) Mardiyah, A. A. (2019). Budaya literasi sebagai upaya peningkatan keterampilan berpikir kritis di era industri revolusi 4.0. *Prosiding SNP2M (Seminar Nasional Penelitian Dan Pengabdian Masyarakat) UNIM*, 1, 171–176.
- 15) Meliyanti, M., Raraswati, P., Hidayat, D. N., & Aryanto, S. (2021). Kajian Literatur: Perkembangan literasi dan numerasi di lingkungan keluarga. *Jurnal Pendidikan Tambusai*, 5(3), 6504–6512.
- 16) Ong'ayi, D. M. M., Dede Yildirim, E., & Roopnarine, J. L. (2020). Fathers', mothers', and other household members' involvement in reading, storytelling, and play and preschoolers' literacy skills in Kenya. *Early Education and Development*, 31(3), 442–454.
- 17) Prabowo, R. A., Budiyono, K., & Norhalimah, N. (2022). Membangun Budaya Literasi Anak Usia Dini Dengan Penguatan Pendampingan Keluarga. *Al-Madrasah: Jurnal Pendidikan Madrasah Ibtidaiyah*, 6(3), 667–675.
- 18) Putro, K. Z., Amri, M. A., Wulandari, N., & Kurniawan, D. (2020). Pola interaksi anak dan orangtua selama kebijakan pembelajaran di rumah. *Fitrah: Journal of Islamic Education*, 1(1), 124–140.
- 19) Rohman, S. (2017). Membangun budaya membaca pada anak melalui program gerakan literasi sekolah. *TERAMPIL: Jurnal Pendidikan Dan Pembelajaran Dasar*, 4(1), 151–174.
- 20) Silawati, E., Harun, C. A., Ananthia, W., Muliawati, D. N., Yuniarti, Y., & Yuliatiningsih, M. S. (2018). Literasi media anak usia dini: Strategi penanggulangan kekerasan seksual pada anak. *Prosiding Seminar Nasional & Internasional*, 1(1).
- 21) Uce, L. (2017). The golden age: Masa efektif merancang kualitas anak. *Bunayya: Jurnal Pendidikan Anak*, 1(2), 77–92.
- 22) Widodo, M. M., & Ruhaena, L. (2018). Lingkungan literasi di rumah pada anak pra sekolah. *Indigenous: Jurnal Ilmiah Psikologi*, 3(1), 1–7.

## The Role of Parents in Improving Early Childhood Literacy Skills

- 23) Wijayatiningsih, T. D., Budiastuti, R. E., Ifadah, M., Mulyadi, D., & Aimah, S. (2019). Persepsi Siswa dan Guru TK Bunga Cahaya terhadap Implementasi Literasi Sejak Dini. *Prosiding Seminar Nasional Pascasarjana (Prosnampas)*, 2(1), 871–875.
- 24) Zati, V. D. A. (2018). Upaya untuk meningkatkan minat literasi anak usia dini. *Jurnal Bunga Rampai Usia Emas*, 4(1), 18–21.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## The Influence of Brand Image, Product Quality and Sales Promotion on Shopping Interest in Online Marketplaces



Robi Darmawan<sup>1</sup>, Sekar Dinda Pratiwi<sup>2</sup>, Dyah Ayu Safitri<sup>3</sup>, Lidya Pratama Sari<sup>4</sup>, Nadya Desi Aulia<sup>5</sup>, Renny Sari Dewi<sup>6</sup>, Maryam bte Badrul Munir<sup>7</sup>

<sup>1,2,3,4,5,6,7</sup> Faculty of Economics and Business, Universitas Negeri Surabaya, Indonesia

**ABSTRACT:** The Republic of Indonesia is currently undergoing a transformative phase known as the Fourth Industrial Revolution. The fourth industrial revolution, sometimes referred to as Industry 4.0, entails the integration of automation technology and data interchange within the realm of manufacturing technology. The swift advancement of the industrial revolution serves as a catalyst for commercial entities to enhance their operational efficiency. During the contemporary era of industrial revolution, commercial entities have undertaken numerous endeavours to ensure that the products they promote adhere to consumer standards. In order to investigate the extent to which brand image, product quality, and sales promotion impact sales in the online marketplace, the researcher conducted a study named "The Influence of Brand Image, Product Quality, and Sales Promotion on Shopping Interest in the Online Marketplace." The present study employed quantitative research methods, specifically utilising a correlational research design. The findings indicated that the variables of brand image, product quality, and sales promotion exert an impact on the level of student interest in engaging in online marketplace transactions. This study examines the relationship between the variable X1, representing brand image, and data adequacy. The findings indicate that X1 has the biggest influence on data adequacy, with a coefficient of 0.848. Furthermore, the indicators X1.1 and X1.2, which pertain to firm image and customer image respectively, exhibit the strongest influence on the dependent variable Y.

**KEYWORDS:** brand image, marketplace, product quality, sales promotion, shopping interest

### I. INTRODUCTION

Indonesia is presently undergoing the fourth industrial revolution. The Industrial Revolution 4.0 refers to the integration of automation technology and data interchange within the realm of manufacturing technology. The current industrial period facilitates the utilisation of contemporary technology that is capable of functioning across all sectors of the economy. The inception of the fourth industrial revolution, commonly referred to as Industry 4.0, commenced in the year 2016. This era is characterised by the emergence of the digital economy, big data analytics, the Internet of Things (IoT), robotics, and cloud computing systems. These technological advancements continue to shape contemporary activities. The objective of the Industrial Revolution 4.0 initiative is to stimulate and enhance Indonesia's economy, positioning it among the top 10 global economies by 2030 through the augmentation of export operations. The Ministry of Industry in Indonesia actively promotes the advancement of Industry 4.0, as seen by the establishment of the Kominfo page (2019). The Government of Indonesia must make preparations for the advent of the fifth-generation network, commonly referred to as the 5G network, as part of their efforts to embrace Industry 4.0. The industrial revolutions have both positive and negative affects on many stakeholders and serve different purposes. The anticipation of the potential failure to attain the industrial revolution holds significant importance in view of the continuously escalating global issues. The advent of the Industry 4.0 era is intricately linked to the swift and widespread progress observed in the realm of commerce. This assertion can be substantiated by the emergence of digital enterprises that provide a wide array of advantages, hence generating substantial demand across various age demographics.

In order to enhance product sales outcomes and mitigate losses, the adoption of a brand image is a key strategy. Brand image refers to the evaluation and perception of consumers regarding the goods or services being promoted within a specific market, as stated by Aakel and Biel (1993) and Mahiri (2020). Consumers have the ability to develop this evaluation from personal experiences or by considering the reputation given by other individuals and various media outlets. Furthermore, Keller (2000) posits, as supported by Ikhbarul Kahfa and Wahjono (2023), that brand image refers to the consumer's perception of a brand or product, both in terms of its intended use and actual usage. This image encompasses multiple facets, specifically the brand's

## **The Influence of Brand Image, Product Quality and Sales Promotion on Shopping Interest in Online Marketplaces**

memorability, recognizability, and positive repute. The presence of a brand image facilitates consumer engagement and transactions, as well as enhances the accessibility of information regarding the range of products or services provided by the associated firm, including attributes such as durability, materials, prices, and more. The utilisation of brand image apps in the online marketplace is widely favoured by the younger demographic in contemporary times. Online marketplaces offer brands the opportunity to enhance brand recognition and drive sales, while concurrently facilitating brand discovery among untapped client segments. Moreover, these platforms enable firms to explore international markets, evaluate their viability, and effectively liquidate excess inventory within an off-price setting. Nevertheless, it is crucial for brands to acknowledge that engaging in marketplace sales might potentially exert strain on profit margins and impose restrictions on their ability to manage the consumer experience. In general, markets present a valuable avenue for businesses to access a diverse range of consumers and should be seen as a crucial component of a comprehensive brand strategy. The authors did a research study named "The Impact of Brand Image, Product Quality, and Sales Promotion on Consumer Interest in the Online Marketplace."

### **II. LITERATURE REVIEW AND HYPOTHESES**

In the study conducted by Pandiangan et al. (2021), it was found that brand image serves as a cognitive cue utilised by customers to assess a product in situations where they possess limited knowledge about it. The attitudes and inclinations of consumers towards a brand are strongly connected to the impact of brand image on a product. According to Bagas et al. (2017), corporations strategically develop distinct brand images for their products in order to establish differentiation from competitors within the market. According to Huda (2020), there is a positive correlation between the strength of a product's developed brand image and its ability to attract people for purchase. The establishment of a robust brand entails the construction of a distinct and memorable image, which serves to fortify its standing in the minds of consumers. This process involves the cultivation of perceptions that are shaped by the brand's interactions and connections with its client base (Winarto, 2011).

According to Kotler and Keller (2015), quality refers to the comprehensive set of attributes and features inherent in a product or service, which determine its capacity to meet consumer needs. According to Tjiptono in Mamahit's (2015) study, the concept of quality encompasses multiple elements within a product offering, which in turn result in advantageous outcomes for clients. According to Irawan and Japariato (2008), product quality can be defined as a collection of properties inherent in a good or service that enables it to fulfil consumer needs. These attributes encompass several aspects such as durability, reliability, accuracy, ease of maintenance, and other pertinent characteristics of the product. Ernawati (2019) posits that the decision-making process of customers is strongly influenced by product quality, since it directly impacts their purchase decisions.

Sales promotion, referred to as promotional sales, is a marketing strategy that offers further value or incentives to salespeople, distributors, or end customers in order to stimulate swift sales (Belch & Belch, 2015: 529, as referenced in Adi, 2022). Kotler and Armstrong (2006: 441) assert that Anugrahita and Samiono (2015) contend that sales promotion is linked to immediate incentives aimed at stimulating the acquisition or sale of a product or service. Sales promotion is a strategic marketing activity aimed at enhancing sales and providing supplementary value for products and services to consumers (Hermansyah et al., 2022).

Kotler (2008), as cited in Sarah and Rahman (2019), posits that shopping interest or buying interest is a phenomenon that occurs in response to stimuli encountered when observing a product. Subsequently, an inclination to make a purchase arises with the intention of acquiring this commodity. According to a study conducted by Rizky and Yasin (2014), as referenced by Syahnaz and Wahyono (2016), purchasing interest is a prevalent inclination among purchasers, occasionally leading to conflicts with their financial circumstances. Buyer purchasing intent is a latent inclination residing within the cognitive realm of the buyer.

### **III. RESEARCH METHOD**

The research employed a quantitative methodology, utilising a correlation model. Quantitative research methods encompass systematic approaches to acquiring knowledge and addressing problems, utilising numerical data sets as the primary form of information (Nasehudin & Gozali, 2012). The purpose of this correlation study methodology is to establish associations or identify connections between two variables. This study examines the relationship between the independent variable and the dependent variable. The independent variables examined in this research include brand image, product quality, and sales promotion, while the dependent variable is shopping interest.

The author employs expert theory to establish and ascertain the demographic and research sample for the study. As stated by Margono in Hernaeny's (2021) study, the population mean refers to the aggregate data that is the primary subject of investigation within a specific domain and timeframe. When an individual presents data, the magnitude or quantity of the extant population will correspond to the provided numerical value, hence implying an association between population and data. The study's sample comprises students enrolled in the Faculty of Economics and Business at Surabaya State University, spanning the years 2020 to 2022.

## The Influence of Brand Image, Product Quality and Sales Promotion on Shopping Interest in Online Marketplaces

The research sample refers to a subset of the population that is selected for the purpose of study, with the intention of being representative rather than comprising the entire population (Supardi, 1993). In essence, the sample can be defined as a portion extracted from the population that is deemed adequate for representing the population as a whole. The research sample comprised students enrolled in the Faculty of Economics and Business at Surabaya State University between 2020 and 2022. The inclusion criteria for the sample were active enrollment as students and utilisation of online marketplace applications. The research employed a probability sampling technique, namely proportional random sampling. Proportional random sampling is a method that guarantees an equal opportunity for every individual within a population to be chosen. The Taro Yamane formula, as described by Imron (2017), was employed in this study to estimate the appropriate sample size. Consequently, a sample of 100 respondents was obtained.

This study employs primary and secondary data sources in its research methodology. Primary data sources refer to data that is collected directly from original sources, as stated by Pramiyati et al. (2017). Sugiyono in Batubara (2015) elucidates the concept of primary data sources, which he defines as the direct providers of data to researchers. The material utilised in this study was derived from the company's official statements and explanations that are directly pertinent to the conducted research. Alternatively, primary data sources can be defined as sources of data that are directly received from the original source, including but not limited to interviews, observations, or questionnaires. According to Sugiyono as cited in Batubara (2015), secondary data sources refer to data that are not obtained directly from the primary source. For instance, it originates from the field of literature and the discipline of literary studies. The data utilised in this study is derived from both primary and secondary sources. The research utilised questionnaires as the primary data source, while the secondary data source consisted of literature studies derived from publications in scientific journals, theses, and books. The data analysis techniques employed in this study encompass validity tests, reliability tests, communality tests, KMO Bartlett tests, Pearson correlation tests, and dimension reduction tests.

### IV. RESULT AND DISCUSSION

Once the requisite data has been acquired, the subsequent step involves subjecting the data to testing using SPSS for Windows version 24. The tests conducted include the validity test, reliability test, Pearson correlation test, communality test, KMO Bartlett test, and dimension reduction test.

#### 1. The Assessment of Validity

The validity test is employed by researchers to assess the validity of a questionnaire. According to Ghozali (2018: 51), the validity of an instrument or questionnaire is determined by its ability to elicit information that corresponds to the intended measurements. According to Raharjo (2014), the validity test determines the validity of a decision-making process by considering if the two-tailed significance value is less than 0.05. The results of the validity test for the variables of brand image, product quality, sales promotion, and shopping interest indicate that a total of 98 question items have been deemed valid. The given data satisfies the specified criteria, as indicated by a significance value of less than 0.05. Hence, a total of 98 question items meet the criteria for inclusion in the questionnaire.

#### 2. Reliability Test

**Table 1. Reliability Test X1**

Reability Statistics	
Cronbach's Alpha	N of Itens
.894	15

The results of the reliability test conducted on the Brand Image ( $X_1$ ) variable indicate that the Cronbach's alpha value for this variable is higher than the threshold value of 0.6, namely  $0.894 > 0.6$ . The findings of this study indicate that each statement in the questionnaire pertaining to the Brand Image ( $X_1$ ) variable can be considered reliable and trustworthy.

**Table 2. Reliability Test X2**

Reability Statistics	
Cronbach's Alpha	N of Itens
.938	39

The results of the reliability test conducted on the variable representing product quality ( $X_2$ ) indicate that its Cronbach's alpha value is higher than the established threshold of 0.6, specifically 0.938. The findings from the reliability test conducted on the



## The Influence of Brand Image, Product Quality and Sales Promotion on Shopping Interest in Online Marketplaces

Product Quality variable (X<sub>2</sub>) indicate that each statement within the questionnaire pertaining to the Product Quality (X<sub>2</sub>) variable may be considered reliable and dependable.

**Table 3. Reliability Test X3**

Reability Statistics	
Cronbach's Alpha	N of Itens
.935	14

The reliability test conducted on the sales promotion variable (X<sub>3</sub>) reveals that its Cronbach's alpha value is higher than the threshold value of 0.6, specifically 0.935. The findings of this study demonstrate that all statements within the questionnaire pertaining to the Sales Promotion (X<sub>3</sub>) variable have been assessed as reliable and credible.

**Table 4. Reliability Test Y**

Reability Statistics	
Cronbach's Alpha	N of Itens
.900	30

The findings of the reliability test conducted on the shopping interest variable (Y) indicate that variable's Cronbach'alpha value is greater than the primary, namely 0.900 > 0.6.. The findings of this study demonstrate that all items in the questionnaire assessing the variable of Shopping Interest (Y) have been determined to possess high levels of trustworthiness and dependability.

### 3. Pearson Correlation Test

**Table 5. Pearson Correlation Test**

X1		X2	X3	Y	
X1	Pearson Correlation	1	.800**	.642**	.607**
	Sig. (2-tailed)		.000	.000	.000
	N	102	102	102	102
X2	Pearson Correlation	.800**	1	.769**	.785**
	Sig. (2-tailed)	.000		.000	.000
	N	102	102	102	102
X3	Pearson Correlation	.642**	.769**	1	.500**
	Sig. (2-tailed)	.000	.000		.000
	N	102	102	102	102
Y	Pearson Correlation	.607**	.785**	.500**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	102	102	102	102

The table reveals a discernible association between the brand image variable (X<sub>1</sub>) and shopping interest (Y). The Pearson correlation coefficient of 0.607 indicates a high positive link between brand image and shopping interest, placing it inside the category of strong correlation. The brand image's contribution may be calculated using the formula is  $R^2 = r^2 \times 100\%$ , where r represents the correlation coefficient. In this case, the correlation coefficient is 0.607. By substituting this value into the formula, we find that the brand image's contribution is equal to  $(0.607)^2 \times 100\%$ , which simplifies to 36.8%. This indicates that 36.8% of the variance in the shopping interest variable (Y) may be accounted for by the brand image variable (X<sub>1</sub>), while the remaining 63.2% is attributable to other factors not examined in this study.

The table displays a discernible association between the variable of product quality (X<sub>2</sub>) and the level of purchasing interest (Y). The Pearson correlation coefficient is calculated to be 0.785, indicating a high positive link between product quality and shopping interest. The contribution of product quality can be calculated using the coefficient of determination, denoted as R<sup>2</sup>. In this case, R<sup>2</sup> is equal to the square of the correlation coefficient, r, multiplied by 100%. By substituting the given value of r (0.785) into the equation, the contribution of product quality is determined to be 61.6% ( $R^2 = r^2 \times 100\% = (0.785)^2 \times 100\% = 61.6\%$ ). The findings indicate that the product quality variable (X<sub>2</sub>) accounts for 61.6% of the variation in the shopping interest variable (Y), while the remaining 38.4% can be attributed to factors not examined in this study.

The table reveals a discernible association between the sales promotion variable (X<sub>3</sub>) and shopping interest (Y). The Pearson correlation coefficient is shown to be 0.500, indicating a moderate positive link between sales promotion and shopping interest.

## The Influence of Brand Image, Product Quality and Sales Promotion on Shopping Interest in Online Marketplaces

The sales promotion's contribution can be calculated using the formula  $R^2 = r^2 \times 100\%$ , where  $R^2$  represents the contribution and  $r$  represents the proportion. In this case, the proportion is 0.500, resulting in a contribution of 25% ( $R^2 = r^2 \times 100\% = (0.500)^2 \times 100\% = 25\%$ ). This implies that 25% of the variance in the shopping interest variable (Y) may be accounted for by the sales promotion variable ( $X_3$ ), while the remaining 75% is attributable to other factors not examined in this study. The null hypothesis ( $H_0$ ) is rejected and the alternative hypothesis ( $H_a$ ) is accepted based on the statistical significance level ( $sig. = 0.000 < 0.05$ ). Consequently, it can be concluded that each variable examined in this study exhibits a statistically significant association.

### 4. Communalities Test

**Table 5. Communalities Test X1**

Reability Statistics	
Cronbach's Alpha	Initial
.765	1000

From the table, it can be seen that the value of  $X_1$  is 0.765, this means that 76.5% of the  $X_1$  magnitude variable can be explained by the factors formed.

**Table 6. Communalities Test X2**

Reability Statistics	
Cronbach's Alpha	Initial
.927	1000

From the table, it can be seen that the value of  $X_2$  is 0.927, this means that 92.7% of the variable amount of  $X_2$  can be explained by the factors formed.

**Table 7. Communalities Test X3**

Reability Statistics	
Cronbach's Alpha	Initial
.927	1000

From the table, it can be seen that the value of  $X_3$  is 0.691, this means that 69.1% of the  $X_3$  magnitude variable can be explained by the factors formed.

**Table 8. Communalities Test Y**

Reability Statistics	
Cronbach's Alpha	Initial
.927	1000

Based on the test results in the table above, it can be seen that the value of Y is 0.681, this means that 68.1% of the variable magnitude of Y can be explained by the factors formed.

### 5. KMO Bartlett Test

**Table 9. KMO and Bartlett Test**

Kaiser-Meyer-Olkin Measure of Sampling Adqeuncy		.729
Bartlett's Test of Sphericity	Approx . Chi Square	291.353
	df	6
		Sig.
		.000

**Table 10. Anti-image Metrics**

	X1	X2	X3	Y
Anti-image Covariance	X1	.358	-.115	-.022
				.013

## The Influence of Brand Image, Product Quality and Sales Promotion on Shopping Interest in Online Marketplaces

	X2	-.115	.146	-.136	-.147
	X3	-.022	-.136	.379	.095
	Y	.013	-.147	.095	.358
Anti-image Correlation	X1	.848 <sup>a</sup>	-.500	-.059	.036
	X2	-.500	.649 <sup>a</sup>	-.577	-.643
	X3	-.059	-.577	.757 <sup>a</sup>	.258
	Y	.036	-.643	.258	.720 <sup>a</sup>

From the table, it can be interpreted that the significance value of the Kaiser- Meyer-Olkin Measure of Sampling Adequacy is 0.729 or this value is greater than 0.5. Likewise, the MSA value in the Anti image Matrices table is as follows:

$$X1 = 0.848 > 0,5$$

$$X2 = 0.649 > 0,5$$

$$X3 = 0.757 > 0,5$$

$$Y = 0.720 > 0,5$$

So it can be concluded that each variable in this study is sufficient for further analysis. And variable  $X_1$  is the variable that has the highest influence on data adequacy.

### 6. Dimension Reduction Test

**Table 11. Dimension Reduction Test**

Component	Total	Initial Eigenvalues	Cumulative %	Extraction Sums of Squared Loadings		
		% of Variance		Total	% of Variance	Cumulative %
1	8.428	60.203	60.203	8.428	60.203	60.203
2	1.294	9.243	69.447	1.294	9.243	69.447
3	.854	6.102	75.549			
4	.672	4.802	80.352			
5	.483	3.448	83.799			
6	.453	3.236	87.035			
7	.376	2.688	89.723			
8	.328	2.341	92.064			
9	.274	1.960	94.024			
10	.229	1.633	95.657			
11	.204	1.457	97.114			
12	.168	1.199	98.312			
13	.128	.916	99.228			
14	.108	.772	100.000			

Based on the information provided in the table, it can be inferred that component 1 in the Initial Eigenvalues table has a value of 8.428%, which exceeds 1. Hence, the initial component accounts for 60.203% of the observed variation. In the above table, it can be observed that the value of component 2 is 1.294%, which can be interpreted as being more than 1. Hence, the initial component accounts for 9.243% of the observed variation. In components 3 to 14, the value is less than 1, so precluding it from being a factor. Therefore, it can be inferred that the variables with the most significant influence on Y are Indicator X1.1, also known as the Company Image Indicator, and Indicator X1.2, commonly referred to as the Consumer Image Indicator.

### V. CONCLUSION

Based on the findings of previous studies conducted on students enrolled in the Faculty of Economics and Business at State University of Surabaya, it can be inferred that the factors of brand image, product quality, and sales promotion exert a significant impact on students' inclination to engage in online marketplace transactions. This study reveals that the variable  $X_1$ , representing brand image, exhibits the most significant impact on data adequacy, with a coefficient of 0.848. Furthermore, the indicators that exert the most influence on the dependent variable Y are Indicator X1.1 (Company Image Indicator) and Indicator X1.2 (Consumer

## The Influence of Brand Image, Product Quality and Sales Promotion on Shopping Interest in Online Marketplaces

Image Indicator). The research holds significant relevance due to the growing popularity of internet shopping among college students and the general population. Within the realm of business, possessing knowledge regarding the various aspects that exert an influence on the preferences of students when it comes to online buying holds significant strategic importance. This study offers a comprehensive examination of the strategies employed by corporations to enhance the appeal and engagement of online shopping among students, focusing specifically on the utilisation of brand image, product quality, and sales promotion. The findings of this study hold significant practical ramifications for internet enterprises and marketers. Organisations can leverage these research findings to develop robust branding strategies, enhance product quality, and devise more efficient promotional campaigns aimed at attracting college students as their online clientele. Furthermore, educational institutions may take into account the findings of this research when formulating a curriculum that caters to the specific needs and interests of students pursuing studies in marketing and e-commerce. Hence, the study not only enhances scholarly comprehension but also holds tangible implications in the realms of commerce and education.

### ACKNOWLEDGMENT

The author of this scientific research and paper expresses gratitude to a higher power for the successful completion of the study, acknowledging the role of divine grace and mercy in ensuring the timely and accurate completion of the article. We would like to express our gratitude to Renny Sari Dewi, S.Kom, M.Kom, MCE, MOS, and Dr. Maryam Bte Badrul Munir, S.Pd., M.Si, for their invaluable guidance throughout the study proposal preparation process up till the completion of this scholarly publication. The study project was ultimately approved through the research grant selection process for faculty-level students at State University of Surabaya, Faculty of Economics and Business. The research persisted until it was ultimately published in the International Journal of Multidisciplinary Research and Analysis (IJMRA). The authors express their gratitude for the collaborative contributions and assistance provided by mentors and colleagues. The significance of Renny Sari Dewi, S.Kom, M.Kom, MCE, MOS, and Dr. Maryam Bte Badrul Munir, S.Pd., M.Si, is in their emphasis on fostering a collaborative atmosphere as a means to attain success. This accomplishment serves as evidence of our dedication to attaining success through a pursuit of excellence. The author expresses gratitude to all individuals who have provided assistance and demonstrated exemplary performance. Recommendations for future researchers working with similar variables should aim to expand the scope of their research to encompass larger objectives. By doing so, the resulting implications can be more generally applicable and beneficial.

### REFERENCES

- 1) KOMINFO (2019). Apa itu Industri 4.0 dan bagaimana Indonesia menyongsongnya. Retrieved from [https://www.kominfo.go.id/content/detail/16505/apa-itu-industri-40-dan-bagaimana-indonesia-menyongsongnya/0/sorotan\\_media](https://www.kominfo.go.id/content/detail/16505/apa-itu-industri-40-dan-bagaimana-indonesia-menyongsongnya/0/sorotan_media) (Online), Accessed on 20 November 2023
- 2) Ikhbarul Kahfa, Z., & Wahjono, S. (2023). Brand Image E-commerce Tokopedia terhadap Minat Beli Konsumen.
- 3) Mahiri, E. A. (2020). Pengaruh brand image dan store atmosphere terhadap keputusan pembelian pada konsumen Badan Usaha Milik Desa (BUMDES) Mart Banjaran. *Coopetition: Jurnal Ilmiah Manajemen*, 11(3), 227–238.
- 4) Mamahit, P., Soegoto, A. S., & Tumbuan, W. A. (2015). Pengaruh Brand Image, Brand Trust, Dan Kualitas Produk Terhadap Keputusan Pembelian mobil Toyota All New Yaris Pada PT. Hasjrat Abadi Manado. *Jurnal Berkala Ilmiah Efisiensi*, 778-779.
- 5) Pratama, B. S., Fathoni, A., & Hasiolan, L. B. (2017). Analisis Pengaruh Brand Image, Kualitas Produk Dan Harga Terhadap Keputusan Pembelian Produk Kartu Perdana Telkomsel (Studi Pada Pengunjung Di Event-Event Kampus). *Journal of Management*, 4-5.
- 6) Winarto, J. (2011). Hubungan Antara Citra Merek Dengan Ekuitas Merek. *Jurnal Manajemen*, 104-105.
- 7) Mamahit, P., Soegoto, A. S., & Tumbuan, W. A. (2015). Pengaruh Brand Image, Brand Trust, Dan Kualitas Produk Terhadap Keputusan Pembelian mobil Toyota All New Yaris Pada PT. Hasjrat Abadi Manado. *Jurnal Berkala Ilmiah Efisiensi*, 778-779.
- 8) Mamahit, P., Soegoto, A. S., & Tumbuan, W. A. (2015). Pengaruh Brand Image, Brand Trust, Dan Kualitas Produk Terhadap Keputusan Pembelian mobil Toyota All New Yaris Pada PT. Hasjrat Abadi Manado. *Jurnal Berkala Ilmiah Efisiensi*, 778-779.
- 9) Irawan, D., & Japarianto, E. (2013). Analisa Pengaruh Kualitas Produk Terhadap Loyalitas Melalui Kepuasan Sebagai Variabel Intervening Pada Pelanggan Restoran Por Kee Surabaya. *Jurnal Manajemen Pemasaran*, 2-4.
- 10) Adi, I. (2022). Pengaruh Motivasi Belanja Hedonis, Gaya Hidup Berbelanja Dan Promosi Penjualan Terhadap Pembelian Impulsif Pada Konsumen E-Commerce Tokopedia Indonesia (Studi Kasus Di Surabaya). *Jurnal Manajemen dan Start-Up Bisnis*, 531-532.

## The Influence of Brand Image, Product Quality and Sales Promotion on Shopping Interest in Online Marketplaces

- 11) Anugrahita, S., & Samiono, B. E. (2015). Analisis Hubungan In-Store Promotion Dengan Impulse Buying. *Jurnal Akuntansi, Keuangan, dan Syariah Al-hISBAH*, 49-51.
- 12) Sarah, S., Rachman, A., & Febrianti, T. (2019). Pengaruh Fashion Lifestyle, Design, Dan Celebrity Endorser Terhadap Purchase Intention (Studi Pada UMKM Cibaduyut, Bandung). *Jurnal Indonesia Membangun*, 63-65.
- 13) Syahnaz, N. B., & Wahyono. (2016). Faktor Yang Mempengaruhi Minat Beli Konsumen Di Toko Online. *Management Analysis Journal*, 391-393.
- 14) Ernawati, D. (2019). Pengaruh Kualitas Produk, Inovasi Produk, Dan Promosi Terhadap Keputusan Pembelian Produk Hi Jacks Sandal Bandung. *Jurnal Wawasan Manajemen*, 17-21.
- 15) Hendayana, Y., & Afifah, N. (2020). Pengaruh Brand Ambassador dan Korean Wave Terhadap Minat Belanja Online Melalui Marketplace Tokopedia. *Jurnal Ekonomi dan Bisnis*, 35-38.
- 16) Hermansyah, T., Kamanda, S. V., & Qolbi, N. (2022). Keputusan Pembelian Pada E-Commerce Shopee Ditinjau Dari Pengaruh Faktor Sales Promotion, Brand Image, Dan Price. *Jurnal Al-Amal*, 19-21
- 17) Nasehudin, T. S., & Gozali, N. (2012). *Metode Penelitian Kuantitatif*, Bandung: CV. Pustaka Setia.
- 18) Ul'fah Hernaeny, M. P. (2021). *POPULASI DAN SAMPEL*. Pengantar Statistika 1, 33.
- 19) PEKELITIAN, L. *Populasi Dan Sampel Penelitian*.
- 20) Imron, H. A. (2017). Peran Sampling dan Distribusi Data dalam Penelitian Komunikasi Pendekatan Kuantitatif. *Jurnal studi komunikasi dan media*, 21(1), 111-126.
- 21) Pramiyati, T., Jayanta, J., & Yulnelly, Y. (2017). Peran Data Primer Pada Pembentukan Skema Konseptual Yang Faktual (Studi Kasus: Skema Konseptual Basisdata Simbumil). *Simetris: Jurnal Teknik Mesin, Elektro Dan Ilmu Komputer*, 8(2), 679-686.
- 22) Batubara, H. (2013). Penentuan harga pokok produksi berdasarkan metode full costing pada pembuatan etalase kaca dan aluminium di UD. Istana Aluminium Manado. *Jurnal EMBA: Jurnal Riset Ekonomi, Manajemen, Bisnis dan Akuntansi*, 1(3).
- 23) Ghozali, I. 2018. *Aplikasi Analisis Multivariate Dengan Program IBM SPSS 25*. Semarang: Badan Penerbit Universitas Diponegoro.
- 24) Raharjo S. 2014. Cara melakukan Uji Validitas Product Moment dengan SPSS. URL : <https://www.spssindonesia.com/2014/01/uji-validitas-product-momen- spss.html>. Accessed on 18 September 2023.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Kinds and Levels of Probiotics for Colored Chicken Breed



Mr. John Genesson Omo

Ilocos Sur Polytechnic State College

**ABSTRACT:** Health risk issues caused by antibiotics as growth promoters as well as a change in meat preference to chickens led the exploration for alternatives. The study determined the best kind and level of probiotics to colored chicken in terms of growth performance, carcass quality and economic analysis. One Hundred Sixty Five (165) day-old chicks were randomly distributed into eleven treatments replicated thrice employing RCBD.

Comparable performance were observed on colored birds given different probiotics from 10 to 30% levels in terms of growth performance and carcass quality. However, giving the colored birds probiotics at 30% level resulted to a higher cost of feeds to produce a kilogram gain in weight.

**KEYWORDS:** feed conversion ratio, gain in weight, probiotics, sasso, wet feeding.

### INTRODUCTION

#### Situation Analysis

Poultry raising specifically broiler production is a promising agro-based industry that provide livelihood in the countryside with considerable profit. Broiler provides the largest meat supply in the Philippines as compared to other livestock. Meat from broiler is preferred by most people in the world because it contains less fat laden with cholesterol that is detrimental to health and it is also much cheaper or affordable to most Filipinos.

The Philippine Statistics Authority (2020) reported the Philippines had a total inventory of chicken to an estimated 178.26 million birds from October to December 2019. Broiler went down by 12.2 percent (56.39 million) from its previous year's level of 64.22 million birds as of January 01, 2020. The top producing Region is the Central Luzon with 13.79 million broiler chicken or 24.5 percent of the total broiler chicken inventory.

Broiler are chickens raised for meat purposes and have originated from a native chicken called red jungle fowl of Indian Subcontinent. Due to the growing consumer demand for a cheaper poultry meat, the broiler industry improved tremendously through breeding and improved nutrition to increase the weight of breast muscle (de Jong *et al.*, 2012).

On the other hand, colored chicken breeds (e.g Sasso, Hubbard etc.) are dual purpose birds which are raised for both meat and egg. They are raised for meat consumption from 6 ½ to 9 weeks of age on its average weight of 1.297 kgs reared either in battery cages or deep litter floor (Yakubu and Madaki, 2017).

Due to a change to consumer preference, more and more consumers switch to "organic/free ranged or slow growing birds" as they believe these birds are far healthier, tastier and safer to consume than the conventionally produced fast-growing birds or we call broiler chickens. On the other hand, series of researches were conducted entire the world just to meet the growing demand of consumers using antibiotics and growth enhancer in the ration. The use of subtherapeutic doses of antibiotics to protect the animals against infections, improved the general health, growth performance and feed efficiency (Gadde *et al.*, 2018). These practices are perceived to lead to microbial resistance to the drugs in use, resulting in consumer concerns regarding residues in food products. The relatively recent ban of subtherapeutic doses of certain antibiotics as feed additives in the European Union led to a general decline in animal health (Castanon, 2007). Due to their various side-effects such as antibiotic resistance, destruction of beneficial bacteria in the gut, and dysbiosis (Alagawany *et al.*, 2018), the use of antibiotics in poultry feed as a growth promoter has been restricted in many countries around the world. Consequently, there is a growing interest in finding viable alternatives for growth enhancement and disease prevention in the poultry sector. Probiotics are considered alternative feed additives to antibiotics and can be defined as microbial food supplements which beneficially affect the host by improving its intestinal microbial balance (Khan and Naz, 2013).

## Kinds and Levels of Probiotics for Colored Chicken Breed

Probiotics are one of the options in this regard for improving poultry production. Probiotics are defined as “live microorganisms that, when administered in adequate amounts, confer a health benefit on the host.” They are available in various forms for use as feed additives. Probiotics as feed additives aid in proper digestion of feed hence make the nutrients available for faster growth. Immunity can also be improved by addition of probiotics to poultry diets. Moreover, probiotics aid in improving meat and egg quality traits. Various infectious diseases of poultry can be countered by use of probiotics in their feed. A proper selection of probiotic strains is required for gaining optimal effects. (Alagawany *et al.*, 2018). Probiotics present a potential alternative to the prophylactic use of antibiotics in feed animals. Also known as direct-fed microbials, probiotics are classified as live nonpathogenic microorganisms that are capable of maintaining a normal gastrointestinal microbiota (Ohimain and Ofongo, 2012).

Aside from the probiotics help in terms of growth parameters like feed conversion ratio (FCR), improved gain in weight it could also accounts to an improved quantity and quality of meat, eggs and milk (Musa *et al.*, 2009). Moreover, Van *et al.* (2006) pointed out the reduction on the contamination of eggs caused by *Salmonella* bacteria through the supplementation of probiotics. It has also been recorded that probiotics contributed to the increase in production and improved quality of eggs (Kurtuglo *et al.*, 2004).

Animal health is one of the top priority in the production chain regardless of the species. Probiotic organism has the ability to improved health condition of animals when adhered to digestive tract, hence, a better productivity (Isolauri *et al.*, 2004) and improved immunological response of the host (Patel *et al.*, 2015) will be observed.

Probiotic's mode of action in terms of animal health and disease prevention based on adaptive immune system is very important. The intestinal lumen, is very rich not only on essential nutrients and good microorganisms but also pathogens which produces toxins and other harmful substances (Willing *et al.*, 2012). There is a barrier that is being produced by the epithelial cells which separates internal body tissues from lumen environment (Liao and Nyachoti, 2017) hence influencing intestinal cellular “stability” (Ng *et al.*, 2009). The barrier is said to be first line of defense against pathogenic microorganisms namely: *Campylobacter*, *Clostridium*, *Eimeria* and *Salmonella* (Dalloul & Lillehoj, 2005; Stern *et al.*, 2001) which confirms the findings of Zhang and Kim, (2014); Lei *et al.* (2015) that it could also prevent diseases such as salmonellosis, campylobacteriosis or coccidiosis in the GIT (gut innate immunity), but with the continuous stress or disease the host is experiencing, this barrier can be disrupted (Willing *et al.*, 2012; Lee *et al.*, 2016). Probiotics have been observed to restore the GIT mucosa barrier function in both in vitro and in vivo models (Garcia-Lafuente *et al.*, 2001; Madsen *et al.*, 2001). Borchers *et al.* (2009), stated that immune response of an animal should either be stimulated and suppressed. In a research conducted, researchers found out that through stimulation of the gastro intestinal immune response, the normal gut microbiota has the ability to support the defense system of the animal against pathogens (Yirga, 2015).

Aside from poultry species, it has been observed on several studies that probiotics improve other farm animals as well. Farm animals can be affected greatly by biotic and abiotic-causing stress (e.g. hauling, management, diets etc.). Due to the following factors, these may lead to the disturbance of the intestinal ecosystem' balance and risk of having pathogenic infections. There are fantastic and significant effect of probiotics on the utilization and absorption of feed as it increases the total body weight of different farm animals which includes piglets (Li *et al.*, 2006; Casey *et al.*, 2007), goats, sheep (Chiofalo *et al.*, 2004), cattle, horses (de Rezende *et al.*, 2012)

Probiotics can be composed of one or many strains of microbial species, with the more common ones belonging to the genera *Lactobacillus*, *Bifidobacterium*, *Enterococcus*, *Bacillus*, and *Pediococcus* (Gaggia *et al.*, 2010). Probiotics and prebiotics maybe classified as functional food; that which affects bodily functions in a positive manner so as to improve health or if its effect extends to the physiological or psychological levels going beyond the traditional nutritional effect. Probiotics are live microorganisms which when administered in adequate amounts confer a beneficial health effect on the host. Lactic acid bacteria (LAB), *Bacillus* and *Bifidobacteria* are the most common types of probiotics (Parvez *et al.*, 2006)

Several good microorganisms are made known to the public and one of the beneficial probiotics is the Lactic Acid Bacteria (LAB). LAB are ubiquitous microorganisms which belong to a large group of bacteria that produces lactic acid as a by-product that renders benefits not only to crops but also for livestock production. LAB can grow and survive in acidic (low-pH) environments. They are generally considered safe for human consumption which other countries use to preserve food and noted to be good in the digestive systems. Some of their benefits are prolonging storage life by inhibiting food spoilage, enhancing flavors taste and textures, and preserve nutritive value by producing lactic acid as “fermentation metabolite” (Nordqvist, 2004).

Relating to animal production, an anaerobic and stinking livestock pen can be transformed into an odorless system when applied with LAB cultured organisms (DuPont and Fischer, 2012). On the long run, through feeding or supplication in their drinkers can be of great help to enhance their immunity, foster a healthy gut flora, and aid in digestion (Corcionivoschi *et al.*, 2010, Fajardo *et al.*, 2012).

## Kinds and Levels of Probiotics for Colored Chicken Breed

The research conducted by Konstatinov *et al.* (2008) used bacteria such as *Lactobacillus sobrius* or *Lactobacillus paracasei* (Bomba *et al.*, 2002) to limit the pathogenic *E. coli*'s intestinal colonization. In addition, a comparative study between Competitive Exclusion (CE) Culture and Mucosal Competitive Exclusion (MCE) Culture was conducted to test their efficacy for the elimination of *Salmonella* spp. infections and *Campylobacter* colonization in 210 chicks of broiler chicken respectively (Stern *et al.*, 2001). The results showed that there were more colonized *Salmonella* Typhimurium in the birds treated with CE than those birds treated with MCE but on the other hand, a more superior effect was displayed by the birds treated with MCE as compared to those birds treated with CE in the case of *Campylobacter* genus bacteria colonization.

On the other hand, IMO or the indigenous microorganism are members of useful microorganisms including filamentous fungi, yeast and bacteria that inhabits non-cultivated soil and surfaces of living things and are often found under bamboo trees which have the potential in improving soil fertility, phosphate solubilisers, biodegradation, plant growth promoters and nitrogen fixation (Tiquia and Michel, 2002; Umi and Sariah, 2006)

Ghosh *et al.* (2004) added that IMO could be used in the production of "compost tea" which could improve soil quality and through the beneficial microorganism's colonization eventually be the first line of defense to protect crops against microbial infections.

There are reported delightful benefits of IMO in animal production. The use of IMO solution in reducing the stinking smell of commercial piggeries and poultry farms have been observed through the action of the beneficial microorganisms hindering the multiplication of bad microorganisms/ pathogen which causes foul smell (Cho and Koyama, 1997).

Furthermore, Effective Microorganisms (EM) are anaerobic microorganisms that are somehow act the same function as the IMO which consists of lactic acid bacteria (*Lactobacillus* spp.), yeast (*Saccharomyces* spp.) and photosynthetic bacteria (*Rhodospseudomonas* spp.) (Zuraini *et al.*, 2010). They harvest energy from soil heat and the sun to convert gases such as ammonia, exudates from root system and soil organic fraction into amino acids, sugars and nucleic acids which are called building materials of cells. As they produce such materials, it helps in the growth, yield, quality and protection of vegetable crops (Olle and Williams, 2013; Global Partners, 2015).

From the above discussions, the use of different forms of probiotics offers more advantages in producing healthy animals, producing safe meat for human consumption. This will not only provide safe meat but affordable meat for the family.

At present, the country is still importing poultry meat to fill up the demand due to fluctuating or inadequate supply. The inadequate supply could be attributed to low feed conversion ratio because of inferior quality of feeds.

The most common reason of problems for small poultry raising is the failure to supply a balanced starter feed. The second reason is the failure to supply fortified additive in correct proportions. With this two main problems, it could result to birds suffering from poor feathering, increase fatness that will lead to leg problems and on top of that is slow growth that definitely renders low income (<https://www.gov.mb.ca/agriculture/livestock/production/poultry/basic-feeding-programs-for-small-chicken-flocks.html>, Manitoba,)

Hence, this study entitled "Kinds and Levels of Probiotics for Colored Chicken Breed (Hubbard)" was conducted to enhance the nutritive value of the available commercial feeds in the market, to increase the profit of the small to medium backyard poultry raisers despite the high cost of commercial feeds and also to contribute or generate higher revenue for the growth of our economy.

### General Objectives

The study was conducted to determine the performance of colored chicken breed (Sasso) fed with different probiotics.

### Specific Objectives

1. To determine the best type of probiotics on the growth performance of colored chickens.
2. To determine the effects of the different levels of probiotics on the growth performance of colored chickens.
3. To determine the dressing percentage and leaf fat percentage as affected by different probiotics.
4. To determine the profit above feed medicine and stock cost as affected by different probiotics.

### Time and Place of the Study

The study was conducted at DMMSU- NLUC Compound, Sapilang, Bacnotan, La Union from June 24 to August 24, 2020.

### Definition of Terms

*Ad libitum* refers to the process of giving sufficient supply of water and feeds to the broilers daily.

*Brooding* refers to the process of providing heat to young chicks.

*Carcass Weight* refers to the weight of the dressed bird after removing the shanks, head, and internal organs.



## Kinds and Levels of Probiotics for Colored Chicken Breed

*Colored Chicken/ Sasso* refers to a dual type chicken reared for its meat and egg. It usually grows for 1.3 kg when reared from 6 to 9 weeks.

*Effective Microorganism Activated Solution (EMAS)* is a kind of probiotic which is activated from the pure cultured and strictly selected effective microorganisms.

*Feed Conversion ratio* is the ability of the bird to convert the feeds into kilogram gain.

*Fermentation* is the process of letting the feeds to be fermented by the different probiotics for a short period of time before feeding to colored breed chickens.

*Indigenous Microorganism (IMO)* is a kind of probiotic which is rich in indigenous microorganisms that were derived from undisturbed places like forest beds.

*Kinds* refers to the different probiotics used in the experiment like IMO, EMAS and LABS.

*Lactic Acid Bacteria Serum (LABS)* is a kind of probiotic in which its main microorganism is lactobacilli from yakult cultivated to become a serum. Ideal for enhancing the productivity of the animal host.

*Levels* refers to the varying percentages/ration of application of the probiotics to the feeds.

*Performance* refers to final weight, gain in weight, feed consumption, feed conversion ratio, dressing percentage, leaf fat percentage, cost of feeds to produce a kilogram gain in weight and profit above feeds, stock cost and medicine.

*Probiotics* refers to the strain of live microorganisms that has the ability to improve the animal's health status and achieve better performance like IMO, EMAS and LABS.

*Supplements* are the different probiotics added to low-cost feed to increase its nutritive value.

*Wet feeding* is the process of feeding the broilers in a wet form. The feeds are wet by lactic acid bacteria serum, effective microorganism activated solution, and indigenous microorganism (IMO) solution or pure water.

## METHODOLOGY

### Research Design

One hundred eighty colored meat type breeds (Sasso) of chicks were used in the study. After 14 days of brooding, the chicks were distributed randomly into eleven treatments employing the Randomized Complete Block Design (RCBD) in three blocks. Each treatment had 15 chicks divided into three replications.

The treatments used were the following:

T<sub>0</sub> – Water (Negative control)

T<sub>1</sub> – Commercial Probiotics (Positive Control)

T<sub>2</sub> – 10% Lactic Acid Bacteria Serum (LABS)

T<sub>3</sub> – 20% Lactic Acid Bacteria Serum (LABS)

T<sub>4</sub> – 30% Lactic Acid Bacteria Serum (LABS)

T<sub>5</sub> – 10% Effective Microorganism Activated Solution (EMAS)

T<sub>6</sub> – 20% Effective Microorganism Activated Solution (EMAS)

T<sub>7</sub> – 30% Effective Microorganism Activated Solution (EMAS)

T<sub>8</sub> – 10% Indigenous Microorganism (IMO)

T<sub>9</sub> – 20% Indigenous Microorganism (IMO)

T<sub>10</sub> – 30% Indigenous Microorganism (IMO)

### Materials and Procedures

#### Construction of Cages

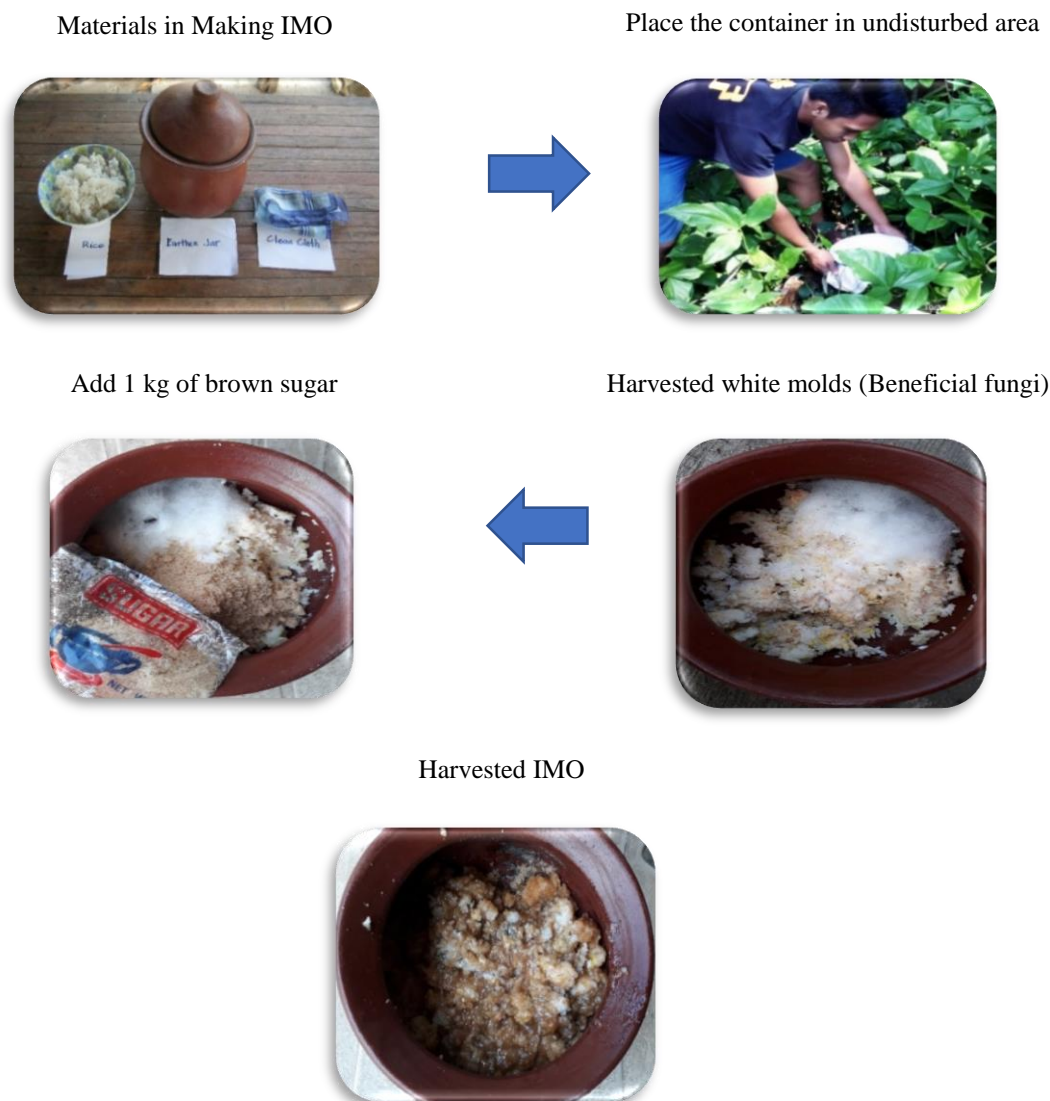
Prior to the arrival of the chicks, lumber, chicken wire and other materials for cage construction were purchased from the hardware store in the Municipality of Bacnotan, La Union. The dimension used for each cage was 2 ft. height x 2ft. width x 2.5 ft. long to come up with the standard floor area of one ft<sup>2</sup> per bird. The floor of cages was two feet above the ground. A commercial disinfectant and portable sprayer was used to disinfect the cages and the vicinity of the experimental area. All sides of the cages used for brooding the chicks were covered with sacks to maintain the required temperature. Six 30 wattage incandescent bulbs were used in the brooding cage to provide heat and lighting. Feeders and waterers were purchased and placed inside the cages prior to the arrival of the chicks. Individual containers were purchased to store the treatments [purified water, indigenous microorganism (IMO), effective microorganism activated solution (EMAS) and lactic acid bacteria serum (LABS)]. A portable top loading balance was used after brooding to determine the initial weight of the broilers before assigning them in the experimental diets. One week prior to the conduct of the experiment, the cages, waterers, feeders and the vicinity of the experimental area

## Kinds and Levels of Probiotics for Colored Chicken Breed

were disinfected to avoid diseases and pest infestation. In each experimental unit, five chicks were reared or a total of 165 chicks. The chicks were bought from a reliable agricultural outlet in the Municipality of Bacnotan, La Union.

### Procedures in the Preparation of Indigenous Microorganism (IMO)

A kilogram of rice was cooked. The cooled cooked rice was placed in an earthen pot. The mouth of the container was covered completely with a cotton cloth and tied with rubber band which prevented small insects from getting in. The container was placed on the floor of the nearest undisturbed vegetation and was left there for three days when whitish moldy filaments formed in the cooked rice a kilogram of sugar was added and mixed thoroughly and positioned in a dark, cool place until it appeared muddy after seven days of fermentation.



**Fig 1. Procedures in the Preparation of Indigenous Microorganism (IMO).**

### Procedures Employed in Making Lactic Acid Bacteria Serum (LABS)

The Lactic Acid Bacteria Serum (LABS) was prepared using rice washing. Second rice washing was preferred due to cleaner and absence of foreign matters. The collected rice washing was poured on a container covered with a piece of cloth and was placed on an undisturbed area without direct exposure to sunlight, maintaining an ideal room temperature of about 30°C not exceeding 40°C for right fermentation. The rice washing was fermented for seven days. On the eighth day, a kilo of brown sugar, a kilo of skim milk, and 100 ml of culture milk were added to 11 liter of fermented rice washing. The mixture was stirred thoroughly until the sugar and skim milk have been fully dissolved. The mixture was transferred in a bigger container covered with cloth and was fermented for 7 days in undisturbed area. After 15 days of fermentation, Lactic Acid Bacteria Serum (LABS) was harvested with a sweet-sour smell and taste.

## Kinds and Levels of Probiotics for Colored Chicken Breed



Fig 2. Procedure in the Preparation of Lactic Acid Bacteria Serum (LABS).

### Procedures in Making Effective Microorganism Activated Solution (EMAS)

The Effective Microorganism Activated Solution (EMAS) was produced by using one liter volume of Effective Microorganism or the mother culture, 1 kg of brown sugar was diluted in a one liter of water and lastly, twenty liters of tap water (non-chlorinated) was added. These ingredients were mixed in a clean basin, stirred thoroughly until homogeneous mixture was observed and stored in a clean bottle container. The containers were fully air-locked making the environment anaerobic which resulted in faster fermentation process. The accumulated gas were daily released inside the containers; the solution were kept away from direct sunlight and were stored on a room temperature for five days.

## Kinds and Levels of Probiotics for Colored Chicken Breed

Effective Microorganism  
Mother Culture



Just add 1 kg  
of brown sugar



To 28 liters of  
non-chlorinated  
water

Effective Microorganism  
Activated Solution (EMAS)



Fig 3. Procedures in the Preparation of EMAS

### Preparation of Experimental Birds

Upon arrival, the chicks were given water with five percent sugar solution for 2 hours which provided them source of energy. Inside the brooding area, six 30 watt incandescent bulbs were used which provided the required heat to the chicks. As the chicks grew and develop their feathers, supplemented heat was gradually decreased. During brooding, the chicks were fed with Commercial Chick Booster. The chicks were given medicated water which promoted faster growth and good health. The chicks were brooded for 14 days.

### Procedures in the Conduct of the Experiment

After brooding stage, five birds were grouped and weighed using a portable top loading balance used in determining their initial weight before the implementation of the treatments. All the data gathered were recorded. The researcher used the fishbowl technique on the distribution of the birds by using 11 pieces of paper written with the corresponding treatments and then drawn to represent a treatment. After the first block was finished wherein five birds were randomly placed in each cage, the researcher proceeded to the 2<sup>nd</sup> and 3<sup>rd</sup> blocks and repeated the same steps and procedures that was done in the first block. The lighting was shifted from incandescent bulb to fluorescent light.

The feeds that were used after brooding were gradually shifted from chick booster to broiler starter crumble, the researcher used low-cost BSC to test whether the probiotics could improve the feed quality subjected to corresponding treatments.

The treatment solutions were made by mixing 100 ml of each probiotics (LABS, EMAS and IMO) to 900 ml of tap water, 200 ml solution to 800 tap water and 300 ml solution to 700 ml of tap water, respectively.

### Preparation of the Wet Feeds

In a pail, a liter of each treatment solution was added to two kilograms of commercial feeds and were thoroughly mixed until all the feeds were uniform in consistency. The pails were covered and allowed to stay undisturbed overnight to obtain a partially fermented feeds and to ensure the solution was fully absorbed prior to feeding. The researcher prepared the feed mixture thrice a week for the first two weeks of rearing then for the subsequent weeks, feed mixtures was prepared every day to ensure the freshness of the feeds.

*Ad libitum* feeding was strictly implemented throughout the rearing period following the treatments to allow the experimental birds to obtain optimum growth and development.

### Data Gathered

**1. Initial Weight (kg) at day 14.** This was gathered by weighing 5 birds per replication at the start of the study, 14 days after brooding period by using a portable top loading balance. The total weight was divided by 5 to represent the mean weight

**2. Final Weight (kg) after 64 days.** This was gathered by weighing 5 birds per replication after rearing for 64 days by using a portable top loading balance.

## Kinds and Levels of Probiotics for Colored Chicken Breed

**3. Gain in Weight (kg).** This was computed by subtracting the initial weight from the final weight of the birds.

**4. Feed Consumption (kg).** This was computed by adding the total weight of the feed in wet form consumed by the birds throughout the duration of the study.

**5. Feed Conversion Ratio.** This was computed by dividing the feed consumed to the gain in weight of the birds.

**6. Cost of Feed to Produce a Kilogram Gain in Weight.** This was computed by multiplying the Feed Conversion Ratio (FCR) to the price per kilogram of the dietary ration (Php).

**7. Dressing Percentage (%).** This was computed by dividing the carcass weight (kg) to the live weight (kg) multiplied by 100.

**8. Leaf Fat Percentage (%).** This was computed by dividing the leaf fat weight (g) to the Carcass weight (kg) multiplied by 100.

**9. Profit Above Feed, Medicine and Stock Cost.** This was computed by subtracting the cost of feeds, cost of probiotics, medication and stock from the sale value of the birds at 64 days old.

### Analysis of Data

All data gathered were analyzed using Analysis of Variance (ANOVA) in Randomized Complete Block Design, difference between and among treatment means were further tested using Tukey's Honest Significant Differences (HSD) Test.

## RESULTS AND DISCUSSION

### Initial Weight of Birds

The initial mean weight of the birds assigned to the different treatments was 340 grams (Appendix Table 1). Analysis of Variance revealed no significant differences among the treatment means.

### Final Weight of Birds

The final weight of birds as affected by different kinds and concentrations of probiotic solution is shown in Table 1. The final weight ranged from 1.33 to 1.46 kgs. The result showed no significant differences as influenced by the treatments indicating that the birds had comparable weights at the end of the study.

The result conformed to the result of the previous study conducted by Yousefi and Karkoodi (2007) that the body weight changes were not significantly different among treatment groups or was not affected by the dietary probiotic supplementation. Arslan *et al.* (2004) reported too that probiotics had no significant ( $P \leq 0.05$ ) effect on growth in broilers.

On the other hand, the foregoing result contradicts with previous study of Abdel-Hafeez *et al.*, (2017) that chicks fed diets supplemented with probiotic, prebiotic and synbiotic (with and without feed restriction) exhibited higher body weight and feed efficiency than chicks fed the control diets.

**Table 1. Mean Final Weight of Birds (kg) as Affected by Different Kinds and Concentrations of Probiotic Solution Added to the Base Ration.**

Kinds and Concentration of Probiotic Solution	Final Weight (Kgs)
T <sub>0</sub> – Water	1.31
T <sub>1</sub> – Commercial Probiotics	1.33
T <sub>2</sub> – 10% LABS	1.43
T <sub>3</sub> – 20% LABS	1.43
T <sub>4</sub> – 30% LABS	1.42
T <sub>5</sub> – 10% EMAS	1.38
T <sub>6</sub> – 20% EMAS	1.46
T <sub>7</sub> – 30% EMAS	1.42
T <sub>8</sub> – 10% IMO	1.45
T <sub>9</sub> – 20% IMO	1.44
T <sub>10</sub> – 30% IMO	1.38

Likewise, Song *et al.* (2014) reported, too a significant increase in body weight gain in broilers fed with probiotics Lactobacillus, Bifidobacterium, coliforms and Clostridium species.

## Kinds and Levels of Probiotics for Colored Chicken Breed

Further, the result corroborates to the study of Kabir *et al.* (2004) that live weight gains were significantly higher ( $P < 0.01$ ) in birds supplemented with probiotics as compared to the control group at all levels during the 2<sup>nd</sup>, 4<sup>th</sup>, and 6<sup>th</sup> weeks of age, both in vaccinated and non-vaccinated birds. Other study (Apata, 2008) demonstrated increased liveweight gain in probiotic fed birds.

Moreover, the result conformed to the study of Chitra *et al.* (2004) that inclusion of probiotic and ascorbic acid both independently and simultaneously either in feed or in drinking water to broilers had made significant ( $P \leq 0.01$ ) improvement in body weight of commercial broilers. Gupta (2004) also reported higher body weight gain in broilers after supplementation of probiotics at the field level.

### Total Gain in Weight (kg) of the Birds

Table 2 shows the total mean gain in weight of the birds as affected by feeding with BSC wet with different kinds and concentrations of probiotic solutions. Analysis of variance revealed no significant differences on the gain in weight of the birds reared during the 1<sup>st</sup> week, 3<sup>rd</sup> week, 4<sup>th</sup> week, 6<sup>th</sup> week, 7<sup>th</sup> week and the final gain in weight.

On the other hand, significant differences on the gain in weight during the 2<sup>nd</sup> and 5<sup>th</sup> week of rearing were observed. During the 2<sup>nd</sup> week of rearing, the birds fed with BSC wet with 10% LABS solution (T<sub>1</sub>) have the heaviest gain in weight with a mean of 0.25 kg which significantly differed to that of the control (water T<sub>0</sub>) with a mean of 0.16 kg, but is comparable to the gain in weight of all the other birds fed with BSC feeds wet with different kinds and concentrations of probiotic solution. Kessler *et al.* (2000) stated that an initial slow growth rate increases at a certain age span until achieve a maximum rate (acceleration), and decreases gradually (deceleration). The occurrence is called the inflection point of the curve, which relates maximum growth to age and changes shape from concave to convex.

**Table 2. Mean Gain in Weight of the Birds (kg) Fed with BSC Wet with Different Kinds and Concentrations of Probiotic Solution.**

Kinds Concentrations Probiotic Solution	and of	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Final GW
T <sub>0</sub> – Water		0.15	0.16 <sup>b</sup>	0.25	0.13	0.87 <sup>c</sup>	0.10	0.10	0.97
T <sub>1</sub> – Com. Probiotics		0.13	0.21 <sup>ab</sup>	0.19	0.14	0.09 <sup>bc</sup>	0.11	0.11	0.99
T <sub>2</sub> – 10% LABS		0.14	0.25 <sup>a</sup>	0.21	0.14	0.11 <sup>abc</sup>	0.11	0.12	1.09
T <sub>3</sub> – 20% LABS		0.15	0.22 <sup>ab</sup>	0.21	0.15	0.13 <sup>ab</sup>	0.11	0.12	1.09
T <sub>4</sub> – 30% LABS		0.14	0.24 <sup>a</sup>	0.23	0.17	0.87 <sup>c</sup>	0.10	0.12	1.08
T <sub>5</sub> – 10% EMAS		0.12	0.22 <sup>ab</sup>	0.23	0.14	0.10 <sup>bc</sup>	0.11	0.13	1.04
T <sub>6</sub> – 20% EMAS		0.15	0.21 <sup>ab</sup>	0.24	0.13	0.14 <sup>a</sup>	0.10	0.15	1.12
T <sub>7</sub> – 30% EMAS		0.15	0.23 <sup>a</sup>	0.22	0.13	0.11 <sup>abc</sup>	0.12	0.12	1.08
T <sub>8</sub> – 10% IMO		0.14	0.23 <sup>a</sup>	0.27	0.14	0.12 <sup>abc</sup>	0.10	0.12	1.11
T <sub>9</sub> – 20% IMO		0.16	0.21 <sup>ab</sup>	0.25	0.12	0.09 <sup>bc</sup>	0.12	0.14	1.10
T <sub>10</sub> – 30% IMO		0.16	0.20 <sup>ab</sup>	0.22	0.14	0.87 <sup>c</sup>	0.11	0.12	1.04

\*Means in a column followed by the same letter are not significantly different at 0.05 level of Tukey's HSD Test.

On the 5<sup>th</sup> week of rearing, the birds fed with BSC feeds wet with 20% EMAS solution (T<sub>6</sub>) registered the highest (0.14 kg) gain in weight which significantly differed to the birds of T<sub>0</sub>, T<sub>1</sub>, T<sub>4</sub>, T<sub>5</sub>, T<sub>9</sub> and T<sub>10</sub> spanning from 0.87 to 0.10 kg, but comparable to the birds of T<sub>2</sub>, T<sub>3</sub>, T<sub>7</sub> and T<sub>8</sub> ranging from 0.11 to 0.13 kg. This conform to the findings of Samli *et al.* (2007) that there are fantastic and significant effect of probiotics on the utilization and absorption of feed as it increases the total body weight of different farm animals which was exhibited by chickens and turkeys (Torres-Rodriguez *et al.*, 2007).

When probiotics are administered with the unchallenged group, results showed significantly higher body weight, body weight gain or immune organ weights, whereas no differences were observed in the challenged groups. In addition, birds receiving probiotics had lower mortality, with reduction in lesions. Overall, this is an indication that supplementation of probiotics in ovo may improve performance and offer immunity against infection (Pender *et al.* 2016).

This implies that probiotics had taken effect as it improved the weight of birds (Pender *et al.* 2016) from the first few weeks of rearing but as it reached the inflection point, the ability of the birds to convert the feeds into its body weight decreased. (Yakubu and Madaki, 2017).

Anjum *et al.* (2005) reported that multi-strain probiotics (protexin) supplementation in the diet significantly ( $P < 0.05$ ) improved body weight gain in broilers.

## Kinds and Levels of Probiotics for Colored Chicken Breed

Sherief and Sherief (2011) reported that significantly higher body weight is recorded on broiler flocks that received probiotics. Zhang and Kim (2014) reported an overall increase in body weight gain in chicken fed with multi-strain probiotics compared with that in control group fed basal diet. Mansoub (2010) reported significant increase in body weight of broilers fed with *Lactobacillus acidophilus* and *Lactobacillus casei*. Amer and Khan (2011) showed that the supplementation of probiotic (*Lactobacillus acidophilus*, *Bacillus subtilis*, *Saccharomyces cerevisiae* and *Aspergillus oryzae*) indicated significant increase body weight gain after 6 weeks of experiment.

Cao *et al.* (2013) found that supplementation the broiler diets with a single strain of *Lactobacillus (Enterococcus faecium)* significantly improved the BW and BWG compared to the control. A consistent improvement in BWG of chickens fed a culture of *Lactobacillus* has also been reported (Awad *et al.*, 2009).

### Feed Consumption of Birds

The weekly feed consumption of the birds as affected by feeding with BSC wet with different kinds and concentrations of probiotic solution is shown in Table 3. Result revealed no significant differences among the treatments on the 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup>, 5<sup>th</sup>, and 7<sup>th</sup> week of rearing. The feed consumption of the birds during the 1<sup>st</sup> week of rearing ranges from 0.39 to 0.45 kg, on the 2<sup>nd</sup> week ranges from 0.60 to 0.66 kg, on the 3<sup>rd</sup> week ranges from 0.56 to 0.61 kg, on the 4<sup>th</sup> week ranges from 0.48 to 0.67 kg, on the 5<sup>th</sup> week ranges from 0.52 to 0.59 and on 7<sup>th</sup> weeks of rearing ranges from 0.73 to 0.87 kg.

Likewise, analysis of variance on the total feed consumption as affected by feeding with BSC wet with different kinds and concentrations of probiotic solution revealed no significant differences between the treatments with means ranging from 3.95 to 4.29 kg.

On the other hand, result on the feed consumption of the birds on the 6<sup>th</sup> week of rearing has significant differences among the treatments where the birds fed with BSC wet with LABS 20% (T<sub>3</sub>), EMAS 10% (T<sub>5</sub>) and IMO 10% (T<sub>8</sub>) attained the highest feed intake (0.68 kg), but comparable to the other treatments except for the birds of T<sub>0</sub> (BSC wet with water). The result of this study is in agreement to the findings of Engberg *et al.* (2009) where wet feeds increase villi length which leads to increased animal's food uptake, nutritional uptake, weight gain, food utilization, feed conversion and egg production. Likewise, it also lowers sugar content by 77% and a 3% higher crude protein.

**Table 3. Mean Feed Consumption of Birds (kg) as Affected by the Different Kinds and Concentrations of Probiotic Solution Added to the Feeds.**

Kinds and Concentrations of Probiotic Solution	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Total FC
T <sub>0</sub> – Water	0.45	0.61	0.60	0.48	0.54	0.62 <sup>b</sup>	0.78	4.08
T <sub>1</sub> – Com. Probiotics	0.44	0.64	0.58	0.54	0.56	0.66 <sup>ab</sup>	0.77	4.19
T <sub>2</sub> – 10% LABS	0.41	0.63	0.56	0.49	0.55	0.66 <sup>ab</sup>	0.85	4.16
T <sub>3</sub> – 20% LABS	0.41	0.63	0.60	0.57	0.59	0.68 <sup>a</sup>	0.80	4.29
T <sub>4</sub> – 30% LABS	0.40	0.65	0.60	0.55	0.52	0.64 <sup>ab</sup>	0.81	4.17
T <sub>5</sub> – 10% EMAS	0.39	0.65	0.57	0.54	0.52	0.68 <sup>a</sup>	0.84	4.20
T <sub>6</sub> – 20% EMAS	0.42	0.61	0.61	0.54	0.56	0.67 <sup>ab</sup>	0.87	4.28
T <sub>7</sub> – 30% EMAS	0.40	0.62	0.60	0.56	0.57	0.67 <sup>ab</sup>	0.84	4.26
T <sub>8</sub> – 10% IMO	0.43	0.61	0.61	0.50	0.59	0.68 <sup>a</sup>	0.84	4.27
T <sub>9</sub> – 20% IMO	0.41	0.66	0.60	0.53	0.54	0.66 <sup>ab</sup>	0.75	4.16
T <sub>10</sub> – 30% IMO	0.42	0.60	0.56	0.49	0.53	0.63 <sup>ab</sup>	0.73	3.95

\*Means in a column followed by the same letter are not significantly different at 0.05 level of Tukey's HSD Test.

Feeding viable *Lactobacillus* at 1100 mgkg<sup>-1</sup>(4.4 x 10<sup>7</sup> colony forming units (cfu) kg<sup>-1</sup>) increased daily feed consumption, egg size, Nitrogen and Calcium retentions (Nahashon *et al.*, 1996). Shareef (2009) reported that probiotic (*Saccharomyces cerevisiae*) supplementation of broilers had significantly increased feed consumption.

### Feed Conversion Ratio

The feed conversion ratio of the chickens fed with BSC wet with different kinds and concentrations of probiotic solution is shown in Table 4. Analysis of variance revealed significant differences between the chickens under the different treatments reared for 64 days.

## Kinds and Levels of Probiotics for Colored Chicken Breed

The feed conversion ratio has significant differences ( $p < 0.01$ ) wherein birds at T<sub>9</sub> (fed with BSC wet with 20% IMO) were the most efficient (3.80) and significantly differed to the birds of T<sub>0</sub> and T<sub>1</sub> which ranges from 4.22 to 4.27 but comparable to all other treatments.

The result implies that the birds fed with natural probiotics are more efficient in converting the feeds intake in gaining heavier body weight. It corroborates the findings of Kurtuglo *et al.* (2004) that a positive impact was noted on the feed conversion ratio when probiotics is added on the diet of chickens. Likewise, there is also a significant result upon the administration of the probiotic on the animal's growth, modulation of intestinal microbotas' activity (Mountzouris *et al.*, 2007). Some studies reported that probiotic supplementation in the diet can improve BWG and FCR in chickens (Nayebpor *et al.* 2007; Apata, 2008; Ignatova *et al.* 2009; Sen *et al.* 2012).

In addition, *Bacillus coagulans*-supplemented broiler feed significantly improved final and daily weight gain, feed conversion ratio and survival rate, when compared to the un-supplemented control group, and is recommended to replace growth promoters in broiler production (Awad *et al.* 2009; Francesca *et al.* 2010; Huyghebaert *et al.* 2011; Kral *et al.* 2012; Zhou *et al.* 2010).

**Table 4. Mean Feed Conversion Ratio (FCR) of Chickens as Affected by Feeding with BSC Wet with Different Kinds and Concentrations of Probiotic Solution.**

Kind and Concentrations of Probiotic Solution	Feed Conversion Ratio**
T <sub>0</sub> – Water	4.22 <sup>a</sup>
T <sub>1</sub> – Com. Probiotics	4.27 <sup>a</sup>
T <sub>2</sub> – 10% LABS	3.82 <sup>b</sup>
T <sub>3</sub> – 20% LABS	3.93 <sup>ab</sup>
T <sub>4</sub> – 30% LABS	3.85 <sup>b</sup>
T <sub>5</sub> – 10% EMAS	4.03 <sup>ab</sup>
T <sub>6</sub> – 20% EMAS	3.83 <sup>b</sup>
T <sub>7</sub> – 30% EMAS	3.94 <sup>ab</sup>
T <sub>8</sub> – 10% IMO	3.85 <sup>b</sup>
T <sub>9</sub> – 20% IMO	3.80 <sup>b</sup>
T <sub>10</sub> – 30% IMO	3.81 <sup>b</sup>

\*Means in a column followed by the same letter are not significantly different at 0.01 level of Tukey's HSD Test.

Naik *et al.* (2000) valued the effect of different probiotics (*Lactobacillus acidophilus*, *Saccharomyces cerevisiae* and their combination) on the performance of broilers and reported that supplementation of *Lactobacillus* to the basal diet at 0.05% improved feed efficiency in broilers as compared to unsupplemented controls. Safalaoh *et al.* (2001) showed that effective microorganisms (probiotics) improved feed efficiency in broilers alone or with antibiotics, which is more pronounced at the higher dosage (30g/kg feed). Upendra and Yathiraj (2002) observed that supplementation of *Lacto-sacc* at 250g/ton of feed resulted in an improvement of FCR, which was 10.8% better over that of control. Gupta (2003) supplemented broiler diets with different strains of *Lactococci* and *Bacitracin*. He observed that all the diets showed lower ( $P \leq 0.05$ ) FCR than control. Chitra *et al.* (2004) reported that inclusion of probiotics and ascorbic acid both independently and simultaneously either in feed or in drinking water to broilers had made significant ( $P \leq 0.01$ ) improvement in total feed consumption and feed efficiency during summer season. Gupta (2004) also observed that supplementation of probiotics improved FCR in broilers at the field level. Anjum *et al.* (2005) observed that there was significant ( $P \leq 0.05$ ) improvement in feed conversion ratio after supplementation of multi-strain probiotics (protexin) in broilers; however, no improvement in feed intake was observed.

### Dressing and Leaf Fat Percentage of Birds

The dress and leaf fat percentage of birds as affected by feeding with BSC wet with various probiotics is presented in Table 5. Analysis of variance revealed no significant differences among the treatments both on the dress and leaf fat percentage of birds. The mean dress percentage ranges from 68.40 % to 76.38% while the leaf fat percentage ranges from 0.74 to 1.39%.

The result on dressing percentage conformed to the studies conducted by Moreira *et al.* (2001), Maiorca *et al.* (2001) and Correa *et al.* (2003) noted no significant effect on broiler performance and carcass yield in response to probiotic supplementation.

These results are in agreement with those of Adil *et al.* (2011) who reported that the carcass characteristics of broiler chicken fed diets supplemented with organic acids showed no significant ( $P > 0.05$ ) differences between various treatments.



## Kinds and Levels of Probiotics for Colored Chicken Breed

**Table 5. Mean Carcass Traits of Chickens Fed with BSC Wet with Different Kinds and Concentrations of Probiotic Solution.**

Kinds and Concentrations of Probiotic Solution	Dressing Percentage	Percent Leaf Fat
T <sub>0</sub> – Water	74.17	1.27
T <sub>1</sub> – Commercial Probiotics	72.86	1.36
T <sub>2</sub> – 10% LABS	69.14	1.02
T <sub>3</sub> – 20% LABS	69.97	0.90
T <sub>4</sub> – 30% LABS	68.40	1.29
T <sub>5</sub> – 10% EMAS	72.41	1.12
T <sub>6</sub> – 20% EMAS	76.38	0.82
T <sub>7</sub> – 30% EMAS	72.73	1.05
T <sub>8</sub> – 10% IMO	70.66	1.39
T <sub>9</sub> – 20% IMO	72.17	0.99
T <sub>10</sub> – 30% IMO	71.84	0.74

However, other studies contradict to the result wherein probiotics supplementation has a significant effect on carcass yield, live weight gain, immune response, and prominent cut up meat parts (Soomro *et al.*, 2019). Likewise, results of other studies revealed that dressing percentage were in line with other researchers who reported that the dressing percentage was increased by the addition of probiotics (Saiyed *et al.*, 2015). Toghiani and Tabeidian (2011) reported too that carcass characteristics were improved by the addition of prebiotic in broiler diet which might be related to inhibition of colonization of intestinal pathogens and improved utilization of nutrients (protein and energy) in diet. Kabir *et al.* (2004) and Falaki *et al.* (2010) found that probiotic increases significantly ( $P < 0.01$ ) carcass yield in both vaccinated and non-vaccinated broiler chicks. Furthermore, Mahajan *et al.* (1999) found that the mean values of hot dress weight, cold dress weight, and dressing percentage were significantly ( $P < 0.05$ ) higher in broilers fed probiotic.

On the other hand, the result of the study on leaf fat contradicts to the findings of other studies. Salma *et al.* (2007), reported that dietary supplementation of bacteria (*Rhodobacter capsulatus*) could improve fatty acid profile in broilers. Also a positive correlation between intra muscular fat content of breast muscle and shear force was also observed in the study of Yang *et al.* (2010). In a study conducted by Mateova *et al.* (2008), a decrease in serum cholesterol level and total lipids was observed after feeding *Lactobacillus fermentum* probiotic at  $10^9$  cfu/g and oligosaccharide prebiotics to broilers.

The result implies that fat deposition is a parameter that is more important to slow growing birds and cannot be seen due to earlier slaughter (64 days) compared to other studies where birds are being slaughtered at 120 days (Sakomura *et al.*, 2005).

### Cost of Feed to Produce a Kilogram Gain in Weight

Table 6 presents the cost of feed consumed to produce a kilogram gain in weight of broilers as affected by the different kinds and concentrations of probiotic solution supplemented to the feeds. Analysis of variance revealed significant result ( $p < 0.05$ ) wherein the birds fed with BSC wet with 30% EMAS solution have the highest cost of feeds consumed with a mean of Php122.85, while the lowest was obtained by the birds in T<sub>3</sub> (BSC wet with 10% LABS solution) with mean of Php107.62.

Comparison among treatment means revealed that birds fed with BSC wet with 10% LABS significantly had the cheaper cost of feeds to produce a kilogram gain in weight compared to those wet with 30% EMAS but comparable to the cost of feeds to produce a kilogram gain in weight in the treatments wet with plain water, commercial probiotics, 20% LABS, 30% LABS, 10% EMAS, 20% EMAS, 10% IMO, 20% IMO and 30% IMO.

**Table 6. Mean Cost of Feeds to Produce a Kilogram Gain in Weight of the Chickens and Profit Above Feed, Medicine and Stock Cost of Chickens as Affected by Feeding with BSC Wet with Different Kinds and Concentrations of Probiotic Solution.**

Treatment	Cost of Feeds (Php)*	Profit (Php)
T <sub>0</sub> – Water	113.92 <sup>ab</sup>	71.06
T <sub>1</sub> – Commercial Probiotics	118.53 <sup>ab</sup>	68.15
T <sub>2</sub> – 10% LABS	107.62 <sup>b</sup>	87.95
T <sub>3</sub> – 20% LABS	115.40 <sup>ab</sup>	79.32
T <sub>4</sub> – 30% LABS	117.64 <sup>ab</sup>	76.49
T <sub>5</sub> – 10% EMAS	114.29 <sup>ab</sup>	76.74
T <sub>6</sub> – 20% EMAS	114.02 <sup>ab</sup>	83.62

## Kinds and Levels of Probiotics for Colored Chicken Breed

T <sub>7</sub> – 30% EMAS	122.85 <sup>a</sup>	71.16
T <sub>8</sub> – 10% IMO	110.70 <sup>ab</sup>	86.54
T <sub>9</sub> – 20% IMO	115.67 <sup>ab</sup>	79.74
T <sub>10</sub> – 30% IMO	122.67 <sup>a</sup>	67.37

\*Means in a column followed by the same letter are not significantly different at 0.05 level of HSD Test.

The result implies that the cost of feeds to gain a kilogram gain in weight of birds was significantly affected by wet feeding with the use of different kinds and levels of probiotics. If growth performance and feed efficiency are increased in commercial farming, then the costs of production are likely to be reduced. Also, if the chicken flock is able to resist disease and survive until they are of marketable size, the subsequent cost of medication and overall production costs would be reduced drastically (Torres-Rodriguez *et al.*, 2007). Which was in accordance to the report of Gutierrez-Fuentes *et al.* (2013) when they evaluated the effect of a commercial lactic acid bacteria-based probiotic (FloraMax-B11) and the results showed an increase in body weight and improvement in feed conversion upon using the probiotic.

The cost benefit analysis showed that the increase in body weight of 100 g, when converted to a cost benefit ratio, suggested that for every \$ 1 spent on this probiotic there was a cost benefit of 1:22.57. The results of the study also conform to the finding Anjum *et al.* (2005), the researchers concluded that protexin probiotic supplementation is beneficial for better weight gains, feed efficiency and economic efficiency in broiler chicks. Their study revealed that per bird total return average on sale was \$1.59 at total average expenditure of \$0.982. The net per bird income was \$0.611 on average. This indicated that supplementation of broiler starter and finisher diets with protexin at 100 g/t in starter and 50 g/t in finisher diets were economically beneficial and encouraging where treated groups generated more profit than the control group (Anjum *et al.*, 2005).

### Profit Above Feed, Medicine and Stock Cost

The profit above feed medicine and stock cost of birds as affected by feeding with BSC wet with various natural supplements is presented in Table 6. Analysis of variance revealed no significant differences on the profit above feed, medicine and stock cost. Birds fed with BSC wet with 10% LABS gained the highest profit with a mean of 87.95Php while the lowest profit was those birds fed with BSC wet with 30% IMO with a mean of 67.37Php.

## SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

### Summary

This study was conducted at DMMMSU-NLUC, Bcnotan, La Union from June 24 to August 24, 2020 to determine the best type of probiotics, to determine the effect of the different levels of probiotics on the growth performance of colored chickens, to determine the dressing percentage and leaf fat percentage and also to determine the profit above feed, medicine and stock cost as affected by different probiotics.

One hundred eighty chicks were used in the study. After 14 days of brooding, the chicks were distributed randomly into eleven dietary treatments employing the Randomized Complete Block Design (RCBD) in three blocks.

The following are the salient findings of the study:

1. The highest gain in weight of the birds during their 1<sup>st</sup> week of rearing was achieved both by those fed with BSC wet with 20% IMO (T<sub>9</sub>) and BSC with 30% IMO (T<sub>10</sub>) with 0.16 kg, on the 2<sup>nd</sup> week by T<sub>2</sub> (BSC with 10% LABS) with 0.25 kg, on the 3<sup>rd</sup> week by T<sub>8</sub> (BSC with 10% IMO) with 0.27 kg, on the 4<sup>th</sup> week by T<sub>4</sub> (BSC with 30% LABS) with 0.17 kg, on the 5<sup>th</sup> week by T<sub>6</sub> (BSC with 20% EMAS) with 0.14 kg, on the 6<sup>th</sup> week by T<sub>9</sub> (BSC with 20% IMO) with 0.12 kg and on the 7<sup>th</sup> week by T<sub>6</sub> (BSC with 20% EMAS) with 0.15 kg, while the total gain in weight was attained by those fed with BSC with 20% EMAS (T<sub>6</sub>) with 1.12 kg.

2. The birds that consumed the least amount of feeds during the 1<sup>st</sup> week of rearing were those fed with BSC wet with 10% EMAS (T<sub>5</sub>) with 0.39 kg, on the 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup>, 7<sup>th</sup> week and the total feed consumption was recorded by T<sub>10</sub> (BSC with 30% IMO) with 0.60 kg, 0.56 kg and 0.49 kg, 0.73 kg and 3.95 kg respectively, by T<sub>4</sub> (BSC with 30% LABS) and T<sub>5</sub> (BSC with 10% EMAS) on the 5<sup>th</sup> week both with 0.52 kg and by T<sub>0</sub> (BSC with water) with 0.62 kg on the 6<sup>th</sup> week.

3. The most efficient birds in converting the feeds they consumed to carcass were those with the lowest FCR such as the birds of T<sub>10</sub> (BSC with 30% IMO) on the 1<sup>st</sup> week of rearing with 2.57, the birds of T<sub>2</sub> (BSC with 10% LABS) on the 2<sup>nd</sup> week (2.50), the birds of T<sub>5</sub> (BSC with 10% EMAS) on the 3<sup>rd</sup> week (2.46), the birds of T<sub>4</sub> (BSC with 30% LABS) on the 4<sup>th</sup> week (3.24), the birds of T<sub>6</sub> (BSC with 20% EMAS) on the 5<sup>th</sup> week (3.94), the birds of T<sub>9</sub> (BSC with 20% IMO) on the 6<sup>th</sup>, 7<sup>th</sup> week and the final FCR with 5.39, 5.48 and 3.80 respectively.

4. The highest dressing percentage was achieved by the birds fed with BSC wet with 20% EMAS (T<sub>6</sub>) with 76.38%.

## Kinds and Levels of Probiotics for Colored Chicken Breed

5. The highest profit was attained by the birds of T<sub>8</sub> (fed with BSC wet with 10% IMO) with PhP86.54 per bird.

### CONCLUSIONS

Based on the result of the study, the following conclusions were derived:

1. The best type of probiotic used for growth performance of colored chickens is the Effective Microorganism Activated Solution (EMAS).
2. Supplementation of 20% level of probiotics could result to better growth performance of colored type chickens such as heavier gain in weight, greater feed consumed and a more efficient feed conversion.
3. Supplementation of 20% EMAS to the bird's feed gave the highest dressing percentage and on the same manner the lowest leaf fat percentage could be achieved when supplemented with 30% IMO.
4. Higher profit above feed medicine and stock cost could be obtained by supplementing the feeds of the birds with 10% IMO.

### RECOMMENDATIONS

Based on the conclusions, the following are highly recommended:

1. To attain the highest total gain in weight, the feeding of the birds with BSC supplemented with 20% EMAS (T<sub>6</sub>) is recommended.
2. To attain the highest dressing percentage, the feeding of the birds with BSC supplemented with 20% EMAS (T<sub>6</sub>) is recommended.
3. To attain the highest percent leaf fat of the birds, the feeding with BSC supplemented with 10% IMO (T<sub>8</sub>) is recommended.
4. To attain the highest profit per bird, the feeding with BSC supplemented with 10% IMO (T<sub>8</sub>) is recommended.

### REFERENCES

- 1) Abdel-Hafeez, H. M., Saleh, E. S. E., Tawfeek, S. S., Youssef, I. M. I., & Abdel-Daim A. S. A. (2017). Effects of probiotic, prebiotic and symbiotic with and without feed restriction on performance, hematological indices and carcass characteristics of broiler chickens. *Asian-Australasian Journal of Animal Science*. 30 (5): 672–682.
- 2) Adil, S., Bandy, T., Bahat, G.A., Salahuddin, M., & Raquib, S. (2011). Response of broiler chicken to dietary supplementation of organic acids. *Journal of Central European Agriculture*. 12 (3): 2011. 498-508.
- 3) Alagawany, M., Abd El-Hack, M. E., & Farag, M. R. (2018). The use of probiotics as eco-friendly alternatives for antibiotics in poultry nutrition. *Environmental Science Pollution Research*. 25, 10611–10618. Retrieved on October 14, 2020 from <https://doi.org/10.1007/s11356-018-1687-x>
- 4) Amer, M. Y., & Khan S. H. (2012). A comparison between the effects of a probiotic and an antibiotic on the performance of Desi chickens. *Veterinary World*. 5 (3): 160-165.
- 5) Anjum, M. I., Khan, A. G., Azim, A., & Afzal, M. (2005). Effect of dietary supplementation of multi strain probiotic on broiler growth performance. *Pakistan Veterinary Journal*. 25 (1): 25-29.
- 6) Apata, D. F. (2008). Growth performance, nutrient digestibility and immune response of broiler chicks fed diets supplemented with a culture of *Lactobacillus bulgaricus*. *Journal Science and Food Agriculture*. 88, pp. 1253-1258
- 7) Arslan, M., Ozcan, M., Matur, F., Coteliloglu, U., & Ergul, E. (2004). The effect of probiotics on leptin level, body, liver and abdominal fat weights during the rapid growth phase of broilers. *Indian Veterinary Journal*. 81 (4): 416-420.
- 8) Awad, W.A., Ghareeb, K., Abdel-Raheem, S., & Bohm, J. (2009). Effects of dietary inclusion of probiotic and synbiotic on growth performance, organ weights, and intestinal histomorphology of broiler chickens. *Poultry Science*. 88, pp. 49-56
- 9) Bomba A, Nemcova, R., Gancarcikova, S., Herich, R., Guba, P., & Mudronova, D. (2002). Improvement of the probiotic effect of micro-organisms by their combination with maltodextrins, fructo-oligosaccharides and polyunsaturated fatty acids. *British Journal of Nutrition*. 88 (1):95–9.
- 10) Borchers A. T., Selmi, C., Meyers, F. J., Keen, C. L., & Gershwin, M. E. (2009). Probiotics and immunity. *Journal of Gastroenterology*. 44: 26–46.
- 11) Cao, G. T., Zeng, X. F., Chen, A. G., Zhou, L., Zhang, L., & Xiao, Y. P. (2013). Effects of a probiotic, *Enterococcus faecium*, on growth performance, intestinal morphology, immune response, and cecal microflora in broiler chickens challenged with *Escherichia coli* K88. *Poultry Science*. 92 (2013), pp. 2949–2955
- 12) Casey, P. G., Gardiner, G. E., & Casey, G. (2007). A 5-strain probiotic combination reduces pathogen shedding and alleviates disease signs in pigs challenged with *Salmonella enterica* serovar Typhimurium. *Applied Environmental Microbiology*. 73:1858–63.

## Kinds and Levels of Probiotics for Colored Chicken Breed

- 13) Castanon, J. I. (2007). History of the use of antibiotic as growth promoters in European poultry feeds. *Poultry Science*. 86, pp. 2466-2471 17954599
- 14) Chiofalo, V., Liotta, L., & Chiofalo, B. (2004). Effects of the administration of Lactobacilli on body growth and on the metabolic profile in growing Maltese goat kids. *Reproduction and Nutrition Development*. 44: 449–57.
- 15) Chitra, P., Mohan, B., & Vishwanathan, K. (2004). Effect of probiotic with ascorbic acid on growth performance of broilers in the summer season. *Indian Journal of Poultry Science*. 39 (3): 281-284.
- 16) Cho, H. K., & Koyama, A. (1997). Korean natural farming: indigenous microorganisms and vital power of crop/livestock. *Korean Natural Farming*. 172 pp.
- 17) Corcionivoschi, N., Drincianu, D., Pop, I. M., Stack, D., Stef, L., Julean, C., & Bourke, B. (2010). The effects of probiotics on animal health. *Animal Science and Biotechnologies*. 43: 35–41.
- 18) Corrêa, G. S. S., Gomes, A. V., Corrêa, A. B., & Salles, A. S. (2003). MattosEfeito de antibiótico e probióticos sobre o desempenho e rendimento de carcaça de frangos de corte. *Arquivo Brasileiro de Medicina Veterinária e Zootecnia*; 55 (4): 2003. 467-473.
- 19) Dalloul, R.A., & Lillehoj H. S. (2005). Recent advances in immunomodulation and vaccination strategies against coccidiosis. *Avian Diseases*. 49: 1–8.
- 20) De Jong, I., Berg, C., Butterworth, A. & Estevéz, I. (2012). Scientific report updating the European Food Safety Authority EFSA opinions on the welfare of broilers and broiler breeders. Supporting Publications 2012: EN-295.
- 21) De Rezende A. S. C, Trigo, P., Lana, A. M. Q., Santiago, J. M., Silva, V. P., & Montijano, F. C. (2012). East as a feed additive for training horses. *Ciencia Agrotecnologia*. 36: 354–62.
- 22) DuPont, M. W., & Fischer, D. (2012). The Natural Farming Concept: A new economical waste management system for small family swine farms in Hawai'i. LM-23. University of Hawai'i, College of Tropical Agriculture and Human Resources, Honolulu, HI
- 23) Engberg, R., Hammershoj, M., Johansen, N., Abouseken, M., Steinfeldt, S., & Jensen, B. (2009). Fermented feed for laying hens: Effects on egg production, egg quality, plumage condition and composition and activity of the intestinal microflora. *British Poultry Science*. doi: 10.1080/00071660902736722
- 24) Fajardo, P., Pastrana, L., Mendez, J., Rodriguez, I., Fucinos, C. & Guerra, N.P. (2012). Effects of feeding of two potentially probiotic preparations from lactic acid bacteria on the performance and faecal microflora of broiler chickens. *Scientific World Journal* 2012:562635. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3362022/>
- 25) Falaki, M., Shams, M., Dastar, B., & Zrehdaran, S. (2010). Effect of different levels of probiotic and prebiotic on performance and carcass characteristics of broiler chickens. *Journal of Animal and Veterinary Advanced*. 9: 2010, 2390-2395.
- 26) Francesca, G., Paola, M., & Bruno, B. (2010). Probiotics and prebiotics in animal feeding for safe food production. *International Journal of Food Microbiology*. 141, pp. S15-S28 (Supplement)
- 27) Gadde, U.D., Oh, S., Lillehoj H.S., & Lillehoj, E.P. (2018). Antibiotic growth promoters virginiamycin and bacitracin methylene disalicylate alter the chicken intestinal metabolome. *Science Reports*. 8, p. 3592
- 28) Gaggia, F., Mattarelli, P., & Biavati, B. (2010). Probiotics and prebiotics in animal feeding for safe food production. *International Journal of Food Microbiology*. 141, pp. S15-S28 20382438
- 29) García-Lafuente, A., Antolín, M., Guarner, F., Crespo, E., & Malagelada, J. R. (2001). Modulation of colonic barrier function by the composition of the commensal flora in the rat. *Gut*. 2001 Apr; 48(4): 503–507. doi: [10.1136/gut.48.4.503](https://doi.org/10.1136/gut.48.4.503)
- 30) Ghosh, P. K., Ramesh, P., Bandyopadhyay, K. K., Tripathi, A. K., Hati, K. M., & Misra, A. K. (2004). Comparative effectiveness of cattle manure, poultry manure, phosphor compost and fertilizer-NPK on three cropping systems in vertisoils of semi-arid tropic. 1. Crop yields and systems in performance. *Bioresource Technology*. 95: 77-83.
- 31) Global Partners. Emrojapan.com. (2015). EM Research Organization. Archived from the original on 8 December 2015.
- 32) Gupta, M. (2003). Effect of combination of different strains of microbes isolated from indigenous sources. M.V.Sc. thesis, Chaudhary Sarwan Kumar Krishi Vishvavidyalaya (H. P.), India.
- 33) Gupta, T. (2004). Field evaluation of some useful microbes as growth promoters in broilers. M.V.Sc. Thesis, Chaudhary Sarwan Kumar Krishi Vishvavidyalaya (H.P.), India.
- 34) Gutierrez-Fuentes, C. E., Zuñiga-Orozco, L. A., Vicente, J. L., Hernandez-Velasco, X., Menconi, A., Kuttappan, V. A., . . . , & Hargis, B. M. (2013). Effect of a Lactic Acid Bacteria Based Probiotic, FloraMax-B11®, On performance, bone qualities and morphometric analysis of broiler chickens: an economic analysis. *International Journal of Poultry Science*. 12, p. 322
- 35) Huyghebaert, G., Ducatelle, R., & Immerseel, F. V. (2011). An update on alternatives to antimicrobial growth promoters for broilers *Veterinary Journal*. 187, pp. 182-188.

## Kinds and Levels of Probiotics for Colored Chicken Breed

- 36) Ignatova, M., Sredkova, V., & Marasheva, V. (2009). Effect of dietary inclusion of probiotic on chickens performance and some blood indices. *Biotechnology of Animal Husbandry*. 25, pp. 1079-1085.
- 37) Isolauri, E, Salminen, S., & Ouwehand, A. C. (2004). Probiotics. *Best Practical Research on Clinical Gastroenterology*. 18:299–313.
- 38) Kabir, R. M. M., Rahman, M. M., Amed, S. U., & Sani, M. L. (2004). The dynamics of probiotics on growth performance and immune response in broilers. *International Poultry Science*. 3 (5): 361-364.
- 39) Kabir, S. M. L., Rahman, M. M., Rahman, M. B., & Ahmed. S. U. (2004). The Potential of probiotics in promoting microbiological meat quality of broilers. *Journal of Bangladesh Social and Agriculture Science Technology*. 2, 2004, 93-96.
- 40) Kessler, A. M., Snizek, P. N., & Brugalli, I. (2000). Manipulação da quantidade de gordura na carcaça de frangos. *Conferência Apinco de Ciência Tecnologia Avícolas*. FACTA, Campinas, SP, Brazil. p. 117-133.
- 41) Khan, R. U., & Naz, S. (2013). The applications of probiotics in poultry production. *World's Poultry Science Journal*. 69: 3, 621-32, DOI: [10.1017/S0043933913000627](https://doi.org/10.1017/S0043933913000627)
- 42) Konstantinov, S.R., Smidt, H., Akkermans, A.D.L., Casini, L., Trevisi, P, Mazzone, M., . . . & de Vos, W. (2008). Feeding of Lactobacillus sobrius reduces Escherichia coli F4 levels in the gut and promotes growth of infected piglets. *FEMS Microbiology and Ecology*. 66: 599–607.
- 43) Kral, M., Angelovicova, M., & Mrazova, L. (2012). Application of probiotics in poultry production. *Scientific Papers on Animal Science and Biotechnologies*. 45, pp. 55-57
- 44) Kurtoglu, V., Kurtoglu, F., & Seker, E. (2004). Effect of probiotic supplementation on laying hen diets on yield performance and serum and egg yolk cholesterol. *Food Additives Contamination*. 21: 817–23.
- 45) Lee, I. K., Kye, Y. C., Kim, G., Kim, H. W., Gu, M. J., & Umboh, J. (2016). Stress, nutrition, and intestinal immune responses in pigs—a review. *Asian Australasian Journal of Animal Science*. 29: 1075–82.
- 46) Lei, X., Piao, X., Ru, Y., Zhang, H., Péron, A., & Zhang, H. (2015). Effect of Bacillus amyloliquefaciens-based direct-fed microbial on performance, nutrient utilization, intestinal morphology and cecal microflora in broiler chickens. *Asian Australasian Journal of Animal*. 28 (2): 239–46.
- 47) Liao, S.F., & Nyachoti, M. (2017). Using probiotics to improve swine gut health and nutrient utilization. *Animal Nutrition*. 3 (4): 331–43.
- 48) Li, X., Yin, J., & Li, D. (2006). Dietary supplementation with zinc oxide increases igf-I and igf-I receptor gene expression in the small intestine of weanling piglets. *Journal of Nutrition*. 136:1786–91.
- 49) Madsen, K., Cornish, A., Soper, P., McKaigney, C., Jijon, H. & Yachimec, C. (2001). Probiotic bacteria enhance murine and human intestinal epithelial barrier function. *Gastroenterology*. 121:580–91.
- 50) Mahajan, P., Sahoo, J., & Panda, P. C. (1999). Effects of probiotic feeding and seasons on the growth performance and carcass quality of broilers. *Indian Journal of Poultry Science*. 34: 167–176.
- 51) Mansoub, N. H. (2010). Effect of probiotic bacteria utilization on Serum Cholesterol and Triglycerides contents and performance of broiler chickens. *Global Veterinaria*. 5 (3): 184-186.
- 52) Mateova, S., Saly, J., Tuckova, M., Koscova, J., Nemcova, R., Gaalova, M., & Baranova D. (2008). Effect of probiotics, prebiotics and herb oil on performance and metabolic parameters of broiler chickens. *Medycyna Weterynaryjna*, 64: 294-297.
- 53) Maiorka, A., Santin, E., Sugeta, S. M., Ameida, J.G., & Macari, M. (2001). Utilização de prebióticos, probióticos e simbióticos em dietas para frangos. *Revista Brasileira de Ciência Avícola*. 3 (1) 75-82.
- 54) Moreira, J., Mendes, A. A., Garcia, R.G., Almeida, I. C. L, & JR, J. G. C. (2001). Efeito do uso do probiótico sobre o desempenho e rendimento de carcaça em frangos de corte. In: XXXVIII Reunião Anual da SBZ, Piracicaba. *Anais Piracicaba*. p 852-854.
- 55) Mountzouris, K. C., Tsirosikos, P., & Kalamara, E. (2007). Evaluation of the efficacy of a probiotic containing Lactobacillus, Bifidobacterium, Enterococcus, and Pediococcus strains in promoting broiler performance and modulating cecal microflora composition and metabolic activities. *Poultry Science*. 86 (2): 309–17.
- 56) Musa, H. H., Wu, S. L., & Zhu, C. H. (2009). The potential benefits of probiotics in animal production and health. *Journal of Animal Veterinary Advancement*. 8 (2): 313–21.
- 57) Nahashon, S. N., Nakaue, H. S., & Mirosh, L. W. (1996). Performance of single comb White Leghorn fed a diet supplemental with a live microbial during the growth and egg laying phases. *Animal Feed Science and Technology*. 57 (1-2): 25-38.
- 58) Naik, D. G., Javedmulla, A., & Shivakumar, M. C. (2000). Performance of broilers supplemented with probiotics. *Karnataka Journal of Agricultural Sciences*. 13 (4): 957-960.

## Kinds and Levels of Probiotics for Colored Chicken Breed

- 59) Nayeopor, M., Farhoman, P., & Hashemi, A. (2007). Effects of different levels of direct fed microbials (Primalac) on growth performance and humoral immune response in broiler chickens. *Journal of Animal Veterinary Advancement*. 6, pp. 1308-1313
- 60) Ng, S. C., Hart, A. L., Kamm, M. A., Stagg, A. J., & Knight, S. C.. (2009). Mechanisms of action of probiotics: recent advances. *Inflammatory Bowel Diseases*. 15: 300–10.
- 61) Nordqvist, C. (2004). Lactic acid bacteria - their uses in food. *Medical News Today*. Retrieved on November 25, 2020 from <http://www.medicalnewstoday.com/releases/14023.php>
- 62) Ohimain, E.I., & Ofongo, R. T. S. (2012). The effect of probiotic and prebiotic feed supplementation on chicken health and gut microflora: A review. *International Journal of Animal Veterinary Advancement*, 4, pp. 135-143
- 63) Olle, C., & Williams, Y. (2013). "Effective microorganisms and their influence on vegetable production – a review". *Journal of Horticultural Science & Biotechnology*. 88 (4): 380–386. doi:10.1080/14620316.2013.11512979.
- 64) Parvez, S., Malik, K., Ah Kang, S., & Kim, H. Y. (2006). Probiotics and their fermented food products are beneficial for health. *Journal of Applied Microbiology*. 100, pp. 1171-1185
- 65) Patel, S., Shukla, R., & Goyal, A. (2015). Probiotics in valorization of innate immunity across various animal models. *Journal of Functional Foods*. 14: 549–61.
- 66) Pender, C., Kim, S., Potter, T., Ritzi, M., Young, M., & Dalloul, R. (2016). Effects of in ovo supplementation of probiotics on performance and immune competence of broiler chicks to an *Eimeria* challenge Beneficial Microbes. 7, pp. 699-705
- 67) Philippine Statistics Authority. (2020). Chicken egg situation report. Retrieved on November 25, 2020 from <https://www.psa.gov.ph/content/chicken-egg-situation-report-october-december-2019>
- 68) Sakomura, N. K., Longo, F. A., Oviedo-Rondon, E.O., Boa-Viagem, C., & Ferraudo, A. (2005). Modeling energy utilization and growth parameter description for broiler chickens. *Poultry Science*. 84: 1363-1369.
- 69) Salma, U., Miah, A., Maki, T., Nishimura, M., & Tsujii, H. (2007). Effect of dietary *Rhodobacter capsulatus* on cholesterol concentration and fatty acid composition in broiler meat. *Poultry Science*. 86, pp. 1920-1926
- 70) Safalaoh, A. C. L., Smith, G. A., Senanayake, Y. D. A., & Sangakkara, U. R. (2001). Effective microorganisms as an alternative to antibiotics in broiler diets: effect on broiler growth performance, feed utilization and serum cholesterol. Sixth International Conference on Kyusei farming. Proceedings of the conference on greater productivity and a cleaner environment through Kyusei nature farming, University of Pretoria, Pretoria, S. Africa. 28- 31 October, 1999. pp. 150-155.
- 71) Samli, H. E., Senkoylu, N., & Koc, F. (2007). Effects of *Enterococcus faecium* and dried whey on broiler performance, gut histomorphology and intestinal microbiota. *Archive of Animal Nutrition*. 61: 42–9.
- 72) Saiyed, M. A., Joshi, R. S., Savaliya, F. P., Patel, A. B., Mishra, R. K., & Bhagora, N. J. (2015). Study on inclusion of probiotic, prebiotic and its combination in broiler diet and their effect on carcass characteristics and economics of commercial broilers. *Veterinary World*. 8 (2015), pp. 225-231
- 73) Sen, S., Ingale, S. L., Kim, Y. W., Kim, J. S., Kim, K. H., Lohakare, J. D., Kim, E. K., . . . & Chae, B.J. (2012). Effect of supplementation of *Bacillus subtilis* LS 1–2 to broiler diets on growth performance, nutrient retention, caecal microbiology and small intestinal morphology. *Research in Veterinary Science*. 93, pp. 264-268 21757212
- 74) Shareef, A. M. (2009). Effect of probiotic (*Saccharomyces cerevisiae*) on performance of broiler chicks. *Iraqi Journal of Veterinary Sciences*. 23: 23-29.
- 75) Sherief, M. A., & Sherief, M. S. A.. (2011). The effect of single or combined dietary supplementation of Mannan Oligosaccharide and probiotics on performance and slaughter characteristics of broilers. *International Journal of Poultry Science*. 10 (11): 854-862.
- 76) Soomro, R. N., Abd El-Hack, M. E., Shah, S. S., Taha, A. E., Alagawany, M., Swelum, A.A., . . . & Tufarelli, V. (2019). Impact of restricting feed and probiotic supplementation on growth performance, mortality and carcass traits of meat-type quails. *Animal Science Journal*. 90 (2019), pp. 1388-1395
- 77) Stern, N. J., Cox, N. A., & Bailey, J. S. (2001). Comparison of mucosal competitive exclusion and competitive exclusion treatment to reduce *Salmonella* and *Campylobacter* sp. colonization in broiler chickens. *Poultry Science*. 80: 156–60.
- 78) Tiquia, S. M., & Michel, F. C. Jr. (2002). "Analysis of Microbial Community Diversity during Livestock Manure Composting using T-RFLP of 16S rRNA genes" in *Microbiology of Composting*. Edited by H. Insam et al., Heidelberg: Springer-Verlag, pp.65-82 (2002).
- 79) Toghiani, M., & Tabeidian, S. A. (2011). Effect of probiotic and prebiotic as antibiotic growth promoter substitutions on productive and carcass traits of broiler chicks. *International Conference on Food Engineering and Biotechnology*. 9 (2011), pp. 82-96

## Kinds and Levels of Probiotics for Colored Chicken Breed

- 80) Torres-Rodriguez, A., Donoghue, A. M., Donoghue, D. J., Barton, J., Tellez, G., & Hargis, B. (2007). Performance and condemnation rate analysis of commercial turkey flocks treated with a Lactobacillus sp.—based probiotic. *Poultry Science*. 86: 444–6.
- 81) Umi, K. M. S., & Sariah, M. (2006). Utilization of microbes for sustainable agriculture in Malaysia: current status. Bio prospecting and management of microorganisms. National Conference on Agro biodiversity conservation and sustainable utilization, pp 27–29. Retrieved on October 14, 2021 from <https://thepoultrysite.com/articles/feeding-chickens-for-best-health-and-performance>.
- 82) Upendra, H. A., & Yathiraj, S. (2002). Effect of probiotic preparation (Lacto-Sacc) on performance and livability in broiler chicks under field conditions. *The Veterinarian*. 26: 11-14.
- 83) Van, I. F., Russell, J. B. & Flythe, M. D. (2006). The use of organic acids to combat Salmonella in poultry: a mechanistic explanation of the efficacy. *Avian Pathology*. 35: 182-8.
- 84) Willing, B. P., Malik, G., & van Kessel, A. G.. (2012). Nutrition and gut health in swine. In: Chiba LI, editor. Sustainable swine nutrition. Chichester: Wiley. p. 197–213.
- 85) Yakubu A., & Madaki, J. (2017). Modelling growth of dual-purpose Sasso hens in the tropics using different algorithms. *Journal of Genetics and Molecular Biology*. 1 (1), pp. 1-9.
- 86) Yang, X., Zhang, B., Guo, Y., & Jiao, P. (2010). Long F. Effects of dietary lipids and Clostridium butyricum on fat deposition and meat quality of broiler chickens. *Poultry Science*. 89, pp. 254-260
- 87) Yirga H. (2015). The use of probiotics in animal nutrition. *Journal on Problem of Health*. 3: 132.
- 88) Yousefi, M., and Karkoodi, K. (2007). Effect of probiotic Thepax and Saccharomyces cerevisiae supplementation on performance and egg quality in laying hens. *International Journal of Poultry Science* 6: 52-54.
- 89) Zhang, Z. F., & Kim, I. H. (2014). Effects of multistrain probiotics on growth performance, apparent ileal nutrient digestibility, blood characteristics, cecal microbial shedding, and excreta odor contents in broilers. *Poultry Science*. 93 (2): 364–70.
- 90) Zhou, X., Wang, Y., Gu, Q., & Li, W. (2010). Effect of dietary probiotic, Bacillus coagulans, on growth performance, chemical composition, and meat quality of Guangxi Yellow chicken. *Poultry Science*. 89, pp. 588-593
- 91) Zuraini, Z., Sanjay, G., & Noresah, M. (2010). Effective Microorganism (EM) technology for water quality restoration and potential for sustainable water resources and management. Proceedings of the International Congress on Environmental Modelling and Software Modelling for Environment’s Sake, Fifth Biennial Meeting held between 5th- 8th July 2010, Ontario Canada.
- 92) Manitoba Agriculture. (2019). Basic Feeding Programs for Small Chicken Flocks. Retrieved on January 25, 2019 7:54 p.m from <https://www.gov.mb.ca/agriculture/livestock/production/poultry/basic-feeding-programs-for-small-chicken-flocks.html>



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## The Effect of Topical Gel Secretome Hypoxic Mesenchymal Stem Cells (SH-MSCs) on IL-6 and TGF- $\beta$ Gene Expression (Experimental Study in Male Wistar Alopecia-Like Rat Models Induced by Fluconazole)



Meri Aldila Rahmanita<sup>1</sup>, Agung Putra<sup>2</sup>, Deddy Hermansyah<sup>3</sup>

<sup>1</sup>Postgraduate student of Biomedical Sciences, Faculty of Medicine, Universitas Islam Sultan Agung, Jl Kaligawe KM 4 Semarang 50012

<sup>2,3</sup>Department of Biomedical Sciences, Faculty of Medicine, Universitas Islam Sultan Agung, Jl Kaligawe KM 4 Semarang 50012

**ABSTRACT:** Alopecia induced by the accumulation of reactive oxygen species (ROS) stimulates changes in the immune and neuroendocrine systems. Hair follicles have dermal papillary cells (DPCs) that bind to corticotropin-releasing factor (CRF) receptors. Research shows that transforming growth factor (TGF- $\beta$ ) is one of the expressions that can be an indication of the influence of CRF. The effect of CRF itself is to cause hair loss. The purpose of this study was to determine the Secretome of Hypoxia Mesenchymal Stem Cells (SH-MSCs) against IL-6 expression and TGF- $\beta$  expression. This study used experimentally in vivo with the Post Test Only Control Group Design method. The subjects of this study were male rats of Wistar strain which were divided into 4 treatments consisting of 1 healthy group, 1 negative control group, 1 treatment group with SH-MSCs dose 10% in a dose of 200 mg/rat/day gel, and 1 more treatment group with SH-MSCs dose 20% in a dose of 200 mg/rat/day. On the 21st day, IL-6 expression and TGF- $\beta$  expression were examined. Data were analyzed using the One-Way ANOVA Test and the Kruskal-Wallis Test to determine the effect of each group. The One-Way ANOVA test showed the results of IL-6 expression ( $p = 0.000$ ) showed a significant difference ( $p < 0.05$ ) and the Kruskal-Wallis test of TGF- $\beta$  expression ( $p = 0.000$ ) with SH-MSCs dose 200 was a significant difference ( $p < 0.05$ ). The administration of 10% and 20% doses of SH-MSCs in 200 mg gel may decrease IL-6 expression. Dosed SH-MSCs 20% increased TGF- $\beta$  expression in alopecia-like rats. The development of the use of SH-MSCs is expected to be an alternative to alopecia therapy that is more beneficial and safe for the body.

**KEYWORDS:** Secretome Hypoxia Mesenchymal Stem Cells (SH-MSCs), IL-6x, TGF- $\beta$

### I. INTRODUCTION

Alopecia is a disorder where there is loss of part or all of the hair on parts of the body or hair.<sup>1</sup> In alopecia, there are changes in several pro-inflammatory cytokines such as tumor necrosis factor- $\alpha$  (TNF- $\alpha$ ) and interleukin-6 (IL-6) which causes changes in the morphology and growth cycle of hair which results in hair loss and baldness. Accumulation-induced alopecia reactive oxygen species (ROS) will stimulate changes in the immune and neuroendocrine systems. Hair follicles have dermal papillary cells (DPCs) that bind to receptors of corticotropin-releasing Factor (CRF). Research shows that transforming growth factor (TGF- $\beta$ ) is one of the expressions that can be an indication of the influence of CRF. The effect of CRF itself can cause hair loss.<sup>1</sup> Increasing levels of TGF- $\beta$  as an anti-inflammatory mediator is expected to reduce CRF and reduce the rate of hair loss. Various therapies have been developed to treat alopecia, but conventional treatment is accepted Food Drug Administration (FDA) only Minoxidil and Finasteride. This treatment only provides temporary results as well has many side effects on long-term use.<sup>1</sup> Therefore, safe and effective therapeutic approaches are needed as a complement to existing conventional therapies. One of the therapies developed for the treatment of alopecia is using Secretome Hypoxia Mesenchymal Stem Cells (SH-MSCs).<sup>1</sup> Alopecia areata is a type of alopecia whose prevalence is known to occupy 2% of the total global population in the world. The prevalence has increased from 0.1% in 1970 to 2.11% in recent years. In the USA, the prevalence of alopecia areata is high 0.57% to 3.8% of the population.<sup>4</sup> The prevalence of alopecia in the USA varies across different populations and studies.<sup>5</sup> Alopecia areata can develop into more severe forms, namely alopecia totalis (AT), which is the loss of all the hair on the scalp, and alopecia universalis (AU), which is the loss of



## The Effect of Topical Gel Secretome Hypoxic Mesenchymal Stem Cells (SH-MSCs) on IL-6 and TGF- $\beta$ Gene Expression (Experimental Study in Male Wistar Alopecia-Like Rat Models Induced by Fluconazole)

all the hair on the body.<sup>5</sup> Most alopecia patients come from the age group 30 to 59 years, namely the productive age group.<sup>6</sup> These various studies show that better therapy is needed to treat alopecia. SH-MSCs is an MSC culture medium that is conditioned in hypoxia and has gone through a filtration process using a technique of tangential flow filtration (TFF).<sup>7</sup> Preclinical studies show SH-MSCs can promote hair growth through nicotinamide adenine dinucleotide phosphate (NADPH) oxidase.<sup>8</sup> Preclinical studies show that SH-MSCs contain various anti-inflammatory cytokines, e.g vascular endothelial growth factor (VEGF), Insulin-like growth factor (IGF), hepatocyte growth factor (HGF), bone morphogenic proteins (BMPs), interleukin-6 (IL-6), and other cytokines that are closely related to hair regeneration<sup>1</sup>. SH-MSCs also contain TGF- $\beta$  which is an anti-inflammatory cytokine and inhibits hair loss.<sup>1,7</sup> Other preclinical studies examined in vitro the effects of the secretome Adipose Stem Cells (ADSCs) in a mouse model of Androgenic Alopecia. This research found an immunomodulatory effect<sup>9</sup>. The secretome of ADSCs showed expression interferon- $\gamma$  (IFN- $\gamma$ ), chemokine ligand 9 (CXCL9), chemokine ligand 10 (CXCL10), and T-cell infiltration. The effect of ADSCs on alopecia was also confirmed with preclinical studies. In this preclinical study, follicular genesis and hair growth are mediated by the secretory properties of white adipocytes. The results of this study pave the way for regenerative therapy of ADSCs for androgenic alopecia. There were thirty-five signaling proteins analyzed, VEGF levels, epidermal growth factor (EGF), IL-6, Eotaxin, monocyte chemoattractant protein-3 (MCP-3), IFN $\gamma$ -inducible protein-10 and macrophage inflammatory protein (MIP-1 $\alpha$ ) which shows higher levels in the bald zone, conversely, MCP-1 is the lowest in the bald zone.<sup>10</sup> Clinical studies reported an increase in Wnt signaling in DPCs which is one of the main factors that increase hair growth. The Secretome of MSC and platelet-derived growth factor (PDGF) affects hair growth through cell proliferation to prolong the anagen phase fibroblast growth factor (FGF-7), induces cell growth (activation It extracellular signal-regulated kinase (ERK), stimulates hair follicle development ( $\beta$ -catenin), and suppresses apoptotic signals (Bcl-2 release and Akt activation).<sup>16</sup> Interleukin-6 is a cytokine that plays a role in the non-specific immune system and the specific immune system.<sup>11</sup> Clinical studies have found that IL-6 plays a role in the pathogenesis of one type of alopecia, namely alopecia areata, through the regulation of cell pathways T helper 1 (Th1) and T helper 2 (Th2). Th2-induced IL-6 will cause hair root collapse during the anagen phase through inhibition of the immune system and inadequate regulation of T cells. The clinical study found that disruption of the IL-6 signaling pathway can cause hair to grow back.<sup>13</sup> TGF- $\beta$  is a functional regulatory polypeptide that controls many aspects of cellular function including independent cell renewal, differentiation, proliferation, migration, apoptosis, adhesion, angiogenesis, and survival. TGF- $\beta$  as a pleiotropic cytokine has been shown to play a role in regulating stem cell differentiation through pathway-related cross-talk Smad and non-Smad.<sup>12</sup> TGF- $\beta$  is also an anti-inflammatory mediator that is expected to reduce hair loss. Various studies report that SH-MSCs can suppress the secretion of pro-inflammatory cytokines. Administration of SH-MSCs can improve the condition of alopecia-like by inhibiting the inflammatory response through reducing levels of pro-inflammatory cytokines IL-6, IL-1 $\beta$ , TNF- $\alpha$ , and increasing anti-inflammatory cytokines IL-10 and TGF- $\beta$ 1. However, topical administration of SH-MSCs gel on the expression of IL 6 and TGF- $\beta$  in Alopecia-like has never been done. Based on this background, it is necessary to carry out research to determine the effect of administering SH-MSCs-based gel on the expression of the IL-6 and TGF- $\beta$  genes in the Wistar mice model of alopecia-like.

## II. MATERIAL AND METHOD

This research is experimental research with a Post Test Only Control Group Design Group Design. The research subjects used 24 male Wistar rats 8-12 weeks old with a weight between 150-250 grams that meets the inclusion and exclusion criteria, adapted for 7 days. This study used 4 treatment groups, a control group of healthy mice (S), a negative control group of alopecia-like rat models with control 100 mg base gel NaCl (K), treatment group 1, namely model mice alopecia-like by administering topical 10% SH-MSCs gel at a dose of 200 mg/rat/day (P1), and treatment group 2, namely alopecia-like rats model by administering 10% SH-MSCs topical gel at a dose of 200mg/rat/day (P2), on the 28th day of male Wistar rats skin samples were taken to examine IL-6 expression and TGF- $\beta$  expression

### Research materials

The material for this research consists of culture material consisting of rat umbilical cord, fluconazole oral tablet, acetone-olive oil NaCl 0.9%, PBS, DMEM, FBS, fungizone, and penstrep. While the materials used for the treatment process are water-based gel, 70% alcohol, PBS, Ketamine, and Xylasine.

### Research equipment

This research uses equipment in the form of cell culture equipment consisting of a Biosafety Cabinet (BSC), micropipette, CO incubator<sup>2</sup>, dissecting kit, 75T flask, microscope, and dissecting set to take skin samples after treatment. Hypoxic culture conditions are obtained using a hypoxic chamber. Oxygen meters are used to measure oxygen levels inside a hypoxic chamber.

## **The Effect of Topical Gel Secretome Hypoxic Mesenchymal Stem Cells (SH-MSCs) on IL-6 and TGF- $\beta$ Gene Expression (Experimental Study in Male Wistar Alopecia-Like Rat Models Induced by Fluconazole)**

Apart from that, this study also used sterile swabs to apply SH-MSC gel. The tool used for analysis of the cytokines Interleukin 6 and TGF- $\beta$  is qRT-PCR.

### **Mesenchymal Stem Cell Isolation Procedure from Umbilical Cord**

The entire process is done in-house biosafety cabinet class 2, using sterile equipment and working with high sterility techniques. (1) The umbilical cord separated from the rat fetus and the blood vessels were removed. (2) Using tweezers, the umbilical cord was placed in a Petri dish, and the umbilical cord was washed thoroughly using PBS. (3) Umbilical cord collected and placed in a sterile container containing 0.9% NaCl. (4) Umbilical cord chopped until fine and placed evenly in a 25T flask and let stand for 3 minutes until the tissue adheres to the surface of the flask. (5) A complete medium consisting of DMEM, fungizone, penstrep, and FBS) is added slowly until it covers the tissue. (6) The explants were incubated in an incubator at 37°C and 5% CO<sub>2</sub>. (7) Cells will appear after approximately 14 days from the start of the culture process. (8) The medium was replaced every 3 days by removing half of the medium and replacing it with a new complete medium. (9) Cell maintenance was carried out until the cells reached 80% confluency.

### **Hypoxia Process**

MSCs reaching 80% confluency were added with a complete medium of up to 10 mL. A flask that has been filled with MSC is then put inside a hypoxic chamber. Nitrogen gas is channeled through the inlet valve and an oxygen meter is placed in the sensor hole to measure the oxygen concentration inside the chamber. Nitrogen is added until the indicator needle shows a concentration of 5% oxygen. Chamber The containing flask was incubated for 24 hours at 37°C. After 24 hours, the culture medium was taken and filtered using TFF to obtain SH-MSC which was then mixed with gel according to the dosage of P3 and P4.

### **RNA extraction and cDNA synthesis**

Blood samples were taken and a multistage centrifugation process was carried out using Ficoll Paque so that PBMCs were obtained. Skin samples were fixed in 10% formalin and made into paraffin blocks. A 100 mg skin sample was then cut into small pieces and put into a tube filled with 50 mL of RNA Iso Plus. On the other hand, there are 10 PBMCs. Each cell was transferred to a microtube and given 50 mL of RNA Iso Plus. The skin pieces were ground using a micropaste and 50 mL of RNA Iso Plus was added and kept at room temperature for 5 minutes. Add 20 mL of chloroform and vortex until the solution becomes milky white. Incubate at room temperature for 2-3 minutes, and centrifuged at 15,000 rpm for 15 minutes at 400C until the solution in the tube appears to have 3 layers. The top layer is RNA (liquid phase), the second layer is DNA (semisolid phase) and the bottom layer contains cell debris. The top layer was transferred to a new centrifuge tube and the volume was measured, and a volume of isopropanol equal to the RNA taken from the top layer was added. The Eppendorf tube was shaken until white threads appeared, then centrifuged at 15,000 rpm for 10 minutes at 400C. The supernatant is discarded until a white pellet is visible at the bottom of the tube. After drying, 100 mL of 70% ethanol was added to the solution (Diethyl percarbonate) DEPC then turned back and forth repeatedly and centrifuged again at 15,000 rpm for 5 minutes at a temperature of 400C. The supernatant was discarded and 30-50  $\mu$ m DEPC was added. The mixture was incubated at 550C for 10 minutes. Next, the total RNA solution was obtained and stored at -800C. RNA was quantified with Nanodrop. The quantification results were calculated to be 3000 ng. Synthesis of cDNA by making mixture A by mixing the calculated RNA samples, 1  $\mu$ L of OligoDT, and PCR water until it reaches a volume of 10  $\mu$ L, then incubating for 5 minutes at a temperature of 700C. Mixture A was added with mixture B consisting of 5X buffer 4  $\mu$ L, DEPC-Treated H<sub>2</sub>O 5  $\mu$ L, and ReverTraAce 1  $\mu$ L. The mixture was incubated at 250C for 5 minutes, 420C for 50 minutes and 850C for 5 minutes.

### **Readings of Interleukin 6 and TGF B Expression with Time-Polymerase Chain Reaction (RT-PCR)**

IL 6 and TGF- $\beta$  expression readings were analyzed using reverse Transcription-Polymerase Chain Reaction (RT-PCR). A mixture of 3  $\mu$ L cDNA samples, Taq master mix (dNTPs, Taq DNA polymerase, reaction buffer, and MgCl<sub>2</sub>) as much as 12.5  $\mu$ L, specific primer for each target gene as much as 0.6  $\mu$ L for forward and reverse primers and 8.3  $\mu$ L Nuclease Free Water. PCR products were then analyzed using Illumine qRT-PCR. The GAPDH primer sequences used were F: 5'-GCG ACA GTC AAG GCT GAG AATG -3' and R: 5'-TCT CGC TCC TGG AAG ATG GTGA -3'. The IL-6 primer sequences used were F: 5'-TCC TAC CCC AAC TTC CAA TGC TC-3' and R: 5'-TTG GAT GGT CTT GGT CCT TAG CC-3'. The TGF- $\beta$  primer sequences used were F: 5'-TAC CAT GCC AAC TTC TGT CTG GGA-3' and R: 5'-ATG TTG GAC AAC TGC TCC ACC TTG-3'. The increase in gene expression was analyzed in the ratio of increase to housekeeping genes using the software EcoStudy.

# The Effect of Topical Gel Secretome Hypoxic Mesenchymal Stem Cells (SH-MSCs) on IL-6 and TGF- $\beta$ Gene Expression (Experimental Study in Male Wistar Alopecia-Like Rat Models Induced by Fluconazole)

## III. RESULT

### Validation of MSCs

SH-MSCs isolation was carried out in the laboratory of Stem Cell and Cancer Research (SCCR) Indonesia, Semarang, using the umbilical cord of 21-day-old pregnant mice. The isolation results were then cultured in T75 flasks with a complete medium. The results of the MSCs culture after the 5th passage showed an image of cells attached to the bottom of the flask with morphology spindle-like cells (Figure 1) using microscopic observation.

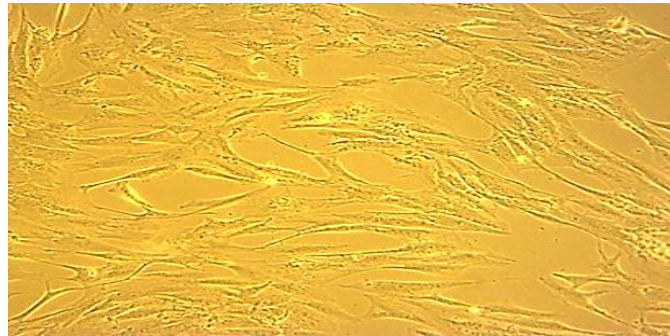


Figure 1. The morphology of MSCs resembles fibroblast cells at 200x magnification

The results of MSC isolation were validated using flow cytometry to show the ability of MSCs to express various surface marker special. Quantitative results are the percentage of positive expression of CD 90.1 (97.6%), CD 29 (97.7%), and negative expression of CD 45 (1.5%), and CD 31 (3.2%) (Figure 2).

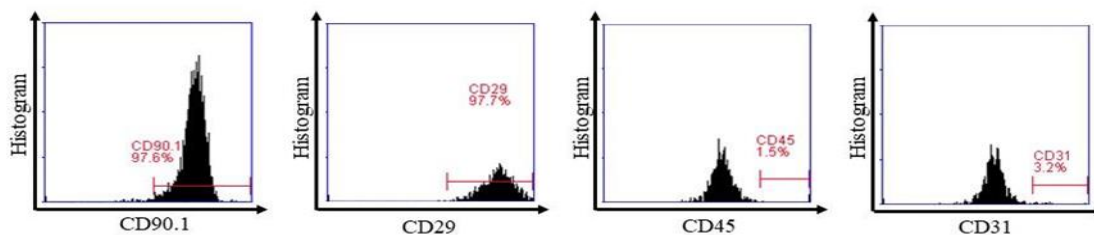


Figure 2. Expression of CD90, CD29, CD45, and CD31 on MSCs

MSC cells were cultured in osteogenic and adipogenic induction medium for 21 days to determine their differentiation ability into osteocytes and adipocytes. The image of osteogenic differentiation of MSCs is shown by arrows on cells containing calcium deposits with staining Alizarin Red Figure 3. Adipogenic differentiation of MSCs is indicated by arrows on cells containing accumulated lipid droplets with staining Oil Red O (Figure 4). Calcium and fat deposition resulting from the differentiation of MSCs into osteocytes and adipocytes are shown in red in each culture.

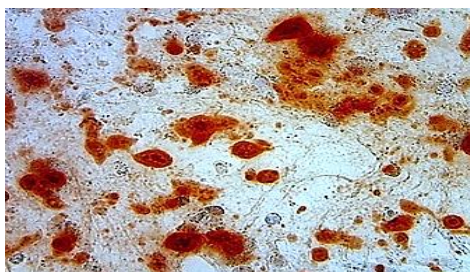


Figure 3. MSCs can differentiate into osteocytes

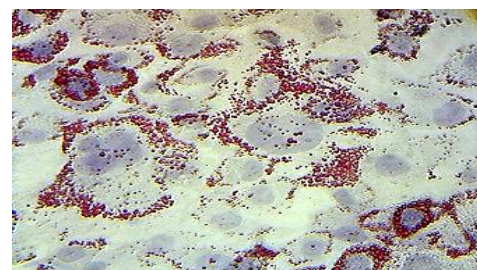


Figure 4. Adipocytes after staining Alizarin Red and Oil Red O at 200x magnification

### Effect of Administration of SH-MSCs on Expression TGF- $\beta$ and IL-6 expression

Study influence of hypoxic mesenchymal stem cell secretome on IL-6 expression and TGF- $\beta$  expression Induced Wistar rat fluconazole was done for 21 days until the rat became an Alopecia-Like model. The results of the research are listed in Table 1.

## The Effect of Topical Gel Secretome Hypoxic Mesenchymal Stem Cells (SH-MSCs) on IL-6 and TGF-β Gene Expression (Experimental Study in Male Wistar Alopecia-Like Rat Models Induced by Fluconazole)

**Table 1. Results of Mean Analysis, Normality Test, Homogeneity Test on IL-6 expression and TGF-β expression**

Variable	Group				Sig.(p)
	S	K N=6	P1 N=6	P2 N=6	
<b>IL-6 (ng/L) Expression</b>					
Mean	1.000	3.026	2.454	1.419	
Std. deviation	0.141	0.133	0.225	0.134	
Shapiro Wilk	0.960*	0.346*	0.584*	0.591*	
Levene Test					0.686**
One Way Anova					0.000***
<b>TGF-β Expression</b>					
Mean	1.000	0.683	1.302	3.176	
Std. deviation	0.141	0.183	0.131	0.394	
Shapiro Wilk	0.960*	0.434*	0.144*	0.007	
Levene Test					
Kruskall Wallis					0.000***

Information: \*Normal  $p > 0.05$  \*\*Homogeneous  $p > 0.05$  \*\*\*Significant  $p < 0.05$

Table 1 shows that the lowest mean IL-6 expression was in the healthy rat group (S), followed by the treatment group (P2) alopecia-like rat model by administering SH-MSCs gel at a dose of 200 μL/kgBW in 200 mg gel, and followed by the treatment group (P1) of Alopecia-like rat models by administering SH-MSCs gel at a dose of 100 μL/kgBW in 200 mg gel. The highest mean IL-6 expression was in the negative control (K-) mouse model group alopecia-like with control 200 mg NaCl base gel. All groups of IL-6 expression levels based on the Shapiro-Wilk test are normally distributed with a p-value  $> 0.05$  and the homogeneity test result shows a homogeneous p-value of 0.561 ( $p > 0.05$ ), so data analysis uses a parametric test One Way ANOVA. One-way ANOVA test result showed significant differences between all groups with a p-value of 0.000 ( $p < 0.05$ ), then continued with the test Pos Hoc LSD to find out which groups are the most influential. The highest mean TGF-β expression (Table 1) is in the treatment group (P2) of Alopecia-like rat models by administering SH-MSCs gel at a dose of 200 μL/kgBW in 200 mg gel, then followed by the treatment group (P1) of Alopecia-like rat models by administering SH-MSCs gel at a dose of 100 μL/kgBW in 200 mg gel, and followed by a group of healthy rats (S). The lowest mean TGF-β expression was in the negative control (K) alopecia-like rat model group with control 200 mg NaCl base gel. All groups expressed TGF-β expression based on the Shapiro Wilk test one of the groups, namely the treatment group (P2), did not normally distribute with a value of 0.007 p-value  $< 0.05$ . Kruskal-Wallis test result shows significant differences between all groups with a p-value of 0.001 ( $p < 0.05$ ). Then continue using the Mann-Whitney test to find out which groups are the most influential.

### Differences in IL-6 Expression Between Groups

The difference in IL-6 expression between the 2 groups was determined by the test Post Hoc LSD as presented in Table 2.

**Table 2. Differences in IL-6 Expression between the 2 Groups**

Group	p-Value
S vs K	0.000*
S vs P1	0.000*
S vs P2	0.000*
K vs P1	0.000*
K vs P2	0.000*
P1 vs P2	0.000*

\*LSD Post Hoc Test with a significant value of  $p < 0.05$

Test Post Hoc LSD test Table 2 shows the expression of IL-6 in the healthy mouse group (S), there is a significant difference to the group (K) p-value 0.000 ( $p < 0.05$ ), the healthy mouse group (S) there is a significant difference to the group (P1) p-value -value 0.000 ( $p < 0.05$ ), and in the healthy mouse group (S) there was a significant difference to group (P2) p-value 0.000 ( $p < 0.05$ ). There is a significant difference in group (K) to group (P1) with a p-value of 0.000 ( $p < 0.05$ ) and there is a significant difference in group (K) to (P2) with a p-value of 0.000 ( $p < 0.05$ ). Then there is also a significant difference between groups (P1) and (P2) with a p-value of 0.000 ( $p < 0.05$ ). Based on the data above, it can be concluded that administration of SH-MSCs gel in doses of 10% and 20% in

## The Effect of Topical Gel Secretome Hypoxic Mesenchymal Stem Cells (SH-MSCs) on IL-6 and TGF-β Gene Expression (Experimental Study in Male Wistar Alopecia-Like Rat Models Induced by Fluconazole)

200 mg gel has a significant effect on reducing IL-6 expression in male Wistar rats with the alopecia-like model so the hypothesis statement is accepted.

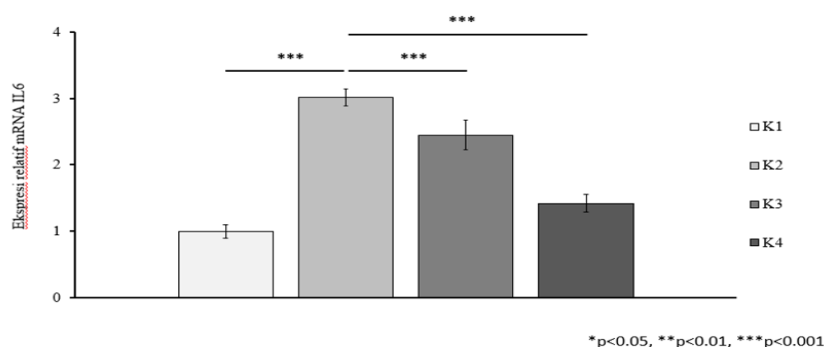


Figure 5. The expression of IL-6

### The Different of TGF-β Expression between Groups

The difference in TGF-β expression between the 2 groups was determined by the Kruskal-Wallis test with the Mann-Whitney test as presented in Table 3.

Table 3. Differences in TGF-β Expression between the 2 Groups

Group	p-Value
S vs K	0.010*
S vs P1	0.010*
S vs P2	0.004*
K vs P1	0.056
K vs P2	0.000*
P1 vs P2	0.004*

\*Mann-Whitney test with a significant value of  $p < 0.05$

The Mann-Whitney test result (Table 3), shows the expression of TGF-β in the healthy mouse group (S), there is a significant difference between the group (K) p-value 0.010 ( $p < 0.05$ ), the healthy mouse group (S) there is a significant difference compared to the group (P1) p-value -value 0.010 ( $p < 0.05$ ), and in the healthy mouse group (S) there was a significant difference to group (P2) p-value 0.004 ( $p < 0.05$ ). There is no significant difference in group (K) to group (P1) with a p-value of 0.056 ( $p < 0.05$ ) and there is a significant difference in group (K) to (P2) with a p-value of 0.000 ( $p < 0.05$ ). There is also a significant difference between groups (P1) and (P2) with a p-value of 0.004 ( $p < 0.05$ ). Based on the data above, it can be concluded that administration of SH-MSCs gel at a dose of 10% did not have a significant effect on increasing TGF-β expression so the hypothesis statement was rejected. Administration of 20% SH-MSCs gel in 200 mg gel had a significant effect on increasing TGF-β expression in male Wistar rats in the alopecia-like model so the hypothesis statement was accepted.

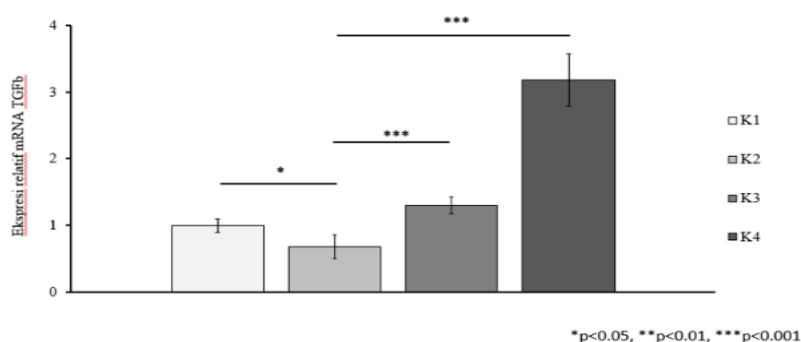


Figure 6. The expression of TGF-β mRNA

## IV. DISCUSSION

Hair loss is determined by various factors: inherited (trichodystrophy and alopecia androgenetic), accompanying comorbid conditions, hormonal damage (thyroid organ disease, insulin resistance), immune system (alopecia and lupus erythematosus), poor

## The Effect of Topical Gel Secretome Hypoxic Mesenchymal Stem Cells (SH-MSCs) on IL-6 and TGF- $\beta$ Gene Expression (Experimental Study in Male Wistar Alopecia-Like Rat Models Induced by Fluconazole)

nutrition, environmental elements (drugs, ultraviolet (UV) radiation), mental disorders (stress and trichotillomania), and aging. These factors are detrimental and affect the hair cycle, thereby reducing stem cell activity and requiring time for hair follicles to recover.<sup>1</sup> Perceived stress (internal or external) can stimulate changes in neuroendocrine immunity. It has been shown that prolonged stress can increase inflammatory cytokines (e.g. INF- $\gamma$ ) leading to inflammation and ending in apoptosis, cell senescence, and premature catagen transition. DPCs in hair follicles have receptors for corticotropin-releasing factor (CRF). CRF inhibits hair shaft elongation and DPC proliferation by arresting division in the G2/M phase. Additionally, it contributes to the accumulation of reactive oxygen species (ROS) which also stops the cell cycle. CRF decreases the expression levels of anagen-related cytokines, such as hepatocyte growth factor (HGF), Wnt5a, TGF $\beta$ , and Vascular endothelial growth factor (VEGF). The stress of hair loss contributes to a negative feedback loop that increases the incidence of hair loss.<sup>2</sup> Hair Follicle (HF) are immunologically similar spots to the cerebrum, eyes, and gonads, and they are influenced by the neuroendocrine-immune system. In physiological conditions, this is influenced by (1) Low or no expression of the principal MHC I antigen, (2) the presence of non-functional Langerhans cells, and (3) local expression of immunosuppressive substances (TGF- $\beta$ 1 and  $\alpha$ -melanocyte MSH). The conclusion from this is that HF can easily be used in transplantation.<sup>16</sup> MSCs actively participate in angiogenesis through direct differentiation, cell contact interactions with endothelial cell lineages, and the release of pro-angiogenic factors in a paracrine manner. Paracrine factors can increase the blood supply of damaged tissue through the activation and recruitment of stem and progenitor cells. MSCs possess several angiogenesis factors, interleukin-8 (IL-8), Insulin-Like Growth Factor 1 (IGF-1), and Vascular Endothelial Growth Factor (VEGF). These pro-angiogenic factors can form vascular networks and increase the migration of endothelial cell derivatives in vitro. In addition to the secretion of angiogenic factors by MSCs, it has been revealed that various factors present in the secretome can activate angiogenic properties in endothelial cells. For example, MSCs influence hair growth through cell proliferation to prolong the anagen phase (FGF-7), induce cell growth (ERK activation), stimulate hair follicle development ( $\beta$ -catenin), and suppress apoptotic cues (BCL-2 release and Akt activation).<sup>1</sup> This study showed that IL-6 expression decreased very significantly compared to the negative control group. Then, TGF- $\beta$  expression increased significantly compared to the negative control group. This shows that SH-MSCs influence IL-6 expression and TGF- $\beta$  expression. This is thought to be because another content of SH-MSCs is TGF- $\beta$ , where TGF- $\beta$  can activate SMAD2/3 phosphorylation for translocation to the nucleus and induce the expression of anti-inflammatory cytokines.<sup>18</sup> Maintaining MSCs is critical for tissue homeostasis in repair. Their division does not occur frequently in mature organisms, and most of them are not in prime condition. Thus, it is very important to understand their activation and induction components, which will enable the use of multipotent cells in regenerative plastic surgery and hair regrowth. Their use is complicated by the fact that receptor expression on various growth factors and microenvironmental effects may vary.<sup>16</sup> TGF- $\beta$  levels increased on the seventh day due to the proliferation phase. Higher than the healthy group because they are in the inflammatory phase. This is in line with previous studies which state that platelet aggregation and release of ADP, PDGF, tumor growth factor b (TGFb), and CXCL4 activate local cells (fibroblasts and keratinocytes) and the immune cascade to initiate inflammation. Keratinocytes, as the main cell type of the epidermis, release proinflammatory cytokines and antimicrobial peptides and proteins (AMPs). Together, these immune responses aim to decontaminate the wound bed by recruiting neutrophils and macrophages to the alopecia.<sup>19</sup> Each dose of SH-MSCs topical gel showed a different decrease in IL-6 expression and an increase in TGF- $\beta$  expression. This indicates that each dose showed a different response to IL-6 expression and TGF- $\beta$  expression, which means that each dose has different responses to inflammation. If compared between the two doses, the 10% and 20% doses both reduced IL-6 expression compared to the control group. This research is in line with previous research which stated that 23 weeks after the last treatment using MSC there was an increase in average hair thickness ( $29 \pm 5.0\%$ ) above the initial value for the targeted area. 12 weeks after the last injection with A-PRP the average hair number and hair density ( $31 \pm 2\%$ ) increased significantly.<sup>16</sup> Another study also said that among the thirty-five signaling proteins analyzed, the levels of VEGF, EGF, IL-6, Eotaxin, MCP-3, IFN $\gamma$ -inducible protein-10, and MIP-1 $\alpha$  were higher in the bald zone compared to the periumbilical zone.<sup>10</sup> 20% SH-MSCs topical gel showed increased TGF- $\beta$  expression compared to the control group, while 10% SH-MSCs topical gel did not show increased TGF- $\beta$  expression compared to the control group. This research is in line with previous research which compared MSC-CM-T doses of 10% and 20% for healing wounds. In this study, it was found that a 20% dose of MSC-CM-T was more effective in initiating an increase in wound closure rates.<sup>19</sup> The weakness of this study is that histopathological examination of CD45 and CD68 was not carried out to determine the presence of inflammatory lymphocytes and macrophages (M1) after administration of SH-MSCs gel and in this study it is not known how long the application was carried out. It is necessary to carry out histopathological examination of CD45 and CD68 to determine the presence of inflammatory lymphocytes and macrophages (M1) after administration of SH-MSCs gel. Future researchers are expected to examine the duration of application of the SH-MSCs gel even longer.

# The Effect of Topical Gel Secretome Hypoxic Mesenchymal Stem Cells (SH-MSCs) on IL-6 and TGF- $\beta$ Gene Expression (Experimental Study in Male Wistar Alopecia-Like Rat Models Induced by Fluconazole)

## V. CONCLUSION

The Administration of 10% and 20% SH-MSCs gel at a dose of 200 mg/rat/day can reduce IL-6 gene expression. The administration of 10% SH-MSCs gel at a dose of 200 mg/rat/day did not increase TGF- $\beta$  gene expression, and the administration of SH-MSCs gel at a dose of 20% at a dose of 200 mg/rat/day can increase TGF- $\beta$  gene expression.

## ACKNOWLEDGEMENT

The authors declare no conflict of interest and no involvement of sponsors or funding for this research.

## REFERENCES

- 1) Salhab O, Khayat L, Alaeddine N. Stem cell secretome as a mechanism for restoring hair loss due to stress, particularly alopecia areata: narrative review. *J Biomed Sci.* 2022 Oct 5;29(1):77.
- 2) Deng W, Zhang Y, Wang W, Song A, Mukama O, Huang J, et al. Hair follicle-derived mesenchymal stem cells decrease alopecia areata mouse hair loss and reduce inflammation around the hair follicle. *Stem Cell Res Ther.* 2021 Dec 21;12(1):548.
- 3) Lee HH, Gwillim E, Patel KR, Hua T, Rastogi S, Ibler E, et al. Epidemiology of alopecia areata, ophiasis, totalis, and universalis: A systematic review and meta-analysis. *J Am Acad Dermatol.* 2020 Mar;82(3):675–82.
- 4) Simakou T, Butcher JP, Reid S, Henriquez FL. Alopecia areata: A multifactorial autoimmune condition. *J Autoimmun.* 2019 Mar;98:74–85.
- 5) Thompson JM, Park MK, Qureshi AA, Cho E. Race and Alopecia Areata amongst US Women. *Journal of Investigative Dermatology Symposium Proceedings.* 2018 Jan;19(1):S47–50.
- 6) Uzuncakmak TK, Engin B, Serdaroglu S, Tuzun Y. Demographic and Clinical Features of 1,641 Patients with Alopecia Areata, Alopecia Totalis, and Alopecia Universalis: A Single-Center Retrospective Study. *Skin Appendage Disord.* 2021;7(1):8–12.
- 7) Putra A, Widyatmoko A, Ibrahim S, Amansyah F, Amansyah F, Berlian MA, et al. Case series of the first three severe COVID-19 patients treated with the secretome of hypoxia-mesenchymal stem cells in Indonesia. *F1000Research.* 2021;10:1–19
- 8) Jeon SH, Hyunju KIM, Jong Hyuk Sun. Hypoxia enhances the hair growth-promoting effects of embryonic stem cell-derived mesenchymal stem cells via NADPH oxidase 4. *J Biomed Pharmacotherapy.* 2023 Mar;159:114303
- 9) Kim JE, Oh JH, Woo YJ, Jung JH, Jeong KH, Kang H. Effects of mesenchymal stem cell therapy on alopecia areata in cellular and hair follicle organ culture models. *Exp Dermatol.* 2020 Mar 21;29(3):265–72.
- 10) Andjelkov K, Eremin II, Korac A. Different levels of EGF, VEGF, IL-6, MCP-1, MCP-3, IP-10, Eotaxin and MIP-1 $\alpha$  in the adipose-derived stem cell secretome in androgenetic alopecia. *Exp Dermatol.* 2022 Jun 19;31(6):936–42.
- 11) Tanaka T, Narazaki M, Kishimoto T. IL-6 in Inflammation, Immunity, and Disease. *Cold Spring Harb Perspect Biol.* 2014 Oct; 6(10): a016295.
- 12) El-Refaei AM, Elhabak DM, Khashaba DA. More is Not Always Better in Hair Growth Factors. Epidermal Growth Factor: Hair Growth Factor Involved in Alopecia Areata Pathogenesis. *Int J Trichology.* 2020 Jul-Aug; 12(4): 182–187.
- 13) Walker C, Kelly E, James T et al. Hair Growth in a Patient with Alopecia. *J Skin Appendage Disord (2021) 7 (5): 408–412.*
- 14) Aisyah R, Jatmik SW. The Tgf-B Signaling Pathway Plays a Role in Stem Cell Self-Renewal, Differentiation, and Proliferation. *Journal of Medika Science Vol 15, No.1, June 2019.*
- 15) Young L, Jehim K, Jemin K, et al. The Effect of Conditioned Media From Human Adipocyte-Derived Mesenchymal Stem Cells on Androgenetic Alopecia After Nonablative Fractional Laser Treatment. *J Dermatologic Surgery 46(12):p 1698-1704, December 2020.*
- 16) Gentile P, Maria G, Allesandra B, et al. Platelet-Rich Plasma and Micrografts Enriched with Autologous Human Follicle Mesenchymal Stem Cells Improve Hair Re-Growth in Androgenetic Alopecia. *J. Biomedicines.* 2019 Jun; 7(2): 27
- 17) Ho Bak D, Mi J, Soon R, et al. Human umbilical cord blood mesenchymal stem cells engineered to overexpress growth factors accelerate outcomes in hair growth. *Korean J Physiol Pharmacol.* 2018 Sep; 22(5): 555–566
- 18) Chang, Pauklin. ROS and TGF $\beta$ : from pancreatic tumour growth to metastasis *Journal of Experimental & Clinical Cancer Research (2021) 40:152*
- 19) Kuntardjo N, et al. Topical gel of mesenchymal stem cells-conditioned medium under TNF- $\alpha$  precondition accelerates wound closure healing in full-thickness skin defect animal model. *J Med Life.* 2022 Feb;15(2):214-221



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Towards a Healthier Boyolali Community: The Social Return on Investment (SROI) on the Family Care Health Optimization Service Program (Yok Peka)



Fendy Eko Wahyudi<sup>1</sup>, Muhammad Subhan<sup>2</sup>, Muhammad Arief Zuliyani<sup>3</sup>, Betie Febriana<sup>4</sup>

<sup>1,2,3</sup>Department of International Relations, Universitas Diponegoro, Jl. Prof. Sudarto, Semarang, Indonesia 50139

<sup>4</sup>Faculty of Nursing, Universitas Islam Sultan Agung, Jl. Kaligawe Raya, Semarang, Indonesia 50112

**ABSTRACT:** PT Pertamina Patra Niaga Fuel Terminal (FT) Boyolali, commonly referred to as FT Boyolali, is a fuel terminal that is part of the leading lubricant company in Indonesia, namely PT Pertamina Lubricants. FT Boyolali has several Corporate Social Innovation (CSI) programs spread across the company's closest area, including Teras District, in Boyolali Regency. The program entitled Yok Peka is a form of Social Innovation carried out by FT Boyolali to address social problems to prevent and deal with health cases in pregnant women and toddlers in Boyolali Regency, especially cases of stunting and cases of Chronic Energy Deficiency (CED) pregnant women. Apart from that, this program also supports the formation of economic empowerment of health cadres and the community to balance health standards with improving the community's economy. The effectiveness of the CSI Yok Peka program is measured using the social return on investment (SROI) method to determine the output and outcomes felt by various stakeholders and also to determine the comparison (ratio) between investment and benefits quantitatively. SROI is a method companies can use to measure the return on business investment for a program or social activity carried out using a financial quantification (monetization) calculation approach. The results of the SROI analysis of the Yok Peka program in the period 2020 to 2022 show a benefit value of IDR 635.799.963 compared to an investment value of IDR 165.650,000. In other words, every investment of IDR 1 in the Yok Peka program can produce benefits of IDR 3.84 (SROI = 1: 3.84).

**KEYWORDS:** Yok Peka, Chronic Energy Deficiency (CED), Social Return on Investment (SROI), Corporate Social Responsibility (CSR), Corporate Social Innovation (CSI).

### INTRODUCTION

Corporate Social Responsibility (CSR) is a form of corporate responsibility towards consumers, communities, employees, shareholders, and the environment affected by the company's operations. The implementation of CSR is the response of the business world when it sees environmental and social aspects as an opportunity to increase competitiveness and as part of risk management toward the sustainability of its business activities (Cahya, 2014). In particular, for companies engaged in and related to natural resources, it is obligatory to carry out corporate social and environmental responsibility. Furthermore, as regulated in the Regulation of the Minister of Environment and Forestry No. 1 of 2021 concerning the Corporate Rating Assessment Program (Proper), each company participating in Proper beyond compliance must choose one Community development program (Comdev) that is proposed as a flagship program that meets the criteria of social innovation.

PT Pertamina Patra Niaga Fuel Terminal (FT) Boyolali or commonly referred to as FT Boyolali is a fuel terminal that is a part of PT Pertamina Patra Niaga Central Java Region, Indonesia. FT Boyolali has several CSR programs spread across various areas which are included in the company's closest area, including Teras District, Boyolali Regency. The Yok Peka Program is a form of Social Innovation organized by FT Boyolali in order to address existing social problems, including prevent and deal with health cases in pregnant women and toddlers in Boyolali Regency, especially cases of stunting and pregnant women with Chronic Energy Deficiency (CED). In addition, the program also supports the creation of economic empowerment of village health worker (cadre) and the community in order to balance the level of health with an increase in the community's economy.

Furthermore, to measure the success of the Yok Peka Program, it is necessary to have a method to quantify the impact of the program. The effectiveness of corporate social innovation (CSI) can be measured by the Social Return On Investment (SROI) method, to determine the outputs and outcomes perceived by various stakeholders and also to know the comparison (ratio)



## Towards a Healthier Boyolali Community: The Social Return on Investment (SROI) on the Family Care Health Optimization Service Program (Yok Peka)

between investment and benefits. According to Santoso et al., (2018), SROI is a method that can be used by companies to measure returns on business investment for a program or social activity with a financial quantification (monetization) calculation approach. In contrast to conventional investment measurement tools that only focus on calculating financial aspects, SROI includes broad concept measurements, including social, environmental and economic values.

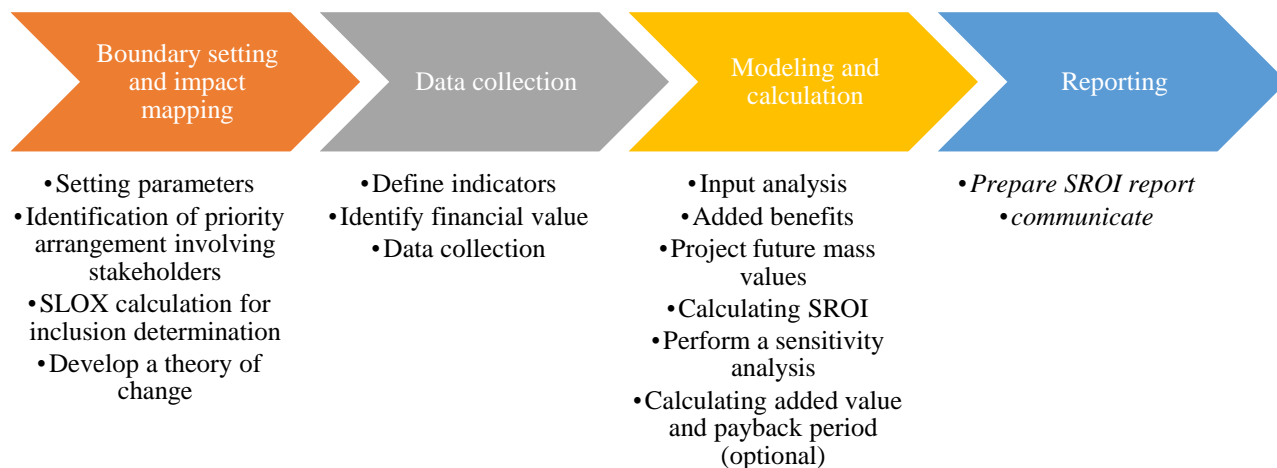
In this study, SROI was used as a method to quantify Yok Peka's CSR program using an evaluative method by measuring the resulting impact. Data collection was obtain through in-depth interviews with Integrated Healthcare Center (Posyandu) members, Hatra Makmur Group, Sampetan village government, beneficiary communities, and Community Development Officers of FT Boyolali. The SROI study will be carried out in 3<sup>rd</sup> ring (closest) areas, namely in areas that need corporate social responsibility assistance to address existing social problems.

### THEORITICAL FRAMEWORK

Social Return on Investment (SROI) is a process of understanding, measuring, and reporting related to social, environmental, and economic value created by organizations. SROI is a measurement approach developed from a cost-benefit analysis, social accounting, and social auditing that captures social value by translating social objectives into financial and non-financial measures (Lawlor et al., 2008). Meanwhile, according to Nicholls et al., (2009), SROI is a framework for measuring and calculating a much broader concept of value including reducing inequality among stakeholders, environmental degradation, and increasing welfare by combining social, environmental, and economic benefits. The SROI ratio is between the value generated and the investment required to achieve an impact.

Moreover, the SROI approach has advantages over other approaches, including comprehensive approach that includes social, economic, and environmental aspects (triple bottom line), accountability, change management, cost and time effectiveness, as well as simple and clear indicators through ratio results (Lawlor et al., 2008). In addition, applying the SROI method in measuring social impact is very feasible and low-cost if the organization already has the desired cost, income, and outcome data (Budiono, 2012).

**Chart I: Stages of SROI Analysis**



The concept of SROI was developed in England in 2008 with seven principles to create a framework, namely: (1) Stakeholder involvement, (2) Understanding of change, (3) Assessment of important things, (4) Focus on clear material inputs, (5) No excessive claims, (6) Transparency, (7) Verify results (Nicholls et al., 2009). Subsequently, SROI has a strategic advantage, including the involvement of stakeholders in measuring the impact of a program or project run by the company. Through the involvement of these stakeholders, SROI can provide measurement and analysis results that are far more comprehensive and feasible when compared to conventional investment measuring tools such as cost-benefit and incremental ratios (Purwohedi, 2016). Furthermore, according to Nicholls et al., (2009), the SROI analysis has six stages, namely 1) Defining the scope and identifying key stakeholders, 2) Mapping impacts, 3) Proving and assessing impacts, 4) Building impacts, 5) Calculating SROI, 6) Reporting and Implementation.

# **Towards a Healthier Boyolali Community: The Social Return on Investment (SROI) on the Family Care Health Optimization Service Program (Yok Peka)**

## **METHODS**

### **Establish Scope and Identify Stakeholders**

At this stage, it is important to have clear boundaries about the scope of the SROI analysis, who will be involved in the process and in what form the involvement will take place. The term "Stakeholder" does need to be explained, even though it is currently used as a matter of course. Who or what the stakeholders are, how they can be identified and why a stakeholder analysis is a core component of any impact measurement. There are several sub-stages, including:

- a. Establishing the basic logic of a project or program within the framework of a theory of change to understand the essential cause-and-effect relationships of an intervention.
- b. Grouping stakeholders into categories and subgroups that tend to have the same perspective.
- c. Placing all stakeholders, together with a preliminary assessment of how they affect or are affected by the program, including positive and negative effects

### **Performing SLOX Calculations for Determining Inclusion Criteria**

On this study, the data analysis technique refers to measuring the level of social acceptance of stakeholders towards company activities that are related to the company's core business and also the company's CSR. In this study, data analysis techniques used the Social License to Operate Index (SLOX) model proposed by Boutilier and Thomson (2011). In their model, Boutilier and Thompson measure the level of social acceptance of stakeholders towards company activities.

The SLOX in question is based on a number of questions that measure the company's social license level from four variables, namely:

1. Economic Legitimacy
2. Socio Political-Legitimacy
3. Interactional Trust
4. Institutionalized Trust

The SLOX research has 15 statements to measure the SLOX level of each stakeholder with the following assessment categories:

- a. the answer "Strongly agree" is given a weight value of 5
- b. the answer "Agree" is given a weight value of 4
- c. the answer "Neutral" is given a weight value of 3
- d. the answer "Disagree" is given a weight value of 2
- e. the answer "Disagree" is given a weight value of 1

### **Mapping the Outcomes of Each Stakeholder**

In this section, we discuss how the activities will be analyzed using certain inputs that will produce outcomes for stakeholders. Basically, this section maps the relationship between input, output, and outcome (theory of change or logic model). There are five stages that will be carried out in this section, namely:

- a. Start impact mapping
- b. Identify inputs
- c. Perform an assessment of the input
- d. Clarifying output
- e. Describe the outcomes

### **Establish Indicators and Values for Each Outcome**

Indicators are a way to tell if a change has occurred. Indicators are applied to each outcome before moving on to the next stage, namely developing an impact map by explaining one or more indicators for each outcome. After having indicators that are relevant to stakeholders and scope, it is necessary to examine these indicators so that they are not only measurable but can be measured within the scope and resources that have been determined. There are four stages in this section, namely:

- a. Developing outcome indicators
- b. Collect outcome data
- c. Determines how long the outcome will last
- d. Assign a value to each outcome

### **Impact Fixation**

This stage is important to reduce the risk of overclaiming the outcome. There are four sections that must be taken, including:

## Towards a Healthier Boyolali Community: The Social Return on Investment (SROI) on the Family Care Health Optimization Service Program (Yok Peka)

### a. Deadweight and displacements

Deadweight is a measure of the number of results that will occur even if the activity does not occur. It is calculated as a percentage.

### b. Attribution

Attribution is a judgment about how much of a result is due to the contribution of the organization or other people. Attribution is calculated as a percentage (i.e. the proportion of results attributable to the organization). It indicates the part of the deadweight where we have better information and where we can relate the results to other people or organizations.

### c. Drop off

After the previous stage considers how long the outcomes last. In the coming years, the number of outcomes is likely to be less or, if they are the same, more likely to be influenced by other factors, resulting in lower attribution to the organization. Drop-offs are used to account for this and are only calculated for results lasting more than one year. Drop-offs are usually calculated by subtracting a fixed percentage from the level of outcomes remaining at the end of each year.

### d. Calculating impacts

All of these aspects of impact are usually expressed as a percentage. Except when having more accurate information, it is acceptable to round estimates to the nearest 10%. In some cases, there may be an assumption that there is an increase in value rather than a decrease. However, it is not recommended to increase the impact as a result of considering an issue. In this situation, neither would make a deduction.

## Calculating SROI

There are four stages (plus one optional stage) to calculate SROI, including:

### a. Projecting it to a future value

The first step in calculating the ratio is to project the value of all the results achieved in the future. In the previous step, had to decide how long the result would be.

### b. Calculating net present value

To calculate the NPV costs and benefits paid or received in different time periods need to be added up. For this reason, the costs and benefits are proportional to the discount process. The principle of discounting or discounting generally favors receiving money today rather than tomorrow because of the risk (e.g. the money will not be paid) because of the opportunity cost (e.g. the potential return from investing the money elsewhere). This principle is known as "time value of money".

### c. Calculating ratios

The calculation of the initial SROI ratio is done by dividing the benefit discount value by the total investment.

$$SROI\ ratio = \frac{Present\ Value}{Value\ of\ inputs}$$

Alternative calculation of net SROI ratio. This is done by dividing the NPV value by the investment value. Both are acceptable but depending on the needs of the analysis used:

$$Net\ SROI\ ratio = \frac{Net\ Present\ Value}{Value\ of\ inputs}$$

### d. Perform a sensitivity analysis

The purpose of the analysis is to test which assumptions have the greatest influence on the model calculations performed. The suggested approach is to calculate how much we need to change each estimate for social returns to a social return ratio of IDR 1 for an investment of IDR 1. With this calculation the sensitivity analysis carried out to changes in estimates can be shown. This makes it possible to report the amount of change required to change a ratio from positive to negative or vice versa.

### e. Calculating the payback period (operational stage)

The 'payback period' describes how long it takes for the investment to pay off. The basic formula for calculating the payback period:

$$Payback\ Period\ in\ Months = \frac{Investment}{Annual\ impact/12}$$

## **Towards a Healthier Boyolali Community: The Social Return on Investment (SROI) on the Family Care Health Optimization Service Program (Yok Peka)**

### **Reporting SROI**

#### **a. Reporting to Stakeholders**

SROI aims to create accountability to stakeholders. Therefore, it is important that the results of the analysis are communicated to stakeholders in an appropriate manner. By conducting this SROI study, that the community empowerment activities can be accessed by stakeholders.

#### **b. Using the Results**

The results of the SROI study will serve as an evaluation for the Company, activity implementers, and the beneficiaries of the program. In addition, through SROI, predictive studies can also be executed to test how feasible a program proposal is to be implemented. This is important so that it can be ensured that each program can be ascertained in as much detail as possible the potential success and benefits of the program.

#### **c. Changes following the SROI Evaluation Analysis**

Evaluation of SROI analysis is also expected to produce changes in the organization. Both at the corporate, executive, and community levels. The organization needs to respond to the findings and think about the implications for organizational goals, governance, systems and work practices of the organization to act on the recommendations and the findings are incorporated into the strategy in the planning process so that it gets better in the future.

#### **d. Assurance**

Assurance is a process by which information in reports is verified. This report has gone through a verification process by independent academics who have knowledge and experience in SROI-based research.

### **Theory of Change**

Theory of Change is a detailed description of the sequence of events that produces change for a large number of people in a stakeholder group. The diagrams in this section identify the theory of change for the Yok Peka program. This diagram was developed through the results of field research, FGDs with stakeholders, especially parties: companies, activity implementers, communities, and village government. Apart from that, the Yok Peka program's theory of change is also refined with secondary sources, documentation, activity reports, and activity implementation reports.

The use of the theory of change is important to avoid excessive claims and overvaluation. On the other hand, in order to avoid double counting, it is the long-term end result that is assessed as the impact of a program. This is because although all steps are important to achieve the overall outcome, the end result of the theory of change holds the greatest value to stakeholders and depends on the other steps in the process being achieved.

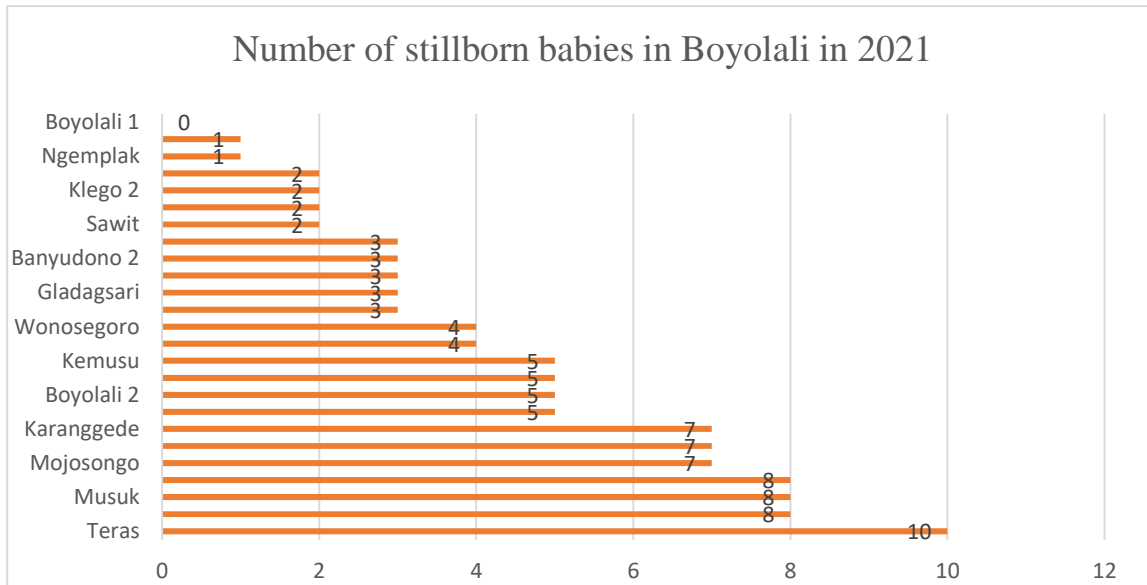
## **RESULTS AND DISCUSSION**

### **Program Profiles**

The Yok Peka program is one of the CSR innovation programs from the Boyolali Fuel Terminal (FT) located in Boyolali Regency. This program is the answer to community problems in a number of community empowerment areas from PT. Pertamina Patra Niaga FT Boyolali especially in the health sector. In the midst of the COVID-19 Pandemic in 2020, public health conditions in a number of villages in Boyolali experienced problems. Among these health problems are Posyandu activities in preventing stunting under-fives and cases of Chronic Energy Deficiency Pregnant Women (CED) cannot be carried out. This is due to the existence of the COVID-19 Pandemic which has resulted in very limited community activities.

**Towards a Healthier Boyolali Community: The Social Return on Investment (SROI) on the Family Care Health Optimization Service Program (Yok Peka)**

**Chart 1 Number of Stillborn Babies in Boyolali in 2021**

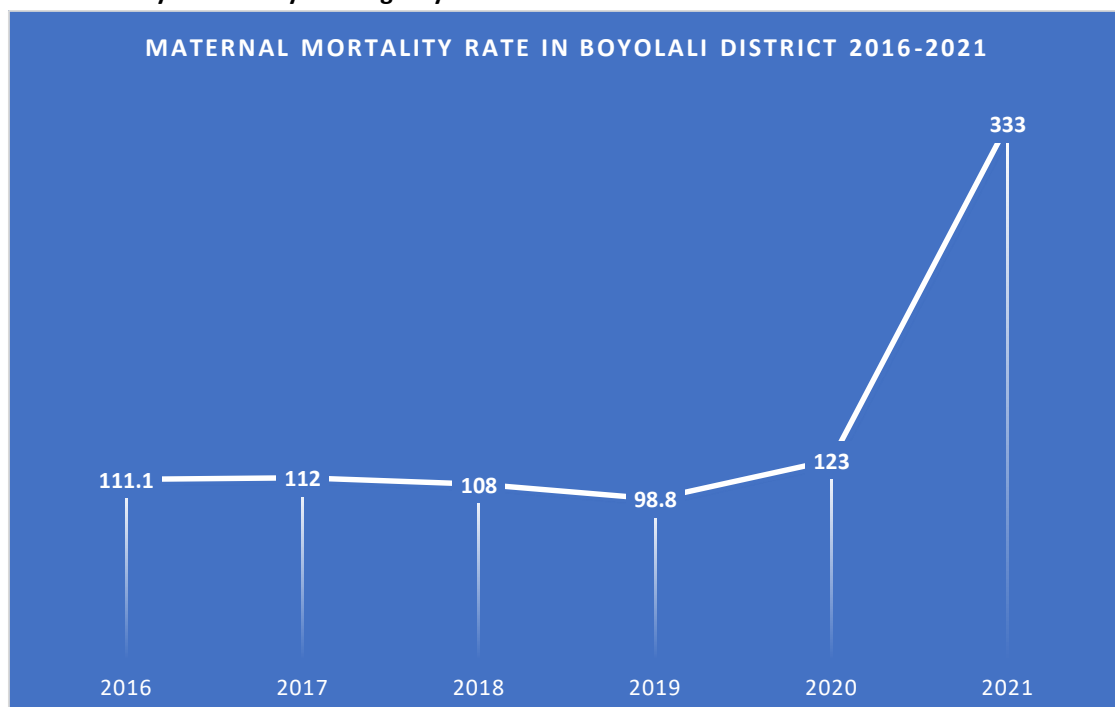


**Source: Boyolali Health Service 2021**

On the other hand, the problem of stunting and also pregnant women with CED has become a social problem in Boyolali, especially in a number of 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> Ring areas of the company. Based on data released by the Boyolali District Health Office in 2021, it shows that there have been a number of cases of stillbirths in Boyolali. For 2021, the stillbirth rate in Boyolali is 7.9 / 1,000. meaning that in every 1,000 population there is an average of 7.9 stillbirths. In terms of numbers, there will be 108 stillbirths in total. The highest cases are in the Ring 1 area of PT. Pertamina FT Boyolali, namely Teras subdistrict. In 2021, there were 10 cases of stillbirth in Teras (Boyolali Health Office, 2021).

However, in terms of the maternal mortality rate in Boyolali, in 2021 it is found to be 333/100,000 with a total number of cases of maternal death of 45 people. This figure is higher than the maximum limit of maternal deaths, which is 19 cases, and when compared to cases of maternal deaths in 2020, there has been a sharp increase. In 2020 the number of cases of maternal death is only 17 cases (Boyolali Health Office 2021).

**Chart 2 Maternal Mortality Rate in Boyolali Regency 2016-2021**



**Source: Boyolali Health Service 2021**

## **Towards a Healthier Boyolali Community: The Social Return on Investment (SROI) on the Family Care Health Optimization Service Program (Yok Peka)**

### **Details of Yok Peka Program**

#### **Provision of Supplementary Food (PMT) and Desyandu (Delivery Integrated Service Post)**

The Supplementary Feeding Program (PMT) for Toddlers and the Elderly is generally a program that is commonly found in villages or sub-districts. Every month, people, especially toddlers or the elderly, are given additional nutritious food in packaged forms, such as fruit juice drinks, porridge, pudding or biscuits. However, since the onset of the COVID-19 Pandemic, Posyandu activities have experienced a number of obstacles and have stopped. PT. Pertamina Patra Niaga FT. Boyolali provides assistance with Toddler and Elderly Supplemental Food, COVID-19 Health protocol equipment, and Health measuring devices, so that this program continues every month. This activity was carried out in a number of areas around Boyolali, including Teras subdistrict and Sampetan Village.

Desyandu (Delivery Integrated Service Post) is an innovation that has never been implemented in Boyolali. This innovation changed the posyandu implementation system. In general, Posyandu activities are centered in one location that is easily accessible by the community. Posyandu participants then routinely visit the location to get services, while Desyandu is the other way around. Posyandu cadres visited the homes of the participants, both toddlers and pregnant women, to provide services.

In Sampetan Village, the provision of PMT through Desyandu is organized to ensure that the community, especially pregnant women, toddlers, the elderly, and adolescents, get additional nutritious food every month and monitor health growth. This is conducted in order to prevent stunting and also malnutrition, especially among vulnerable people. Initially this program was implemented in the Teras subdistrict area and then replicated in a number of locations, especially in Sampetan Village that there were 41 pregnant women, 482 toddlers, and 180 elders. Moreover, the PMT program is carried out to prevent people from getting chronic diseases, besides that PMT is useful to ensure that people eat nutritious food at least once every month or twelve times a year. Even when pregnant women or toddlers get poor examination results, they are immediately given intervention in the healthy food delivery program for 1 full month.

#### **Si-Kembang application**

To support the effectiveness of posyandu program, CSR FT Boyolali created the Growth and Development Information System or Si-Kembang. So far, the process of recording the results of monitoring the growth and development of toddlers is conducted manually using a book. This is very inefficient and risks data loss. The working principle of Si-Kembang is as an information system that contains data on the results of posyandu activities. Data input by health cadres when carrying out posyandu activities will be calculated automatically and display the results in the form of nutritional status. This calculation is in accordance with the Anthropometric Standards for Children in the Decree of the Minister of Health Number 1995/Menkes/SK/XII/2010 concerning Anthropometric Standards for Assessment of Children's Nutritional Status.

Other features available in Si-kembang include educational content about child health and development, as well as other information such as nutrition calculators, immunization schedules, a list of the nearest midwives and health facilities. The nutritional calculator is a feature to find out the nutritional status of toddlers, so parents can monitor their child's growth and development independently. Si Kembang is a website-based application that can be accessed by anyone, including residents in 1<sup>st</sup>, 2<sup>nd</sup> or 3<sup>rd</sup> Ring of company areas.

#### **Addition of Posyandu Health Equipment**

Apart from developing Desyandu and Si-Kembang application, PT. Pertamina Patra Niaga FT Boyolali also carried out additional Health Equipment activities for Health and Posyandu cadres. This program is a stimulant program that aims to make services at each posyandu better with more complete equipment. The provision of medical device assistance is carried out in stages and adapts to the needs of the Posyandu.

The medical equipment available at each posyandu in Sampetan village is limited. Therefore, the renewal of medical devices at the Posyandu, has increased the level of community participation in bringing toddlers and their babies to the Posyandu. The upgrading of medical devices made children feel curious and comfortable when carrying out examinations at the Posyandu. Moreover, the number of people in participating in Posyandu has increased significantly.

#### **Emergency Car Modification**

One of the CSR programs implemented by PT Pertamina Fuel Terminal Boyolali is Emergency Car Modification. The Emergency Car Modification is a program in changing or adding facilities to the emergency car that owned by the village. Before being modified, the Village Emergency Car was only used to transport corpse by reporting to the village. Therefore, the Emergency Car was then added with medical equipment such as oxygen cylinders and other medical devices that are commonly placed in ambulances so that they meet standards for use in emergencies.

## Towards a Healthier Boyolali Community: The Social Return on Investment (SROI) on the Family Care Health Optimization Service Program (Yok Peka)

Moreover, PT Pertamina Patra Niaga FT Boyolali also helped find workshops that were capable of modifying or adding equipment to the cars that the village already owned so that they were up to standard to be used as an ambulance that could be used during emergencies. Moreover, the car can also be used as a means of transportation to take patients in case of an emergency, for example from the Village Health Post to the Health Center or also from residents' homes directly to the nearest hospital.

### Traditional Herbal Medicine Training (Ginger Jamu Making Training)

The Pertamina SEHATI: YOK PEKA program consists of many types of assistance, the MSME Traditional Herbal Medicine Training for Health Cadres is one of them. It is a training program for posyandu health cadres in Sampetan village to be able to make herbal medicine from ginger as an alternative to maintaining health. With the MSME Traditional Herbal Medicine Training program for Health Cadres, it will create new MSMEs that can move on their own and can ease the financial burden on their health cadres, so that they can provide better service when running health programs.

### Satellite Posyandu

Sampetan village is a village located on the slopes of Mount Merbabu, and because of its geographical conditions, many places in Sampetan village are classified as "blank spots" or places where cellular telecommunications networks are unreachable. Under normal conditions, this is not too dangerous, but when combined with an emergency situation such as a health or safety problem, this can become very dangerous.

In addition, with the extreme topographical conditions, health access activities are often disrupted. In terms of health check-up activities, both at the Posyandu and at the Puskesmas (Public health center) for toddlers, the elderly, adolescents, and also pregnant women, there are still several hamlets experiencing difficulties. Desyandu's activities covering such a wide area were also considered very burdensome. Therefore, PT. Pertamina Patra Niaga FT Boyolali then held a Satellite Posyandu program. This activity consists of two sub-activities. The first is the activity of Provision of Security and Emergency Communication Facilities in the form of communication satellites. Second, is the Satellite Posyandu in Sampetan village.

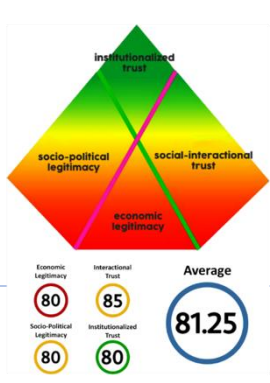
Prior to the installation of this new communication satellite, the village security guard (linmas) in charge of maintaining security in the village used an Handy talkie (HT) as a communication tool. However, without a communication satellite that functions as a transmitter, this tool was only able to connect HT between linmas officers with a radius of 3 sub-villages. Since the existence of this communication satellite, almost the entire village of Sampetan has entered the range of communication devices, including areas that are closer to Mount Merbabu, such as Ganduman and Baturejo Villages.

### Identification of Stakeholders

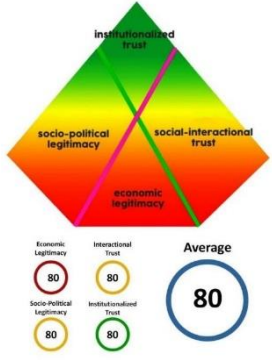
#### Beneficiary Inclusion List

Stakeholders have different levels of receiving benefits and engaging in Comdev activities. Beneficiaries who have measurable and significant monetization will be used as input in the SROI calculation. Conversely, beneficiaries who do not have significant monetization value are not included in the calculation. In addition to using monetization value indicators, the inclusion criteria in this SROI calculation use the involvement parameters in social engagement measurements and the SLOX value.

**Table 2. Stakeholders involved**

No	Stakeholders	Reasons for Involvement	Typical SLOX (Sample)
1	Teras Desyandu Cadres, Sampetan Health Cadres, and Sampetan & Seboto Desyandu Cadres	The benefits received have a measurable and significant monetization value (in terms of knowledge, social roles, skills, economy, etc.) In the social engagement assessment, it has an average acceptance score (SLOX) of more than or equal to 81.25	

## Towards a Healthier Boyolali Community: The Social Return on Investment (SROI) on the Family Care Health Optimization Service Program (Yok Peka)

2	Pregnant women, toddlers, elderly	The benefits received have a measurable and significant monetization value (in terms of health improvement) In the social engagement assessment, have an average acceptance score (SLOX) of more than or equal to 80	
3	Community Development Officer (CDO)	The benefits received have a measurable and significant monetization value (in terms of income, achievement of key performance indicators (KPI), and work portfolio)	
4	The general public who use the Si-Kembang application and also the village Government	The benefits received have a measurable and significant monetization value (in terms of utilization of Application buildings, Emergency Car, and Communication Satellites for disaster response and health)	

### Calculation of Input Value, and Expected Changes

The Yok Peka Program is an effort to empower the community in the health sector so that people can avoid the problem of stunting, stillbirth, pregnant women with Chronic Lack of Energy conditions or even the death of pregnant women. Some of the activities carried out in the Yok Peka Program consist of: Providing PMT, Desyandu, making the Si-Kembang application, adding Posyandu health equipment, modifying Emergency car, training on innovations in making powdered ginger herbs, and satellite posyandu. Based on the activities, inputs to stakeholders analyzed in this SROI are:

Stakeholders	Number of Individuals (Total)	Program	Cost	Change Targets
Teras Desyandu Health cadre	60	PMT Assistance (Providing Supplemental Food) for Toddlers and Pregnant Women (2020)	IDR 5,550,000 (Source of funds PT. Pertamina Patra Niaga FT Boyolali)	There are health Cadres who are enthusiastic and have good social status in the community to organized Delivery Posyandu.
		Assistance in making the Si-Kembang Toddler Posyandu Health Registration Application (2020)	IDR 21,000,000 (Source of funds PT. Pertamina Patra Niaga FT Boyolali)	
		Health equipment assistance for Toddler Posyandu (2021)	IDR 6,000,000 (Source of funds PT. Pertamina Patra Niaga FT Boyolali)	
Sampetan & Seboto Health Cadres	87	Assistance for toddler health posyandu (2021)	IDR 21.600.000 (Source of funds PT. Pertamina Patra Niaga FT Boyolali)	There are health cadres who are enthusiastic and have good social status in the community to carry out Delivery Posyandu. Health cadres also have joint ventures.
		MSME Training on Traditional Herbal Medicine for Health Cadres & Provision of Production Equipment (2022)	IDR 6.000.000 (Source of funds PT. Pertamina Patra Niaga FT Boyolali)	
		Assistance in Establishing a Satellite Posyandu (2022)	IDR 33.000.000 (Source of funds PT. Pertamina Patra Niaga FT Boyolali)	



## Towards a Healthier Boyolali Community: The Social Return on Investment (SROI) on the Family Care Health Optimization Service Program (Yok Peka)

		PMT Innovation Training for health cadres (2022)	<b>IDR 6.000.000</b> (Source of funds PT. Pertamina Patra Niaga FT Boyolali)	
<b>Toddlers, Elderly and Pregnant Women on the Terrace, Sampetan, Seboto</b>	2020: • Toddler 503 • Pregnant 42	PMT Assistance (Providing Supplemental Food) for Toddlers and Pregnant Women (2020)	<b>IDR 33.000.000</b> (Source of funds PT. Pertamina Patra Niaga FT Boyolali)	Improving the Health of Toddlers, Pregnant Women and the Elderly as well as Ease of Assets and Access to Health
		Assistance with medical equipment for toddlers posyandu (2021)	<b>IDR 6.000.000</b> (Source of funds PT. Pertamina Patra Niaga FT Boyolali)	
	2021: • Toddler 458 • Pregnant 37	Assistance with medical equipment for toddlers posyandu (2021)	<b>IDR 21.600.000</b> (Source of funds PT. Pertamina Patra Niaga FT Boyolali)	
		Assistance in Establishing a Satellite Posyandu (2022)	<b>IDR 21.600.000</b> (Source of funds PT. Pertamina Patra Niaga FT Boyolali)	
	2022: • Toddler 476 • Pregnant 42 • Seniors 180	PMT Innovation Training for health cadres (2022)	<b>IDR 6.000.000</b> (Source of funds PT. Pertamina Patra Niaga FT Boyolali)	
<b>Villagers</b>	Village Population 6,189 1,254 Users	Assistance in making the Si-Kembang Toddler Posyandu Health Registration Application (2020)	<b>IDR 21.000.000</b> (Source of funds PT. Pertamina Patra Niaga FT Boyolali)	Reducing the risk of stunting, growth in height and weight that is not optimal and the risk of death for pregnant women
		Emergency Car Modification Assistance (2022)	<b>IDR 42.000.000</b> (Source of funds PT. Pertamina Patra Niaga FT Boyolali)	Emergency Car can function as ambulances and facilitate access to emergency and medical transportation for residents
<b>Village Government and Community Protector</b>	40	Communications Satellite Assistance (2022)	<b>IDR 18.000.000</b> (Source of funds PT. Pertamina Patra Niaga FT Boyolali)	Handling & Communication of health and security emergencies becomes faster
<b>Community Development Officer</b>	3	Participation as a companion for comdev activities (2020-2022)	<b>IDR 7.500.000</b> (Source of funds PT. Pertamina Patra Niaga FT Boyolali)	Community assistance, documentation, and implementation of the Yok Peka Program.

### Impact Calculation Approach and Monetization

The comdev activities described above have several medium and long term impacts which can be measured quantized by nominal monetization. The following table shows the outcomes that have been recorded along with their impact values as measured by proxies.

<b>N o</b>	<b>Stakeholders</b>	<b>Outcome</b>	<b>Monetization Approach</b>	<b>Proxy Type</b>	<b>Reference source</b>	<b>Unit Impact Value</b>	<b>Impact Value x Number of Beneficiaries</b>
1	Health cadre	Increased enthusiasm as a Desyandu Health Cadre	the cost of participating in the	Financial Proxy	<a href="https://geraie.sq.com/produ">https://geraie.sq.com/produ</a>	IDR 650,000	IDR 39,000,000

**Towards a Healthier Boyolali Community: The Social Return on Investment (SROI) on the Family Care Health Optimization Service Program (Yok Peka)**

	Desyandu Teras		Self Empowerment training		ct/cfw/the-amazing-you		
2	Teras Toddlers	Additional increase in Adequate Nutrition during a Pandemic and simple medical monitoring	interviews with a number of people how much money they are willing to pay for simple examinations, giving children vitamins and measuring children's growth and development during a pandemic in 1 year	Willingness to Pay	interviews, journals/notes of program implementation	IDR 60,000	IDR 30,180,000
3	Pregnant mother	Additional adequate health and nutrition improvements during the pandemic and simple medical monitoring	interviews with a number of people how much they are willing to pay for simple examinations, calculation of Estimated Date of Birth (HPL) and measurement of weight and health condition of pregnant women during a pandemic in 1 year	Willingness to Pay	interviews, journals/notes of program implementation	IDR 240,000	IDR 10,080,000
4	Teras Desyandu Health cadre	Increased pride as well as health record skills and assets	the cost of participating in the Self Empowerment training	Financial Proxy	<a href="https://geraiesq.com/product/cfw/the-amazing-you">https://geraiesq.com/product/cfw/the-amazing-you</a>	IDR 650,000	IDR 39,000,000
5	Application Users	Reducing the risk of stunting, growth in height and weight that is not optimal and the risk of death for pregnant women	estimated costs that need to be spent for consultation on baby/toddler weight and ideal pregnancy conditions	Financial Proxy	interviews, journals/notes of program implementation	IDR 420,000	IDR 526,680,000
6	Community Development Officer	Pride of work and increased experience of community empowerment	Cost of classes or sessions following motivational training	Financial Proxy	<a href="https://geraiesq.com/product/cfw/the-amazing-you">https://geraiesq.com/product/cfw/the-amazing-you</a>	IDR 650,000	IDR 1,950,000
7	Teras Desyandu Health cadre	Increased pride as well as health record skills and assets	the cost of participating in the Self Empowerment training	Financial Proxy	<a href="https://geraiesq.com/product/cfw/the-amazing-you">https://geraiesq.com/product/cfw/the-amazing-you</a>	IDR 650,000	IDR 23,400,000
8	Village Toddler	Residents can access minimum measurements of height and weight growth of toddlers	the cost that citizens are willing to pay to obtain a basic health check	Financial Proxy	Observation of work processes, interviews, journals/records of production activities (annual)	IDR 60,000	IDR 28,920,000

**Towards a Healthier Boyolali Community: The Social Return on Investment (SROI) on the Family Care Health Optimization Service Program (Yok Peka)**

9	Pregnant mother	Additional adequate health and nutrition improvements during the pandemic and simple medical monitoring	interviews with a number of people how much they are willing to pay for a simple examination, calculating the HPL and measuring the weight and health condition of pregnant women during a pandemic in 1 year	Willingness to Pay	interviews, journals/notes of program implementation	IDR 240,000	IDR 8,880,000
10	Community Development Officer	Pride of work and increased experience of community empowerment	Cost of classes or sessions following motivational training	Financial Proxy	<a href="https://geraiesq.com/product/cfw/the-amazing-you">https://geraiesq.com/product/cfw/the-amazing-you</a>	IDR 650,000	IDR 1,950,000
11	Health cadres Desyandu Sampetan & Seboto	Increased pride as well as health record skills and assets	the cost of participating in the Self Empowerment training	Financial Proxy	<a href="https://geraiesq.com/product/cfw/the-amazing-you">https://geraiesq.com/product/cfw/the-amazing-you</a>	IDR 650,000	IDR 23,400,000
12	Sampetan & Seboto Village Toddlers	Reducing the risk of stunting and suboptimal height and weight growth	Cost Estimation and Evaluation of the Intervention Program for Providing Processed Food for Special Medical Purposes (PKMK) to Improve Nutritional Status	Financial Proxy	<a href="https://jurnal.fkm.ui.ac.id/jurnal-eki/article/view/5323/1288">https://jurnal.fkm.ui.ac.id/jurnal-eki/article/view/5323/1288</a>	IDR 5,495,438	IDR 2,648,801,116
13	Sampetan & Seboto Pregnant Women	Additional adequate Health and Nutrition improvements and simple medical monitoring	interviews with a number of people how much they are willing to pay for a simple examination, calculating the HPL and measuring the weight and health condition of pregnant women during a pandemic in 1 year	Willingness to Pay	interviews, journals/notes of program implementation	IDR 240,000	IDR 10,080,000
14	Health cadres Desyandu Sampetan & Seboto	Health cadres have the knowledge to make herbal powder from ginger	Community Service Costs for the Implementation of Science and Technology Program for the Higher Education Community	Financial Proxy	<a href="https://lppm.undip.ac.id/wp-content/uploads/Panduan-Penelitian-dan-Pengabdian-kepada-Masyarakat-Edisi-XIII.pdf">https://lppm.undip.ac.id/wp-content/uploads/Panduan-Penelitian-dan-Pengabdian-kepada-Masyarakat-Edisi-XIII.pdf</a>	IDR 150,000,000	IDR 150,000,000
15	Youth Health Cadres &	Family Welfare Programme (PKK) members, members of health cadres and also	Increased additional income earned by the PKK group from	Financial Proxy	Observation of work processes, interviews,	IDR 120,000,000	IDR 1,440,000,000

**Towards a Healthier Boyolali Community: The Social Return on Investment (SROI) on the Family Care Health Optimization Service Program (Yok Peka)**

	Business Groups	Youth Business Groups can produce Herbal Ginger Powder at home	Jamu Jahe production in 1 year		journals/records of production activities (annual)		
16	Village Toddler	Toddlers get increased nutrition and body immunity so they can reduce the risk of stunting	Cost Estimation and Evaluation of the Intervention Program for Providing Processed Food for Special Medical Purposes (PKMK) to Improve Nutritional Status	Financial Proxy	<a href="https://jurnal.fkm.ui.ac.id/jurnal-eki/article/view/5323/1288">https://jurnal.fkm.ui.ac.id/jurnal-eki/article/view/5323/1288</a>	IDR 5,495,438	IDR 2,615,828,488
17	Village Elder	The elderly get increased nutrition and body immunity	Elderly Medical Check Up Costs	Financial Proxy	<a href="https://www.sehatq.com/promo/medical-check-up-mcu-lansia-1-laboratorium-klinik-ultra-medica-semarang">https://www.sehatq.com/promo/medical-check-up-mcu-lansia-1-laboratorium-klinik-ultra-medica-semarang</a>	IDR 368,000	IDR 66,240,000
18	Pregnant mother	Pregnant women get improved health, nutrition and body immunity	interviews with a number of people how much they are willing to pay for a simple examination, calculating the HPL and measuring the weight and health condition of pregnant women during a pandemic in 1 year	Financial Proxy	interviews, journals/notes of program implementation	IDR 240,000	IDR 10,080,000
19	The government and protector of the Sampetan Village community	Handling health emergencies becomes faster	costs that are willing to be paid so that Pemdes and Linmas can respond more quickly to emergency conditions including health	Willingness to Pay	interviews, journals/notes of program implementation	IDR 500,000	IDR 20,000,000
20	Health cadres Desyandu Sampetan & Seboto	Increasing the social role of health cadres	the cost of participating in the Self Empowerment training	Financial Proxy	<a href="https://geraisq.com/product/cfw/the-amazing-you">https://geraisq.com/product/cfw/the-amazing-you</a>	IDR 650,000	IDR 56,550,000
21	Village Toddler	Toddlers get improved health, nutrition and body immunity	Cost Estimation and Evaluation of the Intervention Program for Providing Processed Food for Special Medical Purposes	Financial Proxy	<a href="https://jurnal.fkm.ui.ac.id/jurnal-eki/article/view/5323/1288">https://jurnal.fkm.ui.ac.id/jurnal-eki/article/view/5323/1288</a>	IDR 5,495,438	IDR 2,615,828,488

**Towards a Healthier Boyolali Community: The Social Return on Investment (SROI) on the Family Care Health Optimization Service Program (Yok Peka)**

			(PKMK) to Improve Nutritional Status				
2 2		Families of toddlers get easier access to health	saving time and transportation costs to the Posyandu at the Village level because there are already Posyandu at the RT level	Reseource Allocation	interviews, journals/notes of program implementation	IDR 300,000	IDR 142,800,000
2 3	Village Elder	The elderly get improved health, nutrition and body immunity	Elderly Medical Check Up Costs	Financial Proxy	<a href="https://www.sehatq.com/promo/medical-check-up-mcu-lansia-1-laboratorium-klinik-ultra-medica-semarang">https://www.sehatq.com/promo/medical-check-up-mcu-lansia-1-laboratorium-klinik-ultra-medica-semarang</a>	IDR 368,000	IDR 66,240,000
2 4		The elderly have easy access to health checks	saving time and transportation costs to the Posyandu at the Village level because there are already Posyandu at the RT level	Reseource Allocation	interviews, journals/notes of program implementation	IDR 300,000	IDR 54,000,000
2 5	Pregnant mother	Pregnant women get improved health, nutrition and body immunity	interviews with a number of people how much they are willing to pay for a simple examination, calculating the HPL and measuring the weight and health condition of pregnant women during a pandemic in 1 year	Financial Proxy	interviews, journals/notes of program implementation	IDR 240,000	IDR 10,080,000
2 6		Pregnant women have easy access to health checks	saving time and transportation costs to the Posyandu at the Village level because there are already Posyandu at the RT level	Reseource Allocation	interviews, journals/notes of program implementation	IDR 300,000	IDR 12,600,000
2 7	residents of Sampetan Village	Guaranteed transportation assets and access to health for residents	The cost of renting an ambulance in one year is an average of pregnant women, sick or deceased residents in Sampetan Village	Financial Proxy	interviews, journals/notes of program implementation	IDR 600,000	IDR 48,000,000

## Towards a Healthier Boyolali Community: The Social Return on Investment (SROI) on the Family Care Health Optimization Service Program (Yok Peka)

28	Health cadres Desyandu Sampetan & Seboto	Health cadres have the knowledge to create PMT innovations	Community Service Costs for the Implementation of Science and Technology Program for the Higher Education Community	Financial Proxy	<a href="https://lppm.undip.ac.id/wp-content/uploads/Panduan-Penelitian-dan-Pengabdian-kepada-Masyarakat-Edisi-XIII.pdf">https://lppm.undip.ac.id/wp-content/uploads/Panduan-Penelitian-dan-Pengabdian-kepada-Masyarakat-Edisi-XIII.pdf</a>	IDR 150,000,000	IDR 150,000,000
29	Community Development Officer	Pride of work and increased experience of community empowerment	Cost of classes or sessions following motivational training	Financial Proxy	<a href="https://geraiesq.com/product/cfw/the-amazing-you">https://geraiesq.com/product/cfw/the-amazing-you</a>	IDR 650,000	IDR 1,950,000

### Recapitulation of Impact Value and SROI Calculation

The adjusted impact value is then divided by the investment value (which is the input value), so that the return on investment can be determined. The following table shows SROI values per year from 2020 to 2022, as well as predictive SROI values for 2023 to 2025.

Years	2020	2021	2022	2023	2024	2025
Present value of each year	70,102,500	126,680,523	439,016,940	329,375,560	250,308,287	193,115,471
Total Present Value (PV)	70,102,500	196,783,023	635,799,963	965,175,523	1,215,483,810	1,408,599,281
Net Present Value (PV minus the investment)	41,052,500	137,633,023	470,149,963	799,525,523	1,049,833,810	1,242,949,281
Social Return (Value per amount invested)	2.41	3.33	<b>3.84</b>	5.83	7.34	8.50

\*Indonesian Bank Discount Rate = 5%

The results of the SROI analysis for the period 2020 to 2022 show a benefit value of Rp. 635,799,963 compared to the investment value of Rp. 165,650,000. In other words, every Rp. 1 investment in the Yok Peka program can generate benefits of Rp. 3.84 (SROI = 1: 3.84). As a comparison, the following is a comparison of the results of Yok Peka's SROI analysis compared to the SROI analysis of related programs.

Location & Project	Analysis	Immediate Impact (Program End)
SROI Evaluation Project Search For North Lanarkshire Council (adults with a learning disability)	SROI	1 : 3.8
SROI Evaluation for Modified Vehicles for People with Disability	SROI	1 : 2.78
SROI Evaluation for Community Learning Innovation Fund (CLIF) Project in Birmingham Disability Resource Centre (DRC)	SROI	1 : 3.8
SROI Evaluation for YOK PEKA by PT Pertamina Fuel Terminal Boyolali	SROI	1 : 47
SROI evaluation for Yok Peka by PT Pertamina Fuel Terminal Boyolali	SROI	1 : 3.84

## Towards a Healthier Boyolali Community: The Social Return on Investment (SROI) on the Family Care Health Optimization Service Program (Yok Peka)

### CONCLUSION

The Yok Peka comdev program has been implemented by PT Pertamina Patra Niaga Fuel Terminal (FT) Boyolali. The comdev program is held in the company's ring 1, ring 2 and ring 3 areas by involving fostered partners or direct beneficiaries, namely: Posyandu cadres in Teras Village, Sampetan Village, and also Seboto Village. Conditions before the program showed access and asset problems faced by toddlers as well as pregnant women and the elderly in the health sector. This condition is even shown by the occurrence of cases of infant mortality, stunting under five and the death of pregnant women. After carrying out social innovation through Yok Peka activities, village communities are then able to be more empowered and have assets and access to health.

Based on data from the Government and also village midwives, the Yok Peka program in 2022 has succeeded in helping to improve the nutrition of 50 toddlers who were previously categorized as stunting. Compared to 2021, there were cases of death of pregnant women, in 2022 there will not even be any cases of death of pregnant women. In addition, there were 12 pregnant women who were later declared to have passed the KEK condition. The results of the SROI analysis for the period 2020 to 2022 show a benefit value of Rp. 635,799,963 compared to the investment value of Rp. 165,650,000. In other words, every Rp. 1 investment in the Yok Peka program can generate benefits of Rp. 3.84 (SROI = 1: 3.84).

Another result of the Yok Peka Program is that Teras Village and Sampetan Village, which previously had health problems, were designated as Alert Villages based on the Boyolali Regent's Decree. In addition, the Yok Peka program was able to bring about systemic changes in two ways. The first is related to how vulnerable groups are able to own assets and access health. The second is related to how changes in the community and village government in dealing with disaster conditions and also health emergencies. This is of course very essential, especially learning from the cases of the COVID-19 pandemic that have hit. Not only that, through the Yok Peka program, Sampetan Village was then announced as through Village Regulations as a Healthy Village. On the other hand, the Yok Peka program has also succeeded in increasing the welfare of health cadres through an entrepreneurial innovation program. So that a strong chain of community empowerment is realized through the Yok Peka Program.

### REFERENCES

- 1) Budiono, A. (2012), Social Impact Measurement: A Literature Review of the Method, Limitations and Applications [Pengukuran Dampak Sosial: Sebuah Tinjauan Literatur Terhadap Metode, Keterbatasan dan Aplikasinya]. Bina Ekonomi Vol 21 No 2, 132-139.
- 2) Lawlor, E., Neitzert, E., & Nicholls, J. (2008). Measuring Value: A Guide to Social Return on Investment (SROI). The New Economics Foundation, Second edition, 56. <https://commdev.org/wp-content/uploads/2015/06/Measuring-Value-A-Guide-to-Social-Return-on-Investment.pdf>
- 3) Nicholls, J., Lawlor, E., Neitzer, E., & Goodspeed, T. (2009). A guide to Social Return on Investment. Development, 3(January), 55. <http://scholar.google.com/scholar?hlmen&btnG=Search&q=intitle:A+guide+to+Social+Return+on+Investment#6>
- 4) Purwohedi, U. (2016). Social Return on Investment (SROI) - A Technique for Benefit-Measuring/Impact of a Program or Project [Sebuah Teknik untuk Mengukur
- 5) -Manfaat/Dampak dari Sebuah Program atau Proyek]. June 2016.
- 6) Regulation of the Minister of Environment and Forestry Number 1 of 2021 concerning Programs for Evaluation of Corporate Performance Ratings in Environmental Management [Peraturan Menteri Lingkungan Hidup dan Kehutanan Nomor 1 Tahun 2021 tentang Program Penilaian Peringkat Kinerja Perusahaan dalam Pengelolaan Lingkungan Hidup]. 1-312.
- 7) Santoso, M. B., Adit Enegara, R. Ismanto, S. U., Mumajad, I., & Mulyono, H. (2018). Assessment of the Impact of CSR Implementation Social Investment. Jurnal Pemikiran Dan Penelitian Administrasi Bisnis Dan Kewirausahaan, 3(2), 153-167.
- 8) V. Then et al. (2017). Social Return on Investment Analysis: Measuring the Impact of Social Investment. Palgrave Studies in Impact Finance.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Risk Factors of Roundhouse Kick Wushu Injury: Systematic Review and Meta-Analysis



Sugiyon Dwi Pangestu<sup>1</sup>, Ali Satia Graha<sup>2</sup>

<sup>1,2</sup>Department of Sport Science, Faculty of Sport and Health Science, Yogyakarta State University, Indonesia St. Colombo No.1, Karangmalang, 55281, Yogyakarta, Indonesia

**ABSTRACT:** The roundhouse kick is a basic kicking technique in martial arts which is very important in achieving victory. The roundhouse kick is a simple move, easier, faster and more powerful than any other foot action that is also easy to use for attack and for defence, therefore it is the move most used. The aim of this study was to identify and critically assess the evidence relating to risk factors for roundhouse kick injuries. A systematic review was conducted according to the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) framework. Articles were searched using Scopus, Google Scholar and PubMed. The results of the selected articles revealed that risk factors for injury in roundhouse kick wushu, namely competition experience, technique, history of previous injuries, age, overuse, physical fitness, warm-up and stretching. All risk factors for injury due to competition experience, technique, previous injury history, age, overuse, physical fitness, warm-up and stretching are things to consider. History of previous injuries is the most important factor that can cause injury. Handling and care need to be done optimally to minimize the occurrence of injuries or recurrence of old injuries. In addition, physical fitness, warming up and stretching also really need to be considered before doing sports activities, especially doing roundhouse kick wushu movements to reduce the risk of injury. All risk factors for injury due to competition experience, technique, previous injury history, age, overuse, physical fitness, warm-up and stretching are things to consider. History of previous injuries is the most important factor that can cause injury. Handling and care need to be done optimally to minimize the occurrence of injuries or recurrence of old injuries. In addition, physical fitness, warming up and stretching also really need to be considered before doing sports activities, especially doing roundhouse kick wushu movements to reduce the risk of injury. All risk factors for injury due to competition experience, technique, previous injury history, age, overuse, physical fitness, warm-up and stretching are things to consider. History of previous injuries is the most important factor that can cause injury. Handling and care need to be done optimally to minimize the occurrence of injuries or recurrence of old injuries. In addition, physical fitness, warming up and stretching also really need to be considered before doing sports activities, especially doing roundhouse kick wushu movements to reduce the risk of injury. History of previous injuries is the most important factor that can cause injury. Handling and care need to be done optimally to minimize the occurrence of injuries or recurrence of old injuries. In addition, physical fitness, warming up and stretching also really need to be considered before doing sports activities, especially doing roundhouse kick wushu movements to reduce the risk of injury. History of previous injuries is the most important factor that can cause injury. Handling and care need to be done optimally to minimize the occurrence of injuries or recurrence of old injuries. In addition, physical fitness, warming up and stretching also really need to be considered before doing sports activities, especially doing roundhouse kick wushu movements to reduce the risk of injury.

**KEYWORDS:** Factors, Risk, Roundhouse kick, Wushu, Injury

### I. INTRODUCTION

Wushu can also be interpreted as the art of war or martial arts(El et al., 2022)which includes studying arts, sports, health, martial arts and mental(H. Sun et al., 2022;N. Zhang et al., 2022). Wushu or often also called Kungfu is a martial art that originated in ancient China(Mehrsafar et al., 2019)and spread to all corners of the world through a Chinese named Hua Ren who went abroad and the history of Wushu itself cannot be traced anymore, because it is thousands of years old.(H. Liu & Qu, 2023)and maybe as old as Chinese history where there were many wars(J. Zhang et al., 2022). Wushu can basically be classified into two: the formal/art which is called taolu and the fighting which is often called sanda(Lu, 2008), formal/art wushu is usually a



## Risk Factors of Roundhouse Kick Wushu Injury: Systematic Review and Meta-Analysis

set of choreographed moves (Y. Liu et al., 2023), while wushu fights are characterized by one-on-one fights which are regulated in a regulation (Yi & Yu, 2022). Some of the opinions above can be interpreted that wushu is a martial art that originates from China and has been and continues to be developed through existing regulations. Statistical data, sanda has the highest usage rate and score during the competition (Lei & Lv, 2022), which is the essence of the whole sanda technique (Ren, 2022; Wehner et al., 2022).

Comparisons have been made regarding the technical use of Chinese and foreign Sanda athletes and carried out statistical data (Songs, 2022), the conclusion of the main research is that in punching techniques, intermediate level athletes mainly use straight punches and swing punches, but high scores are often used in leg techniques (Vasconcelos et al., 2020). The studied characteristics related to the technicality of male lightweight athletes and showed that the best lightweight athletes were clearly inferior to the heavyweights in terms of strength (CJ & MGL, 2017) and the use of fists rarely scores points, fists are more often used as fake wobbles (G. Sun & Bin, 2018) mainly relying on leg kicks to score points (Wasik et al., 2022). The roundhouse kick is a simple move (Jung & Park, 2022), easier (Moreira et al., 2021), faster and stronger than any other foot action (Wąsik, Mosler, Ortenburger, Góra, et al., 2021) and also easy to use to attack and to defend (Yugang Li, Faben Van, Yujia Zeng, 2008). This shows that this roundhouse kick is a very effective movement (Ha et al., 2022). Therefore, it can be concluded that the roundhouse kick is a very important thing in wushu (Wąsik, Mosler, Ortenburger, & Góra, 2021).

Wushu in Indonesia has a significant development. The Indonesian government itself includes wushu in the National Sports Grand Design (DBON) program. In different combat sports, risk factors for injury have been studied, including internal and external factors (Kim et al., 2022).

Injuries that occur in roundhouse kicks are higher compared to other attack techniques, knowledge of the risk factors that cause injuries to roundhouse kicks is still needed. Several studies on roundhouse kick injuries are already underway (Pieter, 2005). Identifying and explaining the risk factors that lead to injuries in roundhouse kicks will certainly go a long way in preventing these injuries. To date, and to the best of the author's knowledge the literature review conducted by Kim et al., the author has not specifically explained the risk factors for injury in the roundhouse kick movement. Therefore, the purpose of this study was to conduct a systematic review to identify and explain risk factors for injury in wushu athletes who frequently perform roundhouse kicks.

## II. MATERIALS AND METHODS

The research design in this study used the literature review method. A literature review study is a research design using secondary data related to a particular topic. This literature review study aims to conclude the theory based on several previous research results. The data collection method for this article review uses access to Scopus, Google Scholar and PubMed. The literature review data collection stage uses the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) flow method. The search for research articles is determined by the existing criteria. (1) variables according to written requirements; (2) consistent data collection methods; (3) valid research results; and (4) data analysis is defined precisely and clearly.

Researchers looking for articles related to the topic of risk factors for roundhouse kick injuries using the Scopus, Google Scholar, and PubMed databases were selected because of their ease of access and feasibility to get complete, clear and in-depth articles. In addition, researchers are also looking for open access articles so they can access them free of charge. The keywords used in the search are roundhouse kick, wushu, injury, risk, and factors.

Selection of the type of study was carried out through a screening process and determinations of eligibility were made in the meta-analysis. The selection of studies in this study used several criteria, namely: 1) articles related to roundhouse kick, wushu, injuries, risks, and factors; 2) published within the last 8 years. Next, the researcher selects all titles along with abstracts to check for duplication using the Mendeley application. Search results and the process of selecting articles will be described using a flowchart. The 2020 Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) flow chart is used to summarize the study selection process.

## Risk Factors of Roundhouse Kick Wushu Injury: Systematic Review and Meta-Analysis

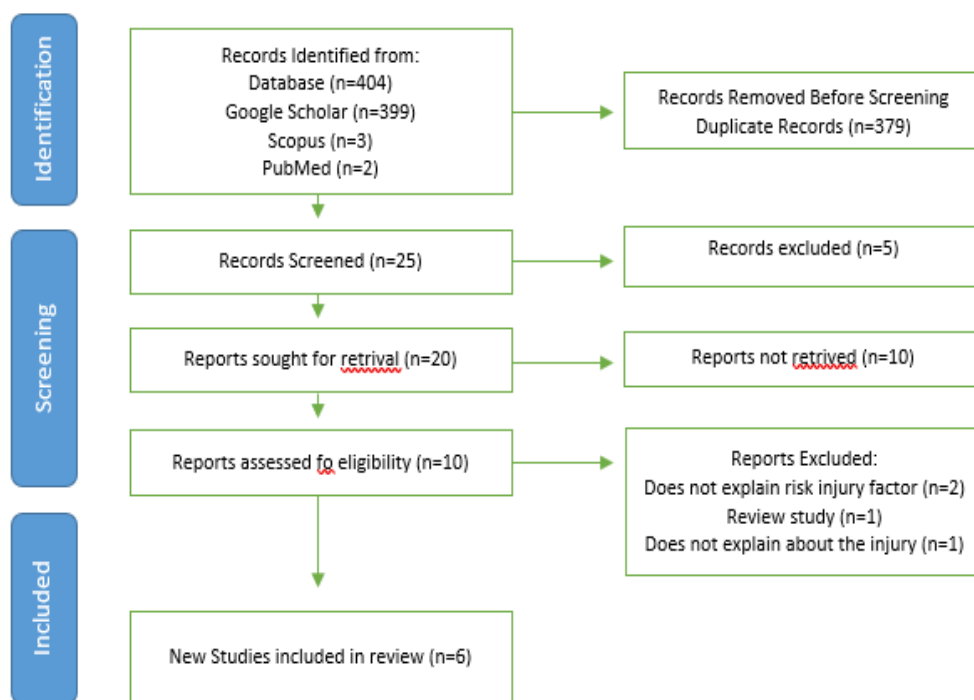


Figure 1. Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) Flowchart

### III. RESULT

From the search results that have been carried out by researchers, six articles related to risk factors for roundhouse kick injuries in the last 8 years have been reviewed and obtained with various research methods and different results. The following is the name of the author (year), study design, sample, number of samples, and risk factors for injury.

Author (year)	Research design	Sample	Number of Samples	Injury Risk Factors
(Su et al., 2023)	Case Report	-	-	Matching experience, History of previous injuries
(Demorest et al., 2016)	Case report	Using data from US Emergency departments for martial arts-related injuries from 1990 to 2003	-	Technique, Warm Up or Stretching, overuse
(Vitale et al., 2018)	Case Report	-	130 Athletes	Age, Experience competing
(Koutures & Demorest, 2018)	Case Report	-	-	Physical Fitness, Past injury history
(Bhatia et al., 2015)	Cross-Sectional	Using data with the University of California, Los Angeles	72 Athletes	Age, Experience, Physical Fitness
(Janzen et al., n.d. 2020)	Case Report	-	-	Stretching or Warming Up

An overview of the study selection process is described in Figure 1. The initial search found 404 articles, consisting of 399 articles from Google Scholar, 3 articles from Scopus, and 2 articles from PubMed. After going through the selection process, 379 articles were automatically deleted, and 25 articles were obtained that were potentially relevant to go through the next selection process. Of the 25 articles, 5 that did not meet the inclusion criteria were deleted, and 20 articles were found. Of the 20 articles reviewed through research titles and abstracts, 10 were deleted, and the remaining 10 deserved analysis. Of the 10

## **Risk Factors of Roundhouse Kick Wushu Injury: Systematic Review and Meta-Analysis**

articles analyzed by the researchers, six were found for review. Deletion of 4 articles was due to 2 articles not being able to explain the risk factors for roundhouse kick injury, 1 article being a systematic literature review.

### **IV. DISCUSSION**

This study is a systematic review that evaluates the risk factors for roundhouse kick injuries. A total of seven injury risk factors have been reviewed and analyzed, namely competition experience, technique, previous injury history, age, overuse, physical fitness, warm-up and stretching.

#### **A. Competing Experience**

Experience is a risk factor for injury in sports because the higher understanding and skills possessed by athletes can influence how they respond to situations and challenges that arise during movement.(Malone et al., 2017)in this case it's a roundhouse kick. In line with researchBell et al.,which states that experience can reduce the level of risk of injury. Another study revealed that inexperienced athletes were more likely to be injured than experienced athletes(Malone et al., 2017).

#### **B. Technique**

Improper or poor technique in sports or physical activity can be a risk factor for injury. Poor technique can cause increased stress on the body, damage physical structure, and affect balance and coordination. Techniques that are poorly understood can increase the risk of injury(Thacker et al., 2004). In addition to reducing the risk of injury, good technique can also optimize movement(Benjaminse et al., 2015)which in this case is a roundhouse kick. In line with researchGabbett & Ryan,which revealed that good technique contributed to the degree of injury sustained.

#### **C. Previous Injury History**

A history of previous injury is a risk factor for injury because previous injury experience can affect a person's physical, psychological, and behavior, which in turn can increase the likelihood of future injury.(Hägglund et al., 2006)revealed that a history of injuries that have been experienced will be more susceptible to injury again. Another study explains that previous injuries create susceptibility to subsequent injuries(Toohey et al., 2017). In line with researchResnick et al.,which reveals that there is a significant relationship between prior injury and trauma which in this case will stimulate the risk of subsequent injury.

#### **D. Age**

Age is a risk factor for injury in physical activity and sports due to physical changes, development and decreased body ability. Age can affect how a person responds to certain exercises or physical activities(Khamalia et al., 2006). Another study revealed that older people experience more injuries(McGuine, 2006). In line with researchGrams et al.,which revealed that old age is closely related to a higher risk of injury. Old age in this case is the age of 50 years and over(Changstrom et al., 2022).

#### **E. Overuse**

Overuse or overuse in physical activity or sports can be a risk factor for injury from too often or too hard doing the roundhouse kick. Roundhouse kicks can cause excessive stress on the body, damage tissue, and increase the risk of injury if done excessively(Divine & Kohl III, 1998). Injuries resulting from overuse can affect athletes(Mahieu et al., 2006). In line with researchKauther et al.,which revealed that overuse increases the risk of injury.

#### **F. Physical Fitness**

Physical fitness involves strength, endurance, balance, flexibility and other components that contribute to the body's ability to perform properly and safely during exercise or physical activity. Poor or poor physical fitness can be a risk factor for injury in physical activity and sports(Carter & Micheli, 2011). In line with researchJones et al.,which explains that the components of physical fitness with the risk of injury have a close relationship. Keeping in shape can reduce the risk of injury(Grant et al., 2015).

#### **G. Warm Up and Stretching**

Incorrect or neglected warm-up and stretching can be a risk factor for injury. Proper warm-up and stretching help prepare the body by increasing blood circulation, improving flexibility and effectively reducing muscle tension(Smith, 1994). In another study, it was explained that athletes who did not warm up and stretch were more prone to injury compared to athletes who did warm up and stretch(Small et al., 2008). In line with researchO'Sullivan et al.,which revealed that warming up and stretching reduced the risk of injury and increased flexibility of the body.

### **V. CONCLUSIONS**

From all the discussion above, it can be concluded that the risk factors for roundhouse kick wushu injuries are competition experience, technique, previous injury history, age, overuse, physical fitness, warm-up and stretching. All risk factors for past

## Risk Factors of Roundhouse Kick Wushu Injury: Systematic Review and Meta-Analysis

injuries, past injury history, physical fitness, warm-up and stretching are things that really need attention. History of previous injuries is the most important factor that can cause injury. Handling and care need to be done optimally to minimize the occurrence of injuries or recurrence of old injuries. Apart from that, physical fitness, warming up and stretching also really need to be considered before doing sports activities, especially doing roundhouse kick wushu movements to reduce the risk of injury.

### REFERENCES

- 1) Bell, N. S., Mangilone, T. W., Hemenway, D., Amoroso, P. J., & Jones, B. L. H. (2000). High injury rates among female army trainees: a function of gender? *American Journal of Preventive Medicine*, 18(3), 141–146.
- 2) Benjaminse, A., Gokeler, A., Dowling, A. V., Faigenbaum, A., Ford, K. R., Hewett, T. E., Onate, J. A., Otten, B., & Myer, G. D. (2015). Optimization of the anterior cruciate ligament injury prevention paradigm: novel feedback techniques to enhance motor learning and reduce injury risk. *Journal of Orthopaedic & Sports Physical Therapy*, 45(3), 170–182.
- 3) Bhatila, S., Covarrubias, N., Chang, E., Campos, L., & Nguyen, D. (2015). The relationship between Taekwondo training habits and injury: a survey of a collegiate Taekwondo population. *Open Access Journal of Sports Medicine*, 121. <https://doi.org/10.2147/oajsm.s80974>
- 4) Carter, C. W., & Micheli, L. J. (2011). Training the child athlete: physical fitness, health and injury. *British Journal of Sports Medicine*, 45(11), 880–885.
- 5) Changstrom, B., McBride, A., & Khodaei, M. (2022). Epidemiology of racket and paddle sports-related injuries treated in the United States emergency departments, 2007–2016. *Physician and Sports medicine*, 50(3), 197–204. <https://doi.org/10.1080/00913847.2021.1892467>
- 6) CJ, G., & MGL, S. (2017). A biomechanical analysis of the roundhouse kicking technique of expert practitioners: A comparison between the martial arts disciplines of Muay Thai, Karate, and Taekwondo. *PloS One*, 12(8), e0182645. <https://doi.org/10.4227/39/58dc40a141223.Fundilng>
- 7) Demorest, R. A., Koutures, C., LaBella, C. R., Brooks, M. A., Diamond, A., Hennrikus, W., LaBotz, M., Logan, K., Loud, K. J., Moffatt, K. A., Nemeth, B. L., Pengel, B. L., Peterson, A., Brenner, J. S., Kelly, A. K. W., Gregory, A. J. M., Halstead, M. E., Bernhardt, D., Jayanthi, N. A., ... Emanuel, A. (2016). Youth participation and injury risk in martial arts. *Pediatrics*, 138(6). <https://doi.org/10.1542/peds.2016-3022>
- 8) El, M., Lanos, C., Ayu, S., Putri, R., Fajar, M., Sari, P. S., & Mahendra, A. (2022). Penataran pelatih wasit/juri wushu tingkat daerah provinsi sumatera selatan. 5(2), 6–10.
- 9) Gabbett, T., & Ryan, P. (2009). Tackling technique, injury risk, and playing performance in high-performance collision sport athletes. *International Journal of Sports Science & Coaching*, 4(4), 521–533.
- 10) Grams, M. E., Sang, Y., Ballew, S. H., Gansevoort, R. T., Kimm, H., Kovessy, C. P., Naimark, D., Oien, C., Smith, D. H., & Coresh, J. (2015). A meta-analysis of the association of estimated GFR, albuminuria, age, race, and sex with acute kidney injury. *American Journal of Kidney Diseases*, 66(4), 591–601.
- 11) Grant, J. A., Bedi, A., Kurz, J., Bancroft, R., Gagnier, J. J., & Miller, B. L. S. (2015). Ability of preseason bloody composition and physical fitness to predict the risk of injury in male collegiate hockey players. *Sports Health*, 7(1), 45–51.
- 12) Ha, S., Kim, M. J., Jeong, H. S., Lee, I., & Lee, S. Y. (2022). Mechanisms of Sports Concussion in Taekwondo: A Systematic Video Analysis of Seven Cases. *International Journal of Environmental Research and Public Health*, 19(16). <https://doi.org/10.3390/ijerph191610312>
- 13) Hägglund, M., Waldén, M., & Ekstrand, J. (2006). Previous injury as a risk factor for injury in elite football: a prospective study over two consecutive seasons. *British Journal of Sports Medicine*, 40(9), 767–772.
- 14) Ilahil, O. A., & Kohl III, H. W. (1998). Lower extremity morphology and alignment and risk of overuse injury. *Clinical Journal of Sport Medicine*, 8(1), 38–42.
- 15) Janzen, L., Black, A., Pike, I., & Bablu, S. (n.d.). Evidence Summary : Martial Arts.
- 16) Jones, B. L. H., Hauret, K. G., Dye, S. K., Hauschild, V. D., Rossi, S. P., Richardson, M. D., & Friedl, K. E. (2017). Impact of physical fitness and bloody composition on injury risk among active young adults: a study of Army trainees. *Journal of Science and Medicine in Sport*, 20, S17–S22.
- 17) Jung, T., & Park, H. (2022). Contributions of Bloody Segments to the Toe Velocity during Taekwondo Roundhouse Kick. *Applied Silences (Switzerland)*, 12(15). <https://doi.org/10.3390/app12157928>
- 18) Kauther, M. D., Wedemeyer, C., Wegner, A., Kauther, K. M., & von Knoch, M. (2009). Breakdance injuries and overuse syndromes in amateurs and professionals. *The American Journal of Sports Medicine*, 37(4), 797–802.
- 19) Khambalia, A., Joshi, P., Brussoni, M., Raina, P., Morrongiello, B., & Macarthur, C. (2006). Risk factors for unintentional injuries due to falls in children aged 0–6 years: a systematic review. *Injury Prevention*, 12(6), 378–381.

## Risk Factors of Roundhouse Kick Wushu Injury: Systematic Review and Meta-Analysis

- 20) Kim, K., Davaasambuu, B.L., Weil, R., & Kim, Y. H. (2022). Biomechanical investigation of anterior cruciate ligament injury risk in piloting leg during taekwondo kicks using motion analysis system. *Journal of Mechanical Science and Technology*, 36(2), 1051–1056.
- 21) Koutures, C., & Demorest, R. A. (2018). Participation and Injury in Martial Arts. *Current Sports Medicine Reports*, 17(12), 433–438. <https://doi.org/10.1249/JSR.0000000000000539>
- 22) Lei, Z., & Lv, W. (2022). Feature Extraction-Based Fitness Characteristics and Kinesiology of Wushu Sanda Athletes in University Analysis. *Mathematical Problems in Engineering*, 2022. <https://doi.org/10.1155/2022/5286730>
- 23) Liu, H., & Qu, C. (2023). Consequences of Lower Limb Strength Trailing on Jump Performance in Athletes of Martial Arts. *Revista Brasileira de Medicina Do Esporte*, 29, 2022–2024. [https://doi.org/10.1590/1517-8692202329012022\\_0340](https://doi.org/10.1590/1517-8692202329012022_0340)
- 24) Liu, Y., Lil, L., Yan, X., He, X., & Zhao, B.L. (2023). Biomechanics of the lead straight punch and related indexes between sanda fighters and boxers from the perspective of cross-border talent transfer. *Frontiers in Physiology*, 13(January), 1–8. <https://doi.org/10.3389/fphys.2022.1099682>
- 25) Lu, C. (2008). Modern wushu: When Chinese martial arts meet Western sports. *Archives of Budo*, 37–39. <http://www.archbludo.com/fulltxt.php?ILCILD=867554>
- 26) Mahieu, N. N., Witvrouw, E., Stevens, V., Van Tiggelen, D., & Roget, P. (2006). Intrinsic risk factors for the development of Achilles tendon overuse injury: a prospective study. *The American Journal of Sports Medicine*, 34(2), 226–235.
- 27) Malone, S., Roe, M., Doran, D. A., Gabbltt, T. J., & Collins, K. D. (2017). Protection against spikes in workload with aerobic fitness and playing experience: the role of the acute: chronic workload ratio on injury risk in elite Gaelic football. *International Journal of Sports Physiology and Performance*, 12(3), 393–401.
- 28) McGuine, T. (2006). Sports injuries in high school athletes: a review of injury-risk and injury-prevention research. *Clinical Journal of Sport Medicine*, 16(6), 488–499.
- 29) Mehrsafari, A. H., Strahler, J., Gazerani, P., Khabiri, M., Sánchez, J. C. J., Moosakhani, A., & Zadeh, A. M. (2019). The effects of mindfulness training on competition-induced anxiety and salivary stress markers in elite Wushu athletes: A pilot study. *Physiology & Behaviour*, 210, 112655. <https://doi.org/10.1016/J.PHYSBLEH.2019.112655>
- 30) Moreira, P. V. S., Falco, C., Menegaldo, L. L., Goethel, M. F., De Paula, L. V., & Gonçalves, M. (2021). Are isokinetic leg torques and kick velocity reliable predictors of competitive level in taekwondo athletes? *PLoS ONE*, 16(6 June), 1–20. <https://doi.org/10.1371/journal.pone.0235582>
- 31) O’Sullivan, K., Murray, E., & Sainsbury, D. (2009). The effect of warm-up, static stretching and dynamic stretching on hamstring flexibility in previously injured subjects. *BLMC Musculoskeletal Disorders*, 10(1), 1–9.
- 32) Pieter, W. (2005). Martial arts injuries. *Epidemiology of Paediatric Sports Injuries: Individual Sports*, 48, 59–73.
- 33) Ren, Y. (2022). Trailing fatigue and recovery of Wushu Sanda athletes based on comprehensive environmental testing. *Applied Mathematics and Nonlinear Sciences*, 2022, 1–11. <https://doi.org/10.2478/amns.2021.2.00223>
- 34) Resnick, H. S., Yehuda, R., Pitman, R. K., & Foy, D. W. (1995). Effect of previous trauma on acute plasma cortisol level following rape. *The American Journal of Psychiatry*.
- 35) Small, K., Mc Naughton, L., & Matthews, M. (2008). A systematic review into the efficacy of static stretching as part of a warm-up for the prevention of exercise-related injury. *Research in Sports Medicine*, 16(3), 213–231.
- 36) Smith, C. A. (1994). The warm-up procedure: to stretch or not to stretch. A brief review. *Journal of Orthopaedic & Sports Physical Therapy*, 19(1), 12–17.
- 37) Song, L. (2022). Three-Dimensional Image Analysis and Trailing Method of Action Characteristics of Sanda Whelp Leg Technique Based on Wavelet Transform. *Advances in Multimedia*, 2022. <https://doi.org/10.1155/2022/1004568>
- 38) Su, A. W., Johns, W., & Bansal, S. (1990). Martial Arts: Orthopaedic Injuries and Related Biomechanics. *JAAOS - Journal of the American Academy of Orthopaedic Surgeons*. [https://journals.lww.com/jaaos/fulltext/9900/martilal\\_arts\\_\\_orthopaedic\\_ilnjuriles\\_and\\_related.768.aspx](https://journals.lww.com/jaaos/fulltext/9900/martilal_arts__orthopaedic_ilnjuriles_and_related.768.aspx)
- 39) Sun, G., & Bin, S. (2018). A new opinion leaders detecting algorithm in multi- relationship online social networks. *Multimedia Tools and Applications*, 77(4), 4295–4307. <https://doi.org/10.1007/s11042-017-4766-y>
- 40) Sun, H., Lv, W., Khadidos, A. O., & Kharabsheh, R. (2022). Research on the influence of fuzzy mathematics simulation model in the development of Wushu market. *Applied Mathematics and Nonlinear Silences*, 7(2), 341–352. <https://doi.org/10.2478/amns.2021.2.00062>
- 41) Thacker, S. B., Gilchrist, J., Stroup, D. F., & Kimsey Jr, C. D. (2004). The impact of stretching on sports injury risk: a systematic review of the literature. *Medicine & Science in Sports & Exercise*, 36(3), 371–378.

## Risk Factors of Roundhouse Kick Wushu Injury: Systematic Review and Meta-Analysis

- 42) Toohey, L. A., Drew, M. K., Cook, J. L., Finch, C. F., & Gaida, J. E. (2017). IIs subsequent lower limb injury associated with previous injury? A systematic review and meta-analysis. *British Journal of Sports Medicine*, 51(23), 1670–1678.
- 43) Vasconcelos, B. B., Protzen, G. V., Galliano, L. M., Kirk, C., & Del Vecchio, F. BL. (2020). Effects of High-Intensity Interval Trailing in Combat Sports: A Systematic Revile with Meta-Analysis. *Journal of Strength and Conditioning Research*, 34(3), 888–900. <https://doi.org/10.1519/JSC.0000000000003255>
- 44) Vitale, J. A., Bassani, T., Galbusera, F., Bianchi, A., & Martinelli, N. (2018). Injury rates in martial arts athletes and predictive risk factors for lower limb injuries. *The Journal of Sports Medicine and Physical Fitness*, 58(9), 1296–1303. <https://doi.org/10.23736/S0022-4707.17.07536-3>
- 45) Wasik, J., Mosler, D., Gora, T., Ortenburger, D., Chalimoniuk, M., & Langfort, J. (2022). Kinematic Differences between Traditional and Sport Version of Roundhouse Kick Executed by Male Taekwon-do Masters. *Journal of Men’s Health*, 18(6).



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Time of *Sargassum* Tea Application on the Growth and Yield of Garlic



**Cherisse May S. Hayohay**

Ilocos Sur Polytechnic State College

**ABSTRACT:** The present farming management uses inorganic fertilizer that include chemical pesticides and chemical fertilizer which damage our natural ecosystems where different living organisms live. Therefore there is an urgent need to have solution to this particular agricultural problem. Hence, this study on time of sargassum tea application (30 DAP, 60 DAP AND 90 DAP) of the growth and yield of garlic conducted from October 17, 2014 to February 13, 2015 at the Citrus Project of DMMMSU-NLUC, Bacnotan La Union. Results revealed that the application of sargassum tea at 80 DAP to garlic produced more yield (6093.75 kg/ha) than those plants subjected to other treatments.

**KEYWORDS:** chemical pesticides, ecosystems, inorganic fertilizer, organic farming, sargassum tea,

### INTRODUCTION

#### Situation Analysis

Garlic (*Allium sativum* L.), or *bawang*, is an annual herb of the *Amaryllidacea* family. It produces bulb which is surrounded by sheaths and composed of a thin bubbles and cloves which capable in forming a new plant. Bubbles are used as food and for medicinal purposes, like cancer. They can also help to clean the pollutants in our body. Garlic also contains antibiotic substance, which inhibits the growth of certain bacteria and fungi (DA, 2013).

Ilocos Region remains to be the consistent supplier of garlic in the country exhibiting a surplus production of about 2.7 thousand metric tons where Ilocos Norte highly contributed in catering the deficit supply of other provinces and non-producing regions. The production trend over the years is declining because of the imported garlic that discouraged the local producers and diverted their production to other cash crops. One of the main issues with garlic production is the high input costs, especially those associated with chemical fertilizers. Organic fertilizers are now being introduced to reduce the cost of production. Organic farming is a type of agriculture which had been used for thousands of years. The use of organic fertilizers such as vermicompost and seaweeds are advantageous to the plant growth and as a flowering hormone and also a source of plant nutrients. Organic fertilizers can be a solution to the problem on the adverse continuous use of chemical fertilizers by providing organic matter content of soil rate (Villanueva, 2011). They can also improve the physical make-up of the soil (Sangatan and Sangatan, 2005). Seaweeds are among the world's most valuable marine resources and are utilized as a raw material in numerous industries as well as food for humans and animals. Research indicates that seaweed extract can boost soil nutrient uptake and provide resistance against fungal, insect, and frost attack. Applying seaweed fertilizer can help increase production because it contains hormones that promote growth, such as gibberellins and auxin. (Sridhar and Rengasamy, 2010).

Seaweed extracts have proven in giving positive results in plants. In the horticultural industry, seaweed extracts are undoubtedly now widely accepted. Some improvements that have been made to fruit, vegetable, and flower crops include increased yields, improved seed germination, increased resistance to certain pests, and increased uptake of soil nutrients. (FAO, 2013).

According to Sridhar and Rengasamy (2011), as cited by Cayat (2014), that seaweeds include significant concentrations of gibberellins, cytokinin, and plant growth regulator.

According to Kourik (2013), as cited by Natan (2014), that small amounts of potassium, phosphorus, and nitrogen can be found in seaweeds. Seaweeds have up to 1.2 percent nitrogen, 0.2 to 1.3 percent phosphorus, and 2.8 to 10 percent potassium on a dry weight basis. The 100% benefits of organic fertilizer sargassum seaweed, as stated by Quingdao (2011), as cited by Calcaligong (2014), can give effective plant recovery from stresses, enhance crop resistance to diseases and promote the plant photosynthesis increase yields and benefit formation of protein and plant cells.

## Time of Sargassum Tea Application on the Growth and Yield of Garlic

Horizon (2003) reported that applying liquid seaweed extracts will boost crop yields, make plants more resistant to frost, improve their uptake of inorganic soil constituents, increase their resilience to stress, and decrease fruit storage losses. On fruit, flowers, vegetables, and lawns, it also encourages rapid growth and aids in the prevention of pests and diseases.

Gibberellic acids are naturally occurring plant hormones. Gibberellic acids are used as plant regulators to promote cell elongation and division, which impacts leaves and stems and ultimately impacts fruit development and fruit set. (<http://www.epa.gov/oppsrrd1/REDS/factsheets/4110fact.pdf>).

### Objectives

This study was conducted to find out the best time of applying *sargassum* tea on the growth and yield of garlic.

### Time and Place of the Study

The study was conducted from October 17, 2014 to February 13, 2015 at the experimental area of the Don Mariano Marcos Memorial State University, North La Union Campus, Sapilang, Bacnotan, La Union.

### DEFINITION OF TERMS

**Bulb** is a short thickened underground modified leaves with fleshy scale-like leaves that is filled with reserved foods.

**Bulblet** refers to the numerous small bulbs of garlic which are harvested for human consumption and are used for planting materials.

**Bureau of Soil Recommendation (BSR)** refers to the amount of commercial fertilizer needed by the crop.

**Clove** is one section of the bulb of garlic used as planting material.

**DAP** refers to the days after planting.

**Foliar spraying** refers to the process used in applying *sargassum* tea on leaf surfaces of garlic.

**Inorganic fertilizer** refers to the chemical fertilizer applied to garlic.

**Organic farming** means raising of crops without applying synthetic chemicals like fertilizers and pesticides. Refers to the *sargassum* tea and vermicompost used in the experiment.

**Sargassum tea** refers to the solution from seaweed soaked in fresh water and applied to garlic.

**Yield** refers to the weight of garlic bulbs produced in kilograms per hectare.

### METHODOLOGY

#### Research Design

**Site selection.** A well-drained area of approximately 171 square meters, more or less flat and formerly planted with black, red and white beans and located at the Citrus Project of the DMMMSU-NLUC Bacnotan, La Union was selected as experimental site.

**Land Preparation.** The area was prepared thoroughly by two times passing of a rotovator. Prior to rotovating, the area was cleared of farm wastes, weeds and stubbles. Raising of beds into 20 cm and furrows were prepared at a distance of 20 cm manually employing shovel, spade and garden fork as the need arose.

**Lay out.** The area was laid out following the Randomized Complete Block Design (RCBD) in four blocks. Each block was subdivided into four equal plots where the different treatments were randomly allocated. Each plot had a dimension of 2.0 m x 4.0 m. The distance of planting was 10cm between hills and 20 cm between rows. An alley of 50 cm between blocks and plots were provided for convenience in carrying other field and experimental operations like weeding, spraying of *sargassum* tea, gibberellic acid application, fertilization and data gathering.

The different treatments used in the experiment were as follows:

T<sub>1</sub>- Gibberellic acid application 30 DAP only

T<sub>2</sub>- *Sargassum* tea application 30 DAP

T<sub>3</sub>- *Sargassum* tea application 60 DAP

T<sub>4</sub>- *Sargassum* tea application 80 DAP

### MATERIALS AND PROCEDURES

**Procurement and Collection.** Ten kilogram of seed pieces were procured at the Bacnotan Public Market and cloves were separated. Sixty kilogram of seaweeds were collected at Pandan, Bacnotan, La Union. The gibberellic acid (GA<sub>3</sub> 10%) was procured at the Agro Service and Sales City of San Fernando, La Union. Twelve sacks of vermicompost were taken at Baroro, Bacnotan La Union and at DMMMSU-NLUC Piggery Project while rice straw was collected at Sapilang, Bacnotan La Union.



## Time of Sargassum Tea Application on the Growth and Yield of Garlic

**Application of Vermicompost.** Vermicompost had been reported that vermicompost application can provide a high nutritive fertilizing value and a growth promoter over the conventional compost and thus, improving the fertility of the soil. Broadcasting of vermicompost on furrows was done before planting at the rate of 50 kilogram per plot or five kilograms per row.

**Planting Material Preparation.** The planting materials were prepared by separating the cloves from one another and each tip of clove was cut using sharp knife and blades. This was done to facilitate the sprouting of the cloves.

**Planting.** Planting of garlic was done in the morning following the distance of 10 cm between rows and 20 cm between furrows. Cloves were dibbled and pushed into hole with the growing point upward and covered with a thin layer of the soil.

**Mulching.** Mulching is a process of applying farm waste like rice straw at a thickness of three cm which prevented the growth of weeds, conserved moisture and maintained the cleanliness and orderliness of the experimental area.

**Irrigation / Watering.** Water is an important factor in crop production. It is an indispensable material in the maintenance of plant's body temperature, act as nutrient carrier, maintenance of cell turgor and act as medium of all biological processes. Besides, water is needed in making the soil nutrients available for root absorption. Watering was done after planting which facilitated the early establishment of the planting materials and was repeated every after three days until it reaches 85 days after planting using garden hose.

**Weeding.** Weeds are plants growing in places where they are not wanted. They compete with the focal crops in terms of nutrients, water, light, carbon dioxide and space. They act as alternate hosts of some important pests. The growth of weeds in the experimental area was managed by hand pulling. It was done when the weeds were still small because large weeds when pulled can disturb the roots of garlic causing stress.

**Soil Analysis.** A kilogram of composite soil sample was taken from the experimental area prior to land preparation and later submitted to the Soil Laboratory in the City of San Fernando, La Union for standard soil analysis. Collection of the soil sample was done by taking at random following the standard sampling procedures using a shovel and bolo. It was done by making a V-cut from each soil hole. The soil sample was air-dried for seven days prior to submission.

**Fertilizer Application.** Most of the crop areas are deficient of some nutrients essential for plant growth. Hence, the need to add plant nutrients is of utmost necessity in order to produce necessary soil factors required for normal plant growth and development. In the present study, fertilizer application was done at 30 days and 45 days after planting. An amount of 330.4 grams per plot of urea was dissolved in 64 liters of water divided into two equal volume and sprayed directly to the leaves.

**Sargassum Tea Preparation** Seaweeds can cause effective plant recovery from stresses, enhance crop resistance to diseases and promote the plant photosynthesis increase yields and enhance formation of protein and plant cells (Quingdao, 2011). Seaweeds were washed with sea water to remove sand and some materials. They were washed further with fresh water to remove the excess salt and air dried for seven days. Thirty kilograms of dried seaweeds were soaked in a drum with 200 liters of fresh water. Then, they were stirred every after two days for 30 days.

**Sargassum Tea Application.** Two tablespoonfulls of *sargassum* tea were filtered with cloth before mixing in sixteen liters of water. Application of *sargassum* tea was done following the specified treatments until the leaves dripped with the solution.

**Gibberellic Acid Application.** Application of gibberellic acid was done to promote plant growth and development and to increase bulb yield (Castaneda, 2009). Tablet of gibberellic acid was dissolved in 50 ml of water before mixing in 16 liters of water. Application of gibberellic acid was done late in the afternoon.

**Harvesting and Drying.** Harvesting was done when the tops were dried and began to fall over after 110 days. It was done by hand pulling. Sun drying of harvested bulbs was done by hanging them for five days.

## DATA GATHERED

The different crop characteristics that were measured and recorded were as follows:

**Number of leaves.** This was taken by counting the numbers of leaves of the 10 sample plants per plot at 15 DAP, 30 DAP, 60 DAP and 90 DAP.

**Plant height (cm).** This was taken at 15 DAP, 30 DAP, 60 DAP and 90 DAP by measuring the height at the base to the top of the tallest leaf.

**Bulb diameter (cm).** This was taken by measuring the diameter of bulbs using vernier caliper.

**Weight of bulbs.** This was determined by measuring the weight of bulbs in kilograms per plot and converted

## Time of Sargassum Tea Application on the Growth and Yield of Garlic

**Number of cloves per bulb.** This was determined by counting the number of cloves produced per bulb.

### ANALYSIS OF DATA

The data gathered were analyzed using the Analysis of Variance (ANOVA) in RCBD. The differences between and among treatment means were subjected to DMRT (Duncan's Multiple Range Test).

### RESULTS AND DISCUSSION

#### Mean Height of Garlic

The mean plant height of garlic at 15, 30, 60, and 90 days after planting is presented in Table 1. As can be noted, at 15 DAP, plant height ranged from 25.68 cm (T<sub>4</sub> – *sargassum* tea at 80 DAP) to 31.20 cm (T<sub>2</sub> - *sargassum* tea at 30 DAP). At 30 DAP, the mean height ranged from 41.58 cm (T<sub>3</sub> - *sargassum* tea at 30 DAP) to 43.63 cm (T<sub>1</sub> - Gibberellic acid). At 60 DAP and 90 DAP, the mean plant height ranged from 48.88 cm to 49.38 and 51.55 cm to 51.78 cm respectively.

**Table 1. Mean height (cm) of garlic as affected by the time of *sargassum* tea application**

Treatment	Mean			
	15 DAP	30 DAP	60 DAP	90 DAP
T <sub>1</sub> - Gibberellic acid 30 DAP	27.69	43.63	49.38	51.78
T <sub>2</sub> - <i>Sargassum</i> tea application 30 DAP	31.20	42.83	48.88	51.55
T <sub>3</sub> - <i>Sargassum</i> tea application 60 DAP	26.39	41.58	49.10	51.70
T <sub>4</sub> - <i>Sargassum</i> tea application 80 DAP	25.68	43.10	49.30	51.57

Analysis of variance (Appendix Tables 1a, 3a, 5a and 7a) disclosed no significant differences. Results imply that the mean height of plants were not significantly influenced by the different time of *sargassum* tea application, indicating that *sargassum* tea does not significantly influence the height of garlic applied at 30,60 and 80 DAP.

#### Mean Number of Leaves of Garlic

The mean number of leaves of garlic at 15, 30, 60, and 90 days after planting as affected by *sargassum* tea application is shown in Table 2.

**Table 2. Mean number of leaves of garlic as affected by the time of *sargassum* tea application**

Treatment	Mean			
	15 DAP	30 DAP	60 DAP	90 DAP
T <sub>1</sub> - Gibberellic acid	4.13	7.05	9.23	13.13
T <sub>2</sub> - <i>Sargassum</i> tea application 30 DAP	3.73	6.85	9.33	12.90
T <sub>3</sub> - <i>Sargassum</i> tea application 60 DAP	3.92	7.15	9.50	13.13
T <sub>4</sub> - <i>Sargassum</i> tea application 80 DAP	3.85	7.18	9.18	13.03

At 15 days after planting, the mean number of leaves of garlic ranged from 3.73 (T<sub>2</sub>) to 4.13 (T<sub>1</sub>), 30 DAP from 6.85 (T<sub>2</sub>) to 7.18 (T<sub>4</sub>) leaves, 60 DAP ranged from 9.18 (T<sub>4</sub>) to 9.50 (T<sub>3</sub>) and 90 DAP from 12.90 (T<sub>2</sub>) to 13.13. (T<sub>1</sub> and T<sub>3</sub>), respectively. Analysis of variance (Appendix Tables 2a, 4a, 6a, 8a) disclosed insignificant results. The results showed that the mean number of leaves of garlic follows the trend of results in the plant height. Hence, the same reason is applicable.

**Mean Bulb Diameter of Garlic (cm)** the influence of *sargassum* tea application on mean garlic bulb diameter is shown in Table 3. Harvested bulb from plants applied with *sargassum* tea at 80 DAP produced the biggest (2.37 cm) while those applied with gibberellic acid only had recorded the smallest (1.87 cm).

## Time of Sargassum Tea Application on the Growth and Yield of Garlic

**Table 3. Mean bulb diameter of garlic (cm) as affected by the time of *sargassum* tea application**

Treatment	Mean
T <sub>1</sub> - Gibberellic acid application 30 DAP	1.87 <sub>b</sub>
T <sub>2</sub> - <i>Sargassum</i> tea application 30 DAP	2.29 <sub>a</sub>
T <sub>3</sub> - <i>Sargassum</i> tea application 60 DAP	2.32 <sub>a</sub>
T <sub>4</sub> - <i>Sargassum</i> tea application 80 DAP	2.37 <sub>a</sub>

\*\*All means followed by the same letter are not significantly different at 0.01 level (DMRT).

Analysis of variance (Appendix Table 9a) showed highly significant results. Comparison of means employing the DMRT revealed that all garlic plants applied with *sargassum* tea have comparable bulb diameter and all were significantly bigger than those applied with gibberellic acid only. The results imply that bulbing of garlic plants are *sargassum* tea responsive. *Seaweed* extract has been shown to induce resistance to frost, fungal, and insect attack and increases nutrients uptake from soil. Seaweed fertilizer application is useful in achieving higher production because it contains growth-promoting hormones like auxin and gibberellins (Sridhar and Rengasamy, 2010).

### Mean Weight of Bulb of Garlic

Table 4 shows the mean weight of bulbs of garlic as affected by *sargassum* tea application. Bulbs of garlic applied with *sargassum* tea 60 DAP recorded the heaviest (12.19 g/bulb) or equivalent to 1523.44 kg/ha, while those applied with gibberellic acid had the lightest (6.43 g/bulb) or 804.06 kg/ha.

**Table 4. Mean weight of bulb of garlic in as affected by the time of *sargassum* tea application**

Treatment	Mean		
	g/bulb	g/plot	Kg/ha
T <sub>1</sub> - Gibberellic acid application 30 DAP	6.43 <sub>d</sub>	643.25 <sub>d</sub>	804.06 <sub>d</sub>
T <sub>2</sub> - <i>Sargassum</i> tea application 30 DAP	8.35 <sub>c</sub>	834.75 <sub>c</sub>	1043.44 <sub>c</sub>
T <sub>3</sub> - <i>Sargassum</i> tea application 60 DAP	10.23 <sub>b</sub>	1022.55 <sub>b</sub>	1278.19 <sub>b</sub>
T <sub>4</sub> - <i>Sargassum</i> tea application 80 DAP	12.19 <sub>a</sub>	1218.75 <sub>a</sub>	1523.44 <sub>a</sub>

\*\*All means followed by the same letter are not significantly different at 0.01 level (DMRT).

Results of the analysis of variance (Appendix Tables 10a, 11a, and 12a) were found highly significant. Mean comparison revealed highly significant differences among and between treatment means. It can be inferred that when *sargassum* tea was applied early (30 DAP and 60 DAP), the bulbs produced were significantly smaller than those applied at 80 DAP. It has been observed that the early application of *sargassum* tea induced the garlic plants in producing bulbs earlier. Once the plants produced bulbs early, the amount of photosynthates that have to be used for furtherance of growth and development had been utilized in bulb formation. According to Mahadeen (2011), the availability of food reserves in large cloves can have a positive effect on crop establishment and increase plant height and leaf number. This was in agreement with results reported by Ahmed *et al.* (2007), Castellanos *et al.* (2004) and Stahlschmidt *et al.* (1997), that due to the availability of food reserves, the young cloves were able to grow and develop rapidly.

### Mean Number of Cloves of Garlic per Bulb

Table 5 shows the data on the mean number of cloves of garlic per bulb as affected by seaweed tea application. Garlic applied with *sargassum* at 80 DAP recorded the most number of cloves (12.98) while those garlic applied with *sargassum* at 60 DAP had the lowest number of cloves (8.58).

**Table 5. Mean number of cloves of garlic per bulb as affected by the time of *sargassum* tea application**

Treatment	Mean
T <sub>1</sub> - Gibberellic acid application 30 DAP	11.42 <sub>b</sub>
T <sub>2</sub> - <i>Sargassum</i> tea application 30 DAP	10.80 <sub>b</sub>

## Time of Sargassum Tea Application on the Growth and Yield of Garlic

T <sub>3</sub> - <i>Sargassum</i> tea application 60 DAP	8.58 <sub>c</sub>
T <sub>4</sub> - <i>Sargassum</i> tea application 80 DAP	12.98 <sub>a</sub>

\*\*All means followed by the same letter are not significantly different at 0.01 level (DMRT).

Analysis of variance revealed highly significant result (Appendix Table 11a). Comparison of means employing the DMRT disclosed that garlic applied with *sargassum* tea 80 DAP recorded significantly (0.01 level) the most number of cloves when compared to other garlic in other treatments. Garlic in T<sub>1</sub> (Gibberellic acid) and T<sub>2</sub> (*sargassum* tea applied at 30 DAP) produced comparable numbers of cloves and significantly more than those in T<sub>3</sub> (*sargassum* tea applied at 60 DAP). The results indicate that application of *sargassum* tea at 80 DAP (T<sub>4</sub>) induced the plants to have longer vegetative growth. Hence, bigger bulbs with more cloves had been recorded. The results are in parallel with the statement of Knott and Deanon (1967) that the size of bulb formation is determined by the leaf area which can supply the necessary carbohydrates. It is possible that as the critical day length for bulbing is reached a hormone may be produced in sufficient quantity to inhibit the formation of leaf blades. These bladeless sheaths as well as the sheaths of bladed leaves formed earlier increase in thickness thus forming the bulb.

## SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

### Summary

The time of applying *sargassum* tea on garlic was studied from October 17, 2014 to February 13, 2015 to find out the best time of applying *sargassum* tea on the growth and yield of garlic as well as on the economics of producing garlic. The different treatments were: T<sub>1</sub>- Gibberellic acid 30 DAP, T<sub>2</sub>-*Sargassum* tea 30 DAP, T<sub>3</sub>- *Sargassum* tea 60 DAP, T<sub>4</sub>- *Sargassum* tea 80 DAP.

Based on the result of the study, analysis of variance disclosed no significant differences on the mean plant height of garlic as affected by *sargassum* tea application.

Plants subjected to different treatments showed no significant differences on the mean number of leaves of garlic as affected by *sargassum* tea application.

However, on the mean bulb diameter of garlic, analysis of variance showed highly significant results.

On the mean weight of bulb of garlic, analysis of variance showed highly significant results.

On the mean number of cloves per bulb of garlic, analysis of variance revealed highly significant results.

### CONCLUSIONS

Results of the study disclosed that the number of leaves at 15 DAP, 30 DAP, 60 DAP and 90 DAP including plant height at 15 DAP, 30 DAP, 60 DAP and 90 DAP were not significantly influenced by the different times of application of *sargassum* tea. However, highly significant results were noted on the weight of bulb, bulb diameter and number of cloves per bulb. Further *sargassum* tea applied at 80 DAP resulted to higher yield than those plants subjected to other treatments.

### RECOMMENDATIONS

The application of *sargassum* tea at 80 DAP is recommended for garlic. It is further recommended that studies on the aspects of frequency of application and different concentrations of *sargassum* tea applications be conducted.

### REFERENCES

- 1) AHMED, H.G, and M.D MAGAJI. 2007. Response of Garlic (*Allium sativum* L.) To Irrigation Interval and Clove Size in Semi-Arid, Nigeria. <http://scialert.net>. Accessed on February 22, 2015 at 9:00am
- 2) AITKEN, J.B. (1964). Seaweed Products as a Fertilizer and Soil Conditioner for Horticulture Crops. Department of Horticulture; Clemson College, South Carolina. P259
- 3) ARANCON, NORMAN, 2004. Influenced of Vermicompost on Soil Chemical and Physical Properties in Tomato Field. African Journal of Biotechnology, Vol.7 pp 2377-2401.
- 4) BOJE, L. D. and Y. B. ANGELES, 2013. Frequency of Spraying Vermitea to Mungbean (Var MRA 9711-10) Under DMMMSU Condition. Unpublished Undergraduate Thesis. DMMMSU-NLUC, Bacnotan La Union. 4p.
- 5) CALCALIGONG, C.D, and E. B. ABALOS. 2014. Foliar fertilizer as Supplement to Vermicompost on the Growth and Yield of Glutinous Corn (*Zea mays* L.) Unpublished Undergraduate Thesis, DMMMSU-NLUC, Bacnotan, La Union
- 6) CAYAT, L.B, and V.M. LIBUNAO, 2014. Influence of Vermicompost and Seaweeds tea on the Growth and Yield of Sweetcorn Intercropped with Cowpea. Unpublished Undergraduate Thesis, DMMMSU-NLUC, Bacnotan, La Union.

## Time of Sargassum Tea Application on the Growth and Yield of Garlic

- 7) DUCULAN, A.F. and E. B. ABALOS, 2013. Vermitea as Supplement to Vermicompost for Honey corn Intercropped with Mungbean. Unpublished Undergraduate Thesis. DMMMSU-NLUC Bacnotan, La Union
- 8) DUGENO, M. 2005. Vermicomposting the Buro-buro experience, Agriculture Magazine, Vol.IX No.1, pp 8-13. January 2005.
- 9) DEPARTMENT OF AGRICULTURE. Garlic commodity profile (Region 1). Pgs. 1-6
- 10) GOJAR, J, C. and L. A. ANCHETA. 2014 Rates of Vermicompost Application of Mungbean (*Vigna radiate* L.) Unpublished Undergraduate Thesis DMMMSU-NLUC, Bacnotan, La Union
- 11) GUMAPAC, M, M. 2011. Garlic: Expanding what we know and what we should. <http://www.bar.gov.ph/chronicle-home/archives-list/62-september-2011-issue/201-garlic-expanding-what-we-know-and-what-we-should>. Accessed on February 22, 2015 at 9:00am
- 12) HORIZON, M. 2003. What are the Benefits of Using Liquid Seaweed Fertilizer? <http://mistyhorizon2003.hubpages.com/hub/The-Benefits-of-Using-Liquid-Seaweed-Fertilizer>. Accessed on February 22, 2015 at 9:00am
- 13) MAHADEEN, A. 2011. Influence of Clove Weight on Vegetative Growth and Yield of Garlic (*Allium sativum*) Grown under Drip Irrigation. <http://journals.ju.edu.jo/JJAS/article/viewFile/2282/2185>. Accessed on February 22, 2015 at 9:00am
- 14) NATAN, C.P, and V.M LIBUNAO. 2014. Seaweed Liquid Fertilizer with Vermicast Tea on the Growth and Yield of Yellow Corn Intercropped with Red Beans. Unpublished Undergraduate Thesis DMMMSU-NLUC, Bacnotan, La Union
- 15) SANGATAN, P, D. and R.L, SANGATA, 2005. Production Guide to Organic Gardening. Technologies and Livelihood Series. Wisemans Books Trading Quezon City.
- 16) SHAHIDUR, R.M. and M.A, ISLAM. 2004. Effects of Planting Date and Gibberellic Acid on the Growth and Yield of Garlic. <http://198.170.104.138/ajps>. Accessed on February 22, 2015 at 9:00am
- 17) SRIDHAR S. and R. RENGASAMY. 2011. Influence of Seaweed Liquid Fertilizer on Growth and Biochemical Characteristics of *Arachis Hypogea* L. Under Field Trial. Dept. of Botany, Govt. Arts College, University of Madras Tamil Nadu, India. <http://journalecobiotechnology.com/article/viewPDFInterstitial/10225/.5950>. Accessed on February 24, 2015 at 8:30am
- 18) SRIDHAR S. and R. RENGASAMY. 2010. Studies on the Effect of Seaweed Liquid fertilizer on the flowering plant *tagateserecta* in the field Trial, <http://www.soeagra.com/abr/vol2/5.pdf>. Accessed on august 10, 2014.
- 19) SUSTAINABLE AGRICULTURE TECHNOLOGIES. 2012. (<http://www.wormwigmaw.com/vermicompost-organic-fertilizer/>) Accessed on August 10, 2014.
- 20) VILLANUEVA, O.D, and E.M. PERA. 2011. Kind of Manure Tea for Tomato (var. Diamante) Production under DMMMSU Condition. Unpublished Undergraduate Thesis DMMMSU-NLUC, Bacnotan, La Union



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Health Problems and Nutritional Status among Children Under-Five Years in Diocese of Agats: A Cross-Sectional Study



Fransisca B. Batticaca<sup>1</sup>, Eva Sinaga<sup>2</sup>

<sup>1,2</sup>Nursing Department, Faculty of Medicine, Cenderawasih University

**ABSTRACT:** From September to February 2018, the number of measles and under-nutrition cases among children under five years in Agats reached a peak of 651 cases and 223 cases, respectively. It was reported that measles and undernutrition were responsible for 91% of child mortality in Agats. This study aimed to identify the correlation between health problems with nutritional status among children under five in the Diocese of Agats, Asmat. A descriptive quantitative with a cross-sectional approach was conducted from May to September 2018 among 39 mothers and 53 children. Data were collected by using an attendance list that consisted of mother and child characteristics, nutritional status was measured by using steelyard balance and microtoise, and the results would subsequently be converted to the standardized anthropometry: Weight for Age Z-score (WAZ) and Weight for Height Z-Score (WHZ). Results revealed that child health problems were cough and influenza (28%), febrile (1,9%), and itches (3,8%) while the nutritional status categorized normal (43.3%), underweight (33.1%), and waste (23.3%). Chi-Square test found that there was a significant correlation between health problems and nutritional status of children under-five ( $p$ -value: 0,035; CI 95% = 0,68 – 0,79). It is concluded that health problems are associated with nutritional status among children under five. It is recommended that regular health promotion to improve mothers' knowledge should be conducted by healthcare workers, volunteers, teachers, stakeholders, and the local government of Asmat Regency.

**KEYWORDS:** Health problem, nutritional status, children under five

### I. INTRODUCTION

The Diocese of Agats is a part of the Metropolitan Archdiocese of Merauke that was established in May 1969. It is located in Agats, Asmat Regency, South Papua, Indonesia with a total area of 37.00 km<sup>2</sup> and consists of 12 parishes (Keuskupan Agats-Asmat, 2020a). Asmat regency consists of 23 districts, 224 villages/sub-districts, and 17 public health centers (Widiantoro, 2018, January 17). The vision of Agats Diocese is to be a fraternal communion of the People of God who are mature in the faith, using the local cultural pattern "Jeu and Wair" which is illuminated and inspired by the values of the gospel in realizing salvation. To achieve this vision, the Diocese of Agats has stated its missions, including developing participatory pastoral work based on the concrete situation and values of society, developing inculturation in all life aspects of the Agats diocese church, empowering local communities to be able to fight for economic interests, education, solidarity, and equality at the family level as well as at cross-villages level, and fighting for changes in public policies in the interests of the community, collaborating with the community. The strategy to reach the vision and missions is by empowering pastoral to develop communities to be participative and transformational community (Keuskupan Agats-Asmat, 2020b).

Empowering or empowerment is a community nursing activity that actively involves the community to solve problems and make decisions at the individual, family, and community levels by changing social disparities (Anderson & McFarlane, 2015; Nies & McEwen, 2014). The vision and mission of the Agats diocese are in accordance with the Healthy Indonesia Program (Indonesia Sehat Program), which is to increase the health and nutritional status of the community through health strategies and community empowerment supported by financial protection and equity in health services. One of the targets of the Papua Medium-term Development Plan 2019/2023 (Rencana Pembangunan Jangka Menengah) is to improve maternal and child health and nutrition (Pemerintah Provinsi Papua, 2019). However, this goal has not been fully achieved. This is shown by the outbreak of measles and malnutrition which caused the death of children in Asmat District.

Studies found that there is a significant correlation between malnutrition and measles (Tran et al., 2023). The Task Force Team of the Indonesian National Army reported that from the beginning of September 2017 to February 2, 2018, there were 651 cases of measles and 223 people with malnutrition, 11 people with measles with complications of malnutrition; 72 people died,

## Health Problems and Nutritional Status among Children Under-Five Years in Diocese of Agats: A Cross-Sectional Study

consisting of 66 measles and 6 malnutrition. Meanwhile, in the Jetsy District, there were 16 cases of measles and malnutrition (Sianipar, 2018, March 12).

The contributing factors of nutrition problems and measles in Asmat Regency were due to various factors, including lack of knowledge, lack of access to health services, difficult terrain, and limited health workers, such as doctors, nurses, nutritionists, and sanitarians. The other factors include infrastructure, hygiene facilities, such as toilets and clean water; economy, education, behavior, swampy soil structures, housing areas, climate changes, limited agricultural land, limited transportation with expensive fuel costs, and limited stock and supply of food for the population.

According to Marilyn, Friedman & Vicky (2019), the role of the family in meeting the nutritional adequacy of toddlers may include helping each family member meet the regular basic needs to consume nutritious food 3 times a day, including exclusive breastfeeding up to 6 months, complementary foods (MP-ASI) starting from 6 months old, and continue breastfeeding until the age of more than 24 months. Various interventions have been carried out to address the issues of nutrition and measles in Agats, such as health services (care and treatment, immunization, provision of supplementary food, provision of latrines, construction of fish-holding ponds) through cross-sectoral and cross-program collaboration between the Indonesian Ministry of Health, the Indonesian National Armed Forces, Police, and other parties. Meanwhile, the strategies adopted by the Ministry of Health to overcome malnutrition in Agats include treatment of critical cases, health service collaboration with the armed forces personnel, police, and other parties, sending medical personnel, logistics, and medicines; rehabilitation of malnutrition patients; case finding in 23 districts. From a total of 12,398 children in Asmat who received health services, it was found that 646 measles and 144 malnutrition, 25 suspected measles, 4 complications of measles and malnutrition (Kemenkes RI, 2018 as cited in Leba, 2018, January 29). The government has also provided a water pond with a capacity of more than 1000 tons, boreholes, and water pipes, and plans to build a bridge and repair damaged wooden bridges (Widiantoro, 2018, February 2). Various interventions still need to be carried out to increase community knowledge, including family empowerment in managing toddler nutrition.

Toddlers are a risk group that is prone to nutritional problems due to their immature immune systems. Therefore, under-treatment may lead to a higher risk of suffering from diseases, such as malnutrition (Gwela et al., 2019). A nutritional-focused health empowerment is expected to improve family knowledge and skills in managing toddler nutrition which might eventually prevent the impacts of malnutrition in the future. The roles of community health nurses in managing toddler nutrition include advisor, educator, and facilitator (Lundy & Janes, 2009 as cited in Batticaca & Kristina, 2017). As a patient advisor, the role includes providing support through health care services for patients; as an educator, the nurse provides education about breastfeeding and supplementary food, balanced nutrition, etc; as a facilitator, the nurse facilitates vulnerable groups on the need of nutritional aspect and initiates positive changes through special programs, such as health promotion about toddler nutrition (Allender et al., 2013; Edelman & Kudzma, 2021). This study aimed to identify the correlation between health problems and nutritional status of children under five in Diocese Agats.

## II. METHOD

A descriptive quantitative with a cross-sectional approach was used to identify characteristics and knowledge of mothers, characteristics, and nutritional status of children. The sample of the study was children under five whose mothers enrolled in the community empowering program, training for mothers to make supplementary food made from pinfish in the Parish Warse District Jetsy area of the Diocese of Agats. The research was conducted from May to September 2018. To protect participants' human rights, the study was approved by the leader Diocese of Agats, the Leader of Parish Warse, the Leader of District Jetsy, the Leader of Warse Village, and all respondents. The respondents were given an information sheet explaining the study's purpose, procedure, and benefits. The samples of this study also confirmed their consent by signing an informed consent. The children who were identified as having health problems were referred to a community health center (Kemenkes RI, 2016). The research instrument on nutritional status was an instrument developed by the Ministry of Health Department Indonesia. The nutritional status was assessed by using anthropometry measurements, including a micro toise to measure height and a body scale to measure body weight. The collected data were analyzed statistically by using the SPSS program. The Chi-square test was used to analyze the correlation between the nutritional status and mother and child characteristics.

# Health Problems and Nutritional Status among Children Under-Five Years in Diocese of Agats: A Cross-Sectional Study

## III. RESULTS

### A. Maternal Characteristics

**Table 1. Maternal characteristics (n=39)**

Category	n	%
Residential location		
Warse	3	7,7
Akamar	7	17,9
Birak	29	74,4
Mother's knowledge about artificial breastfeeding		
Very poor	2	5,1
Poor	19	48,7
Good	16	41
Excellent	2	5,1

Table 1 shows the characteristics of mothers, including address and level of knowledge about breast milk complementary food. The majority of respondents lived in Birak Village (74,4%), followed by Akamar Village (17,9%) and the lowest percentage lived in Warse (7,7%). Just under 50% of the respondents had poor knowledge about complementary food for breast milk while both the lowest and highest categories were at a similar proportion, very poor (5,1%) and excellent (5.1%), respectively.

### B. Child characteristics

**Table 2. Child Characteristics (n=53)**

Category	n	%
Age (months)		
1 - 12	25	47.2
12 - 24	10	18.9
24 - 36	9	17
36 - 48	6	11.3
48 - 59	3	5.7
Gender		
Male	24	45.3
Female	29	54.7
Regency		
Warse	4	7.5
Akamar	6	11.3
Birak	43	81.1

Several specific characteristics of children are presented in Table 2. Almost half of the total children aged 1 to 12 months (47.2%), followed by children aged 12-24 months (18.9%), children aged 24-36 months (17%), children aged 36-48 months (11.3%) and children aged 48-59 months with the least proportion of 5.7%. Just above 50% of the children were female (54.7%) and the majority of the children lived in Birak (81.1)%.

### C. Child Health Problems

**Table 3. Child health problems (n=53)**

Category	n	%
No health problems	35	66
Cough and Influenza	15	28.3
Febrile	1	1.9
Itches	2	3.8

Table 3 describes health issues that were suffered by the children. Most of the children had no health problems (66%) while identified health problems were cough and influenza (28.3%), itches (3.8%), and febrile (1,9%).



# Health Problems and Nutritional Status among Children Under-Five Years in Diocese of Agats: A Cross-Sectional Study

## D. Child Nutritional Status

**Table 4. Child Nutritional Status (n=53)**

Category (BW/A)	n	%
Waste	7	13.2
Underweight	4	7.5
Normal	42	79.2

Table 4 presents the category of child nutrition. Most of the children were categorized as normal (79.2%), underweight waste (13.2%), and underweight (7.5%).

**Table 5. Child Nutritional Status according to Age (n=53)**

Age (months)	Nutritional Status						Total		X2 test	p-value	CI 95%	
	Waste		Underweight		Normal		n	%			0.562	0.581
	n	%	n	%	n	%						
0-12	3	42.9	2	50	20	47.6	25	100	0.763	0.564	0.562	0.581
12-24	0	0	1	10	9	21.4	10	100				
24-36	2	28.6	0	0	7	16.7	9	100				
36-48	2	28.6	1	16.7	3	50	6	100				
48-59	0	0	0	0	3	100	3	100				

Table 5 illustrates the nutritional status of children according to age and its association. By comparison, the group of children between the age of 48-59 had the least nutritional problem with the normal category (100%), followed by children aged 12-24 with the category of normal (21.4%), underweight (10%) and waste (0%). Meanwhile, most of the children aged 0-2 months had nutritional status in the normal category (47.6%), underweight (50%), and waste (42.9%). Children aged 24-36 had normal status (16.7%), waste (28.6%), and underweight (0%). Children aged 36 to 48 were in the normal category (50%), underweight (16.7%), and waste (28.6%). The chi-square test found there was no correlation between child nutritional status and age ( $X^2=10.763$ ,  $p$ -value = 0.564; CI 95% = 0.562-0.581).

**Table 6. Child Nutritional Status according to Gender (n=53)**

Gender	Nutritional Status						Total		X2test	p-value	CI 95%	
	Waste		Underweight		Normal		n	%			0.150	0.165
	n	%	n	%	n	%						
Male	5	28.8	3	12.5	16	66.7	24	100	4.23	0.120	0.150	0.165
Female	2	6.9	1	3.4	26	89.7	29	100				

Table 6 describes the frequency and association between nutritional status and gender of children. The group of children with nutritional problems was male with the category of waste (28%) and underweight (12.5%). While female children dominated by the category of normal (89.7%), underweight and waste accounted for 3.4% and 6.9%, respectively. The chi-square test found child nutritional status had no association with gender ( $X^2 = 4.35$ ,  $p$ -value = 0.120; CI 95% = 0.150-0.165).

**Table 7. Child Nutritional Status according to Address (n=53)**

Area	Nutritional Status						Total	
	Waste		Underweight		Normal		n	%
	n	%	n	%	n	%		
Warse	0	0	0	0	4	100	4	100
Akamar	0	0	0	0	6	100	6	100
Birak	7	16.3	4	9.3	32	74.4	43	100

Table 7 shows the cross-tabulation of address and nutritional status of children. By comparison, the majority of children who lived in Birak Village had normal nutritional status (74.4%), underweight (9.3%), waste (16.3%). Meanwhile, there was no children with nutritional problem in both Warse and Akamar Village (100%).

# Health Problems and Nutritional Status among Children Under-Five Years in Diocese of Agats: A Cross-Sectional Study

**Table 8. Health problems and Nutritional Status (n=53)**

Health problems	Nutritional status						Total		Uji X2	p-value	CI 95%	
	Waste		Underweight		Normal		n	%				
	n	%	n	%	n	%						
No problem	3	8.6	2	5.7	30	85.7	35	100	5,078	*0.035	0.68	0.79
Cough and Influenza	3	20	2	13.3	10	66.7	15	100				
Febrile	0	0	0	0	1	100	1	100				
Itches	1	50	0	0	1	50	2	100				

Table 8 presents the correlation between health problems and nutritional status. Children with no health problems had nutritional status in the normal range (85.7%), underweight (5.7%), and waste (8.6%). Children with cough and influenza were in the normal category (66.7%), underweight (13.3%), and waste (20%). Children with febrile were completely in the normal range (100%). Children with itches were normal (50%), and waste (50%). The chi-square test found that there was a significant correlation between health problems and nutritional status (X2 test=5.078, p-value=0,035, CI 95%=0.68-0.75).

## IV. DISCUSSION

### Maternal Characteristics

The result of this study showed that almost all respondents lived in Birak Village (74,4%), while the other participants lived in Akamar Village (17,9%) and Warse (7,7%). The highest percentage of respondents were residents in Birak Village due to the location where the training was conducted. By comparison, New Warse Village and Akamar Village were located in a remote area, and the primary under-constructed bridge connected both villages to Birak Village. The poor access was exacerbated by the muddy land conditions in all villages.

Table 2 indicates that almost 50% of total respondents had poor knowledge about artificial breastfeeding. This might be related to their illiteracy and low educational background which only reached elementary school. Mothers with excellent (5.1%) and good knowledge (41%) were working as health volunteers who collaboratively worked with Wahana Visi Indonesia (WVI) and teachers in the area. Most of the mothers in this village could not identify their age, did not graduate from elementary school, and were early married from 12 to 14 years old. There were no senior high schools, if they would like to continue their study they should go to the central city or other cities. Women should work hard to meet their fundamental needs, such as fishing and hunting in the forest during low water while when water was high they did nothing and just stayed at home. It is difficult for them to do farming due to poor and muddy land conditions. The illiteracy and poor educational background of mothers, and the poor environment increased the risk of various diseases and under-nutrition (Obasohan et al., 2020).

### Child Characteristics

The majority of children are infants. Infants are a group that is at risk and vulnerable to health problems. Therefore, it is essential to focus on child care and service, particularly the nutritional aspect. Based on the preliminary interview with mothers, children were usually given additional food when they were still three months old. Among the foods given are roasted sago, boiled or fried fish, and vegetables. This might lead to a higher risk for digestive problems, and diarrhea that can be related to under-nutrition.

According to gender, approximately half of the total children were female. Female children are the next generation in the future who will give birth to children therefore their fundamental needs should be taken into account and prioritized. If they suffer from malnourished, they would give birth to children who would probably have similar problems. It eventually might have negative consequences, including the inability to complete education, vulnerability to infectious diseases, cardiovascular diseases, and metabolic disorders in the future (Siddiqui et al., 2020).

### Child Health Problems

The result of this study revealed that most of the children had no health problems (66%) while identified health problems were cough and influenza (28.3%), itches (3.8%), and febrile (1,9%). In 2021, health volunteers reported that most of the children under five who were active visited integrated service stations experienced ARTI, Malaria, and malnutrition. Furthermore, this study finding is also relevant to Basic Health Research (RISKESDAS) conducted by the Health Ministry of the Republic of Indonesia (Kemenkes RI, 2019) which showed that most children under five had Acute Respiratory Tract Infection (ARTI) (62.8%), Diarrhea (12.9%), Malaria (0.4%).

## Health Problems and Nutritional Status among Children Under-Five Years in Diocese of Agats: A Cross-Sectional Study

ARTI is an acute respiratory tract infection caused by bacteria or viruses. Based on anatomy, ARTI can be divided into two types, namely Acute Upper Tract Infection and Acute Lower Tract Infection with epiglottitis as the anatomy border (Maryunani, 2013). Risk factors of ARTI in Holtecamp Village consisted of inadequate and unclean house ventilation, poor environmental conditions, being surrounded by plants such as banana and palm fruits, household emission from wood smoke, insufficient water supply (most households used rainwater, river water, and pond water); poor sanitation (practice open defecation); negative health behaviors (consuming palm fruit, smoking in the house, playing on the ground barefoot, and poor hand hygiene). Febrile is a condition where body temperature increases more than 38°C. Febrile indicates any illness or other conditions in our body as the reaction of the immune system to protect from infectious agents, including viruses, bacteria, and parasites. Several illnesses cause Febrile, such as influenza, sore throat, urinary tract infection, and coronavirus-19 (Zandstra et al., 2021).

Diarrhea is the second leading cause of death in children under five years and it is responsible for 525.000 deaths of children each year. Diarrhea refers to a condition of having three or more loose or liquid stools per day (or more frequently than the normal frequency). Diarrhea may indicate the symptoms of an infection in the intestinal tract, which can be caused by a variety of bacterial, viral, and parasitic organisms. Infection is spread through contaminated food or drinking water, or from person-to-persons as a result of poor hygiene. Interventions to prevent diarrhea include safe drinking water, adequate sanitation, and good practice of hand hygiene (WHO, 2017). Malaria is an acute febrile illness with an incubation period of 7 days or longer. Malaria is caused by four protozoan parasites Plasmodium, including Plasmodium falciparum, Plasmodium malaria, Plasmodium ovale, and Plasmodium vivax. The malaria parasite is transmitted by female Anopheles mosquito (WHO, 2023). Risk factors of malaria in this area included unstandardized house building, poor environmental conditions and water drainage, and negative health behavior. Both Malaria and Diarrhea might be the high-risk diseases in this area according to the environmental and demographic factors. However, it was not found in the study, it might be related to the relatively small size of the sample.

### Child Nutritional Status

Table 5 shows that most of the children under five had nutritional status majority of children who lived in Birak Village had normal nutritional status (74.4%). However, children with malnutrition both underweight and waste, 9.3% and 16.3%, respectively. Meanwhile, there was no children with nutritional problem in both Warse and Akamar Village (100%). Based on the Health Ministry of the Republic of Indonesia (Kemenkes RI, 2018), the nutritional status of children under five was measured according to age, body weight, and height, which was presented in four indicators of anthropometry, including Weight for Age (W/A), Height for Age (H/A), Weight for height Z (H/A), and Body Mass Index for Age (W/H). Nutrition status evaluation is based on Z (relative deviation) to the mean of score from Z-Score can be determined by Standard Deviation (SD). The Cut of points for each nutritional status was  $\pm 2$  SD and nutritional status  $< -3$  SD was defined as severe undernutrition. Body weight and height are converted in the Z-Score table (Casadei & Kiel, 2022). Miller and Rodgers (2009) described how to measure the nutritional status of children by using three measurements of nutritional status for children under five, namely underweight, stunting, and wasting. Meanwhile, Puffer and Serrano (1973 as cited in Miller & Rodgers, 2009) stated that each indicator has an aspect that different for children under five growth and development. Underweight might be influenced by pregnancy period, genetics, nutrition, and maternal health during pregnancy (Sigdel et al., 2020). Stunting and wasting might be related to postnatal external factors, such as environmental factors, socioeconomic factors, and physical environment (Wali et al., 2021; Amadu et al., 2021).

Children with malnutrition were found in Birak Village. The determinant factors might include geographical factors which are swampy, muddy, and covered with tidal water. Additionally, economic difficulty might lead to limited access to the city due to costly transportation fees, and limited access to Public Health Centers due to a lack support of health workers who only had a monthly regular visit. Furthermore, the result of observation found that the majority of households lacked fruit and vegetable consumption due to swampy land conditions. Local people planted only several tropical vegetables and fruits, such as kale, banana, papaya, cassava, and chili in their backyard. The Secretary of the Village stated that people also planted some vegetables, including spinach, and long beans in the field, however, the location was far from their home residents. He also explained that environmental factors that might lead to a higher risk for health problems consisted of poor access (under-constructed bridge), and lack of clean water supply.

WHO (2021a) described that wasting is defined as a child who is too thin for his or her height. Wasting is the result of recent rapid weight loss or the failure to gain weight. A child who is moderately or severely wasted has an increased risk of death, however, it is treatable. In 2020, globally, approximately 45.4 million children under five were wasted of which 13.6 million were severely wasted. This is equivalent to a prevalence of 6.7% and 2.0%, respectively. In 2020, more than half of all children affected by wasting lived in South Asia and nearly one-quarter in sub-Saharan Africa, with similar proportions for children

## Health Problems and Nutritional Status among Children Under-Five Years in Diocese of Agats: A Cross-Sectional Study

affected by severe wasting. At 14.7%, South Asia's wasting prevalence represents a situation requiring a serious need for intervention with appropriate treatment programs (WHO, 2021a). Under-five wasting and severe wasting are highly sensitive to change. Thus, the estimation for these indicators is only reported for the latest year of 2020.

### Nutritional Status and Child Characteristics

The results showed that the majority of toddlers in the age range of 1-12 months had normal nutritional status. The normal category in this age group was related to the provision of breast milk as a source of balanced nutritious food. Breastfeeding is one of the most effective strategies to ensure a child's health and survival. Breast milk is the ideal food for infants that is safe, clean, and contains protective antibodies against various common childhood illnesses (Lyons et al., 2020). Breast milk provides all the energy and up to half of a child's nutrients that the infants need for the first month of life, and it continues to provide up to half or more of a child's nutritional needs during the second half of the first year, and up to one third during the second year of life (Lyons et al., 2020). Breastfed children had a higher result on intelligence tests, and had a lower risk of obesity and diabetes in the future. Women who breastfeed also had a lower risk of breast and ovarian cancers (WHO, 2021b). Therefore, improving nutritional status through providing adequate nutritional intake is needed for breastfeeding mothers, along with the provision of vitamin and mineral supplements. Adequate maternal nutritional status will have positive impacts on the child's nutritional status, particularly during the breastfeeding period.

### Nutritional Status and Health Problems

This study found that the majority of children with no health problems had nutritional status in the normal range (85.7%). Adequate nutrition is essential for either healthy child growth or optimal physical and mental development. This study revealed that children without any illnesses were underweight (5.7%), and waste (8.6%). This might be a result of other contributing factors, including child characteristics, parental/household-related factors, and community/environmental factors (Obasohan et al., 2020). Child characteristics may include age, sex, birth weight, and feeding practices. Parental/household-related factors might be poverty, low maternal education, inadequate food intake, insufficient availability of food, poor breastfeeding practices, and insufficient parental knowledge. Community/environmental factors include poor and unhygienic food preparation and storage practices, non-potable water, abnormal mealtimes, food taboos, and growth and personal choices related to diet (Obasohan et al., 2020; Ansuya et al., 2018). Furthermore, the result of this study showed that most of the children with cough and influenza were in normal nutritional status (66.7%), however, it was also found that children with cough and influenza were underweight (13.3%), and waste (20%). The chi-square test found that there was a significant correlation between health problems and nutritional status ( $X^2$  test=5.078, p-value=0.035, CI 95%=0.68-0.75). This study results are relevant to Ansuya et al. (2018) that found children with malnutrition had a 6.9 times higher risk of having recurrent colds and coughs. Another study showed that 54.5% of children under five with a history of infectious diseases suffered from undernutrition (Perdana et al., 2020). Malnutrition weakens the immune system, resulting in children more vulnerable to infectious diseases. Malnourished children have less nutritional reserves to grow properly and to fight off infections, which decreases their immune system function and increases the frequency and severity of infections (Pecora et al., 2020). Malnutrition also might lead to a delay in the recovery process, which can result in a potentially lethal cycle of exacerbating illness and deteriorating nutritional status (UNICEF, 2023).

## V. CONCLUSION

In conclusion, malnutrition cases, waste, were found in the Warse Jetsy Diocese of Agats. The major health problem was Acute Respiratory Tract Infection. This might be related to maternal factors, such as lack of knowledge and negative health behaviors; and environmental factors, including limited access to health services. There was a correlation between the nutritional status of children under five and health problems,  $X^2$  test 5,078, p-value 0,035 ( $\alpha < 0,05$ ); CI 95% (0,68-0,75). It is recommended that further studies need to identify a nursing care model to increase nutritional status in Paris Warse Jetsy Diocese of Agats. To prevent and decrease the risk of infectious diseases and malnutrition, it is important to conduct intersectoral collaboration among the health department, public and infrastructure department, agricultural department, social workers, Diocese of Agats, and educational institutions. Health workers should be committed to providing and improving health promotion and services for local people, particularly, children and women. The government should improve the infrastructure, especially roads and bridges to promote accessible health services. Social workers should conduct workshops for health volunteers and cadres about how to produce nutritional foods from natural and local resources. The agriculture department should conduct training for local people on rice cultivation or other staple foods to provide food security.

# Health Problems and Nutritional Status among Children Under-Five Years in Diocese of Agats: A Cross-Sectional Study

## ACKNOWLEDGMENT

The authors would like to thank the Rector and Dean of the Faculty of Medicine Cenderawasih University, the Leader of the Diocese of Agats, the Health Department of Agats, health volunteers, and respondents for supporting this study.

## REFERENCES

- 1) Allender, J., Rector, C., Rector, C., & Warner, K. (2013). *Community & public health nursing: Promoting the public's health*. Lippincott Williams & Wilkins.
- 2) Amadu, I., Seidu, A. A., Duku, E., Frimpong, J. B., Jnr, J. E. H., Aboagye, R. G., ... & Ahinkorah, B. O. (2021). Risk factors associated with the coexistence of stunting, underweight, and wasting in children under 5 from 31 sub-Saharan African countries. *BMJ open*, 11(12), e052267. <http://dx.doi.org/10.1136/bmjopen-2021-052267>
- 3) Anderson, E. T., & McFarlane, J. M. (2015). *Community as partner: Theory and practice in nursing*. Philadelphia, PA: Wolters Kluwer.
- 4) Ansuya, Nayak, B. S., Unnikrishnan, B., George, A., N, S. Y., Mundkur, S. C., & Guddattu, V. (2018). Risk factors for malnutrition among preschool children in rural Karnataka: a case-control study. *BMC Public Health*, 18, 1-8. <https://doi.org/10.1186/s12889-018-5124-3>
- 5) Batticaca, F.B., & Kristina, Y. (2017). *Praktek Profesi Keperawatan Komunitas Sebagai Model Pendidikan Dalam Pengembangan Kampung Sehat di Kampung Skouw Muara Tami Kota Jayapura* (Unpublished research). Universitas Cenderawasih, Jayapura
- 6) Casadei, K., & Kiel, J. (2022). *Anthropometric Measurement*. In: StatPearls. StatPearls Publishing, Treasure Island (FL). PMID: 30726000.
- 7) Edelman, C., & Kudzma, E. C. (2021). *Health promotion throughout the life span-e-book*. Elsevier Health Sciences.
- 8) Gwela, A., Mupere, E., Berkley, J. A., & Lancioni, C. (2019). Undernutrition, host immunity and vulnerability to infection among young children. *The Pediatric Infectious Disease Journal*, 38(8), e175. doi: 10.1097/INF.0000000000002363
- 9) Kemenkes RI. (2016). *Pedoman Umum Indonesia Sehat Dengan Pendekatan Keluarga*. Jakarta: Kementerian Kesehatan RI
- 10) Kemenkes RI. (2018). *Buku Saku Pemantauan Status Gizi Tahun 2017*. Jakarta: Direktorat Jenderal Kesehatan Masyarakat Kementerian Kesehatan RI
- 11) Kemenkes RI. (2019). *Laporan nasional riskesdas 2018*. Jakarta: Kemenkes RI
- 12) Keuskupan Agats-Asmat. (2020a). *Sejarah Kami*. Retrieved from: <https://keuskupanagats.or.id/sejarah/>
- 13) Keuskupan Agats-Asmat. (2020b). *Visi Misi*. Retrieved from: <https://keuskupanagats.or.id/visi-misi/>
- 14) Leba, E. E., (2018, January 29). *Hingga Januari 2018, Sebanyak 12.398 Anak Asmat Diperiksa*. *Kompas*. Retrieved from [https://www.kompas.id/baca/nusantara/2018/01/29/hingga-januari-2018-sebanyak-12-398-anak-asmat-diperiksa?open\\_from=Tagar\\_Page](https://www.kompas.id/baca/nusantara/2018/01/29/hingga-januari-2018-sebanyak-12-398-anak-asmat-diperiksa?open_from=Tagar_Page)
- 15) Lundy, K. S., & Janes, S. (2009). *Community health nursing: Caring for the public's health*. Jones & Bartlett Learning.
- 16) Lyons, K. E., Ryan, C. A., Dempsey, E. M., Ross, R. P., & Stanton, C. (2020). Breast milk, a source of beneficial microbes and associated benefits for infant health. *Nutrients*, 12(4), 1039. <https://doi.org/10.3390/nu12041039>
- 17) Marilyn, R., Friedman, B., & Vicky, R. J. (2019). *Family nursing: Research, theory, and practice*. Pearson.
- 18) Maryunani. (2013). *Clean and Healthy Behavior (PHBS)*. Jakarta: CV Trans Info Media (TIM)
- 19) Miller, J. E., & Rodgers, Y. V. (2009). Mother's education and children's nutritional status: new evidence from Cambodia. *Asian Development Review*, 26(1), 131-165. <https://doi.org/10.7282/T3WQ05W4>
- 20) Nies, M. A., & McEwen, M. (2014). *Community/public health nursing-E-book: promoting the health of populations*. Elsevier Health Sciences.
- 21) Obasohan, P. E., Walters, S. J., Jacques, R., & Khatab, K. (2020). Risk factors associated with malnutrition among children under-five years in sub-Saharan African countries: a scoping review. *International journal of environmental research and public health*, 17(23), 8782. <https://doi.org/10.3390/ijerph17238782>
- 22) Pecora, F., Persico, F., Argentiero, A., Neglia, C., & Esposito, S. (2020). The role of micronutrients in support of the immune response against viral infections. *Nutrients*, 12(10), 3198. <https://doi.org/10.3390/nu12103198>
- 23) Pemerintah Provinsi Papua (2019). *Ringkasan Rencana Pembangunan Jangka Menengah Daerah Provinsi Papua (2019-2023)*. Jayapura: Badan Perencanaan Pembangunan Daerah Provinsi Papua. Retrieved from <https://bappeda.papua.go.id/file/974499547.pdf>

## Health Problems and Nutritional Status among Children Under-Five Years in Diocese of Agats: A Cross-Sectional Study

- 24) Perdana, H. M., Darmawansyih, D., & Faradilla, A. (2020). Gambaran Faktor Risiko Malnutrisi pada Anak Balita di Wilayah Kecamatan Tamalanrea Kota Makassar Tahun 2019. *UMI Medical Journal*, 5(1), 50-56. <https://doi.org/10.33096/umj.v5i1.74>
- 25) Puffer, R. R., & Serrano, C. V. (1973). Patterns of mortality in childhood: report of the Inter-American Investigation of Mortality in Childhood (No. 262). Pan American Health Organization.
- 26) Sianipar, T. (2018, March 12). Kematian anak akibat gizi buruk di Asmat berlanjut meski KLB sudah berakhir. *BBC Indonesia*. Retrieved from <https://www.bbc.com/indonesia/indonesia-43363665>
- 27) Siddiqui, F., Salam, R. A., Lassi, Z. S., & Das, J. K. (2020). The intertwined relationship between malnutrition and poverty. *Frontiers in Public Health*, 8, 453. <https://doi.org/10.3389/fpubh.2020.00453>
- 28) Sigdel, A., Sapkota, H., Thapa, S., Bista, A., & Rana, A. (2020). Maternal risk factors for underweight among children under-five in a resource limited setting: A community based case control study. *Plos one*, 15(5), e0233060. <https://doi.org/10.1371/journal.pone.0233060>
- 29) Tran, I. C., Gregory, C., O'Connor, P., Imohe, A., Do, L. A. H., & Suchdev, P. S. (2023). A scoping review on the associations and potential pathways between malnutrition and measles. *MedRxiv*, 2023-01. <https://doi.org/10.1101/2023.01.21.23284872>
- 30) UNICEF. (2023). Child Malnutrition. Retrieved from: <https://data.unicef.org/topic/nutrition/malnutrition/>
- 31) Wali, N., Agho, K. E., & Renzaho, A. M. (2021). Wasting and associated factors among children under 5 years in five south asian countries (2014–2018): Analysis of demographic health surveys. *International Journal of Environmental Research and Public Health*, 18(9), 4578. <https://doi.org/10.3390/ijerph18094578>
- 32) WHO. (2017). Diarrhoeal disease. Retrieved from <https://www.who.int/news-room/fact-sheets/detail/diarrhoeal-disease>
- 33) WHO. (2021a). Levels and trends in child malnutrition: UNICEF.
- 34) WHO. (2021b). Global breastfeeding scorecard 2021: protecting breastfeeding through bold national actions during the COVID-19 pandemic and beyond (No. WHO/HEP/NFS/21.45). World Health Organization.
- 35) WHO. (2023). Malaria. Retrieved from <https://www.who.int/news-room/fact-sheets/detail/malaria>
- 36) Widiatoro, W. (2018, January 17). Humanitarian Missions Rolling In Various sides, from government offices, to military and private organizations, are carrying out humanitarian missions in Asmat. *Kompas*. Retrieved from <https://www.kompas.id/baca/english/2018/01/17/humanitarian-missions-rolling-in>
- 37) Widiatoro, W. (2018, February 2). Clean Water Supply and Sanitation Prioritized. *Kompas*. Retrieved from [https://www.kompas.id/baca/english/2018/02/02/clean-water-supply-and-sanitation-prioritized?open\\_from=Tagar\\_Page](https://www.kompas.id/baca/english/2018/02/02/clean-water-supply-and-sanitation-prioritized?open_from=Tagar_Page)
- 38) Zandstra, J., Jongerius, I., & Kuijpers, T. W. (2021). Future biomarkers for infection and inflammation in febrile children. *Frontiers in Immunology*, 12, 631308. <https://doi.org/10.3389/fimmu.2021.631308>



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Perceptions of Physical Education Teachers Regarding Softball Game Material in Physical Education Subjects Sports and Health in District Public High Schools Purworejo



Yusuf Roikhan Rais<sup>1</sup>, Bernadeta Suhartini<sup>2</sup>, Dima Krisna Wiedarjati<sup>3</sup>, Wahyu Dwi Yulianto<sup>4</sup>

<sup>1,2,4</sup> Department of Sport Science, Yogyakarta State University, Yogyakarta Indonesia

<sup>3</sup> Faculty of Teacher Training and Education, Universitas Terbuka, Indonesia

**ABSTRACT:** The purpose of study This is For know how much Good teacher education perceptions physical education in public high schools throughout the district Purworejo to material softball game in PJOK learning. This research is study descriptive quantitative. Method used in study This is method survey. Instrument previously has tried out For know level of, validity as well as instrument reliability. Of 35 items question tested test \_ try it there are 4 items stated question \_ invalid. Testing reliability stated reliable with Cronbach's alpha score 0.979. This data collection technique use modification Linkert scale with score 1-4 and choice alternative answers strongly agree, agree, less agree, and very less agree. Data analysis techniques using descriptive quantitative with percentage. The results of data analysis show that " Perceptions of Physical Education Teachers Regarding Softball Game Material in PJOK Lessons in State High Schools throughout the Regency Purworejo " literally whole as following : in the "very good " category of 13.6%, the " good " category of 9.1%, the " fair " category good " by 50%, category " poor good " by 22.7%, and in the "very poor " category good " by 4.6%.

**KEYWORDS:** Teacher Perception, Softball Game, PJOK High School Material

### I. INTRODUCTION

Education is part important from life every man. Every individual has get education since they are inside \_ content until end life they . Physical education is one of eye lesson from activity education formally . Physical education is also an an integral part of whole system education in a way intact . The connection with That education physical own goal , goal from education physical based on Thomas's opinion as following , Lee and Thomas (Suherman, 2004: 33) , namely : 1) Developing and maintaining level fitness suitable physique \_ with health and teaching that fitness is something important \_ as well as How fitness influenced by practice , 2) develop Skills proper movement , begins with skill \_ motion basic , then going to to Skills sport certain the end emphasize exercise \_ throughout life .

As an education teacher physical Already should in teaching must teach material listed \_ in curriculum ( Ministry of National Education, 2003), one of them is softball material . Softball is sport A team found in the United States was created by George Hancock in the city of Chicago in 1887. Softball is development from sport the like such as baseball and hardball. Softball can do it too called as Indoor-Baseball, incl sport teams can \_ grouped into the hit ball game . At a glance game This similar rounders ball game , but in softball game really need dexterity and drain Lots thoughts (Suhartini, 2011: 2). In softball games it is necessary various technique basic must \_ controlled by the player . There are five techniques basics done \_ in softball game that is technique throwing the ball (throwing), technique catching the ball (catching), technique hitting the ball (batting), technique intercept the ball without swing (bunting), and technique running base to base and sliding (base running and sliding) (Bethel, 1993: 16-20).

is a sport in Indonesia played in National Sports Week (PON ) event seven in 1969 in Surabaya, however in event This only followed by the team son and so on For team daughter following the competition at the National Sports Week (PON) . eight in Jakarta in 1973. In the development of softball, especially in the Central Java region, it has been played in PORPROV event ( Sports Week Province ). However No all area or regency send his representative . This matter because No all area prepare or own management in sport This . At the PORPROV Java event middle in 2018 from 35 regions the district / city that sends it his representative in event This only there are 8 teams men and 5 teams daughter . This matter indicated Still Lots areas that haven't know This softball sport , no except for district areas Purworejo.

## Perceptions of Physical Education Teachers Regarding Softball Game Material in Physical Education Subjects Sports and Health in District Public High Schools Purworejo

In the Purworejo area development the sport of softball even Not yet Once touched. This is because \_ No exists socialization softball sport from KONI administrators in the district purworejo , as well as socialization through institution education especially at school high school level through teachers. School teachers intermediate upper school (SMA) in the Purworejo area Still Not yet own knowledge about material inside softball learning \_\_ curriculum so that in teaching seldom or even No teach softball material, as happened in one of the school intermediate above (SMA) in Purworejo, teachers not yet understand softball material with Good so that in learning seldom very or even not taught . \_ Teacher still Confused about material as well as the rules contained therein \_ softball game. Even the teacher only Once teach softball game once and because Not yet understand it is likened to like playing rounders so the students understand it play caste and not do softball game .

For that , because Not yet popularize it softball sport in the Purworejo area as well as based on observations made \_ researcher that the teacher hasn't fully understand and teach softball games at school , study in a way comprehensive expected results from study This can give input and improvements , researchers wish browse A case which involved PJOK teachers at State High Schools in the Purworejo area through Perceptions of Physical Education Teachers To Softball Game in Physical Education Subjects Sports and Health in Public High Schools throughout the Regency Purworejo , which will be later will made as material improvement and evaluation

### II. MATERIALS AND METHODS

This research is study descriptive quantitative . According to Arikunto (2010: 139), research descriptive is research only \_ describe circumstances or phenomenon status. Method used in research This is method survey with technique data collection uses questionnaire . According to Sugiyono (2011), the survey method is normal research \_ done with many subjects, intended \_ For gather opinion or information regarding symptom status at time study taking place.

The formula used \_ For measure validity questionnaire as instrument study This use Product Moment formula from Karl Pearson, as as follows ( Arikunto , 2006: 168):

$$r_{xy} = \frac{N \sum XY - (\sum X)(\sum Y)}{\sqrt{\{N \sum X^2 - (\sum X)^2\} \{N \sum Y^2 - (\sum Y)^2\}}}$$

Information :

- $r_{xy}$  = Korelasi momen tangkar
- $N$  = Cacah objek uji coba
- $\sum X$  = Sigma atau jumlah X (skor butir)
- $\sum Y$  = Sigma atau jumlah Y (skor faktor)
- $\sum XY$  = Sigma tangkar (perkalian dengan Y)

According to Azwar, (2016: 168) for determine criteria score with use Evaluation Reference Norms (PAN) in scale as following :

**Table 1. Criteria PAN score**

Range Score	Category
$X > M + 1.5 SD$	Very Good
$m + 0.5 SD < X < m + 1.5 SD$	Good
$M - 0.5 SD < X < M + 0.5 SD$	Currently
$M - 1.5 SD < X < m - 0.5 SD$	Not enough
$X < M - 1.5 SD$	Not enough Very

Note : M = Mean SD = Standard Deviation X = Score

This research including to in study population Because subject study is all education teachers district -wide public high school physical Purworejo , namely 22 teachers from 11 high schools. From the analysis that has been done done obtained provision For overall score \_ study teacher education perceptions physical to material softball game on the eyes PJOK lessons are as following : score highest 119, score lowest 94, mean (M) 105.3, and standard deviation (SD) 7.3. Following served table distribution frequency results categorization from the results obtained For construct . Contract means limit change or variables that will researched (Hadi



## Perceptions of Physical Education Teachers Regarding Softball Game Material in Physical Education Subjects Sports and Health in District Public High Schools Purworejo

S, 1991: 7). Contract in study This is teacher education perceptions physical to material softball game on the eyes lesson education physical sports and health at state high schools throughout the district Purworejo

**Table 2. Distribution frequency construct study**

No	Score Intervals	Category	Frequency	Percentage %
1	$X > 116$	Very good	3	13.6
2	$108 < X < 116$	Good	2	9.1
3	$101 < X < 108$	Enough	11	50
4	$94 < X < 101$	Not enough	5	22.7
5	$X < 94$	Very less	1	4.6
Amount			22	100

From table 2 above showing that teacher education perceptions physical to material softball game on the eyes PJOK lessons in state high schools throughout the district purworejo is in the "very good " category at 13.6%, " good " 9.1%, " fair. " either "50%," less good " 22.7%, and "very poor good " 4.6%.

Variables used in study This is single variable type that is teacher education perceptions physical to material softball game in learning education physical district high school sports and health Purworejo . Perceptions of education teachers physical to material softball games are measured use questionnaire with several factors:

### 1. Functional Factors

Represents benefit softball game against development physical , mental and intelligence , data on factors functional obtained through questionnaire consists of 11 items question with amount 22 respondents . There are 4 alternatives answer with score highest each answer is 4 and the lowest is 1. From the analysis that has been carried out it is obtained results as following , score highest in aspect functional 43, score lowest 34, mean/ mean (M) 38.3 and standard deviation (SD) 2.8. Below is presented a table

**Table 3. Distribution functional factor frequency**

No	Score Intervals	Category	Frequency	Percentage %
1	$X > 42$	Very good	3	13.6
2	$40 < X < 42$	Good	2	9.1
3	$37 < X < 40$	Enough	10	45.5
4	$34 < X < 37$	Not enough	5	22.7
5	$X < 34$	Very less	2	9.1
Amount			22	100

### 2. Structural Factors

Represents view to softball game , material softball game in curriculum and implementation learning softball game . Data on factors structurally obtained \_ through questionnaire consists of 9 items question with amount 22 respondents . There are 4 alternatives answer with score highest each answer is 4 and the lowest is 1. From the analysis that has been carried out it is obtained results as following , score highest in aspect structural 35, score lowest 27, mean/ mean (M) 30.5 and standard deviation (SD) 2.6. The following is presented table as well as distribution histograms frequency results categorization

**Table 4. Distribution frequency of structural factors**

No	Score Intervals	Category	Frequency	Percentage %
1	$X > 34$	Very good	3	13.6
2	$32 < X < 34$	Good	2	9.1
3	$29 < X < 32$	Enough	7	31.8
4	$27 < X < 39$	Not enough	8	36.4
5	$X < 27$	Very less	2	9.1
Amount			22	100

### 3. Situational Factors

Represents view to sarpras For learning , conditions students and the environment . Data on factors situationally obtained \_ through questionnaire consists of 4 items question with amount 22 respondents . There are 4 alternatives answer with score highest each answer is 4 and the lowest is 1. From the analysis that has been carried out it is obtained results as following , score

## Perceptions of Physical Education Teachers Regarding Softball Game Material in Physical Education Subjects Sports and Health in District Public High Schools Purworejo

highest in aspect situational 16, score lowest 10, mean/ mean (M) 12.9 and standard deviation (SD) 1.4. Below is a table and distribution histogram frequency results categorization.

**Table 5. distribution frequency of situational factors**

No	Score Intervals	Category	Frequency	Percentage %
1	$X > 15$	Very good	1	4.6
2	$14 < X < 15$	Good	2	9.1
3	$12 < X < 14$	Enough	9	40.9
4	$11 < X < 12$	Not enough	8	36.3
5	$X < 11$	Very less	2	9.1
Amount			22	100

### 4. Personal Factors

Represents happen on experience , motivation , and mastery material . Data on personal factors were obtained through questionnaire consists of 7 items question with amount 22 respondents . There are 4 alternatives answer with score highest each answer is 4 and the lowest is 1. From the analysis that has been carried out it is obtained results as following , score highest in personal aspect 28, score lowest 21, mean/ mean (M) 23.5 and standard deviation (SD) 2.4. Below is a table and distribution histogram frequency results categorization

**Table 6. Distribution frequency of personal factors**

No	Score Intervals	Category	Frequency	Percentage %
1	$X > 27$	Very good	3	13.6
2	$25 < X < 27$	Good	1	4.6
3	$22 < X < 25$	Enough	8	36.3
4	$20 < X < 22$	Not enough	10	45.5
5	$X < 20$	Very less	0	0
Amount			22	100

## III. DISCUSSION

Based on results study about teacher education perceptions physical to material softball game on the eyes PJOK lessons at SMAN throughout the district Purworejo are in the category Enough good ( medium ). With teacher frequency data \_ signifies that some teachers have someone understands \_ material softball game on the eyes lesson . According to Krech and Crutchfield the influencing factors perception can categorized as into 4 factors , namely (1) Functional Factors , (2) Structural Factors , (3) Situational Factors , (4) Personal Factors ( Sobur , 2010: 460; Artha, 2013).

In functional factors , results average value ie as many as 38.3 perceptions of education teachers physical to material softball game on the eyes PJOK lessons at SMAN throughout the district Purworejo based on factor functionally categorized \_ Enough Good . With category Enough Good means education teacher physically in the district area purworejo Enough understand material softball game on aspects functional that contains benefit Softball games on development and intelligence student .

In structural factors, mean/ average of aspects structural of 30.5 so in aspect structural Physical education teachers' perceptions of high school level softball games are categorized Enough Good . Although thereby with missing category \_ Good Enough big that is as much as 36.6% means Still many education teachers physical education at high school level in the Purworejo area which is still not enough interested For understand material softball game on the eyes PJOK lessons at high school level in the district Purworejo . However in a way all physical education teachers in the region purworejo Already own interest about softball material on the eyes PJOK lessons at high school level .

On situational factors , in fact whole Physical education teachers ' perceptions of aspects situational is categorized Enough Good . With see comparison categories that have been mentioned that 36.9 % of teachers are categorized not enough good meaning in aspect \_ situational This Still many teachers haven't fully capable For teach softball material at the high school level . That matter Can refers to facilities and infrastructure that are not yet available available as well as condition environment lacking schools \_ possible For do learning softball game .

On personal factors, average or a mean of 23.5 then in a way whole Physical education teachers' perceptions of softball games are categorized Enough Good . However so , if look at the teachers who are in the category not enough Good amounting to 45.5% p the signifies that part large number of PE teachers in the district purworejo who still teaches at the high school level many do

## Perceptions of Physical Education Teachers Regarding Softball Game Material in Physical Education Subjects Sports and Health in District Public High Schools Purworejo

n't own experience playing softball at times college , less motivation For teach material as well as Not yet understand material to be taught in learning .

From the results analysis fourth factors that influence teachers in do perception all factor are in the category Enough Good . That matter signifies that some physical education teachers in the district Purworejo already teaches at the high school level Enough understand material softball game in PJOK learning . However If see part big again the teacher is in the category not enough okay Enough big on each factor affecting \_ teacher's perception of material softball game . That matter means that part big I'm a physical education teacher in the Purworejo area Still Not yet Ready For teach material softball games at the high school level . That matter it can be caused lack of teacher's understanding of softball material , lack of interest For teach , as well No availability means adequate infrastructure \_ For do learning softball game.

#### IV. CONCLUSION

analysis and discussion from Perceptions of Physical Education Teachers Regarding Softball Game Material in PJOK Lessons in State High Schools throughout the Regency Purworejo , in fact overall in the "very good " category was 13.6%, the " good " category was 9.1%, the " fair " category good " by 50%, category " poor good " by 22.7%, and in the "very poor " category good " by 4.6%. Most of the district 's public high school teachers Purworejo own a good look at the material softball game on the eyes PJOK lesson and ready For teach material the

#### REFERENCES

- 1) Suherman, WS 2004. Curriculum Based Physical Education Competencies : Theory and Practice Development . Yogyakarta: Faculty Knowledge UNY Sports .
- 2) Suhartini, B. 2011. Getting to know Softball Sports . Yogyakarta: Faculty Knowledge UNY Sports
- 3) Bethel, D. 1993. Instructions Complete Softball and Baseball.Semarang : Dahara Prize
- 4) Arikunto , S. 2010. Research Procedures ( An Approach Practice ). Jakarta: PT. Rineka Cipta.
- 5) Azwar, S. 2016. Test Achievement ( Function Development Measurement Performance Study ). Yogyakarta: Learning Library
- 6) Hadi, S. 1991. Item Analysis For Instrument Questionnaires , Tests, and Rating Scales. Yogyakarta: Andi Offese .
- 7) Sobur . 2010. General Psychology . Bandung: Pustaka Setia.
- 8) Sugiyono . 2011. Statistics For research. Bandung: Alfabeta .
- 9) Ministry of Education. 2003. Standard Physical Education Subject Competencies School Upper Secondary and Madrasah Aliyah. Jakarta: Department of National Education.
- 10) Artha, Yesika T. 2013. Perceptions of Physical Education Teachers Regarding Pencak Silat Material in Physical Education Subjects Sports and Health for Junior High Schools in the City of Yogyakarta.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Media Relation Strategies of the Finance Track Field of G20 Summit Publicity in Indonesia



Rini Tri Utami<sup>1</sup>, Nanang Trenggono<sup>2</sup>, Andy Corry Wardhani<sup>3</sup>, Anna Gustina Zainal<sup>4</sup>

<sup>1</sup>Student of Communication Department, Faculty of Social Politics, Lampung University

<sup>2,3,4</sup>Lecturers of Communication Department, Faculty of Social Politics, Lampung University

**ABSTRACT:** G20 forum is the mega event firstly held and became the history for Indonesian. Therefore, one of publicity successes of this event is the media relation, so that the showed publicities nationally and internationally can increase the world trustworthiness to Indonesia and can foster the sense of pride at eyes of societies. Moreover, there is the speciality in the publicity efforts and the strategies of media relation carried by G20 Finance Track communication and branding teams where one of the assigned missions is delivering every meeting result progress of working groups as well as delivering the exclusive higher information which is reachable and understandable by the whole scope of societies both national and international. In this study, the media relation activities as the effort to establish the relation with the press are aimed at seven activities which are press conferences, press briefing, press tour, press release, special event, press luncheon, press interviewing. This study used the constructivist paradigm with the descriptive qualitative approach. Data collecting method is conducted by using literature studies, interviewing and data exploring virtually. The result of this study showed that the executed activities in the effort of establishing a good relationship with the press has represented the concepts of media relation. And the most prominent activity in this G20 publicities is press briefing session.

**KEYWORDS:** G20 Summit, Indonesia, Media Relation Strategies, Publicity, The Finance Track Field,

### I. INTRODUCTION

High-level Conference Group of 20 hence forth will be abbreviated into G20 Summit, has been held in Indonesia. As the presidential holder of G20 Summit for a whole year, Indonesia has been able to organize the world-class event successfully and safely. Bali Leader's Declaration has become the mutual agreement of every world leader on the peak meeting on Bali on 15th – 16th of November 2022 which is attended by 17 world leaders and one European Union representative.

As the presidential holder of G20 Summit, Indonesia put itself as the global communication bridge which serving as the balancer and connector of the power of west and east, giving bigger attention to the developing countries, and world peace keeper. Certainly, in order to optimize this function as the bridge, it needs the key and that is to communicate effectively.

In executing this effective communication function either internationally or nationally for the whole of stakeholders, Minister of Finance formed a committee team of G20 Finance Track field meeting arrangement which are the branding and communication teams. Forming this committee as the mandate in executing the Presidential Decree No. 18 of 2021 where Minister of Finance is assigned as the head of I Finance Track field. The branding and communication teams has the duties to research, watch over and control of publicity activity, activate media, and branding the G20 finance track field which affected on the reputation of Ministry of Finance and Indonesian Government. From this matter, it can be concluded that the function of the branding and communication teams is serving as the public relation, hence forth will be abbreviated into PR, where the role and main function are creating good image as well as becoming the informational bridge for their publics.

The first time G20 Indonesia finance track was opened by starting with Finance and Central Bank Deputies Meeting (FCBD) meeting on 9th – 10th of December 2021, then followed by the series of work group meeting which was happening in a marathon manner as long as 32 times. On general, the work group meeting of G20 is executed privately with various exclusive and strict publicity policies. However, in this G20 presidencies in Indonesia, it has special privileges where the government wanted the societies to understand and aware of the information about the ins and outs of this G20. The government wanted to invite people to experience the impact of the result of workgroup discussions by publishing the meeting results on the workgroup generally and appropriate to be known.

## **Media Relation Strategies of the Finance Track Field of G20 Summit Publicity in Indonesia**

The emerging challenge here is how to present the information of the result of the workgroup meeting with the easy understandable language for all people. For Indonesian citizens, the proper publicity will emerge the understanding and the definition about the importance of Indonesia position in the world class. Because in order to make G20 activities successful, certainly the supports and societal roles must be involved in.

The safety and convenience for all the attended world leaders on the peak of G20 meeting must be guaranteed as well. Doing it, the governments can't only do it by themselves, but also needs to involve the whole society. Because the potential occurrence of this G20 meeting for society is quite significant, where the multiplier effect of this event towards societal economy can be contributed on sectors of tourism, hospitality, transportation, creative economy, and local SMEs. Whereas for global societies, the proper publicity can show the world that Indonesia is open for business because in international diplomacy, trustworthiness and credibility at the eyes of the world is the capital for the entry of various cooperations and economic investments.

## **II. LITERATURE REVIEW**

### **A. Government Public Relations**

According to (Cutlip et al., 2009) PR is the management function which forming and maintaining the relation for the organization and their publics where the relation purposes are the mutual benefits and becoming the centre of either its success or failure. It is stated on The Statement of Mexico in (Ruslan, 2016) PR is an art and social sciences which is used to check the tendencies, to predict the consequences, to provide inputs to the organization leader, and to execute the programs and activities which serving either for organizational interests or public interests.

Likewise with PR Government where the assigned role has two double functions namely either to in or to out of organization. For the outside organizational interests namely public, the governmental PR function is informing according to the organizational policies. Whereas for the organization, public reactions will be the organizational inputs (Widjaja, 2002).

Whereas according Bernays in (Widjaja, 2002) PR has three duties, which are: 1) giving the enlightenment for the societies, 2) directly the press uade the societies to change their attitudes and actions, and 3) giving efforts to integrating the attitudes and action from the problem with the societies and vice versa. Therefore it can be concluded that government PR has strategic duties namely take a part in decision making process and tactical duties, such as informing, motivating, creating image, communicating reciprocally.

### **B. G20 Summit Finance Track**

G20 forum is the international forum which formed when economy crisis hit the world on 1999. G20 forum represents 80% of world economy, 75% of international trade, and two-third of the world populations (Bank Indonesia, 2022). This showed that how important this forum is in determining the direction of the world economic policies as well as find the shared solution of global economy situation.

For the first time in 2022, Indonesia hold the G20 presidency. In this forum, Indonesia is the only ASEAN delegation (Kominfo, 2022), becoming one of nine developing countries, as well as becoming the country member with the biggest Muslim majorities in the world. On his speech, the President, Joko Widodo, delivered the big theme of Indonesia G20 Presidency of 2022 namely "Recover Together, Recover Stronger", through this theme, Indonesia the press uades all countries to help each other hand-in-hand, supports to recover together as well as grow stronger and sustainable (Gumilang, 2022).

Basically, the country of G20 member make this forum as the receptacle to foster the feeling of trustworthiness between each country member. The success of G20 will significantly impact not only on the economies of G20 countries but also for the whole world. It can be said that the economic growth and balance of G20 country members will be able to guarantee the world economy stability, because the executed cooperation is operationalized through global network (Astuti, 2020).

### **C. Publicity**

So that it is able to give the understanding to Indonesia citizens as well as world communities about the importance of this event, publicity to the societies needs to be executed. Publication and publicity actually are two different things, according to (Kriyantono, 2008) the differences lies on the media used by. As the broadcasting media, publicity is the publication which used mass media. Therefore, publicity is the part of publication and publication has a broad scope. Publicity can as well be considered as the impact or result of PR activities.

In order to get the proper publicity expected by the organization, then PR should establish a good relation with the media. PR and media are work partners which are mutually benefit and inseparable (Mahfuzhah & Anshari, 2018).

Publicity is one of PR activities which is purposefully planned to achieve a company goal. In order to do that, then information broadcasting must be planned first before go through media. Baus in (Kriyantono, 2008), stated that publicity as the planned message, executed and distributed through ceratin media to fulfil public interests without paying the media. Publicity is every

## Media Relation Strategies of the Finance Track Field of G20 Summit Publicity in Indonesia

information and organizational activities to report the news about activities of either organizational or governmental instances so that it is known by public. If seen from mass media the press practices, publicity is information provided by out sources used by media because that information has the value of news.

### D. Media Relation

The definition of media relation according to (Lesly, 1991), is as the relation with the communication media with the purpose of executing publicity as well as responding the media interests toward organizational interests. Whereas (Iriantara, 2005), defined media relation as part of external public relation which guiding and establishing a good relation with mass media as means of communication between organization and public to achieve organizational goals. PR must have a good relation with journalists continuously holding changes and improvements so that the relation with the press which has been established so far is continuously kept in good (Syaiffulah, 2004). The improvement is actualized by executing media relation activities namely the effort to achieve maximal publication or broadcasting of message or information to create the knowledge and understanding for public from the organization or associated company (Jefkins, 2014).

In media relation, it need strategies and proper tactics, so that the target of the activities is proceeded well. The organization can apply the adaptive or defensive dynamic strategies in facing the media depends on condition and activity purpose which wanted to be achieved (Saputra & Nasrullah, 2014).

Media relation activities covers the press conference, the press meeting, and the press reception (Syaiffulah, 2004). In this study the media relation activities as the effort to establish the relation with the press are aimed at seven activities which are press conference, press briefing, press tour, press release, special event, press luncheon, and press interviewing (Soemirat & Ardianto, 2005). These seven strategies when described is as follows:

- 1) The press conference is inviting the journalist to having a dialogue, with the properly prepared material by the organizer.
- 2) The press briefing is PR activities in giving technical and substantive explanation to the journalist.
- 3) The press tour, these activities are normally held by a company or organization to visit certain regions to persuade the journalist.
- 4) The press release is the written information arranged by the organization describing the published activities on mass media (Darmastuti, 2012).
- 5) The special event is the specific occurrences as the important PR activities satisfying many people to get involved in a chance.
- 6) The press luncheon, namely PR officials is holding a luncheon for all the representatives of mass media or journalists, so that on its chance the press side can meet up with the top organizational managements to listen the development of organizational activities.
- 7) The press interviewing has very private and more individual characteristic. PR or top management which being interviewed is only facing with the associated journalists.

Some researches in the past (Vidiarti et al., 2018), explained about the media relation role in publishing the official programs through Informal approach where the study took place on Purwakarta Regional Government on the media relation activities which tends to be executed informally namely by starting from official program mapping, building the personal relation, providing facilities and services for the media, holding a training for the journalists, and coordinating in the news making processes. (Iswara et al., 2020) stated that from the corporate perspectives, media relation is as well executed in introducing its products namely by reviewing, holding photo competition, handling the media during the product launching, post launching, press release, press calls, regular networking and press gathering.

This study focused on the media relation activities executed by the branding and communication teams on event G20 Finance Track field events held by Indonesia in 2022. This study aimed to find out what are the activities executed by the branding and communication teams through seven activities as previously mentioned above in order to publish G20 Finance Track field activities to create positive image for the Indonesia government either for societies or for world trustworthiness.

The authors chose media relation in G20 Forum activities publication because this mega event is the first time held in Indonesia and will become the history for Indonesia. The expected Impact toward the economy of Indonesia and the world can significantly happen. Therefore one of publication successes of these activities namely from the media relation activities, so that the publicity showed to the public both national and international can increase the trustworthiness to Indonesia at the eyes of the world and foster the sense of pride at eyes of Indonesian societies. Moreover, there is the speciality in the publicity efforts and the strategies of media relation carried by G20 Finance Track communication and branding teams where one of the assigned missions is delivering every meeting result progress of working groups as well as delivering the exclusive higher information which is reachable and understandable by the whole scope of societies both national and international.

## Media Relation Strategies of the Finance Track Field of G20 Summit Publicity in Indonesia

### III. RESEARCH METHOD

Paradigm built in this study is constructivist paradigm where, every individual has different experiences with one another so that it can be concluded that every event taken by the individuals in addressing a matter is valid and respecting those perspectives is important (Patton, 2002). Method used in this study is qualitative descriptive where the purpose of this descriptive study is clarifying and exploring a phenomenon. Whereas the qualitative descriptive is used for analysing the natural object where researchers act as the instrument (Sugiyono, 2009) which then the study result is a created meaning, not a generalization.

Data in this study is collected by data collecting technique conducted through the literature study, interviewing and data exploring virtually. The method of data exploring virtually used for obtaining the data through internet and other virtual networking media (Bungin, 2011). Interviewing is conducted to the key Informant, namely the public relation agency, Krishna Pandu Pradana, the first expert assigned as the Person In Charge in the G20 Finance Track branding and communication teams.

The object of this study focused on how the media relation is executed by the branding and communication teams in the G20 Summit Finance Track Field activity of publications. The material object of this study is the media relation activities on G20 Summit Finance Track field. Whereas the formal object covers the media relation activities (Soemirat, 2005).

### IV. DISCUSSIONS AND RESULTS

G20 Meeting is a high-level world meeting where in its organization has various tied regulations. In this case, the publicity must be presented properly and not violated the decrees of G20 organization itself. Good image of the Indonesian leadership must be kept in front of all G20 members as well as all watching people. Consequently, it is important for the governmental PR to establish a relation with the press, to direct the press so that the misleading information won't happen, as well as to have the common perception where the purpose is to create a good image for Indonesia and can be acknowledged as the new world market power. So in this case mass media for the PR is not as tool however as the working partner (Humas Setkab RI, 2022). As the partner, the emerging relation is collegial relation and equal partnership, so on a publicity at least three sides involved in media relation namely the organization, media and public.

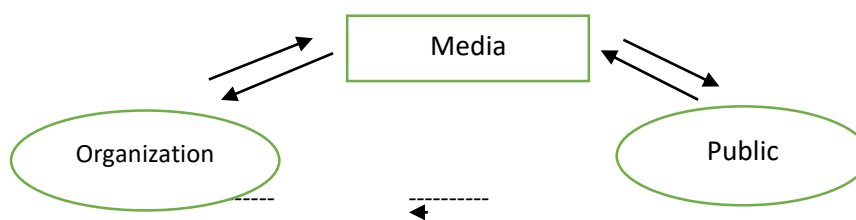


Figure 1: Communication flow on media relation (Iriantara, 2005).

#### A. Media Relation Strategies of The G20 Finance Track Field in Indonesia

Some strategies executed by the G20 Finance track field teams which act as the PR forming the relation with the media in order to be able to proceed well as well as creating the publicity according to the organizational purposes which are:

- 1. The press conference:** is a specific manner made for delivering and clarifying the information or promoting the G20 activities by directly inviting the journalists. In executing the press conference, G20 PR of finance track field organizing it at the pre-event, during the event, post event and has had the planned timeline. At pre event, the press conference served as the information associated to the activities that will be held, what are the meeting that will be held, who, when, and where it will take place. when the event is held, the press conference served as the information of what is resulted in every meeting namely 4 Meeting Ministerial Level (FMCBG), 5 Finance and Central Bank Deputies (FCBD), 14 Working Groups (WG), 12 Joint Meetings and 21 side events. At post event, the press conference served as the information of the conclusion created by those meetings. The press conference is opened for all journalists from various media, due to the general and important information needs to be broadcasted.
- 2. The press briefing:** can be defined as the one-way directions namely from PR to the press about the technical matters in the processes of information delivery. In general, media briefing is executed directly meeting with the media or the journalists in informal situation and discussing an unpublished matter. The purpose of press briefing is to make the same perception, to create positive thoughts toward journalist and media colleagues, and to detect various potential obstacles related to the delivered material. In this case G20 finance track field PR is executing the strategies which is to deliver the information on every finance meeting which will be held so that the press sides can find out the core of the discussion of the meeting which will be held and not having difficulties in narrating the news, remembering that how dense and the number of the held meeting.

## Media Relation Strategies of the Finance Track Field of G20 Summit Publicity in Indonesia

According to the key informant through interviewing, there are some challenges on the coverage technique which are; first “Journalist and media which is allowed to attend press briefing are the registered journalists on the application and is eligible of the international coverage requirements, rules and regulations. This regulation became a new thing for most of journalists because it is considered as very complicated. In order to deal with that, PR team formed the discussion groups through WhatsApp which consisted of national and international journalists. These groups can help each other if there is a difficulty in registering processes, as well as became the discussing place which is technically easy in its execution. The detailed rules in these registering processes is due to the coverage processes were involving international delegation and organization, so the safety and the profile clarity of the covering journalist must be assured.”

Second “beside of the different registering processes from the coverage processes in general, the branding and communication teams cooperated with the substance and outreach teams helping the journalists in narrating the news. The discussion of meeting result with the high-class topic contents is tried to be narrated by using easy-digested language, the purpose is to reach the wider audiences. So not only governmental elites as the policy maker that can take a part in the course of the meeting events but also all scopes of societies.” This is reflected on the Media news on various tiers (levels) and different classes of readers. The media used for inviting covers not only for the tier-1 media and business economy classes, but also identical media with the background topic of societies and social politics were as well cooperating in this coverage even with the news language that is so societal.



Figure 2: the style of publicity G20 event on two media with different tier and reader classes

3. **Press Release** is the written information which is issued by the organization associated with the company publication interests with not being associated to advertisement and should meet the news value to be published by the mass media. The conclusion is that a press release should strongly impressed on people’s heart and mind, expected to give strong meaning as well by people. Press release delivered in the series of these G20 Finance track events are as official publicity from the organization as well related to the freely inaccessible and closed information. Press release is one-way however it can be delivered according to the existed substances.
4. **Press Tour:** is the activities which involved the journalists in by holding the work visit related to the company while delivering a lot of important information about the organization. In G20 Finance Track field activities, press tour was held in order to watch over the G20 preparation in Indonesia, namely at pre event either at the airport during the preparation of world leader arrivals or tour in the venue of the preparation of Summit peak event In Bali.
5. **Press Luncheon/Press Dinner** is the activities of luncheon together by the organizational officials with media officials so in this chance it is created the familiarity and a good relation is established with the media. At least the press Dinner was held twice by the deputies and directors with the invited media editors. In this event, a lot of strategic information are delivered and related to the created policies on the ministerial level meeting. With the existence of this activity, then the perspective similarity of the publicity especially for strategic matters will be directed.
6. **Special Event:** is an *event* which is normally held for getting the attention on the media for the people. Special event in this case is the peak of high-level conferences which took place in Bali on 15<sup>th</sup> – 16<sup>th</sup> of November 2022, beside the peak of G20 Summit there is as well various side events that enliven those activities. At special events, only certain eligible media is allowed to attend the G20 Summit events. However remembering its exclusive characteristic of this event, the journalists indirectly attended to the meeting, however is provided a special room, the media centre room, where the journalists are given the facilities and infrastructures as well as its supporting needs such as huge-sized screen which showing the course of the meeting, strong internet networking, nice sound system, even the refreshments such as coffee, tea, and snack. The various



## Media Relation Strategies of the Finance Track Field of G20 Summit Publicity in Indonesia

side events accompanying the Summit as well has its own attraction for the press publicity, so the more humane news are emerged. Even the news related to the activities of the world leaders which are considered unique are emerged, this is capable of jacking up the publicity and image which is good performance at the implementation of the G20 Summit in Indonesia.

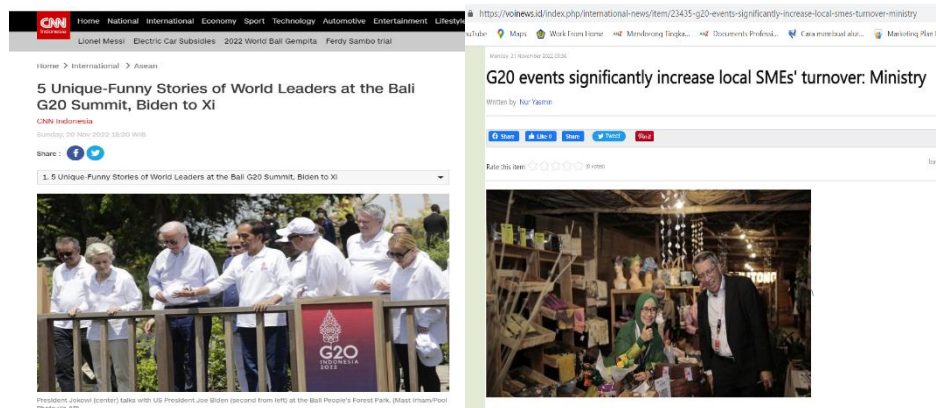


Figure 3: the various humane news of G20 Indonesia

7. **The press interviewing** has more private and individual characteristics. The organization leaders which are interviewed is only facing with the associated journalists. According to the informant, in interviewing session mentioned, “we analysed and made permission recommendation of interviewing session submitted by the media can be approved or not. The analysis is based on the type of aired programs, airing duration, segments, and news tone from the media. So the interviewing session can be the chance for the leaders to deliver the policies and to explain accurately directly to the people.”

### B. Media Monitoring

Media monitoring is the data collecting activities from various media channel to be analysed and identified. This process included, but not limited to, reading, watching, noting till listening the editorial content which is the source of the media. This monitoring process later will be the feedback as well as show organizational reputation in the media. Through general societal opinions which found out the issued information, publication can create good image and governmentally useful. (Permini & Atmaja, 2022). In these G20 Summit activities, media monitoring is executed for the emerging news on the media using the news monitoring special application. News monitoring result is executed weekly, this is executed in order to maintain and to measure so that the number of news keep increasing. Public conversation is measured through Social Network Analysis so the data can be easily and quickly presented. According to Key Informant, “monitoring is executed in order to just keep the publicity in high and positive level. If the weekly data indicated a decrease of publicity, then they will provide even more massive news material so that existed publicity not immediately drowned by other issues. Because the key of the popularity and program success is continuous and massive publicities.”

## V. CONCLUSIONS

Media relation has special PR campaigning functions and steps in the PR processes. Not only just publishing the held activities by one organization but also how that publication sustain or strengthen the organizational image at their public eyes. The executed strategies by the G20 finance track field branding and communication teams had presented the success in a media relation process. Starting from activities of the press conference till the press interviewing as described above, had become the proper model for other organizations in executing the media relation for the international-scale event.

PR relation with the journalist became a stronger bond because between those two parties are mutually need each other. PR needs journalists to publish every activities or events held by their instances either. In the other hand the journalists needs the information to be published as news on the media where they work for. Both parties must mutually establish a good relation so that a harmony is intertwined in executing each duty.

Then the author recommended to sustain the equal relation functions as well mutual relation intertwined between both parties, then it is necessary for both parties to sustain each professionalism. From PR perspective must keep presenting the honest information to the journalists, and from the journalist perspective must act professionally by not acting such as asking for money and extortion.

Author recommended for government PR to establish relation not only in the formal activities but also informal activities. Familiar relation will make ease the PR in expanding the publicity. Various kind of media are as well important to be involved because it can reach all people from various backgrounds.

## Media Relation Strategies of the Finance Track Field of G20 Summit Publicity in Indonesia

Beside of it, it is important to the whole government PR to reconsider the use of social network analysing or social media monitoring tools remembering the recent digital era increases the hoax onslaught, so broadcasted issue velocity can be identified before it is become the communication crisis. Media monitoring by using tools or application can save time as well, so that the government PR practitioner can channel their power and mind for other more strategic things.

### REFERENCES

- 1) Astuti, W. R. D. 2020. G20 Cooperation in Global Economic Recovery from COVID-19. *Andalas Journal of International Studies (AJIS)*, 9(2), 131–148.
- 2) Bank Indonesia. 2022. *Presidensi G20 Indonesia 2022*. <https://www.bi.go.id/id/g20/default.aspx>
- 3) Bungin, B. 2011. *Qualitative Research*. Kencana Predana Media Group.
- 4) Cutlip, S. M., Center, A. H., & Broom, G. M. (2009). *Effective Public Relations* (9th ed.). Kencana Prenada Media Group.
- 5) Darmastuti, R. 2012. *Media Relation – Concepts, Strategies, and Applications*. Andi Offset.
- 6) Gumilang, M. R. 2022. Benefits of the G20 Presidency for Indonesia. <https://www.djkn.kemenkeu.go.id/kpknl-jakarta3/baca-artikel/14750/Manfaat-Presidensi-G20-Bagi-Indonesia.html>
- 7) Humas Setkab RI. 2022. Menkominfo Apresiasi Peran PR Pemerintah Sukseskan Presidensi G20 Indonesia Read more: <https://setkab.go.id/menkominfo-apresiasi-peran-humas-pemerintah-sukseskan-presidensi-g20-indonesia/>
- 8) Iriantara, Y. 2005. *Media relation: Concepts, Approaches, And Practices*. Simbiosis Rekatama Media.
- 9) Iswara, N. D., Uljanatunnisa, U., & Mahdalena, V. 2020. Strategi Media relation dalam Launching Produk Vivo S1 Periode Juli 2019 (Studi Kasus PT Srikandi Imaji Lintaskreasi). *Jurnal Komunika: Jurnal Komunikasi, Media Dan Informatika*, 9(1), 1–10.
- 10) Jefkins, F. 2014. *Public Relations* (5th ed.). Erlangga.
- 11) Kominfo. 2022. *Posisi Indonesia di G20*. <https://indonesiabaik.id/infografis/posisi-indonesia-di-g20>
- 12) Kriyantono, R. 2008. *Public Relations Writing (Production Engineering, Media Public Relations and Corporate Publicity)*. Kencana Prena Media Group.
- 13) Lesly, P. 1991. *Lesly's Handbook of Public Relations and Communications*. Probus Publishing Company.
- 14) Mahfuzhah, H., & Anshari, A. 2018. Media Publikasi PR Dalam Pendidikan. *Al-Tanzim: Jurnal Manajemen Pendidikan Islam*, 2(2), 137–149.
- 15) Patton, M. Q. 2002. *Qualitative research & evaluation methods*. sage.
- 16) Permini, N. L. P. E., & Atmaja, I. M. W. K. 2022. PERAN PR DALAM ACTIVITIES PUBLIKASI ONLINE PEMERINTAH DI KABUPATEN BADUNG. *MODERAT: Jurnal Ilmiah Ilmu Pemerintahan*, 8(3), 620–632.
- 17) Ruslan, R. 2016. *Manajemen Public Relations & Media Komunikasi*. PT Raja Grafindo The press ada.
- 18) Saputra, W., & Nasrullah, R. 2014. *Public Relations 2.0: Theory and Practice of Public Relations in The Cyber Era*. Gramata Publishing.
- 19) Soemirat, S., & Ardianto, E. 2005. *Basics of Public Relations*. PT Remaja Rosdakarya.
- 20) Sugiyono, P. D. 2009. *Metode Penelitian Kuantitatif Kualitatif dan R&D*, Bandung: CV. ALVABETA.
- 21) Syaiffulah, N. M. 2004. *A Practical Guide for Public Relations Practitioners*. Cespus.
- 22) Vidiarti, P., Muhlis, A., & Rasib, A. 2018. Peran Media relation dalam Mempublikasikan Program Kedinasan melalui Pendekatan Informal. *Reputation: Jurnal Hubungan Masyarakat*, 1(2), 20–39.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## A Comparative Study of Healthcare User Satisfaction with Health Checkups in Thailand and Worldwide



Poomipat Kongsaksirikul<sup>1</sup>, Thanhathai Sukthai<sup>2</sup>

<sup>1</sup>Srinakharinwirot University Prasarnmit Demonstration School (Secondary), Bangkok, Thailand

<sup>2</sup>Faculty of Veterinary, Mahanakorn University of Technology, Bangkok, Thailand

**ABSTRACT:** This study aims to explore the potential influence of different factors on the respondents' satisfaction with annual medical checkups. With 125 responses from other age groups and countries, the results explore other trends posed by other grouping criteria. The responses emphasize the importance of the guidelines, policies, and government benefits implied in various aspects of the healthcare system, namely equitability, efficiency, timeliness, and integration, and how they correspond with the respondents' satisfaction. Additionally, a significant portion of the responses are from Thailand. The extensive research on the country's healthcare system has highlighted its strengths and weaknesses that could be further improved.

**KEYWORDS:** Health Checkup, Equitability of Healthcare, Efficiency of Healthcare, Timeliness of Healthcare, Integration of Healthcare

### I. INTRODUCTION

Annual health checkups are essential for people of all ages and genders, especially to identify potential health problems and eliminate possible risk factors.

There are physical and psychological benefits to getting checkups. research from Bijapur Liberal District Educational University states that *"Patients with chronic illness may encounter irreversible changes in health status and may lead to mortality. This is closely related to psychological distress, and approximately 6%–34% of the patients with chronic illness developed depression"* (Kudachi et al., 2023). The research also concludes that there is an important negative relationship between the mental well-being parameters of chronic illnesses. The inability to get annual checkups can lead to overlooking lifestyle-related diseases, which *"Account for a large proportion of mortality rates and healthcare expenses"* (Kang, Kawamura & Noguchi, 2021).

It is encouraged by NorthWestern University to get a health checkup every year, despite the recent health leaders calling for annual health checkups to end, claiming it is a waste of time and resources. Though much research has been published about its importance, many are still looking over its importance. According to the statistics published by the Bureau of Information Office of The Permanent Secretary of The Ministry of Public Health of Thailand in February 2018, only 2% of Thai people go in for annual health checkups (Ministry of Public Health, 2018). Furthermore, the Bureau also states that the majority of Thais believe that annual health checkups are to detect abnormalities or diseases, while in truth, they are to suggest any potential health problems, as stated before. On the other hand, 62% of Americans are reported to get their annual checkups, according to a survey conducted by the Kaiser Family Foundation. The differences in the healthcare system can contribute to these differences.

This research aims to explore possible factors that could influence a person's frequency and attitude toward annual health checkups through a survey with respondents of different demographics according to the World Health Organization's *determinants of quality of care (2020)*

**Timely** – less waiting time, which can prevent harmful delays

**Equitable** – providing care that does not vary in quality demographic, status, and geographical location

**Integrated** – providing care to patients throughout their lives

**Efficient** – resources were used to its' full potential

# A Comparative Study of Healthcare User Satisfaction with Health Checkups in Thailand and Worldwide

## II. METHODOLOGY

A quantitative method was used to gather data about a person's attitude toward medical checkups. We have published an online survey and have received 215 Responses from people from different countries and genders. The questions in the survey include (number of statements). The respondents must answer the statements depending on their degree of agreement on a scale of 1 to 5 (5-likert scale), 1 being strongly disagreed and 5 being strongly agree. The statements can be categorized into four different factors according to WHO's determinants of quality of healthcare:

**Timely:** The current healthcare system provides short waiting times and prevents harmful delays.

**Equitable:** Healthcare is equally accessible and of the same quality for individuals regardless of their gender, ethnicity, geographic location, and socio-economic status

**Integrated:** Care is accessible to people throughout their lives

**Efficient:** The current healthcare system maximizes the utility of available resources

Respondents are split into seven age groups: 15 years and under, 16 to 20 years, 21 to 30 years, 31 to 40 years, 41 to 50 years, 51 to 60 years, and 61 years or over. They are also required to answer whether or not they have personal insurance.

The statements could be categorized as follows;

### 1. General Information

- 1.1. What is your biological sex?
- 1.2. Which region are you from
- 1.3. Which country are you from
- 1.4. How old are you
- 1.5. How often do you visit the doctor for a checkup?
  - 1.5.1. If you chose almost never, what is the reason behind your answer
- 1.6. Do you have personal insurance

### 2. Equitable

- 2.1. I am satisfied with the welfare my government provides
- 2.2. I am satisfied with the cost of medical checkups in my country

### 3. Efficient

- 3.1. I am satisfied with the process of medical checkups in my country
- 3.2. I am satisfied with the quality of care in my medical checkups

### 4. Timely

- 4.1. It is convenient for me to go to the hospital
- 4.2. I am satisfied with the environment of the hospital I go to
- 4.2. It is easy for me to book a health checkup

### 5. Integrated

- 5.1. I have a clear understanding of the reasons behind tests and treatment done during my checkup
- 5.2. The medical staff have a friendly and courteous attitude towards me

## III. RESULTS AND ANALYSIS

With 64% of the respondents being from Thailand, the researchers have also decided to do extensive research on the country's healthcare system.

Category	Statement	Mean
Equitable	Satisfaction with government welfare	3.06
	Satisfaction with cost of checkup	3.40
Efficient	Satisfaction with process of checkup	3.55
	Satisfaction with quality of checkup	3.71

## A Comparative Study of Healthcare User Satisfaction with Health Checkups in Thailand and Worldwide

Timely	Convenience of going to the hospital	3.65
	Satisfaction with hospital environment	3.84
	Easiness to book checkup	3.60
Integrated	Understanding of treatment	3.92
	Friendly attitude of staffs	3.88

### A. Mean Score of Responses Across All Categories

Overall, the mean of satisfaction scores show that the respondents are moderately satisfied with the current healthcare system in their region.

Continent	Equitable	Efficient	Timely	Integrated
Asia	2.88	3.39	3.66	3.85
Europe	3.87	4.04	3.68	3.89
North America	3.88	3.88	3.42	3.75
South America	3.50	3.75	4.00	4.19
Oceania	4.50	4.00	4.16	4.15

### B. Mean Score of Responses By Continent

From Table B, Oceania has a high mean score, with every category being 4 or higher. In contrast, Asia has a lower mean score, especially in Equitability. It was revealed that social security is still unavailable to over half of the Asian-Pacific population (*International Labour Organization, 2022*). This could be a potential reason why Asia has a low satisfaction score with the equitability of its healthcare system.

For efficiency, Europe has the highest satisfaction score. An explanation might be that numerous countries in the EU are developing and implementing clinical guidelines, which resulted in great benefits, namely the ability to make better healthcare decisions in a variety of circumstances, as proven by several projects (Legido-Quigley et al., 2022), resulting in a higher satisfaction score in efficiency.

In the category of timeliness, Oceania has the highest satisfaction score while North America has the lowest. With the pattern of Oceania's population density, hospitals are located according to said pattern of density. With the amount and distribution of hospitals corresponding to the area's population, the time taken to get to the nearest hospitals is relatively low in large cities where the majority of the population lives, hence a high satisfaction score in timeliness.

As for the integration of healthcare, South American respondents are the most satisfied, while the North American ones are the least satisfied.

### Equitable

Equitable	Satisfaction with government welfare	3.06
	Satisfaction with the cost of checkup	3.40

### C. Mean Score of Responses in Equitability

From all 125 responses, male respondents are overall more satisfied than female respondents. Meanwhile, the age groups with the highest and lowest satisfaction scores are 16-20 years and 41-50 years, respectively. The continent with the highest mean score in this category is Oceania and the lowest is Asia.

## A Comparative Study of Healthcare User Satisfaction with Health Checkups in Thailand and Worldwide

Thai National Health Insurance Welfare, commonly known as the "Gold Card," was originally the "30 Baht to cure every disease" project, but later changed, as covered citizens can receive treatment for free instead of paying 30 Baht. In case the treatment cost does not exceed the specified limit. The Thai National Health Insurance Welfare is one of the medical benefits that the Thai Government provides. The overall welfare covers 99.95% of the Thai population, which could be categorized into six groups: Universal Coverage Scheme (UCS), Social Security Scheme (SSS), Civil Servant Medical Benefit Scheme (CSMBS), Local Government Benefit Scheme (LG), Other schemes, and Non registered. Citizens can only request a hospital of their choice in their area of residence, known as a "regular service unit," but they can request to change hospitals no more than four times per year. Citizens can exercise their rights in any hospital except for an emergency illness or accident. The National health insurance coverage includes Promoting health and preventing disease (planning to have children / prenatal care/vaccination / physical examination), childbirth, dentistry, examination and treatment of disease, cost of medicine and medical supplies, cost of food and common room, arrangement of referral of illness to other service units, Thai traditional medicine services, and rehabilitation services for disabled people. (Mahidol University, n.d.)

Additional costs may apply to cover expenses and excess treatment that state funds do not support. In case of serious illness. In general, if the patient does not have a severe illness. There will be no charge for a hospital stay of no more than 72 hours. As stated in the paragraph above, the system could confuse Thai citizens as there are several different welfare coverage plans, each with additional benefits and criteria for eligibility. Furthermore, many minor components of the national health database, such as the people's education about their welfare and the ability to change hospitals, still lack convenience.

Despite the considerable variation of coverage, the Thai national health database still needs to be more efficient. It could impose challenges that prevent Thai people from accessing healthcare services at different hospitals. On top of that, the system still heavily relies on verifying identity via a national ID card rather than biometric information or having a connected electronic health record across different hospitals and healthcare providers. This could significantly explain the low satisfaction score amongst Thai and Asian respondents.

### Efficient

Efficient	Satisfaction with the process of checkup	3.55
	Satisfaction with the quality of the checkup	3.71

### D. Mean Score of Responses in Efficiency

From all 125 responses, male respondents are more satisfied overall with efficiency than female respondents. The age group with the highest and lowest satisfaction scores is 51 - 60 years and over and 41-50 years, respectively. The continent with the highest mean score in this category is Europe, and the lowest is Asia.

As for European countries, for example, in Germany, a medical check-up involves a thorough anamnesis, a physical examination that includes measuring blood pressure, a urine test, a blood test, and an assessment of cholesterol and blood sugar level, with additional testing recommended appropriately. Furthermore, medical checkups in Germany are part of the statutory health screening and preventive examination program, meaning all health insurance providers, public or private, will cover all standard fees for required screenings (Leading Medicine Guide, n.d.).

Meanwhile, a health examination in Thailand is a broad-spectrum disease screening To discover the possibility of having various serious diseases. Thus, it is common for Thai citizens to question the testing necessary to cover the body's health to that extent. The check-up process is similar to those in Germany, only with minor differences in testing. However, the funding of the welfare provided by the Thai government is taken care of by several different parties, which could lead to an unoptimized usage of the funding and the inability to adjust the funding to cover all groups efficiently (Trisadikoon, 2021).

Despite the similarities, there will be variations in identifying endemic or often occurring diseases throughout each region. Thailand's medical costs are higher than those in Germany while being cheaper due to heredity, environmental variations, eating disorders, and other factors. This is particularly true when considering the country's cost of living and population income.

Although the checkup process is nearly identical in Thailand and Germany, the input and output data of resources used in the Thai healthcare system highlights its flaws, resulting in a negative picture in this aspect and a low satisfaction score from the Thai respondents.

## A Comparative Study of Healthcare User Satisfaction with Health Checkups in Thailand and Worldwide

### Timely

Timely	Convenience of going to the hospital	3.65
	Satisfaction with the hospital environment	3.84
	Easiness to book checkup	3.60

### E. Mean Score of Responses in Timeliness

From all 125 responses, female and male respondents are equally satisfied with the timeliness. Meanwhile, the age group with the highest and lowest satisfaction scores is 51-60 and 41-50 years, respectively. Oceania has the highest mean score in this category, and North America has the lowest.

According to a study by Luisa Jorm from the University of New South Wales conducted in 2019, reaching a hospital could take around 75 to 663 minutes in the central part of Australia while only taking 0 to 75 minutes in coastal areas. This corresponds to the statistics published by the Australian Government, showing the majority of the population staying in large coastal cities such as Sydney, Brisbane, and Melbourne. These coastal areas could have a population density of 100 persons per square kilometer. In contrast, the central area of Australia mostly has a population density of less than 0.1 persons per square kilometer, excluding some minor cities in Central Australia with high population density. The respondents from Oceania likely live in these large coastal cities, hence their satisfaction with the timeliness of the healthcare system.

On the other hand, Thailand faces a similar pattern in the distribution of its population in the aspect of population density. A data study by The Medium shows that most healthcare providers are positioned inside the city rather than evenly spread across the area. For example, Phuket has distributed its hospitals across all its islands, resulting in an appropriate time to get to the nearest hospital. Meanwhile, its neighbor, Krabi, failed to do so, especially looking at the Ao Nang area. This very famous tourist attraction could take 30 to 70 minutes to get to the nearest hospital, allowing conditions and complications to worsen and may lead to a higher chance of fatality. Another issue Thailand faces, other than the distance to the hospitals, is the road itself.

According to WHO's *Global Status Report on Road Safety 2015*, Thailand has the second highest road traffic-related death rate in the world at 36.2 deaths per 100,000 population. With such a high rate, time is a crucial element in preventing mortality in patients who have undergone a road accident.

### Integrated

Integrated	Understanding of treatment	3.92
	Friendly attitude of staff	3.88

### F. Mean Score of Responses in Integration

From all 125 responses, female respondents are overall more satisfied than male respondents. The age group with the highest and lowest satisfaction scores is 61 years and older and 41-50, respectively. The continent with the highest mean score in this category is South America, and the lowest is North America. In the understanding of treatment, the age range that is the most satisfied is 21-30 years, followed by 31-40 years, 16 years and under, 41-50 and 51-60 years old, and 61 years or over accordingly. The results show a clear trend as the satisfaction score decreases with age, starting from the 21-30 age group.

The satisfaction score by age groups could extensively explain how the understanding of the treatment correlates to the respondent's age, with their brain mass and functionality decreasing with age. According to a study from University College London, the human brain quickly develops from mid-gestation onwards, with its gray matter reaching a peak just before six years old and the white matter just before 29 years old, gradually decreasing after the milestone.

Additionally, patients who felt that their doctors were attentive to them and regularly communicated with them had higher treatment satisfaction and adherence (*Grillo et al., 2018*). From the medical staff's perspective, patient safety culture, the shared values and beliefs amongst an institution's team, which influence their interaction with the patients (*Agency for Healthcare Research and Quality, n.d.*), is vital to prevent staff burnout and improve their work-life balance. By practicing this healthcare discipline, institutions could greatly benefit from the ability to form a healthy and resilient workforce (*Lu et al., 2022*). With this in mind, the policies implemented in Thailand still need to be adjusted. The Thai work culture must shift from being hierarchical to being more flexible, fostering a culture of cooperation and management and being receptive to the opinions of staff at all levels (*PwC Thailand, 2021*). Disassembling the workplace hierarchy could appear complicated and unnecessary to many older

## A Comparative Study of Healthcare User Satisfaction with Health Checkups in Thailand and Worldwide

generations. However, with the modern world and the need to be heard by newer generations, it is only right to adapt to the ever-changing world to maintain the quality of work. Thus, implementing appropriate working guidelines could positively influence the staff's attitude, resulting in a higher satisfaction score from healthcare service consumers.

"That is a terrible question." You can not just take the world's "best" system" (Emanuel, 2020). Ranking the health care system in each country is an extremely challenging thing to do, despite several rankings such as the "WHO World Health Report " in 2000, The Health Consumer Powerhouse (only ranking European countries), Legatum, and Bloomberg (only ranking system efficiency). Emanuel also states that most rankings have major flaws, such as a lack of updates and a ranking system favoring certain countries. Furthermore, there are no rankings with identical placements of the countries, further proving the challenge. Emanuel wrote that after his extensive research, the conclusion he has come to is that no country has the best healthcare system and that each country's system has its strengths and weaknesses.

### V. CONCLUSIONS

Several factors influence patients' attitudes or opinions toward a medical checkup. Using 125 responses obtained via an online survey combined with research to explain these results, this research explores patients' satisfaction with their healthcare system, using the WHO's determinants of the quality of care: equitability, efficiency, timelines, and integration. Furthermore, an extensive study was conducted on the Thai healthcare system, as 64% of all respondents are from Thailand.

For equitably, Asia is the least satisfied continent, and further research has been done on Thailand, an example country in Asia. Despite 99.5% of the Thai population being covered by the government welfare, the national health database still struggles to effectively operate, with complicated features such as the change of hospitals, along with the lack of Thai people's knowledge about their rights to welfare could potentially be the reason behind the low satisfaction score.

In terms of efficiency, Europe is shown to be the continent with the highest satisfaction score, while Asia is shown to have the lowest. For countries like Germany and Thailand, the checkup processes are greatly similar despite certain geographical and endemic diseases specific to each region. Though both countries' processes are similar, The Thai government fundings for healthcare is taken care of by different parties, making it inefficient and hard to manage appropriately, hence the low satisfaction scores from the respondents.

Regarding timeliness, Oceania appears to have the highest satisfaction score. It is found that the distribution of hospitals match the pattern of the country's population density in each area, resulting in the ability for most of its population to reach a hospital in under 75 minutes, which is the reason for such a high satisfaction score in timeliness. On the other hand, many provinces in Thailand still fail to position hospitals effectively, coupled with an extremely high rate of road-related deaths, the Thai respondents seem to be unsatisfied with the timeliness.

As for integration, a trend could be seen when respondents are sorted by age, the satisfaction score decreases with age starting from 21-30 years old. An explanation could be that the human brain reaches peak development in gray and white matter at 6 and 29 years old accordingly, meaning the ability to quickly understand could decrease with age. Furthermore, patients who felt that their doctors were attentive also seem to be more satisfied. Thailand still needs to improve the work culture in order to create a sustainable workforce in healthcare to satisfy both the staff and patients' needs.

### REFERENCES

- 1) Bureau of Information Office of The Permanent Secretary of MOPH. (2018, February 20). *คนไทยตรวจสุขภาพแคปีละ 2%*. [www.pr.moph.go.th](http://www.pr.moph.go.th).  
<https://pr.moph.go.th/index.php?url=pr/detail/2/07/107400/#:~:text=%22การตรวจสุขภาพ%22%20เป็นสิ่ง,เพื่อส่งเสริมสุขภาพในบุคคล>
- 2) *Why 44 million Americans continue to get annual physicals*. (2015, April 8). <https://www.advisory.com/daily-briefing/2015/04/08/why-44-million-americans-continue-to-get-annual-physicals#:~:text=According%20to%20a%20survey%20from%20the%20Kaiser%20Family,44%20million%20Americans%20get%20the%20exam%20every%20year>.
- 3) World Health Organization: WHO. (2020, July 21). *Quality of care*. [https://www.who.int/health-topics/quality-of-care#tab=tab\\_1](https://www.who.int/health-topics/quality-of-care#tab=tab_1)
- 4) *Types of health systems*. (2023, January 31). Columbia University Mailman School of Public Health. <https://www.publichealth.columbia.edu/research/others/comparative-health-policy-library/health-systems>
- 5) Kwm. (2021, June 11). *Routine medical checkups have important health benefits*. News Center. <https://news.feinberg.northwestern.edu/2021/06/11/routine-medical-checkups-have-important-health-benefits/>



## A Comparative Study of Healthcare User Satisfaction with Health Checkups in Thailand and Worldwide

- 6) *Which country has the world's best health care?* (n.d.). Google Books. [https://books.google.co.th/books?hl=en&lr=&id=x-a0DwAAQBAJ&oi=fnd&pg=PT9&dq=countries+with+the+best+healthcare&ots=h7sm51PG3x&sig=GM7yuZakTWigHN6ISNqXMycP8oi&redir\\_esc=y#v=onepage&q=countries%20with%20the%20best%20healthcare&f=false](https://books.google.co.th/books?hl=en&lr=&id=x-a0DwAAQBAJ&oi=fnd&pg=PT9&dq=countries+with+the+best+healthcare&ots=h7sm51PG3x&sig=GM7yuZakTWigHN6ISNqXMycP8oi&redir_esc=y#v=onepage&q=countries%20with%20the%20best%20healthcare&f=false)
- 7) Jorm, L. (2018). Travel times to hospitals in Australia. *researchGate*, 4. <https://doi.org/10.1038/s41597-019-0266-4>
- 8) c=AU; o=Commonwealth of Australia; ou=Australian Bureau of Statistics. (n.d.). *1301.0 - Year Book Australia, 2001*. <https://www.abs.gov.au/Ausstats/abs@.nsf/0/0B82C2F2654C3694CA2569DE002139D9?Open>
- 9) *Thailand | History, flag, Map, population, language, government, & Facts*. (2023, November 26). Encyclopedia Britannica. <https://www.britannica.com/place/Thailand/Rural-settlement>
- 10) *Bangkok population 2023*. (n.d.). <https://worldpopulationreview.com/world-cities/bangkok-population>
- 11) lwcdwafi. (2018, October 11). This Map Shows If You Will Get to The Hospital In Time from Anywhere in Thailand. *Medium*. <https://medium.com/@iwishcognitivedissonance/this-map-shows-if-you-will-get-to-the-hospital-in-time-from-anywhere-in-thailand-fd73d13aa3db>
- 12) National Health Security Office. (2016). *Universal Health Coverage in Thailand*. [www.nhso.go.th. http://eng.nhso.go.th/assets/portals/1/files/03%20UCS%20Profile%202017.pdf#:~:text=Thai%20population%3A%2065.956%20million%20Universal%20Coverage%20Scheme%20%28UCS%29%3A,Other%20schemes%3A%200.478%20million%20Non%20registers%3A%200.05%20million](http://eng.nhso.go.th/assets/portals/1/files/03%20UCS%20Profile%202017.pdf#:~:text=Thai%20population%3A%2065.956%20million%20Universal%20Coverage%20Scheme%20%28UCS%29%3A,Other%20schemes%3A%200.478%20million%20Non%20registers%3A%200.05%20million)
- 13) *More than half of people in Asia and the Pacific still lack social protection, says new ILO report*. (2022, August 30). [https://www.ilo.org/asia/media-centre/news/WCMS\\_854249/lang--en/index.htm](https://www.ilo.org/asia/media-centre/news/WCMS_854249/lang--en/index.htm)
- 14) Legido-Quigley, H., McKee, M., Nolte, E., & Glinos. (2008). *ASSURING THE QUALITY OF HEALTH CARE IN THE EUROPEAN UNION*. MPG Books Ltd, Bodmin, Cornwall. <https://iris.who.int/bitstream/handle/10665/107894/9789289071932-eng.pdf?sequence=4>
- 15) Ottonova. (2023, July 19). *Medical check-ups*. Ottonova. <https://www.ottonova.de/en/expat-guide/health-wiki/medical-check-up>
- 16) Germany, D. V. F. G. H. (n.d.). *Health check*. <https://www.leading-medicine-guide.com/en/diagnosis/medical-check-up#:~:text=A%20medical%20check-up%20in%20Germany%20is%20part%20of%20the,%2C%20medical%20practitioners%20and%20internists>
- 17) Mawlood, F. (2020, June 8). *FAQ about Medical check-up in Germany*. <https://us-uk.bookimed.com/clinics/country=germany/direction=check-up/>
- 18) *ตรวจสอบสุขภาพเบื้องต้น ตรวจอะไรบ้าง ราคาเท่าไร? | HDMall*. (n.d.). HDmall. <https://hdmall.co.th/c/health-check-up-screening#:~:text=%E0%B8%A3%E0%B8%B2%E0%B8%84%E0%B8%B2%E0%B9%82%E0%B8%9B%E0%B8%A3%E0%B9%81%E0%B8%81%E0%B8%A3%E0%B8%A1%E0%B8%95%E0%B8%A3%E0%B8%A7%E0%B8%88%E0%B8%AA%E0%B8%B8%E0%B8%82%E0%B8%A0%E0%B8%B2%E0%B8%9E%E0%B8%9B%E0%B8%A3%E0%B8%B0%E0%B8%88%E0%B8%B3,%E0%B8%AD%E0%B8%A2%E0%B8%B9%E0%B9%88%E0%B8%97%E0%B8%B5%E0%B9%88%201%2C500-7%2C000%20%E0%B8%9A%E0%B8%B2%E0%B8%97>
- 19) *งบประมาณแผ่นดินกับการจัดสวัสดิการรักษายาบาล*. (n.d.). สถาบันปริดี พนมยงค์ PRIDI BANOMYONG INSTITUTE : [Pridi.or.th. https://pridi.or.th/th/content/2021/05/694](https://pridi.or.th/th/content/2021/05/694)
- 20) Grillo, V., Tan, D., Zhao, X., & Stankas, A. (2018). Patients' Attitudes to Doctor, Treatment Satisfaction and Adherence: A Comparison of Urban China and Japan. *Value in Health*, 21. <https://doi.org/10.1016/j.jval.2018.07.675>
- 21) Ucl. (2022, May 6). *Brain charts map rapid growth and slow decline across lifespan*. UCL News. <https://www.ucl.ac.uk/news/2022/apr/brain-charts-map-rapid-growth-and-slow-decline-across-lifespan>
- 22) *What is Patient Safety Culture? | Agency for Healthcare Research and Quality*. (n.d.). <https://www.ahrq.gov/sops/about/patient-safety-culture.html>
- 23) Lu, L., Ko, Y.-M., Chen, H.-Y., Chueh, J.-W., Chen, P.-Y., & Cooper, C. L. (2022). Patient Safety and Staff Well-Being: Organizational Culture as a Resource. *PubMed Central*. <https://doi.org/10.3390/ijerph19063722>
- 24) PricewaterhouseCoopers. (n.d.). *Thai work culture needs to change to avoid brain drain: PwC*. PwC. <https://www.pwc.com/th/en/press-room/press-release/2021/press-release-08-09-21-en.html>



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## The Effect of Cross Country Running Training on Increasing the VO2Max of Alfalah Futsal Players



Hafiz Mahesvi<sup>1</sup>, Ali Satia Graha<sup>2</sup>

<sup>1,2</sup>Department of Sport Science, Faculty of Sport and Health Science, Yogyakarta State University, Indonesia  
St. Colombo No. 1, Karangmalang, Yogyakarta, 55281, Yogyakarta, Indonesia

**ABSTRACT:** This study aims to determine the effect of cross-country running training on increasing VO2Max. This research was conducted at the Jambi cross-country from July to August. Sixteen treatments were administered at a frequency of three times per week. In this study, a single group pretest-posttest was employed as the design. The researchers targeted Al-falah futsal players as their population. For a sample of sixteen individuals, inclusion and exclusion criteria were employed. The research instrument used in this study measures VO2max pretest and posttest, namely from the Multi Stage Fitness Test. The data analysis processes of homogeneity, normalcy, and hypothesis testing are carried out using SPSS. The study's normality and homogeneity statistics further demonstrate that the distribution is homogeneous and normal ( $\text{sig.} > 0.05$ ). A significant value of  $0.000 < 0.05$  in the hypothesis testing results indicates that cross-country running training increased the VO2max of Al-Falah futsal players. Based on these findings, the cross-country running training program is an effective training program for increasing VO2max.

**KEYWORDS:** Cross Country, VO2Max, Futsal

### INTRODUCTION

Futsal is a ball game played by two teams, each consisting of five people (1,2). The aim of the game of futsal is to put the ball into the opponent's goal, by manipulating the ball with the feet (3). Futsal is a physically demanding sport that requires players to move continually to attack and defend, which can wear players out. The game of futsal is played with fast movements, meaning the ball continues to roll without stopping. Futsal is a dynamic sport and prioritizes changing positions quickly to find space by running. Therefore, futsal is a high-intensity sport (4). High intensity futsal matches require physical effort, good techniques and tactics (5). According to him (6), As a result futsal is considered an intermittent sport with high intensity activity broken up by brief recovery intervals, physical conditioning is crucial for futsal players.

Aerobic endurance plays a very important role in the sport of futsal, because the game of futsal, which involves running back and forth, really requires excellent stamina over a long period of time (7). Has a good VO2max capacity, Futsal players must have it to support their desired achievements. A good VO2max helps support athlete performance (8). The ultimate aerobic power capacity of an individual is known as their aerobic ability (VO2Max). This is based on the greatest quantity of oxygen (O2) that the respiratory, cardiac, and hemohydrolymphatic systems can provide, or the amount of O2, CO2, and nutrients that are transported every minute (9). In this case VO2max is considered the gold standard for assessing a person's aerobic fitness, the higher the VO2Max capacity of a futsal player, the more oxygen the body can use for metabolism and ensuring sufficient stamina when competing.

The results of observations made by researchers were confirmed by tests and measurements to determine the player's VO2max capacity using a multistage fitness test. The measurement test that took part in 16 Al-Falah futsal team players, the results of the VO2max test were 3 players in the sufficient category, 13 players in the under category. Direct measurement of VO2max is widely considered the gold standard and assessment of fitness level (10). Knowing an athlete's endurance profile is the first step that a coach must know before creating a training program for an athlete (11). Researchers concluded from the results of the tests and measurements carried out that there was a need for a training program to increase players' VO2max. To increase VO2max, players need to be given an appropriate and appropriate training program so that the preparations go well. One of the training programs that researchers implemented was cross-country running training to get the players in good physical condition.

Cross-country running is a form of long-distance running carried out in the open, such as roads, mountains,

## The Effect of Cross Country Running Training on Increasing the VO2Max of Alfalah Futsal Players

Settlements or forests. Cross country running techniques have the same basics as long distance running techniques (12). Cross country training is a form of outdoor exercise that aims to increase VO2Max, This exercise is generally done outdoors (13).

### MATERIAL ANDMETHODS

#### Participants

This research is experimental research, The design used in this research was One group pretest-posttest. In this design there is a pretest before treatment is given so that the results of the treatment can be known more accurately. because it can be compared with the situation before treatment. The sample for this research was 16 players from the Alfalah futsal team. This research was conducted for two months consisting of 16 sessions. Sessions are held three times a week. The instrument used in this research is the multistage fitness test. Data were analyzed using statistical analysis techniques (SPSS 25).

#### Procedure

Before starting the measurements, the athletes performed a warm-up routine. The research instrument used in the study was measuring VO2max pretest and posttest, namely the instrument from the Multi Stage Fitness Test (MSFT) to monitor the development of maximum oxygen absorption (VO2max) of athletes. This test involves running continuously between two lines 20 meters apart while you hear a pre-recorded "bleep" sound. Test takers are expected to try to get to the opposite end at the same time as the "bleep" sound. every time the "bleep" sound sounds, Test takers must have arrived at one end of the track. If a participant fails to reach the 20 meter mark before the "bleep" sound, he or she will be given a warning and must keep running until he reaches the mark and at the same time increase his speed so as not to be late for the next bleep. If the test taker experiences two failures in a row, then he is considered eliminated from the bleep test and the mark he achieved last time becomes the score of this test. The treatment was carried out in 16 sessions with a frequency of three meetings per week. This test is given to determine the effectiveness of cross-country running training to increase VO2max. In each treatment of the 16 sessions, participants carried out a warm-up as an opening activity and ended with a cool-down activity.

### RESULT

The research results from 16 players are as follows:

**Table 1. Pretest and Posttest VO2Max data**

No	Pretest	Posttest	Difference	No	Pretest	Posttest	Difference
1	42,6	46,8	4,2	9	42,6	49,3	6,7
2	44,2	48,7	4,5	10	47,7	51,1	3,4
3	39,6	43,6	4	11	52,2	55,7	3,5
4	43,9	47,1	3,2	12	45,5	50,2	4,7
5	45,5	48,7	3,2	13	46,2	49,6	3,4
6	52,5	54	1,5	14	53,1	56	2,9
7	43,9	49	5,1	15	41,8	49,3	7,5
8	43,3	48	4,7	16	46,2	50,5	4,3

**Table 2. Description Data**

	N	Min	Max	Mean	Std. Deviation
PretestVO2Max	16	39,6	53,1	45,67	3,94
Posttest VO2Max	16	43,6	56,0	49,85	3,21

The results of this descriptive statistical value research, The author used a sample of 16 people to obtain an average initial VO2Max ability test score of 45.67 with a standard deviation of 3.94 and the lowest score was 39.6 and the highest score was 53.1. For the final test, the average VO2max ability score was 49.85 with a standard deviation of 3.21 and the lowest score was 43.6 and the highest score was 56.0. Before testing the hypothesis in research, Perform the homogeneity and normalcy tests as prerequisites first. Table 3

displays the results of the normality test, and Table 4 displays the results of the homogeneity test. Using the Shapiro-Wilk test to examine the sig, the normalcy test in this study determined that decision making  $> 0.05$  was considered normal. The normalcy test yielded the following results:

## The Effect of Cross Country Running Training on Increasing the VO2Max of Alfalah Futsal Players

**Table 3. Normality Test**

Shapiro-Wilk				
	Statistic	Df	Sig.	Kesimpulan
Pretest VO2Max	0,902	16	0,086	Normal
Posttest VO2Max	0,928	16	0,228	Normal

In this study, decision making  $> 0.05$  was considered homogeneous, and the homogeneity test employed the Levene Test by examining the sig value. The homogeneity test yielded the following results:

**Table 4. Homogeneity Test**

	Levene Statistics	Df1	Df2	Sig.
VO2Max	0,688	1	30	0,413

In hypothesis testing, researchers use paired t-tests. The research results can be seen in table 5:

**Table 5. Hypothesis Testing**

	Df	t-table	Sig.
Pretest-Posttest VO2Max	15	-11,555	0,000

Based on the statistical analysis of the hypothesis test which has been carried out using the paired t-test in table 5 Above, it can be concluded that cross-country running affects VO2Max in Al-Falah futsal players, as seen in the table above. This t-test verification produces a significant value of  $0.000 < 0.05$ , rejecting hypothesis H0 and accepting hypothesis H1.

### DISCUSSION

This study looked at the effect of cross-country running training on increasing the VO2Max of Al-Falah futsal players. The results of the research statistical analysis for the VO2Max level variable for the cross-country running training method had a sample size of 16 people. The minimum pretest score was 39.6 and posttest 43.6, while the maximum pretest score was 53.1 and posttest 56.0. The average (mean) for the pretest was 45.67 and the posttest was 49.85, then the standard deviation for the pretest was 3.94 and the posttest was 3.21. From the results of the data, it was then tested using a hypothesis test, in this test, verification produces a significant value of  $0.000 < 0.05$ , reject hypothesis H0 and accept hypothesis H1. It means, cross-country running training increases the VO2Max capacity of Al-Falah futsal players.

These results are in line with research conducted by (12) that after using the cross-country running method, a person's VO2Max level can improve and make it possible to carry out physical activity for a longer duration. Then research conducted by (14) shows that cross country training can increase a person's VO2Max. Thus, the cross-country running method is good for increasing VO2max. In accordance with this view, Futsal players need technique, tactics and physique to develop well in order to have good physical abilities (15). Thus, cross-country running can serve as a model for contemporary futsal coaches and players. In future research, a larger sample size and alternative activities can be employed to improve and statistically significantly raise VO2Max in futsal players.

### CONCLUSIONS

Based on the results of research conducted over six weeks, it can be concluded that there is a significant influence of the cross country running training method on increasing the VO2Max of Alfalah futsal players.

### ACKNOWLEDGMENT

Thank you to all parties who helped in the research, until finally i was able to make scientific papers in the form of article writing.

### REFERENCES

- 1) López-Samanes Á, Moreno-Pérez V, Travassos B, Coso J Del. Effects of acute caffeine ingestion on futsal performance in sub-elite players. *Eur J Nutr.* 2021;60(8):4531–40.
- 2) Pinto Oliveira da Motta LF, Breda Vicentini L, Rossi R, De-Bortoli AL, De-Bortoli R. Futsal in Field with Variable Dimensions. *Int J Innov Educ Res.* 2020;8(8):267–74.

## The Effect of Cross Country Running Training on Increasing the VO<sub>2</sub>Max of Alfalah Futsal Players

- 3) Vukušić D, Miošić L. Reinventing and reclaiming football through radical fan practices? NK Zagreb 041 and Futsal Dinamo. Soccer Soc. 2018;19(3):440–52.
- 4) Naser N, Ali A, Macadam P. Physical and physiological demands of futsal. J Exerc Sci Fit. 2017;15(2):76–80.
- 5) Borges L, Dermargos A, Gorjão R, Cury-Boaventura MF, Hirabara SM, Abad CC, et al. Updating futsal physiology, immune system, and performance. Res Sport Med. 2022;30(6):659–76.
- 6) Pupo JD, Detanico D, Budal F, Cesar P, Salvador N, Guilherme L, et al. Capacidade de sprints repetidos e níveis de potência muscular em jogadores de futsal das categorias sub-15 e sub-17. Rev Bras Ciências do Esporte. 2017;39(1):73–8.
- 7) Syroyyudin M, Firlando R, Sovensi E. Profil Kondisi Fisik Pemain Futsal Klub Blancos Kota Lubuklinggau. Silampari J Sport. 2021;1(2):63–70.
- 8) Teatro C, Thompson M, Kulinna PH, Mars H van der, Kwan J. Coaching behaviors and stakeholders' views of coaches' efficacy. Int J Sport Sci Coach. 2017;12(4):452–60.
- 9) Montero D, Diaz-Cañestro C, Lundby C. Endurance Training and V'O<sub>2</sub>max: Role of Maximal Cardiac Output and Oxygen Extraction. Med Sci Sports Exerc. 2015;47(10):2024–33.
- 10) Peric R, Nikolovski Z. Validation of four indirect VO<sub>2</sub>max laboratory prediction tests in the case of soccer players. J Phys Educ Sport. 2017;17(2):608–13.
- 11) Nilsson J, Cardinale D. Aerobic and Anaerobic Test Performance Among Elite Male Football Players in Different Team Positions. LASE J Sport Sci. 2018;6(1):71–90.
- 12) Gumantan A, Fahrizqi EB. Pengaruh Latihan Fartlek dan Cross Country Terhadap Vo<sub>2</sub>Max Atlet Futsal Universitas Teknokrat Indonesia. J Sport Pendidik Olahraga UM Jember. 2020;1(1):1–9.
- 13) Hadiana O, Sartono. Peningkatan Kebugaran Jasmani Melalui Latihan Cross Country Mahasiswa UKM Karate Dimasa Pandemi Covid 19. Phys Act J. 2021;3(1):11–22.
- 14) Manggala A, Maulana F, Bachtiar. Latihan Fartlek dan Latihan Cross Country Untuk Meningkatkan VO<sub>2</sub>MAX Pemain Sekolah Sepakbola. J Educ. 2023;9(4):1734–9.
- 15) Fathoni A, Rachman HA. Effect of Sprint Training Exercise, Shuttle Run and Prevention on Base Softball Running Speed Among High School Students. Acta Fac Educ Phys Univ Comeniana. 2020;60(1):32–43.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Management of North Jayapura Public Health Center in the Stunting Prevention Program for Children Aged 3-5 Years



Annisa Nadhirani<sup>1</sup>, Sutoro<sup>2</sup>, Ferdinant Martinus Djawa<sup>3</sup>, Dwi Angriyani<sup>4</sup>, Trajanus R. Jembise<sup>5</sup>, Evi Sinaga<sup>6</sup>

<sup>1,3,4,5</sup>Faculty of Medicine, Cenderawasih University, Jl. Raya Abepura-Sentani UNCEN Campus Abepura, Papua, Indonesia

<sup>2,6</sup>Faculty of Sports Science, Cenderawasih University, Jl. Raya Abepura-Sentani UNCEN Campus Abepura, Papua, Indonesia

**ABSTRACT:** This study aims to identify and describe the management of North Jayapura Public Health Center in the stunting prevention program in children aged 3-5 years which covers the availability of input (human resources and supplies, and funds), processes (monitoring, movement and implementation, monitoring, control, and evaluation) and outputs in the Stunting Prevention Program for children aged 3-5 years.

This study is qualitative research with a description approach. The study was conducted in North Jayapura Public Health Center from March to May 2023 involving five informants: one head of the public health center as a key informant, one chief of the nutrition and child health services and two staff of the health and child nutrition services as the primary informants, and one patient's family. Semi-structured interviews were conducted to obtain the required primary data. Stunting prevalence reports in North Jayapura Public Health Center in 2022 are used as secondary data.

The interviews showed a wide range of roles from various stakeholders in conducting stunting prevention programs, including midwives, nutritionists, the head of the Public Health Center, cadres, community figures, and health promotion. The funds obtained from the Health Operational Assistance (*BOK*) proved sufficient to implement a stunting prevention program. Facilities and infrastructure in North Jayapura Public Health Center had several adequate facilities such as complete room content based on the needs in implementing the program. The planning process (P1) of the stunting prevention program was carried out by involving screening of pregnant mothers, cooperation with Public Health Center and nursing practitioners, as well as data collection and data analysis, and then planning the activities of the PMT Program. The movement and implementation of the program (P2) was done by monitoring pregnant women at stunting risk and news. The program leaders and the head of the Public Health Center played an important role in the supervision and control of the program. Monitoring, Control, and Performance Assessment (P3) was carried out through supplementary feeding (*PMT*) and body height and weight monitoring. Coverage availability and monthly reports became important indicators in performance assessment. There were constraints in the effectiveness and efficiency of the program, especially about the availability of time and the economy of the people. Educating patients took a long time, so not all patients get optimal education. The results obtained with the presence of the Stunting Prevention Program in North Jayapura Public Health Center could show how many babies are undernourished in the Region of North Jayapura Public Health Center by always providing education and counseling to the mother to understand the importance of the health of the child. The results of the program giving PMT on the child stunting helped to improve the child's nutrition to be better.

In conclusion, the management of stunting prevention programs in North Jayapura Public Health Center requires improvements in resource management, more integrated surveillance, and improved facilities and facilities. Collaboration between the various stakeholders is also the key to the success of the program. With an in-depth understanding of the management of stunting prevention programs, it is expected that the program can be continuously improved to have a positive impact on the health of 3-5-year-olds in the Region.

**KEYWORDS:** Management, stunting, children under five, prevention

# Management of North Jayapura Public Health Center in the Stunting Prevention Program for Children Aged 3-5 Years

## I. INTRODUCTION

Poor nutrition is still one of the early childhood nutrition problems in the world today, including Indonesia. Malnutrition is a chronic nutritional problem caused by inadequate nutritional intake over a long period, the primary cause being the child's nutritional needs are not met. Stunting describes chronic malnutrition during the growth and development phases of early life (Yunus, Septiyanti, & Rahman, 2021). According to the World Health Organization (WHO) (2020), stunting is defined as short or very short based on body length/height when the limit (Z-score) is less than the -2 Standard Deviation (SD) on the WHO growth curve, due to unchangeable conditions as a result of inadequate nutritional intake and/or recurrent to chronic infections occurring in the first 1000 days of life. Short-term impacts of stunting include increased morbidity and mortality, cognitive, motor, and verbal developmental impairments in children, and economic impacts. (Situmorang & Sinaga, 2022).

According to the Indonesian Health Ministry's Nutrition Status Survey (SSGI) for 2022, the prevalence of stunting in Indonesia reached 21.6 per cent. By 2022, Papua's malnutrition rate in young children was the third highest in Indonesia, with 34.6 percent. Stunting prevalence in Papua in news increased by 5.1 percent in 2022 compared to 2021, where it was by 29.5 percent, and in 2022 in Jayapura City was at 20.6 and in Jayapura District at 20.2 percent. In the last 10 years, stunting prevalence in Papua Province has not changed significantly. In 2013, the number of stunting cases in Jayapura was 34.8 percent and in 2018 was 31.4 percent (Situmorang & Sinaga, 2022). Thus, in the 2013-2018 range there was a decrease in stunting by 3.4% and a decline of 958 cases between 2019-2020.

Despite a decline in stunting numbers in Papua, the impact of a decrease in stopping cases is still not significant. Data based on obesity also indicates an increase in stunting. Information that the researchers obtained through an interview with the Chief of the Gizi Service in North Jayapura Public Health Center, it is known that there is an increase in the number of stunting news by 63 cases by 2022. By 2021, there were 23 stunting cases. In 2022, there has been an increase in the prevalence of stunting in each department, with Gurabesi stunting 29 cases, Bhayangkara stunting 15 cases, Trikora stunting 12 cases, Mandala stunting 3 cases, and Angkasa stunting 4 cases that were not found in the previous year.

The treatment and prevention of stunting is the responsibility of all societies. This is reinforced by Mayor Jayapura's Decree No. 31 of 2020 on accelerating the decline in stunting in Jayapura. To optimal stunting treatment and prevention, it requires multi-sectoral cooperation involving researchers, public health centers, hospitals, indigenous leaders, religious and local governments (Situmorang & Sinaga, 2022).

According to the Regulations of the Ministry of Health of the Republic of Indonesia No. 75 of 2014 concerning public health centers, it is explained that public health center is a health care facility that organizes public health efforts and individual health efforts of the first level, with more emphasis on promotional, and preventive efforts, to the highest level of public health in its area of work. A public health center is a health enforcement unit under the supervision of the district/city health department. In general, public health centers should provide preventive, promotional, curative, and rehabilitative services either through Individual Health (*UKP*) or Public Health (*UKM*). Public health centers can provide hospital services in addition to street care services. There must be an effort to improve the quality of services to provide good services to an optimal level of health for the entire community (Nasution, et al., 2021) For the public health center to manage all the health work programs and efforts properly and sustainably, it must be able to formulate a plan of activities and support based on health development policy and the results of a situation analysis (evidence based). Public health center must also monitor and control the activities carried out, followed by the evaluation and resolution of emerging problems. To carry out the public health center activities by the principles and functions of good management, the government has drawn up the guidelines for the management of public health centers as set out in the PMK No. 44 of 2016 on the Management Guidelines (Kemenkes RI, 2016; Al Hikami, Mariana, & Haksama, 2022). Management is a set of processes consisting of planning, organizing, and controlling (Planning, Organizing, Actuating, Controlling) to goals effectively and efficiently. Effective means that the expected goal can be achieved through a process that is well, correctly, and high-quality, based on the results of a situation analysis supported by accurate data and information (based on evidence). However, efficiency means that public health centers can use the resources available to carry out health efforts accurately and correctly according to the standards so that they can the goals of performance that have been set. (Laihad, Sari, Woelandaroe, & Khanal, 2015). Based on the above description, some stunting-related problems are known, and the prevalence rate of stunting in Papua province is higher than the rate of prevalence nationally, which means that stunting treatment in Papua Province is still not optimal. Even an increase in the number of stunting newspapers by 2022 was found in the public health center working area of North Jayapura. The impact of stunting is not only in the short term but also in the long term, i.e. quality and productivity in adulthood, thus, it requires focus to perform stunting management and prevention to the maximum and strive to reduce stunting rates on news involving public health center management functions. Therefore, this study aims to know and explain the management of North Jayapura Public Health Center in the stunting prevention program in children aged 3-5 years which covers the availability of input (human resources and supplies, and funds), processes (evaluation, movement

## **Management of North Jayapura Public Health Center in the Stunting Prevention Program for Children Aged 3-5 Years**

and implementation, monitoring, control, and evaluation) and outputs in the Stunting Prevention Program for Children Aged 3-5 Years. Furthermore, this research is beneficial to optimize the program stunting to prevent the occurrence of stunting and improve the efforts of nutrition improvement, so that the degree of health of the child can be improved.

### **II. METOD**

#### **A. Study Design**

This research is qualitative research with a descriptive approach to digging out information, data, facts, and real circumstances and the bulk of the informants and primary data sources used, then conducting analysis and drawing a conclusion. In-depth information was obtained especially about public health center management in the implementation of the Stunting Prevention Program in children aged 3-5 years. According to Sugiyono (2015), qualitative research is the research used to examine the terms of objects, where researchers are the key instruments (Sugiyono, 2009), data collection techniques are carried out jointly, data analysis is inductive, and the results of qualitative research emphasize meaning rather than generalization. According to Nasir in Rukajat (2018), a descriptive method is a method in the study of the status of a human group, an object, a condition, a system of thought, or a peristitive class in the present.

This investigation was carried out at North Jayapura Public Health Center located at Jl. Ahmad Yani No. 70 A Jayapura, District of North Jayapura, Gurabesi Subdistrict, City of Jayapura, Papua. North Jayapura consists of 5 subdistricts, namely: Kelurahan Gurabesi, Bhayangkara, Mandala, Trikora, Angkasa. The research was conducted from March to May 2023. The research informants and data sources to be investigated are the head of North Jayapura Public Health Center, the head of nutrition and child health services, the staff of nutrition health services, and children of the community in the work area of North Jayapura Public health center (patient relatives). The data used in this study are primary and secondary. Primary data is the source of data that directly provides data to the data collector. In this study, the primary data used is the result of interviews with each respondent in terms of the readiness of the respondent from the input, process, and results of the stunting prevention program carried out by the public health center. The secondary data used in this study is the result of a documentation study on a document covering the data report on the prevalence of stunting numbers in North Jayapura Public Health Center in 2022.

#### **B. Instruments**

In qualitative research, the main instrument is the researcher himself who complements the data and compares the data that has been found through observations and interviews. Researchers plunge into their fields while collecting data, analyzing, and making conclusions (Sugiyono, 2019). In addition, the additional instruments used in this study are in-depth interview guidelines, recorders, cameras, and writing tools.

#### **C. Sampling Technique**

The researchers conducted sampling using purposive samplings based on the ability of the informant to clearly describe the management of North Jayapura Public Health Center in the Stunting Prevention Program at Balita. The informants interviewed in this study are the key informants, the primary informant, and the triangulation informant. The key informant is one person, the Chief of North Jayapura Public Health Center. The main informants are two people, the chief and the staff of the Nutrition & Child Service. The triangulated informants are three persons, the staff in the field of Environmental Health, Mother and Child Health, as well as the families of the patients.

#### **D. Data Collection**

To obtain data or information about the management of North Jayapura Public Health Center in the prevention program of stunting in children aged 3-5 years, the research techniques used in data collection, namely semi-structured interviews and documentation. However, there are limitations on the topic and the flow of the conversation, the speed of the interview is predictable, and flexible but controlled, there is a guideline for the interview that is guided by the flow, sequence, and use of the word, and the purpose of an interview is to understand a phenomenon (Herdiandyah, 2011). The researchers get direct information with the interview technique from the head of the public health center, the head as well as the nutrition and child service staff, and the community. The documentation method is done by collecting data by recording existing data. Documents relating to a person or a group of people, events or events in social situations that are very useful in qualitative research (Yusuf, 2014). The documentation used in this study includes a report of stunting prevalence data in North Jayapura Public Health Center in 2022 and images/photos as evidence gathering data during the study.



# Management of North Jayapura Public Health Center in the Stunting Prevention Program for Children Aged 3-5 Years

## E. Data Analysis

Data analysis is the process of searching and compiling data from the results of interviews, observations, and documentation by organizing data and identifying important data with what needs to be studied and making conclusions so that it is easy to understand (Sugiyono, 2007). Qualitative research data is not numerical, but rather a narrative, story, written and unwritten documents (pictures/photos), or other non-numerical forms (Poerwandari, 2005). The data in this study is the result of interviews and other conclusions that are descriptive results of analysing each conversation. Therefore, after interviewing with the respondents, several analytical steps are carried out: verbatim, initial analysis, coding, finding keywords and themes, interpretation, conclusion, data verification, and triangulation. Verbatim is a phase in which researchers copy the results of interviews from audio to word-by-word transcripts. It's done as an initial step that the researchers are doing to facilitate the next process. Early analysis is done by researchers looking at whether there are late, not clear, or need to dig deeper. When things are found that require further explanation, the researchers call back the respondents and ask for their readiness to be interviewed again until the required data has been collected in full. Encoding is encoding codes to organize and systematize data in full and detail so that the data can display an overview of the subject being studied. With these guidelines, researchers read the interview transcripts back and perform coding, performing data selection that is relevant to the subject of the discussion. The researchers tried to find keywords and themes obtained from the transcripts of interviews with the subjects. Then, the researchers selected the data that matched the problems raised in the study. Patton explained that the analysis process could include concepts derived from the responses or words of the respondents themselves (indigenous concepts) as well as concepts developed or selected by researchers to explain the phenomenon being analyzed. (Sensitizing concepts). Theoretical interpretation of understanding is the conceptual context in which a certain theoretical framework is used to understand existing statements. The final stage is to draw conclusions about the results of the research to make discussions on the subject and to submit suggestions for further research. Next is data verification and triangulation. Moleong (2011) said that the validity of data on qualitative research can be obtained by triangulation. Triangulation is a data validation technique that uses something with another to check and compare the data. According to Denzin, there are four types of triangulation techniques, that is. Triangulation of data sources is a process to test the credibility of data performed by validating data obtained from several data sources. Inter-researcher triangulation commonly called investigator triangulation, research is conducted by using more than one researcher in data collection and analysis to avoid potential individual bias in individual researchers. Triangulation method, that is, validating data through the same data source with different techniques such as interviews, observations, documents, and other data sources. In addition, researchers can also use different informants to test the truth of information. Triangulation theory, that is, the use of a variety of perspectives in analyzing a single set of data (Haryoko, Bahartiar, & Arwadi, 2020).

## F. Etika Penelitian

Research ethics is an ethical guideline that applies to any related research activity between the researchers, in which the research party (the research subject) and the society will obtain the results of such research (Notoatmodjo, 2018). This research holds firmly in the ethics of research is as follows.

Respect for human dignity Respondents need to know information about the purpose of the researchers in conducting the research. The researchers also gave the respondents the freedom to provide information or not.

- Respect for privacy and confidentiality Respondents have various basic rights as individuals who have privacy as well as the freedom to provide information. The identity of the respondent will be kept secret by the researchers using coding.
- Respect for justice and inclusiveness

Researchers always adhere to the principles of fairness, openness, honesty, and caution. The researchers condition the environment so that the principle of openness is always met, that is, by providing an explanation of the procedure in the research. Respondents are guaranteed equal treatment and benefits without distinction of gender, religion, ethnicity, and so on from researchers.

- Balancing harms and benefits in general, research is beneficial specifically to respondents and society. The researchers minimized the adverse impact on the respondents. The research conducted can prevent pain, stress, injury, and even death from the respondents.

## III. RESULTS

The interviews were conducted by the researchers from May to June 2023, the results of the research were obtained using semi-structured interviews with sources as a form of data search and engaged directly in the field followed by data analysis. The results will be described in detail as follows.

# Management of North Jayapura Public Health Center in the Stunting Prevention Program for Children Aged 3-5 Years

## A. Interview Schedule

Table 1 is a table of interviews conducted by researchers for about a month.

Table 1. Interview Schedule

Initial	Date of interview	Time of interview	Location of interview
DW	30 May 2023	14.30 WIT	Maternal and childcare room, North Jayapura Public Health Center
JN	25 May 2023	13.10 WIT	Maternal and childcare room, North Jayapura Public Health Center
ET	22 May 2023	11.30 WIT	Bhayangkara APO Subdistrict Office
TG	23 May 2023	09.30 WIT	Head officer room of North Jayapura Public Health Center
MW	16 May 2023	15.00 WIT	Jl. Pemuda Kloofkamp (Kalibiru) Jayapura

## B. Profile of Respondents

Table 2. is a respondent profile that contains the initial, age, gender, and final education. On the table, each respondent is given a code to show the respondent's sequence and facilitate the process of data analysis.

Table 2. Profile of Respondents

Initial	Age	Gender	Education
DW	47 years old	Female	Bachelor of Midwifery
JN	56 years old	Female	Bachelor of Education (Christian)
ET	48 years old	Female	Associate of Nutrition
TG	55 years old	Male	Master of Public Health
MW	34 years old	Female	High School

The study aims to analyze the management of North Jayapura Public Health Center in the stunting prevention program for children aged 3-5 years. A qualitative approach is used to gain an in-depth understanding of the role and challenges faced by public health centers in running this program. Interviews with informants actively involved in the stunting prevention program were conducted to gather data. Questions in the interview focused on aspects of management of stunting prevention programs, including human resources, funds, facilities and supplies, planning processes, movements and implementation, and monitoring, control, and performance assessment. The results of the interview showed some important findings related to the management of the stunting prevention program at North Jayapura Public Health Center.

- The role of health workers

Through interviews with DW, who has a profession as a midwife, he explained that the various roles of various parties, including midwives, nutritionists, a head of public health center, cadres, public figures, and health promotion, in the conduct of stunting prevention program, this was demonstrated by the results of interviews, stated as below:

"Who's in the role? **Midwifery, nutritionist, head of public health center, cadres, yeah... public figures, public health, health promotion**" (SDM3).

Coordination and collaboration between them are vital to the success of the program, but there are still barriers to monitoring the implementation of the program, especially about public mobility, and access to health services.

In an interview with JN, as a nutrition officer, has an important role in the stunting prevention program at North Jayapura Public Health Center. Their tasks include conducting inputs of news data indicated as undernourished and running the Supplemental Food (PMT) program in the public health center. This is proved by:

"Yah.. **I'm doing data surveys of every indicated child leading to undernourished children**, we're currently doing the Supplemental Feeding program that's done in the public health center..." (SDM2.JN)

His role in monitoring the program is to monitor the results every month to see the progress. The role of the nutritionist and the other parts of maternal and childcare is also important in running the program well.

In an interview with TG, a 55-year-old man with a Master of Public Health education who plays the Chief of North Jayapura Public health center, he explains about the stunting prevention program in North Jayapura. The program involves the provision of special supplements for infants and pregnant mothers, especially for pregnant women with protein energy deficiencies (known in Bahasa Indonesia as KEK). As the leader of the public health center, TG actively monitors the implementation of this program by going

## Management of North Jayapura Public Health Center in the Stunting Prevention Program for Children Aged 3-5 Years

down to the field to ensure that supplementary food is provided to pregnant mothers and young children by the prescribed nutritional standards. He also highlighted the role of the nutrition officer and responsible maternal and childcare in the public health center in running this program, which was proved by interviews, stated below:

"Yes, **the chief, as the leader of the public health center, has always been monitoring the implementation of supplementary feeding activities for pregnant mothers and young children in the way that he controls the descent to the field**, where this year there are 15 of pregnant women who have been undernourished and 15 newspapers who are being given supplemental feeding funded by the Health Operational Assistance (BOK) Fund. In 2003, it was every two weeks that he would be monitored for his body weight and height and the father as a leader should look at the performance of his activities every day because it was given food every day every three months later after that he will be checked again for their growth and development. So Dad went down the field checking it really not until there, really not implemented.. like that, really don't they make food according to the nutritional standards that are made, Dad used to control like that" (SDM2.TG)

"yes.. he went out the field, checking.. actually not.. every 2 days once. not every day, because he has also a lot of activities outside as a leader checking how to process the food in what they do in this public health center, in the kitchen pantry we do not conform to the standard of nutrition that has been determined by the Ministry of Health in the Rectorate of Nutrition. (SDM4.TG)

In an interview with ET, a 56-year-old woman with an education background with a Bachelor of Education in Christian education, explained the stunting prevention program at North Jayapura Public Health Center. ET learned about the program and played a role in providing information to families with stunted children, prospective brides, and pregnant mothers through the LCMIL application for deposit. In the stunting prevention program, various stakeholders are involved such as cadres for family plans, cadres, virgins, and nutrition officers. One of the nutritionists involved is Sister J, as well as Katrin who is a nutritionist from North Jayapura Public Health Center. ET monitored the activities of the stunting prevention program by looking at the changes in the weight of the children brought to the integrated healthcare center. They also saw changes in the road to health cards, such as shifting lines that indicate the situation under the red line or below the red line proven by interviews, stated below:

"Eh... we're gonna give it to you. **Giving information to the families whose children are stunting**, there is a future bride, continues to pregnant woman.. **pregnant woman who is pregnant can we use the application LCMIL.. to get started**" (SDM2.ET)

"Cadre for family planning, cadre, midwifery, nutritionist. Yes, Sister J, eh. There's Katrin (nutritionist from North Jayapura Public Health Center) (SDM3). **When the kids were taken to the integrated healthcare center, we could see that there was a change**, maybe they didn't go up one kilo, one kilo... so... no, they must have moved the line from the Road to the Health Card (KMS), there's a young green, old green, green what you see there. **If there's a line and it goes down, it means under the red line** (SDM4). Based on the results of an interview with a female respondent named MW. In the interview, MW showed his understanding of the stunting prevention program and its role in running it. He feeds his son three times a day and sometimes gives him milk and snacks. According to MW, nutritionists, midwives, and doctors are involved in the program. To monitor the activities of the program, MW obtained information from other mothers through the integrated healthcare center and descended to the public health center directly. However, MW did not know whether the nutrition officers regularly provide reports on the development of the program and the nutritional status of the young in the public health center region of North Jayapura. In terms of facilities and supplies, MW mentions the presence of tables, chairs, and news measuring instruments in the public health center.

"**Usually my kid is fed 3x a day..** sometimes also bought milk same meal" (SDM2.MW)

"**I usually get inform from mom-mama if there is integrated healthcare center so..** if there's service I usually go take my kid to public health center years ago.. not every time integrated healthcare center service available" (SDM4.MW).

- Source of Funds

Furthermore, the funds obtained from Health Operational Assistance (BOK) proved to be inadequate to fully implement the stunting prevention program. The allocation of funds must be managed wisely and adequately by the established jurisprudence. Other drawbacks include the lack of appropriate means and supplies, such as a lack of Doppler for the pregnant mother's examination proved by the results of interviews, namely:

"If enough, not enough, yes.. **it is enough that there is** hehe. He'eh, the money is only from Health Operational Assistance" (DN2). In terms of funding, JN mentioned that the funding for the stunting prevention program in North Jayapura Public Health Center came from BOK (Health Operational Assistance) that was granted was sufficient to implement the stopping prevention program. The allocation of funds is carried out through local supplementary feeding donations and local feed supplies. In running a stunting prevention program, JN mentioned that the means and tools available are anthropometric kits, which are used to measure the weight, height, and length of the young. There is no mention of any obstacles or problems encountered in connection with the means and purposes of this program.

## Management of North Jayapura Public Health Center in the Stunting Prevention Program for Children Aged 3-5 Years

In terms of funding, the stunting prevention program in North Jayapura Public health center is funded through Health Operational Assistance fund (BOK: *Bantuan Operasional Kesehatan*). Although TG stated that the funds were large enough, this is proved by: "weh... if you want to see if you see the first phase of the program, **it feels big enough, it's big enough yes, he'em**" (DN2.TG). TG is also aware of the importance of monitoring the implementation of the program continuously. Based on the explanation from TG proved by:

**"Big..he'eh our funds are pretty big, yeah.** That's about three hundred... yeah, if it's worth a lot, then three-hundred... eighty million... one-year, yes, that's divided as well... that is also... yes, for prevention... for supplementary feeding. Oh... three hundred fifty-seven million nine hundred ninety-eight thousand total local supplementary feeding budget. That's a total of one year, yeah... it's divided into having its transportation for the shipping officer or its funds, there's an ATK also continues to exist for... so this latest technical instructions eighty-three percent (83%) of the total funds for the processing and delivery, fifteen percent (15%) for the transportation of the secret officer, two percent (2%) for those related to the SPJ nutrition responsibility, two per cent (2%) stationary, for example. as it is divided out, like that's the tax cut and the rest is just implemented" (DN3).

Regarding the source of funding, the stunting prevention program in North Jayapura Public Health Center is funded by the National Population and Family Planning Board (BKKBN). Even though ET said the funds were insufficient, they still implemented the program by dividing it evenly among the 30 people involved in the program. The goods and supplies available in the North Jayapura Public Health Center belong quite well, although the ET expressed a desire to have its building to be able to store goods or equipment better stated in the interview, stated as below:

**"The source of money from BKKBN.** The one we've been following since last year. So, we're in three months or six months. So, from January to June, we're making the reports, how much we keep the clown boys, so that's... so yeah. One group is 3.10 thousand rupiah for 3 people for 3. It's not logical if we want what it's called, what the hell we're buying with this." (DN1.ET).

- Facilities and infrastructure

The funds are allocated to various aspects of the program, including transportation of nutrition officers, processing, and delivery of food supplements, as well as administrative needs such as stationary (ATK). In terms of facilities and facilities, North Jayapura Public Health Center has sufficient facilities to implement a stunting prevention program. They have their own kitchen for food processing, rooms equipped with chairs and tables, as well as adequate air conditioning. TG believed that the facilities and infrastructure are already in line with the targets set by the interview results, namely:

"..the advice is, if we have for food processing we have our kitchen upstairs then we can see on the 3rd floor there thou, Ms. J is cooking. **if facilities and infrastructure have their room there, the advice is that if it has a table chair, there are all complete, there is a good room. Prevention of stunting of the processing of food yes** kitchen above.. there is all." (SP1.TG).

According to MW, the infrastructure and facilities are already sufficient by the target. However, there is no information about the obstacles faced if the facilities are not suitable is proved by:

**"it has a table of chairs the same measuring tools are it.. there is a weight of news"** (SP1.JN).

- The process of planning, movement, and implementation, as well as monitoring, control, and evaluation of performance

The planning and preparation of the stunting prevention program has been carried out involving screening of pregnant mothers, cooperation with public health centers and nursing nurses of networking practices, and data collection and data analysis, proved by:

"ee.. the planning of the preparation that was done that ee.. can **the pregnant mother in the screening** then the mother's babies also continued.. what.. **collaboration with the public health center and the nurser practice the networking together**, that is." (PR1).

**"The collection of data... as it is obtained from the results of the examination of patients that came continuously** ee.. what... came to the public health center or integrated healthcare center if the risk of stunting is detected ee.. we usually follow up with the nutrition officer and his team" (PR2).

**"Not all the statistics are supervised**, eh. 'Cause some people don't check in the public health center, some people check in hospitals, practitioners, we're gonna go, that's it.' (DN4).

JN explains that the planning of the stunting prevention program is done by looking at news data that requires intervention. The data collection is carried out through the *EPPGBM* application, and the data analysis is done through the *PSG* (Nutrition Status Analysis). New issues that require attention can be identified through the application, and then the supplementary feeding program is planned. The five-year plan refers to the plan from the health service, while the activity proposal plan is compiled based on data from the *EPPGBM* application. In the implementation of the stunting prevention program, JN works with cadres to monitor the nutritional status of youngsters regularly. This monitoring involves measuring the weight, height, and length of the young. JN also mentioned that the head of the public health center has authority and responsibility over the program

## Management of North Jayapura Public Health Center in the Stunting Prevention Program for Children Aged 3-5 Years

implemented. Regarding the monthly mini-workshops and cross-sector tribulations, JN addressed the question to the head of the public health center. This is proved by the results of the interview, namely:

"it is from us, **based on data from the EPPGBM application** later obtained data how much is planned to carry out this supplementary feeding program" (PR2.TG/ PR5.JN)

"the arrangement yes we ee.. **arranged with the team then we talked with cross-sector and cross-program**" (PR6.JN)

In carrying out the stunting prevention program, North Jayapura Public Health Center has carried out mature planning. They referred to *Renstra* (Strategic Plan) Public health center and carried out the collection and analysis of data to identify the problem and formulate a five-year plan proved by:

"if the planning at all.. that we already.. our stunting territory is quite large in the richness of Gurabesi. We have 5 richnesses, Gurabesi, Bhayangkara, Mandala, Trikora, and Space. Well, to prevent it, it's just that we're now for the prevention that's already outdated. We don't have this anymore. We're preventing it from the womb until she's born. By then they're not gonna grow short anymore, but their children are gonna be tall and tall, enough for their intake... that's it. And this program is gradual we love, next year there is another, next year there is, like that.. **And it's already planned this is a national program so we're dedicated to following the national program and our task to find data on the number of stunts in the Jayapura region, especially in the North Jayapura Public Health Center** work area that we go down, we'll go down.. we check the data all we give them supplementary feeding, such that.. we monitor every 2 weeks once, we measure his weight height, such as that.. his mother we check his pregnancy health of his baby, such a..."(PR1).

"oh, **we have Renstra. Renstra, the strategic plan of the public health center that we've been making five years ahead**, containing our public health center program, **we refer to Renstra of National Health Ministry ee while we are Renstra our last 5 years ago in 2022 in this, we are putting together another from 2023 to 2027**, that's *Renstra* we have ahead. So if for the special planning stunting about this strategic plan, we have the data, we plan for example in this explanation, for example, we get 35 people for the planning ahead we predict, we raise 10% of the number e. g. the number of babies 35 we increase about 10% how, in the next year we increase maybe ee 35 ordinary 40, for example, **so that we can plan for the future like that, but we are also only planning but in the field, we remain down every year**, so if this year we fall later in November we go down again, we see how many stunting we have." (PR4.TG)

The data was also transmitted to the health service and related ministries.

"So, we have an application, **an application... BBG... BBGM...** if it's not the wrong one, the officer knows it, then you can ask **the officers it is the inputs of every data that we have input directly into it is directly sent to the health service to the center of the ministry**. BBGM application is.. if it is wrong, try then ask the nutrition officer Ms. J yes. the application is yes. Well, there they can put in they go down the field to the integrated healthcare center, they come down to the pitch to the... those houses they get, they input every day. From that data linked to the center, the center saw, oh like this.. later next year they sent the money for us to do the nutritional improvement, like that..." (PR2.TG).

In program planning, ET explained that they used healthy boxes as a tool for cooking supplements. However, they faced obstacles in the procurement of foodstuffs, such as green beans that are frequently exposed to yeast. They suggested that the funds be given in the form of money so that they can manage it themselves. ET stated that no performance assessment was made by the public health center in connection with the implementation of the program. However, the services in the program were considered effective and efficient with smooth communication between all parties involved.

At the planning stage, MW lacks knowledge of the planning and preparations undertaken in the stunting prevention program. The data collection is done by recording the patient's data in the KMS book or writing it on paper, as well as by checking the weight and height stated in the interview, i.e.

"Is this **the book of the road to health card**? Or it's typically written on paper... **there's data like weighing the same height measured body newly written there.**" (PR2.MW)

Overall, the interview with MW gave an overview of my understanding and experience related to the stunting prevention program at North Jayapura Public Health Center. Although there are some things that MW is less aware of, such as program planning and certain aspects of program execution, he shows his participation in feeding his son and feels an improvement in the nutrition of his package.

Problem identification and problem-solving is done through education to patients and strengthening of cadres. Five-year plans and proposed action plans are also prepared regularly. In the movement and implementation of the program, grouping is done by monitoring pregnant mothers at stunting risk and monitoring newborn babies. The program manager plays an important role in the supervision and control of the program, with the support of the head of the public health center. Monthly mini workshops and cross-traffic tribulations are also part of the program control efforts. In performance assessment, access to coverage and

## Management of North Jayapura Public Health Center in the Stunting Prevention Program for Children Aged 3-5 Years

monthly reports are important. However, there are still constraints in the service and effectiveness of the program, especially related to the availability of time and the economy of the people proved by:

"**eee effective efficient.. not even at all.. hehehe because ee to educate one patient takes quite a long time, quite a lot, so apparently not all patients, apparently the time is less**" (3P4).

JN noted that monitoring of stunting prevention program is carried out through supplementary feeding (*PMT*) and body height and weight monitoring. The control of the program is done by making a vow to the parents of the newspapers to come to an integrated healthcare center/ public health center. The evaluation of the performance of the public health center in the program execution is done by looking at the access data of the stunting prevention program, especially stunting data.

In the implementation of the program, the nutrition officer plays a role in providing counselling, nutritional advice, and supplementary food (*PMT*) to the young. TG explained (*PMT1*) that they regularly monitor the implementation of counselling, adjudication, and *PMT*, as well as conducting program evaluations through monthly mini workshops. He also explained the importance of cross-trafficking in stunting prevention efforts, involving district heads, educators, religious figures, community figures, and schoolteachers. In its assessment of the performance of the public health center, TG explained that it carried out strict monitoring and monitoring of the implementation of the program. If there's an obstacle, he'll give you a warrant and make sure the repairs are done. It also stated that the services in the implementation of the program had been effective and efficient.

In the implementation of the program, TG said that it could not be known with certainty because the evaluation of growth and development of the news was carried out after three months of program implementation. The number of stunting cases also still needs to be asked of the nutrition officer. However, he said that the stunting prevention program with *PMT* has the potential to help improve young children's nutrition. Finally, TG that through this program, the knowledge of mothers who have news about the importance of nutritional status in children is increasing.

MW also lacks knowledge about identifying problems, solving problems, preparing the Five-Year Plan, the Activity Proposal Plan, and the Plan of Implementation of Activities in the public health center of North Jayapura. In the implementation of the program, MW explained the existence of a grouping of tasks, in which the nutrition section focuses on stunting, while the others have their respective tasks. He also mentioned that nutrition officers and doctors have authority and responsibility for the program implemented.

In terms of counselling, nutrition assessment, and *PMT* news, MW knows that the nutrition officer is doing it. Monitoring related to counselling, maternal counseling, and *PMT* on the news is done by giving food to the news, giving information for the food to run out, and giving the au ram. According to MW, his son improved after the program was implemented. In the surveillance phase, the MW performs the monitoring by feeding three times a day. He also explained how to control the stunting prevention program, which is to give milk first if the child hasn't eaten yet. North Jayapura Public Health Center gets a good assessment in the service to the public this is discussed in the interview, namely:

**"It's customary if you take the food *PMT* to the house is just love all the time**, you know the food has to be finished and you've been given a ram au as well" (*PMT2.MW*). **"If given the 10 ram, kid is better**, you have to do so that you want to eat continuously so that the food gets into the body..." (*PMT3.MW*).

In the output, MW mentioned that his son had improved in child nutrition, with a normal height of ram au. However, there is no information on the total number of stunting cases. MW stated that mothers who have a baby understand the importance of nutritional status in the baby. However, he also expressed his confusion and anxiety in cooking food suitable for his package. In the case of supplementary feeding (*PMT*), MW says that *PMT* can help improve the nutrition of infants. However, there is no information about the overall outcome of the *PMT* program in stunting prevention.

In terms of the outcome of the program, ET revealed that the number of stunting cases in the Bhayangkara Subdistrict of 23 children is stated at:

"We were surprised... when there was a meeting with the head of the service, the chief of service said in the Bhayangkara Subdistrict 119 children, I am asking "who has? What kind of kids are they?" In 2021 he said it was based on ram au. Where did the criteria come from? If only then we hadn't had a circumference of the head. We didn't measure the length of the body. If upper arm's length might have gone, but that's probably two or three times a month, huh. "for 10 Ram au head of the public health center has signed..." "Let the head of public health center have signed... 10 ram au know, I don't want... try to tell me first as many as 119 that from any integrated healthcare center..." **"It turns out to be around 23..."** (O1.ET).

However, he did not know by what criteria the amount was calculated. Regarding the knowledge of mothers about the nutritional status of babies, ET noted that most mothers have understood the importance of nutrition in babies. Despite obstacles in the implementation of the program, such as difficulties in the procurement and distribution of supplements, the stunting prevention program with *PMT* in North Jayapura Public Health Center has the potential to help improve the nutrition of young people.

## Management of North Jayapura Public Health Center in the Stunting Prevention Program for Children Aged 3-5 Years

### IV. DISCUSSION

This study aims to identify and describe the management of North Jayapura stunting prevention program in children aged 3-5 years which covers the availability of input (human resources and supplies, and funds), processes (evaluation, movement, and implementation, monitoring, control, and evaluation) and outputs in the Stunting Prevention Program in Children aged 3 to 5 years. Overall, management of the stunting prevention program in the North Jayapura Public Health Center requires improvements in resource management, more integrated surveillance, and improved facilities and facilities. Collaboration between the various stakeholders is also the key to the success of the program. With an in-depth understanding of the management of stunting prevention program, it is expected that the program can be continuously improved to have a positive impact on the health of 3-5-year-olds in the region. The results of the research will be discussed below concerning the implementation of public health center management.

The implementation of public health center management is divided into three parts: 1) Input, 2) Process (P1,P2,P3), 3) Output. The Input process includes HRM (Human Resources), funds, and resources. The Processes (P1,P2,P3) are divided into three parts, Planning and Preparation (P1), Moving and Implementing (P2), and Monitoring and Control (P3). The latter is the output that is the result of the program carried out. Inputs in the context of stunting prevention programs cover aspects of human resources, funds, and resources (Phitra et al., 2023). The stunting prevention program in North Jayapura Public Health Center has adequate input, well-coordinated processes, and measured results. In overcoming existing barriers, it is important to involve collaboration among the various stakeholders as well as a wise management of funds. Thus, it is expected that stunting prevention program can provide significant benefits in efforts to improve the health of children in the community.

The results of the interviews show that the diverse roles of the various parties are an important part of running the program. The parties involved include the midwife, the nutritionist, the head of the public health center, cadres, public figures, and health promotion. Stunting is a chronic nutritional problem that is common among children in various countries, including Indonesia. To address this problem, the government and various health institutions have undertaken stunting prevention efforts through program aimed at improving the nutritional status of children, especially during pregnancy and the first two years of life. (Setiarsih et al., 2023). Collaboration and coordination between them are crucial to the success of the stunting prevention program (Setiarsih et al., 2023; Afandi et al., 2023).

The results of this study show that there are some obstacles faced in terms of this input. First, the funds obtained from the Health Operational Assistance (BOK) proved insufficient to implement the stunting prevention program thoroughly. Therefore, the allocation of funds must be managed wisely and covered by the established budget. Furthermore, there is a shortage of appropriate tools and tools to run a stunting prevention program. For example, there's a lack of Doppler for the pregnant mother's examination. Although North Jayapura Public Health Center has some adequate facilities, there is still a desire to improve facilities and supplies, including having its building for better storage of goods and equipment.

The research finds that the process (P1,P2,P3) in the stunting prevention program involves several stages, namely planning and preparation, movement and implementation, as well as monitoring and control, as described by Palapessy et al. (2023). In this phase, a five-year plan and a proposed plan of activities are also regularly prepared. This planning process ensures that the stunting prevention program has a clear direction and the right action plan. Special administrative support in program planning or budgeting is essential to do in the prevention of stunting (Syafrawati et al., 2023).

The movement and execution stage (P2) involves grouping and monitoring pregnant mothers at stunting risk and infants. Nutrition officers and other teams are involved in the follow-up to the detected news at stunting risk. In this phase, it is important to run the Supplemental Food (PMT) program and monitor news developments regularly. The results of research by Syafrawati et al. (2023) found that the factor driving the accelerated decline in the prevalence of stunting is the high commitment of public health centers to focusing on maternal health through classrooms for pregnant mothers, babies, infants, and children under five years. Monitoring is carried out through supplementary feeding (PMT) and monitoring of height and weight. coverage access and monthly reports become important indicators in performance assessment. Implementation of appropriate responsibilities by health workers in specific and sensitive program and integration of monitoring and evaluation with outcomes affecting the prevalence of stunting (Syafrawati et al., 2023). Although the process has been carried out, there are constraints in the effectiveness and efficiency of the program, mainly related to the availability of time and the economic constraint of the population. Educating patients takes a long time, so not all patients get optimal education. (Adriany et al., 2023).

The output of this stunting prevention program involves several aspects that need to be evaluated. Program access can be measured through indicators such as increased screening coverage of pregnant mothers, the number of newborns receiving PMTs, and monitoring the growth of newcomers. Besides, the success of the program can also be seen from increased public awareness and understanding of the importance of stunting prevention. (Sukmawati et al., 2023). The decrease in the number of stunts in

## Management of North Jayapura Public Health Center in the Stunting Prevention Program for Children Aged 3-5 Years

the community is a form of the success of the program (Manalor et al., 2023). However, the evaluation of the outcome of the programs also needs to consider the existing constraints, such as the limitations of program monitoring and monitoring related to public mobility and access to health services. In addition, the management of funds and the improvement of adequate facilities should also be a concern to improve the effectiveness of stunting prevention programs.

A stunting prevention program is an effort involving a variety of vital components (Surbakti & Ismail, 2023). First, education and public awareness are key to this program. Through proper education on good and balanced nutrition, care for pregnant mothers, exclusive breastfeeding, and giving nourishing food to children, it is expected that the community can adopt optimal diets and care to prevent stunts (Pratiwi & Asnuddin, 2023). Furthermore, the program involves integrated health care. Collaboration between midwives, nutritionists, doctors, and other health workers is vital. With integrated services, monitoring and monitoring of child growth can be done well, so early intervention can be given if any nutritional problems are detected.

Increased access to health care is also the focus of the stunting prevention program (Sazali et al., 2023). It is important to ensure easy and affordable access for pregnant mothers and children, including adequate health facilities, good prenatal care, and access to adequate nutritional resources. Good and balanced nutrition is an important component of this program. Providing nutritious food to pregnant mothers and children is the main focus. Adequate intake of nutrients, such as proteins, vitamins, minerals, and essential fatty acids, should be carefully observed. Exclusive breastfeeding for six months is also a priority in this program (Dearden et al., 2023). Regular monitoring and monitoring of children's growth is an integral part of the stunting prevention program (Misnaniarti & Rahmiwati, 2023). Periodic measurements of height and weight can detect inappropriate growth and provide immediate intervention if necessary. This function can be optimized through capacity building of integrated healthcare center cadres (Astikasari, 2023).

The success of the stunting prevention program also depends heavily on inter-stakeholder collaboration. Good cooperation between governments, health institutions, communities, and other related sectors is essential in integrating the necessary programs, resources, and support (Syafrawati et al., 2023). In the evaluation of stunting prevention programs, monitoring, and measurement of program access as well as impact assessment achieved are important. A decrease in stunting prevalence, increased screening coverage of pregnant mothers, an increase in exclusive milk coverage, and increased public awareness of stunting can be indicators of the success of the program (Miele et al., 2023).

Thus, the stunting prevention program involves interrelated components. With proper education, integrated health care, access to health services, good and balanced nutrition, monitoring and monitoring of child growth, as well as inter-stakeholder collaboration, it is expected to reduce the prevalence of stunting and improve the quality of life of children. Comprehensive evaluation continues to ensure that the program is effective in achieving its objectives.

### V. CONCLUSIONS

1. The results of the interviews revealed the diverse roles of various stakeholders in conducting stunting prevention programs, including midwives, nutritionists, the head of public health center, cadres, public figures, and health promotion. Coordination and collaboration between them are crucial to the success of this program. The funds obtained from the Health Operational Assistance (BOK) proved sufficient to implement a stunting prevention program. The allocation of funds must be managed wisely and covered by the set budget. Facilities and infrastructure in North Jayapura Public Health Center has several adequate facilities such as complete room content based on the needs in implementing the program.

2. The planning process (P1) of the stunting prevention program is carried out by involving screening of pregnant mothers, cooperation with public health centers and nurses of networking practice, as well as data collection and data analysis and then planning the activities of the *PMT* Program (Supplementary Feeding). The movement and implementation of the program (P2) is done by monitoring the pregnant women at stunting risk and news. Nutrition officers and other teams are involved in the follow-up to the detected news at stunting risk. The program leaders and the head of the public health center play an important role in the supervision and control of the program. Monitoring, Control, and Performance Assessment (P3) is carried out through supplementary nutrition (*PMT*) and body height and weight monitoring. Coverage availability and monthly reports become important indicators in performance assessment. There are constraints in the effectiveness and efficiency of the program, especially about the availability of time and the economy of the people. Educating patients takes a long time, so not all patients get optimal education.

3. The results obtained with the presence of the stunting prevention Program in North Jayapura Public Health Center can show how many babies are undernourished in the public health center region of North Jayapura by always providing education and counseling to the mother to understand the importance of the health of the nutrition of the child.

Based on the above conclusion, several recommendations which may be related would be:



## Management of North Jayapura Public Health Center in the Stunting Prevention Program for Children Aged 3-5 Years

1. This research can focus on measuring the effectiveness of the stunting prevention program carried out in North Jayapura Public Health Center. To what extent the program is successful in reducing stunting incidence, raising public awareness, and improving access and utilization of nutrition-related health services might be revealed.
2. The research can examine the factors that influence the success of stunting prevention programs in the North Jayapura Public Health Center. The factors that can be studied include inter-party collaboration, program monitoring, adequate fund allocation, adequacy of facilities and facilities, and the effectiveness of program implementation.
3. This research can focus on the evaluation of fund management used for the stunting prevention program in North Jayapura Public Health Center. How the allocation of funds from the Health Operational Assistance (HOS) is used should be analyzed, the efficiency of the use of the fund, and whether the funds are sufficient for the goals of the program.
4. This research can look at the role of nutrition officers in running a stunting prevention program in the North Jayapura Public Health Center. The experiences and challenges faced by nutritionists, as well as their contribution in collecting data, providing nutrition education to pregnant mothers and infants, and monitoring the growth of the child might be evaluated.
5. This research can conduct an evaluation of the availability and quality of facilities and infrastructure in the North Jayapura Public Health Center related to the stunting prevention program. Infrastructure needs like Doppler for pregnant mother inspection and better management of storage facilities and equipment may be explored.

### ACKNOWLEDGMENT

The authors are grateful to the North Jayapura Public Health Center and all informants for permitting the data collection process carried out and for the assistance provided during this research.

### REFERENCES

- 1) Adriany, V., & Tesar, M. (2023). Unpacking the discourses of stunting in Indonesian early childhood education and parenting. *Children & Society, 37*(2), 311-325.
- 2) Afandi, M. N., Tri Anomsari, E., Novira, A., & Sudartini, S. (2023). Collaborative governance in a mandated setting: shifting collaboration in stunting interventions at local level. *Development Studies Research, 10*(1), 2212868.
- 3) Al Hikami, M. U., Mariana, & Haksama, S. (2022). Analisis Penerapan Manajemen di Puskesmas Pacet Berdasarkan PMK No. 44 Tahun 2016 Tentang Pedoman Manajemen Puskesmas. *Manajemen Kesehatan Indonesia, 10*(1), 7-19.
- 4) Ambarwati, M. R., Rahayu, T. P., & Herlina, T. (2016). Fungsi Manajemen Puskesmas dalam Program Pemberian ASI Eksklusif (Studi Kualitatif di Wilayah Kerja Puskesmas Sumberagung). *Jurnal Penelitian Kesehatan, 14*(4), 227-232.
- 5) Annur, C. M. (2023, Februari 2). *Prevalensi Balita Stunting Indonesia Berdasarkan Provinsi (2022)*. Retrieved Maret 22, 2023, from katadata.co.id: <https://databoks.katadata.co.id/datapublish/2023/01/26/angka-stunting-indonesia-turun-pada-2022-rekor-terbaik-dekade-ini>
- 6) Annur, C. M. (2023, Februari 3). *Prevalensi Balita Stunting Provinsi Papua Menurut Kabupaten/Kota (2022)*. Retrieved Maret 22, 2023, from katadata.co.id: <https://databoks.katadata.co.id/datapublish/2023/02/03/prevalensi-balita-stunting-kabupaten-asmat-tertinggi-di-papua-pada-2022>
- 7) Arifin, A., Darmawansyah, & A Tenri Sanna Ilma S. (2011). Analisis Mutu Pelayanan Kesehatan Ditinjau Dari Aspek Input Rumah Sakit di Instalasi Rawat Inap RSUD Haji Makassar. *Jurnal MKMI, 7*(1), 141-149.
- 8) Arifin, S., & et al. (2016). *Dasar-Dasar Manajemen Kesehatan*. Banjarmasin: Pustaka Banua.
- 9) Arifudin, Sudirman, & Andri, M. (2017). Evaluasi Sistem Manajemen Sumber Daya Manusia pada Penempatan Kerja Petugas di UPT Puskesmas Lembasada. *Promotif: Jurnal Kesehatan Masyarakat, 7*(1), 1-14.
- 10) Astikasari, N. D. (2023). Posyandu Cadres On Capacity Building: Prevent Stunting By Improving Nutrition During The First 1000 Days Of Life. *Journal of Global Research in Public Health, 8*(1), 145-150.
- 11) Bappenas. (2018). *Pedoman Pelaksanaan Intervensi Penurunan Stunting*. Jakarta: Bappenas (Badan Perencanaan Pembangunan Nasional).
- 12) Black, R. E., et al. (2008). Maternal and child undernutrition: global and regional exposures and health consequences. *Lancet, 243-260*.
- 13) Branca, F., & Ferrari, M. (2002). Impact of micronutrient deficiencies on growth: the stunting syndrome. *Annals of nutrition & metabolism, 8-17*.
- 14) Dearden, K., Mulokozi, G., Linehan, M., Cherian, D., Torres, S., West, J., ... & Hall, C. (2023). The Impact of a Large-Scale Social and Behavior Change Communication Intervention in the Lake Zone Region of Tanzania on Knowledge, Attitudes,

## Management of North Jayapura Public Health Center in the Stunting Prevention Program for Children Aged 3-5 Years

- and Practices Related to Stunting Prevention. *International journal of environmental research and public health*, 20(2), 1214.
- 15) Depkes RI (Departemen Kesehatan Republik Indonesia). (2004). *Keputusan Menteri Kesehatan Republik Indonesia Nomor 128/MENKES/SK/II/2004 Tentang Kebijakan Dasar Kesehatan Masyarakat*. Jakarta: Depkes RI.
  - 16) Haryoko, S., Bahartiar, & Arwadi, F. (2018). *Analisis Data Penelitian Kualitatif (Konsep, Teknis, & Prosedur Analisis)*. Makassar: Badan Penerbit UNM.
  - 17) Herdiansyah, H. (2011). *Metodologi Penelitian Kualitatif*. Jakarta: Salemba Humanika
  - 18) Iryana, & Kawasati, R. (2019). *Teknik Pengumpulan Data Metode Kualitatif*. Sorong.
  - 19) Ismaniar, H. (2015). *Manajemen Unit Kinerja, Untuk: Perekam Medis dan Informatika Kesehatan Ilmu Kesehatan Masyarakat Keperawatan dan Kebidanan*. Yogyakarta: Deepublish.
  - 20) Kemenkes RI (Kementerian Kesehatan Republik Indonesia). (2016). *Peraturan Menteri Kesehatan Nomor 44 Tahun 2016 Tentang Pedoman Manajemen Puskesmas*. Jakarta: Kemenkes RI.
  - 21) Kemenkes RI (Kementerian Kesehatan Republik Indonesia). (2019). *Peraturan Menteri Kesehatan Nomor 43 Tahun 2019 Tentang Pusat Kesehatan Masyarakat*. Jakarta: Kemenkes RI.
  - 22) Kemenkes RI (Kementerian Kesehatan Republik Indonesia). (2011). Keputusan Menteri Kesehatan RI Nomor 1995/MENKES/SK/XII/2010 Tentang Standar Antropometri Penilaian Status Gizi Anak. In *Direktorat Jenderal Bina Gizi dan Kesehatan Ibu dan Anak*. Jakarta: Kemenkes RI.
  - 23) Kristanto, V. H. (2018). *Metodologi Penelitian Pedoman Penulisan Karya Ilmiah*. Yogyakarta: Deepublish.
  - 24) Laihadi, F., Sari, J. K., Woelandaroe, R. D., & Khanal, S. (2015). *Buku Panduan Perencanaan Tingkat Puskesmas Terpadu*.
  - 25) Manalor, L. L., Namangdjabar, O. L., Mirong, I. D., Yulianti, H., Anggaraeningsih, N. L. M. D. P., Kristin, D. M., & Risyati, L. (2023). *Pemberdayaan Masyarakat dalam Upaya Pencegahan Stunting*. Rena Cipta Mandiri.
  - 26) Manurung, et al. (2021). *Kebijakan dan Manajemen Pelayanan Kesehatan*. Medan: Yayasan Kita Menulis.
  - 27) Miele, M. J., Souza, R. T., Vieira, M. C., Pacagnella, R. C., & Cecatti, J. G. (2023). A conceptual framework for nutritional evaluation, screening, and monitoring of pregnant women: Evidence from a Brazilian cohort of nulliparous women. *International Journal of Gynecology & Obstetrics*, 161(1), 40-50.
  - 28) Miles, M. B., & Huberman, A. M. (2014). *Qualitative Data Analysis: A Methods Sourcebook*. Thousand Oaks: SAGE.
  - 29) Misnaniarti, M., & Rahmiwati, A. (2023). Evaluasi Pemantauan Tumbuh Kembang Balita: Literature Review. *Jurnal Ilmiah Permas: Jurnal Ilmiah STIKES Kendal*, 13(3), 821-828.
  - 30) Moleong. (2011). *Metodologi Penelitian Kualitatif*. Bandung: Rosda.
  - 31) Nasution, I. F., Kurniansyah, D., & Priyanti, E. (2021). Analisis Pelayanan Pusat Kesehatan Masyarakat (Puskesmas). *KINERJA*, 18(4), 527-523.
  - 32) Notoatmodjo, S. (2018). *Metodologi Penelitian Kesehatan*. Jakarta: PT Rineka Cipta.
  - 33) Palapessy, V. E., Susanti, R., Febrianti, N., Hariyani, F., & Sucipto, B. (2023). The Role of Health Workers in Preventing Stunting in Children. *Jurnal Ners*, 7(1), 260-265.
  - 34) Phitra, F. A., Lipoeto, N. I., & Yetti, H. (2023). Evaluasi Pelaksanaan Program Pencegahan dan Penurunan Stunting di Desa Lokus Stunting Kabupaten Merangin Tahun 2022. *Jurnal Kebijakan Kesehatan Indonesia: JKKI*, 12(3).
  - 35) Pratiwi, W. R., & Asnuddin, A. (2023). Cegah Balita Dari Stunting Melalui Edukasi Isi Piringku Di Posyandu Cempaka Kabupatten Barru. *Jurnal Altifani Penelitian dan Pengabdian kepada Masyarakat*, 3(3), 450-456.
  - 36) Pusdatin Kemenkes RI. (2016). *Infodatin : Situasi Balita Pendek*. Jakarta: Pusat Data & Informasi Kementerian Kesehatan RI.
  - 37) Rukajat, A. (2018). *Pendekatan Penelitian Kuantitatif: Quantitative Research*. Yogyakarta: Deepublish.
  - 38) Setiarsih, D., Kardina, R. N., Viantri, P., Putri, P. H., Syafiuddin, A., Amalia, R., & Widowati, K. (2023). The important role of multi-sector partnership in stunting management in east java: a literature review. *Bali Medical Journal*, 12(1), 660-664.
  - 39) Situmorang, H. E., & Sinaga, E. (2022). Eksplorasi Pengalaman Tim Kesehatan Stunting di Puskesmas Dalam Pencegahan dan Penatalaksanaan Stunting pada Anak di Jayapura Papua. *Manuju: Malahayati Nursing Journal*, 4(11), 3004-3021.
  - 40) Sugiyono. (2007). *Memahami Penelitian Kualitatif*. Bandung: Alfabeta.
  - 41) Sugiyono. (2015). *Metode Penelitian Kombinasi (Mix Methods)*. Bandung: Alfabeta.
  - 42) Sugiyono. (2017). *Metode Penelitian Kuantitatif, Kualitatif dan R&D*. Bandung: Alfabeta.
  - 43) Sukmawati, E., Marzuki, K., Batubara, A., Harahap, N. A., Efendi, E., & Weraman, P. (2023). The Effectiveness of Early Childhood Nutrition Health Education on Reducing the Incidence of Stunting. *Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini*, 7(4), 4002-4012.

## Management of North Jayapura Public Health Center in the Stunting Prevention Program for Children Aged 3-5 Years

- 44) Surbakti, F. E., & Ismail, I. (2023). The Implementation of Learning Optimization for the Stunting Program. *Edumaspul: Jurnal Pendidikan*, 7(1), 1953-1962.
- 45) Susanti, D. F. (2022, Agustus 6). *Mengenal Apa Itu Stunting*. Retrieved Maret 22, 2023, from kemenkes.go.id: [https://yankes.kemkes.go.id/view\\_artikel/1388/mengenal-apa-itu-stunting](https://yankes.kemkes.go.id/view_artikel/1388/mengenal-apa-itu-stunting)
- 46) Sutarto, Mayasari, D., & Indriyani, R. (2018). Stunting, Faktor Resiko dan Pencegahannya. *J Agromedicine*, 5(1), 540-545.
- 47) Syafrawati, S., Lipoeto, N. I., Masrul, M., Novianti, N., Gusnedi, G., Susilowati, A., ... & Umar, H. B. (2023). Factors driving and inhibiting stunting reduction acceleration programs at district level: A qualitative study in West Sumatra. *Plos one*, 18(3), e0283739.
- 48) TNP2K. (2017). *100 Kabupaten/Kota Prioritas untuk Intervensi Anak Kerdil (Stunting): Buku Ringkasan*. Jakarta: Tim Nasional Percepatan Penanggulangan Kemiskinan (TNP2K).
- 49) Yunus, P., Septiyanti, & Rahman. (2021). Analisis Implementasi Kebijakan Stunting di Puskesmas Antang Kota Makassar. *Window of Public Health Journal*, 2(3), 1285-1294.
- 50) Yusuf, A. M. (2014). *Metode Penelitian : Kuantitatif, Kualitatif & Penelitian*. Jakarta: Prenadamedia Group.
- 51) Sazali, H., Utami, T. N., Batubara, C., Azizah, N., Susilawati, S., Padli Nasution, M. I., ... & Harahap, R. H. (2023). Strengthening Communication: A Strategy to Increase Community Satisfaction in Stunting Services in Indonesia. *The Open Public Health Journal*, 16(1).



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Level of Comprehension of the Material of Big Ball Game in the Online Physical Education Learning for the Fifth Grade Students of Kanisius Kalasan Elementary School



Stefanus Prasetyo Yudi Susanto<sup>1</sup>, Hari Yulianto<sup>2</sup>, Zaza Afnindar Fakhrurozi<sup>3</sup>

<sup>1,2,3</sup> Universitas Negeri Yogyakarta, Yogyakarta, DIY, 55281, Indonesia

**ABSTRACT:** This research is conducted to determine the level of comprehension on the material of bi ball game in the online Physical Education learning for the fifth grade students of Kanisius Kalasan Elementary School.

This research was a descriptive quantitative study. This study used a population as all samples were used as a population, the research population was for about 46 fifth grade students of SD Kanisius Kalasan. The data collection technique used a written test in the form of multiple choice question items. The data analysis used the descriptive quantitative analysis with the results of the assessment of all fifth grade students were carried out with the same tool which would be summarized into 5 levels: very high, high, medium, low, and very low levels. Based on the results of the research, it can be concluded that the level of comprehension on the Big Ball Game material in the online Physical Education learning for the fifth grade students of SD Kanisius Kalasan is as follows: 35 respondents (76.1%) are in the Very High level, 2 respondents (4.34%) are in the High level, 4 respondents (8.7%) are in the Medium level, 2 respondents (4.34%) are in the Low level, and 3 respondents (6.52%) are in the Very Low level. The level of comprehension on the Big Ball Game Material in the online Physical Education learning for the fifth grade students of SD Kanisius Kalasan is very high.

**KEYWORDS:** Level of Comprehension, Big Ball Game Material.

### I. INTRODUCTION

The case of Corona Virus Disease (Covid-19) has not yet ended. The virus originating from the city of Wuhan, China first appeared in December 2019. In Indonesia, the first corona virus case was in March 2020. Two people who were found to be positively infected with the corona virus were residents of Depok, West Java. Both are suspected of contracting the corona virus after having direct contact with Japanese citizens. Since the first positive case, the number of Indonesians infected with COVID-19 has continued to grow. The government has imposed large-scale social restriction policies in several regions to limit the movement of citizens. However, the spread of the coronavirus in Indonesia continues to expand. The spread of the coronavirus in Indonesia is through various ways such as through droplets or splashes of saliva, air, through contaminated surfaces and through human waste.

Because the spread of the corona virus in Indonesia continues to spread, the Ministry of Education and Culture Research and Technology issued a Circular Letter of the Minister of Education and Culture No. 4 of 2020 concerning the Implementation of Policies and Education in the Emergency Period of the Spread of Corona Virus Disease (Covid-19) by canceling and replacing the Teaching and Learning Activities (KBM) process in schools by using an online system at home.

The application of Online Learning applies at all levels in the field of Education including SD Kanisius Kalasan which implements an online learning system that utilizes existing media platforms. Online or distance learning aims to achieve educational standards through the use of information technology using computer devices or gadgets that are interconnected between students and teachers.

Based on a survey in the field conducted by the author. School teachers at SD Kanisius Kalasan currently use Whatsapp, Zoom, Google forms and Youtube applications to conduct the online learning process. These applications are considered simple and easy to use for teachers, elementary students or parents. At SD Kanisius Kalasan, the Whatsapp application is used to form each class, coordinate and send assignments to teachers. However, there are challenges faced during online learning today, namely teachers must be creative and innovative in developing learning methods so that students easily understand the material provided and do not feel bored when learning during a pandemic like this.

## Level of Comprehension of the Material of Big Ball Game in the Online Physical Education Learning for the Fifth Grade Students of Kanisius Kalasan Elementary School

Based on research conducted by the author at SD Kanisius Kalasan, the process of learning PE online for elementary school students with big ball game material is not as expected because this subject has more physical activity and basic movements such as passing, dribbling, and shooting movements that make it difficult for students to understand the material. The Covid-19 pandemic has an impact on learning PE. If before the existence of Covid-19, PE learning could be carried out outside the classroom or outside the school, with the existence of Covid-19, the implementation of PE learning has changed to online. The learning material for big ball games has been provided by the teacher, with the provision of this material, of course students can know big ball games. The teacher then asks students to explain the big ball games that have been learned. However, when repeating the material, there are some students who do not understand the big ball game. This can happen because of students' lazy study habits at home. Here the active role of teachers and students is also not enough in online PE learning, an active role of parents is needed. In online learning, the role of parents is to reiterate the material that has been given by school teachers so that children better understand the concepts given by teachers online, then parents help students in doing assignments if there are difficulties. Parents are also expected to participate as a motivator for students to replace the teacher at school. Parental involvement is needed in the online learning process in PE lessons with the material of Big Ball Games.

Big ball games are a type of sport that uses a large ball as the object and the limbs as the activator. The purpose of big ball games is to maintain the stamina of the body to stay healthy and build a better personality, strong mentality and discipline. Examples of big ball games for school children such as: Soccer, Basketball and Volleyball.

### II. MATERIAL AND METHODS

The research entitled "Level of Understanding of Big Ball Game Material in Online PE Learning for Class V at SD Kanisius Kalasan" is a descriptive study using a quantitative approach.

According to Bungin (2014: 36), quantitative research with a descriptive format that wants to describe the understanding of elementary school students with big ball game material.

This study uses population because all samples are used as population. The population in this study were all fifth grade students at SD Kanisius Kalasan, totaling 46 students.

Data were collected using instruments in the form of written tests in the form of multiple choice questions and the data collection technique used in this study was to give questions to grade V students who were the subject of the study. The collected data were analyzed using quantitative descriptive analysis techniques.

### III. RESULTS AND DISCUSSION

Table 1. Statistical Description of the Level of Implementation of Physical Education Learning in Kanisius Kalasan Elementary School

	C2	Total
Maximum value	10	10
Minimum value	4	4
Average value	8,95	8,95
Center value	10	10
Frequently occurring values	10	10
Standard deviation	1,58	1,58

The table above shows that the overall research results have a minimum score of 4, a maximum score of 10, an average (mean) of 8.95, and a standard deviation of 1.58.

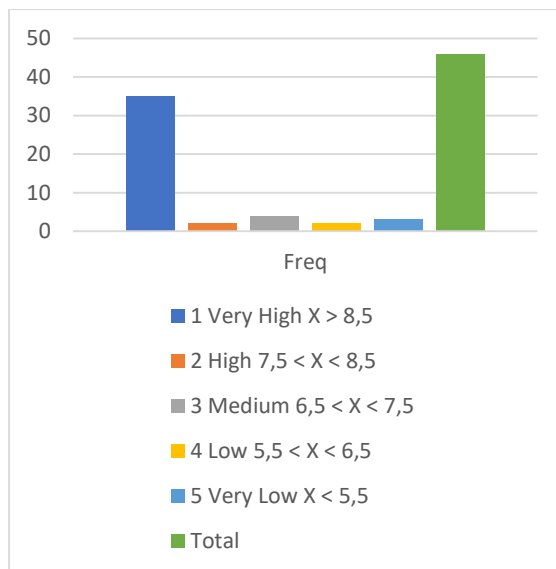
The results of the study are classified based on the scores obtained in five categories as shown in the table below.

Table 1. Distribution of research results on the level of understanding of big ball game material in online pe learning for grade v at kanisius kalasan elementary school

No	Category	Interval	Frequency	%
1	Very High	$X > 8,5$	35	76,1%
2	High	$7,5 < X < 8,5$	2	4,34%
3	Medium	$6,5 < X < 7,5$	4	8,70%
4	Low	$5,5 < X < 6,5$	2	4,34%
5	Very Low	$X < 5,5$	3	6,52%
<b>Total</b>			<b>46</b>	<b>100%</b>

## Level of Comprehension of the Material of Big Ball Game in the Online Physical Education Learning for the Fifth Grade Students of Kanisius Kalasan Elementary School

From the table above, it can be explained that the overall result of the data on the level of understanding of big ball game material in online PE learning for class V at SD Kanisius Kalasan is a very high category in the interval  $X > 8.5$  totaling 35 respondents, a high category in the interval  $7.5 < X \leq 8.5$  totaling 2 respondents, a medium category in the interval  $6.5 < X \leq 7.5$  totaling 4 respondents, a low category in the interval  $5.5 < X \leq 6.5$  totaling 2 respondents, and a very low category with the interval  $X \leq 5.5$  totaling 3 respondents. When displayed in diagram form, it can be seen in the figure below.



### DISCUSSION

From table 2, it can be seen that the average category of the results of the Level of Understanding of Big Ball Game Material in Online PE Learning for Class V at SD Kanisius Kalasan is included in the "very high" category, namely with a percentage of 76.1% as many as 35 respondents. In this study, it means that students have a very good understanding of the big ball game material because according to Hamalik (2001) in Suyanti (2006) states that one of the factors that comes from within oneself is learning habits or learning behavior. Learning behavior is a learning habit that is carried out by individuals repeatedly so that it becomes automatic or takes place spontaneously. Learning behavior is not felt as a burden but as a necessity. This is created because it is continuously carried out with guidance and supervision as well as exemplary in all aspects and educational creativity. In addition, there are conditions and situations in lectures that are created to support creativity and other activities in the context of learning, but there are still some students who have a low level of understanding of big ball game material. This is caused by several factors including

#### 1. learning difficulties

According to Blasic & Jones in Sugihartono et al. (2007: 153), the characteristics of students who experience learning difficulties can be shown from several characteristics in the form of habits or behavior in daily life, how to speak and how to speak, as well as intellectual abilities and learning achievements. This means that the tendency of students who experience learning difficulties can be seen from cognitive thinking abilities, daily attitudes while at school, and skills or behavior in participating in learning and learning activities.

#### 2. not paying attention to the teacher when delivering the material

In the learning process there are input, process, output and feedback stages. Feedback is all information regarding both the output and the learning process. This feedback is needed to improve both the input and the learning process. Finally, from the learning process, learning outcomes are obtained which are expressed as output or output. Outputs that are of poor quality or have not met expectations can be influenced by inputs or inputs that are of poor quality, inappropriate teachers and personnel, inappropriate materials and unsupportive learning methods that cause students not to pay attention to the teacher's explanation (Dimiyati; Mulyono, 2002: 19-20).

#### 3. lack of student interest in learning.

According to Loekmono (1985), the factors that cause lack or loss of student interest in learning are as follows:

a. Physical abnormalities in the eyes, ears, glands, which greatly hinder the child in following lessons or carrying out tasks in class.

## Level of Comprehension of the Material of Big Ball Game in the Online Physical Education Learning for the Fifth Grade Students of Kanisius Kalasan Elementary School

b. Lessons in the classroom do not stimulate the child. The child's ability level is far above what is required in participating in class lessons, as a result the child feels bored.

c. There is a psychological problem or difficulty that causes him to retreat or run away from reality. In this case the child will show the same symptoms everywhere, namely not showing interest or paying attention to everything outside the classroom.

d.8.47 The main attention of the child is devoted to activities outside the classroom, such as sports, classroom activities, work that requires mechanical skills, or doing activities that can earn money.

e. This seeming lack of attention or interest is actually a pretense. The real situation is that he wants to give this impression, so that people can accept the fact that he does not compete or is unable to compete with others, who he sees as much more capable than himself.

### V. CONCLUSIONS

Based on the results of the research, discussion, it can be concluded that the level of understanding of the Big Ball Game Material in Online PE Learning for Class V at SD Kanisius Kalasan is very high, and when viewed from the average (Mean) on Consumer Behavior with a value of 8.95, then the value is also included in the "Very high" category. In this study, it means that students have a very good understanding of the material of big ball games because according to Hamalik (2001) in Suyanti (2006) states that one of the factors that comes from within oneself is learning habits or learning behavior. Learning behavior is a learning habit that is carried out by individuals repeatedly so that it becomes automatic or takes place spontaneously. Learning behavior is not felt as a burden but as a necessity. This is created because it is continuously carried out with guidance and supervision as well as exemplary in all aspects and educational creativity. In addition, there are lecture conditions and situations that are created to support creativity and other activities in the context of learning.

Causal Productions permits the distribution and revision of these templates on the condition that Causal Productions is credited in the revised template as follows: "original version of this template was provided by courtesy of Causal Productions ([www.causalproductions.com](http://www.causalproductions.com))".

### ACKNOWLEDGMENT

The heading of the Acknowledgment section and the References section must not be numbered.

Causal Productions wishes to acknowledge Michael Shell and other contributors for developing and maintaining the IJMRA LaTeX style files which have been used in the preparation of this template. To see the list of contributors, please refer to the top of file IJMRA Tran.cls in the IJMRA LaTeX distribution.

### REFERENCES

- 1) Sadjarto Arief, Dewi Tya Ayu Pransiska. (2021). *Pelaksanaan Pembelajaran Daring Pada Masa Pandemi Covid-19*. Salatiga. Universitas Kristen Satya Wacana
- 2) Nugroho Eko, Roman Andrianto Pangondian, Paulus Insap Santosa. (2019). *Faktor-Faktor Yang Mempengaruhi Kesuksesan Pembelajaran Daring dalam Revolusi Industri 4.0*. Yogyakarta. Departemen Teknik Elektro dan Teknologi Informasi. Universitas Gadjah Mada
- 3) Suparjan, Wahyu, Tahmid Sabri. (2021). *Analisis Faktor Pendukung dan Penghambat Pembelajaran Daring Masa Pandemi COVID-19 Bagi Guru Kelas VI*. Pontianak. Program Studi Pendidikan Guru Sekolah Dasar. FKIP Untan Pontianak
- 4) Mardapi. (2008). *Teknik Penyusunan Instrumen Tes Dan Non Tes*. Yogyakarta: Mitra Cendikia Press.
- 5) Kakung Estu. (2021). *Tingkat Pemahaman Siswa Kelas X Terhadap Materi Pendidikan Jasmani Olahraga dan Kesehatan Serta Aktivitas Pengembangan Secara Daring di SMA N 1 Pundong*. Skripsi. Yogyakarta. Universitas Negeri Yogyakarta.
- 6) Djemari. (2008). *Teknik Penyusunan Instrumen Tes Nontes*. Yogyakarta :Mitra Cendikia.
- 7) Maplus, Om. (2016). *Pengertian Kurikulum serta Definisi Kurikulum Menurut Para Ahli*. <http://www.definisi-pengertian.com/2016/01/pengertian-kurikulum-definisi-menurut-ahli.html>, diakses 09 Februari 2022 pukul 22.37 WIB
- 8) Nuril Ahmadi. (2002). *Permainan Bolabasket*. Era Intermdia. Solo.
- 9) Danny Mielke. 2007. *Dasar-Dasar Sepak Bola*. America: PT Intan Sejati
- 10) ARISKA RAHMA, 135060050 (2017) *Penerapan Model Discovery Learning Untuk Meningkatkan Sikap Rasa Ingin Tahu Dan Hasil Belajar Siswa Pada Tema Indahnnya Kebersamaan Dan Subtema Keberagaman Budaya Bangsaku (Penelitian Tindakan Kelas Pada Tema Indahnnya Kebersamaan Di Kelas IV SDN Asmi Bandung Tahun Ajaran 2016/2017)*. Skripsi(S1) thesis, FKIP Unpas.

## Level of Comprehension of the Material of Big Ball Game in the Online Physical Education Learning for the Fifth Grade Students of Kanisius Kalasan Elementary School

- 11) Supriyanto Edi, Septian Harryoga. (2015). *Faktor-faktor Penentu Tingkat Pemahaman Akuntansi*. Semarang. Fakultas Ekonomi Universitas Islam Sultan Agung
- 12) Hanik Asti Noor. (2015). *Faktor-Faktor Penyebab Kesulitan Belajar Pengolahan Makanan Kontinental Siswa Kelas Xi Di Sekolah Menengah Kejuruan Negeri 3 Wonosari*. Skripsi. Yogyakarta. Program Studi Teknik Tata Boga Fakultas Teknik Universitas Negeri Yogyakarta
- 13) Maulani Ihsan, Aryadie Adnan. (2019). *Minat Belajar Pendidikan Jasmani Olahraga dan Kesehatan*. Padang. Program Studi Pendidikan Kepelatihan Olahraga, Fakultas Ilmu Keolahragaan, Universitas Negeri Padang
- 14) Putri Hilna, Luthfi Hamdani Maula, Din Azwar Uswatun. (2020). *Analisis Proses Pembelajaran Dalam Jaringan (Daring) Masa Pandemi COVID-19 pada Guru Sekolah Dasar*. Sukabumi. Universitas Muhammadiyah Sukabumi, Jawa Barat
- 15) Hartono Dudi, Asep Saefudin. (2017). *Modul 1 Permainan Bola Besar*. Jawa Barat
- 16) Darmawan I Putu Ayub, Edy Sujoko. (2013). *Revisi Taksonomi Pembejajaran Benyamin S. Blomm*. Salatiga. Program Studi Magister Manajemen Pendidikan FKIP Universitas Kristen Satya Wacana
- 17) Widati Sara Sri. (2015). *Tingkat Pengetahuan Guru Pendidikan Jasmani Tentang Materi Pembelajaran Bola Basket di SMP Negeri se-Kabupaten Klaten Barat*. Skripsi. Yogyakarta. Program Studi Pendidikan Jasmani Kesehatan dan Rekreasi Jurusan Pendidikan Olahraga Fakultas Ilmu Keolahragaan Universitas Negeri Yogyakarta



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.



## Popularity of Khmer Foods: Possibility for a Successful Marketing Plan



Vandet Mean

Lyceum of the Philippines University Manila

---

**ABSTRACT:** Khmer food remains relatively undiscovered by both Asians and foreigners. This presents an opportunity for the researcher to explore and promote the popularity of Khmer cuisine to the Generation Z, eventually devising an effective marketing strategy. This study utilized a descriptive quantitative research. In the context of this research, the 260 Cambodian respondents, belonging to Generation Z and having experience with Khmer Foods, were deliberately chosen to align with the study's specific requirements. The findings revealing the factors influencing individuals' interest in Khmer foods shed light on the diverse and multifaceted aspects that contribute to the popularity of this culinary tradition. The findings indicating the factors contributing to the increasing popularity of Khmer foods among Generation Z shed light on the key influencers shaping their culinary preferences.

---

### INTRODUCTION

Plants play a crucial role as essential food sources for the global population, with certain species possessing significant market value due to their nutritional properties (Lindsay, 2023). The growing public interest in nutrition and healthy eating has led to an increased demand for traditional foods, particularly those of plant origin. Recognizing the potential profitability, food enterprises have responded to this demand for traditional foods (Trichopoulou et al., 2007). However, marketing strategies for Traditional Food Products (TFPs) often concentrate on domestic markets due to lower administrative barriers and the complexities associated with international marketing chains. Nevertheless, there is a rising global demand for traditional foods, particularly in high-income countries, leading to the introduction of various exotic products into the international market (Hermann, 2009).

A notable example is amaranth (*Amaranthus* spp.), a staple in the historical diets of the Inca, Maya, and Aztec civilizations in South and Central America. The 1980s witnessed a surge in global interest in amaranth when the United States National Academy of Sciences conducted research, highlighting its remarkable nutritional value and agronomic potential (Caselato-Sousa and Amaya-Farfan, 2012). Many TFPs are derived from underutilized food crops—plant species traditionally consumed by local communities but now overshadowed by more common staple crops. These underutilized crops face challenges such as poor technological properties (e.g., limited shelf life), insufficient recognition of their potential (e.g., nutritional and health benefits), reputational issues (e.g., being associated with famine or poverty, improper handling and storage, and hygiene concerns), and low consumer awareness.

To enhance the market systems for TFPs, effective marketing strategies are required to overcome reputational barriers and emphasize the beneficial properties of underutilized crops. However, the development of such strategies is hindered by a lack of detailed knowledge regarding the perceptions and preferences of potential customers for TFPs. Understanding these aspects is essential for creating efficient marketing strategies that promote the unique qualities of these products. Spices or herbs, whether crafted at home or produced by machines, are transformed into pastes known as "Kroeung," serving as a fundamental element in numerous Khmer dishes. In the realm of Khmer cuisine, any dish featuring Kroeung incorporates the suffix "-Kroeung" into its name (Veneracion, 2021). Khmer culinary offerings are widely acknowledged for their healthiness and nutritional richness, characterized by a light and delectable nature (Any, 2015). Despite boasting a plethora of recipes, Khmer cuisine remains relatively concealed within the borders of Cambodia and has yet to gain substantial recognition on the global stage. While Thai and Vietnamese cuisines have gained widespread acclaim, Khmer food remains relatively undiscovered by both Asians and foreigners. This presents an opportunity for the researcher to explore and promote the popularity of Khmer cuisine to the Generation Z, eventually devising an effective marketing strategy.

Khmer cuisine, deeply rooted in the historical fabric of Cambodia, offers a fascinating journey through time, reflecting the nation's cultural richness and the impact of external influences. Emerging from the grandeur of the Khmer Empire, which

## Popularity of Khmer Foods: Possibility for a Successful Marketing Plan

thrived from the 9th to the 15th centuries, the cuisine was intricately woven with the empire's sophisticated agricultural system. Rice, the dietary cornerstone, formed the basis of numerous dishes that evolved into the diverse array found in contemporary Khmer cooking (angkorfocus.com).

Geographical proximity and cultural exchanges with China, India, and Vietnam introduced a myriad of flavors and culinary techniques to Khmer cuisine. The French colonial period added a distinctive layer with the infusion of baguettes, coffee, and French culinary methods. This fusion created a unique blend of traditional Khmer elements and French influence, exemplifying the adaptability of the culinary tradition (Keng Dam, 2023).

However, the dark chapter of the Khmer Rouge era in the 1970s significantly disrupted Cambodia's culinary landscape. Traditional recipes were lost, and the population faced extreme food shortages. In the aftermath, during the post-Khmer Rouge period, there was a concerted effort to revive and preserve Khmer cuisine as a symbol of national identity. This period of recovery laid the foundation for the modern exploration and celebration of Cambodia's culinary heritage (Grasee, 2023).

Khmer cuisine is characterized by its diverse use of indigenous ingredients. Staples like rice noodles, jasmine rice, freshwater fish, tropical fruits, and aromatic herbs contribute to the distinct flavors of Khmer dishes. Signature dishes such as "Amok," a coconut milk-based curry, and "Bai Sach Chrouk," a breakfast dish featuring grilled pork and rice, showcase the culinary creativity rooted in tradition (Rahuldev, 2022).

In the contemporary context, there is a resurgence of interest in Khmer cuisine on the global stage. Efforts to promote Cambodian food internationally have led to increased recognition, and Khmer chefs are not only preserving traditional recipes but also experimenting with innovative culinary expressions. The act of sharing meals, deeply embedded in Khmer culture, continues to be a significant aspect, blending tradition with a modern approach to create a vibrant and evolving food scene. As Cambodia's culinary identity unfolds, it serves as a testament to the resilience of a people and their determination to preserve, adapt, and celebrate their rich cultural heritage through the art of food.

## METHODOLOGY

This study utilized a descriptive quantitative research methodology, wherein the investigation and depiction of features within a sample or population were the central focus (Coe et al., 2017). The primary objective was to offer a comprehensive understanding of the characteristics inherent in the chosen sample.

Regarding respondent selection, a purposive sampling approach was employed in this paper. Purposive sampling involves non-probability methods where units are intentionally selected based on specific characteristics deemed crucial for the sample. In the context of this research, the 260 Cambodian respondents, belonging to Generation Z and having experience with Khmer Foods, were deliberately chosen to align with the study's specific requirements.

The principal instrument for data collection in this study was a survey questionnaire distributed and retrieved through Google Forms. In the preparation phase, the researcher extensively reviewed literature, including books, unpublished and published theses, dissertations, journals, and other relevant studies, to deepen the understanding of the study's topic. These sources provided valuable insights that contributed to the construction of the questionnaires. To ensure data and findings' accuracy, consistency, and trustworthiness, the researcher conducted validity and reliability tests. Pilot testing involved 10 non-participating respondents to assess reliability.

## RESULTS AND CONCLUSION

1. The findings from the survey of 260 respondents provide insightful information about the level of familiarity with Khmer foods among the sampled population. The results indicate a diverse range of familiarity levels, with 16.3% of respondents describing themselves as somewhat familiar, 39.5% as very familiar, and 43.4% as somewhat familiar with Khmer foods. The relatively high percentage (39.5%) of respondents who claim to be very familiar with Khmer foods suggests a significant awareness or exposure to this culinary tradition within the surveyed group. This could be indicative of a cultural connection or personal interest in exploring and understanding Khmer cuisine. The presence of a substantial portion of respondents (43.4%) who identify as somewhat familiar implies a broader base of recognition, even if not as in-depth as those who consider themselves very familiar. The 16.3% of respondents who characterize themselves as somewhat familiar might represent a group that has a basic understanding or limited exposure to Khmer foods. This segment could potentially be a target for increased awareness campaigns or culinary education initiatives to further enhance their familiarity and appreciation for Khmer cuisine. In essence, the distribution of familiarity levels among the respondents paints a nuanced picture of the varying degrees of awareness and knowledge regarding Khmer foods. These findings can serve as a foundation for developing targeted strategies to promote and popularize Khmer cuisine, both within the surveyed population and potentially in a broader context. Additionally, the data invites further exploration into

## Popularity of Khmer Foods: Possibility for a Successful Marketing Plan

the factors influencing different familiarity levels and how these insights can be leveraged to enhance cultural appreciation and cross-cultural understanding through food.

2. The findings revealing the factors influencing individuals' interest in Khmer foods shed light on the diverse and multifaceted aspects that contribute to the popularity of this culinary tradition. A significant majority, comprising 44.3% of respondents, expressed their fascination with Khmer foods due to the diversity of dishes and ingredients. This suggests a recognition and appreciation for the rich tapestry of flavors, textures, and culinary techniques that Khmer cuisine offers. The emphasis on diversity underscores the expansive range of choices within Khmer foods, appealing to a broad spectrum of preferences. Furthermore, the discovery that 14.1% of respondents are drawn to Khmer foods because of their unique flavors and taste highlights the distinct and palate-pleasing qualities inherent in these dishes. The uniqueness of flavors adds a layer of appeal, suggesting that Khmer cuisine offers a sensory experience that distinguishes it from other culinary traditions. This aligns with the broader trend in global gastronomy where uniqueness and distinctiveness are increasingly valued. Additionally, the recognition of the cultural appeal and heritage of Khmer foods by 13.9% of respondents speaks to the cultural significance embedded in this culinary tradition. Khmer cuisine not only satisfies gastronomic preferences but also serves as a cultural identifier, reflecting the heritage and traditions of the Cambodian people. The influence of historical and cultural factors, acknowledged by 7.8% of respondents, further underscores the deep-rooted connection between Khmer foods and Cambodia's rich history. The role of social media platforms in influencing interest in Khmer foods is evident, with 14.7% of respondents citing exposure through social media and social platforms as a significant factor. This reflects the power of digital platforms in shaping culinary preferences and fostering global awareness of diverse cuisines. Positive recommendations from others, though mentioned by a smaller percentage (4.3%), indicate the impact of personal experiences and word-of-mouth endorsements in shaping individuals' culinary choices. In conclusion, the discussion of these findings emphasizes the multifaceted appeal of Khmer foods, encompassing diversity, unique flavors, cultural significance, historical influence, and the role of modern communication channels. Understanding these factors provides valuable insights for both promoting Khmer cuisine locally and enhancing its recognition on the global culinary stage. It also suggests opportunities for targeted marketing strategies, culinary education initiatives, and collaborations to further amplify the allure of Khmer foods.

3. The findings indicating the factors contributing to the increasing popularity of Khmer foods among Generation Z shed light on the key influencers shaping their culinary preferences. The primary driver, identified by 56% of respondents, is the presence of Cambodian restaurants and food establishments. This suggests that the accessibility and visibility of Khmer foods through local dining establishments play a pivotal role in capturing the attention and interest of Generation Z. The prevalence of Cambodian eateries not only serves as a practical introduction to Khmer cuisine but also creates a platform for cultural exchange within the community. Furthermore, the influence of chefs and culinary experts on the international stage, acknowledged by 40.6% of respondents, underscores the impact of global culinary trends and celebrity chefs in shaping the preferences of Generation Z. This finding highlights the importance of the broader culinary landscape, suggesting that exposure to Khmer foods through renowned chefs and international culinary events contributes significantly to their popularity. This influence can be leveraged to enhance the visibility and recognition of Khmer cuisine on a global scale. Additionally, the role of culinary tourism initiatives and food festivals in Cambodia, noted by 3.4% of respondents, represents a smaller but still noteworthy factor. Culinary tourism can create immersive experiences for both locals and visitors, allowing them to explore and appreciate the richness of Khmer foods in their cultural context. While this percentage is relatively lower, the potential impact of well-curated food festivals and culinary tourism initiatives should not be overlooked, especially in fostering a sense of pride and engagement among the local community. In conclusion, the discussion of these findings emphasizes the significance of local establishments, global culinary influencers, and cultural events in driving the increasing popularity of Khmer foods among Generation Z. The recommendations stemming from this insight could include strategies to further promote and support Cambodian restaurants, collaborations with renowned chefs to elevate the international profile of Khmer cuisine, and the enhancement of culinary tourism initiatives to showcase the diversity and uniqueness of Khmer foods. Ultimately, understanding these factors provides valuable insights for both local and global initiatives aimed at celebrating and promoting the richness of Khmer culinary heritage among the younger generation.

## RECOMMENDATION

1. Based on the findings indicating varying levels of familiarity with Khmer foods among the surveyed population, several recommendations can be proposed to promote and enhance awareness of Khmer cuisine. First and foremost, there is a need for the development and implementation of culinary education initiatives, including workshops and programs, to impart knowledge about Khmer foods. Collaborating with local educational institutions and community centers to integrate Khmer cuisine into curricula could further contribute to widespread understanding. Concurrently, launching targeted promotional campaigns through both digital and traditional media channels can effectively showcase the unique aspects and flavors of Khmer foods. Social media platforms should be leveraged to share visually appealing content, recipes, and stories related to Khmer cuisine. Moreover,

## Popularity of Khmer Foods: Possibility for a Successful Marketing Plan

organizing cultural events and food festivals that feature Khmer foods would provide hands-on experiences and tastings, fostering a deeper connection with the culinary tradition. Collaborations with local restaurants and chefs can play a pivotal role, encouraging the inclusion of Khmer dishes on menus and facilitating fusion creations that appeal to diverse palates. Online resources, such as dedicated platforms and websites, should be developed to offer comprehensive information about Khmer foods, making it easily accessible to a wider audience. Community engagement programs that involve residents in the preservation and promotion of Khmer culinary traditions would not only enhance local appreciation but also contribute to cultural richness. Furthermore, partnerships with tourism initiatives can highlight Khmer culinary experiences in tourism packages, attracting visitors interested in exploring the local cuisine. Gathering continuous feedback from the surveyed population is essential to understanding evolving preferences and tailoring promotional efforts accordingly. By implementing these recommendations, there is a potential to increase awareness, appreciation, and understanding of Khmer cuisine, contributing to the cultural diversity and richness of the culinary landscape. Additionally, fostering a deeper connection with Khmer foods can promote cultural exchange, encourage tourism, and strengthen the community's ties to its culinary heritage.

2. To elevate the appeal and recognition of Khmer cuisine, several recommendations emerge from the factors influencing individuals' interest in Khmer foods. Firstly, there is a need for continuous exploration and development of diverse Khmer dishes and ingredients to uphold and expand the current interest in the cuisine's diversity, as noted by 64.3% of respondents. Collaborative efforts with chefs could fuel innovation and revitalization of lesser-known recipes. Additionally, organizing culinary events and tasting experiences that showcase the unique flavors and tastes of Khmer foods can engage both local residents and tourists, fostering a deeper connection with the cuisine. Cultural promotion initiatives emphasizing the rich heritage and cultural appeal of Khmer foods should be implemented, potentially involving partnerships with cultural organizations, museums, and heritage sites to create immersive experiences. Integrating historical and cultural narratives into promotional materials, both online and offline, could enhance the narrative surrounding Khmer cuisine. Leveraging social media platforms for targeted digital marketing campaigns, engaging influencers, and collaborating with food bloggers to create visually appealing content can extend the reach of the cuisine to a broader audience. Collaborating with influencers, food critics, and culinary experts for tastings, reviews, and endorsements can significantly impact consumer perceptions. Offering cooking classes and culinary workshops to the public can provide hands-on experiences with Khmer recipes, demystifying the cuisine and empowering individuals to recreate these dishes at home. Collaborating with tourism boards to position Khmer cuisine as a significant element of culinary tourism, developing guided culinary tours, food trails, and immersive dining experiences, can highlight the unique aspects of Khmer foods. Lastly, fostering collaborations with chefs and culinary experts from different cultural backgrounds to create fusion dishes incorporating Khmer flavors can attract a diverse audience and contribute to the global appeal of Khmer cuisine. These recommendations collectively aim to celebrate and promote the richness of Khmer culinary heritage.

3. To fortify and perpetuate the burgeoning popularity of Khmer foods among Generation Z, several strategic recommendations emerge from the identified contributing factors. Firstly, there is a pressing need to bolster local Cambodian restaurants and food establishments through supportive initiatives and targeted promotion. Collaborative efforts with business associations, coupled with marketing campaigns and events spotlighting the diverse and authentic nature of Khmer cuisine, can significantly enhance visibility and patronage. Secondly, nurturing collaborations with renowned chefs and culinary experts on the international stage is crucial. Initiatives such as organizing culinary events, creating collaborative menus, and securing media features can amplify the profile of Khmer cuisine, capturing the attention and interest of Generation Z within the broader global culinary landscape. Moreover, providing opportunities for Generation Z to partake in global culinary experiences, including international food festivals and events, is paramount. This exposure not only broadens their culinary perspectives but also fosters an appreciation for Khmer foods in a global context. Enhancing culinary tourism initiatives, such as well-curated food festivals and immersive culinary tours in Cambodia, should be a priority. These initiatives offer both locals and visitors a chance to explore and savor the richness of Khmer foods within their cultural milieu. Leveraging online platforms and engaging influencers, food bloggers, and culinary enthusiasts can be a powerful tool. Encouraging them to share their experiences with Khmer foods through visually appealing content can extend the reach and generate enthusiasm among a broader audience. Education and awareness-building initiatives, including cooking classes, workshops, and cultural exchange programs, need to be integrated into schools and communities. These efforts aim to instill a sense of pride and appreciation for the local culinary heritage among the younger generation. Furthermore, organizing collaborative events and cultural celebrations that bring together local Cambodian restaurants, chefs, and the community can be instrumental.

These gatherings serve as platforms to showcase Khmer foods, fostering a sense of community pride and engagement. Encouraging local restaurants to innovate their menus by incorporating traditional Khmer dishes alongside modern interpretations is key. Implementing promotional campaigns to highlight these new offerings can capture the curiosity and interest of Generation Z. Establishing partnerships with culinary schools to integrate Khmer cuisine into their curricula ensures the continued evolution

## Popularity of Khmer Foods: Possibility for a Successful Marketing Plan

and representation of Khmer foods in the culinary world. This educational collaboration contributes to the training of aspiring chefs and culinary enthusiasts. Lastly, fostering a sense of community involvement and ownership is crucial. Encouraging local residents to actively participate in the promotion and celebration of Khmer foods through community-driven initiatives amplifies the cultural significance and authenticity of Khmer cuisine. By adopting these recommendations, there exists an opportunity to cultivate a sustained and growing interest in Khmer foods, ensuring their enduring popularity among Generation Z both locally and globally.

To further promote Khmer Foods on the global stage, a comprehensive marketing strategy is essential. Here are several key strategies that can be employed:

### Digital Marketing and Social Media Campaigns:

- Utilize social media platforms to showcase visually appealing content, including high-quality images and videos of Khmer dishes.
- Engage influencers and food bloggers to create and share content that highlights the unique flavors, ingredients, and cultural aspects of Khmer cuisine.
- Leverage social media advertising to target global audiences interested in diverse and authentic culinary experiences.

### Online Platforms and Culinary Websites:

- Develop a dedicated website or utilize existing culinary platforms to provide comprehensive information about Khmer Foods, including recipes, cooking techniques, and cultural significance.
- Collaborate with popular culinary websites to feature Khmer dishes, fostering a wider online presence and reaching diverse audiences.

### Culinary Tourism Initiatives:

- Partner with tourism boards to position Khmer cuisine as a significant element of culinary tourism.
- Develop guided culinary tours, food trails, and immersive dining experiences to attract tourists interested in exploring local flavors.

### International Food Festivals and Events:

- Participate in international food festivals and culinary events to showcase Khmer Foods to a global audience. This exposure can generate interest, build awareness, and create networking opportunities.

### Collaborations with Renowned Chefs:

- Collaborate with renowned chefs and culinary experts from different parts of the world. This can involve joint cooking events, collaborative menus, and endorsements to elevate the profile of Khmer cuisine on the global culinary stage.

### Educational Initiatives and Workshops:

- Organize cooking classes, workshops, and educational initiatives in key international culinary hubs. This not only introduces Khmer cuisine to aspiring chefs but also enhances awareness among culinary professionals.

### Cross-Cultural Collaborations:

- Foster collaborations with chefs from other culinary traditions to create fusion dishes that incorporate Khmer flavors. This can attract a diverse audience and create a bridge between Khmer cuisine and other global culinary trends.

### Strategic Partnerships with Restaurants and Food Chains:

- Establish partnerships with international restaurants and food chains to feature Khmer dishes on their menus. This expands the reach of Khmer cuisine to a wider audience and encourages global integration.

### Promotional Materials and Culinary Shows:

- Create visually appealing promotional materials, including brochures, videos, and documentaries, to highlight the uniqueness of Khmer Foods. Distribute these materials at international trade fairs, culinary shows, and events.

### Government and Diplomatic Initiatives:

- Seek support from diplomatic channels to promote Khmer cuisine during international events and gatherings. Government endorsements and collaborations can add credibility and recognition on the global stage.

### Online Cooking Classes and Culinary Demonstrations:

- Offer online cooking classes and live culinary demonstrations, reaching a global audience interested in learning and experiencing Khmer cooking techniques and recipes.

### Brand Ambassadors and Celebrity Endorsements:

- Appoint brand ambassadors or seek celebrity endorsements to create buzz around Khmer Foods. This can enhance the perceived value and desirability of Khmer cuisine in the eyes of a global audience.

## Popularity of Khmer Foods: Possibility for a Successful Marketing Plan

By integrating these marketing strategies, there is an opportunity to not only promote Khmer Foods globally but also foster a deeper appreciation for the rich culinary heritage of Cambodia on the international stage.

### REFERENCES

- 1) Cambodia Tradition and Culture. Retrieved from <https://angkorfocus.com/cambodia-information/cambodia-tradition-culture.html>.
- 2) Caselato-Sousa, V.M.; Amaya-Farfan, J. State of knowledge on amaranth grain: A comprehensive review. *J. Food Sci.* 2012, 77, R93–R104.
- 3) Coe, R., Waring, M., Hedges, L. V., & Arthur, J. (2017). Research methods and methodologies in education. *Sage*.
- 4) Grasee, D. (2023). State Terror and Long-Run Development: The Persistence of the Khmer Rouge. *American Political Science Review*, 1-18. doi:10.1017/S0003055423000382.
- 5) Hermann, M. The impact of the European Novel Food Regulation on trade and food innovation based on traditional plant foods from developing countries. *Food Policy* 2009, 34, 499– 507.
- 6) Johnson, I., Williamson, G., Eds.; Woodhead Publishing: Cambridge, UK, 2003; pp. 222–237.
- 7) Keng Dam, A. 2023. *The New Gastronome Sugar, Spice, and Everything Rice*. <https://thenewgastronome.com/sugar-spice-andeverything-rice/>
- 8) Lindsay, D. Testing the safety of phytochemicals. In *Phytochemical Functional Foods*, 1st ed.;
- 9) Rahuldev Rajguru.2022. *15 Delicious Cambodian Foods You Must Try*. Retrieved from <https://turuhi.com/resources/delicious-cambodian-foods-you-must-try/>
- 10) Trichopoulou, A.; Soukara, S.; Vasilopoulou, E. Traditional foods: A science and society perspective. *Trends Food Sci. Technol.* 2007, 18, 420–427.
- 11) Veneracion, C. (2021). *How To Make Kroeung: Cambodian Marinade and Spice Paste*. Retrieved March 20, 2021, from <https://www.thespruceeats.com/kroeung-cambodian-marinade-spicepaste-3030372>



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## The Influence of Entrepreneurial Knowledge and ICT Self Efficacy on Technopreneurial Intention Mediated Entrepreneurial Motivation



Fannya Turrohmah<sup>1</sup>, Daru Wahyuni<sup>2</sup>

<sup>1,2</sup> Department of Economic Education, Faculty of Economics and Business, Yogyakarta State University, Yogyakarta, Indonesia

**ABSTRACT:** Indonesia's jobless rate is highest among graduates with vocational training. One of these is purportedly because pupils still have poor technologically preeminent intentions even when they are enrolled in vocational school. The purpose of this study is to ascertain how entrepreneurial motivation, through a mediation of entrepreneurship knowledge and ICT self-efficacy, affects students' technopreneurial intention at the SMK TJKT Department in Wonosobo Regency. This study uses a quantitative technique and is verifiable descriptive in nature. Proportional random sampling is the method used for sampling. Methods of gathering data that include questionnaires for ICT factors including self-efficacy, technopreneurial intention, and entrepreneurial motivation, as well as tests for entrepreneurial knowledge variables. The path analysis technique is the data analysis method that is employed. The study's findings indicate that: 1) Students' motivation to pursue entrepreneurship is positively and significantly influenced by their entrepreneurial expertise. 2) ICT self-efficacy positively and significantly affects students' motivation to pursue entrepreneurship. 3) Technopreneurial intention is positively and significantly influenced by entrepreneurial knowledge. 4) Technopreneurial intention is positively and significantly impacted by ICT self-efficacy. 5) Students' entrepreneurial motivation has a positive and significant impact on their intention to become technopreneurials. 6) Students' entrepreneurial motivation acts as a mediating factor between the positive and significant influence of entrepreneurial knowledge on technopreneurial intention. 7) ICT self-efficacy has a favorable and significant impact on technopreneurial intention, which is mediated by students' entrepreneurial motivation.

**KEYWORDS:** ICT Self-Efficacy, Entrepreneurial Motivation, Entrepreneurial Knowledge, and Technopreneurial Intention

### I. INTRODUCTION

For Wonosobo Regency in particular, where the unemployment rate for graduates of vocational and technical schools is still very high, the number of unemployed presents a challenge to the administration because it would exacerbate other issues like poverty and social injustice (Basmar & Sugeng, 2020). Giving SMK graduates extra soft skills like creativity, leadership, and communication as well as encouraging them to have an entrepreneurial spirit while they are still students is one way to combat unemployment among this group of graduates. Students studying entrepreneurship must be able to think freely and adaptably about the field of entrepreneurship. Technopreneurship is one of the subfields of entrepreneurship.

A technopreneur, according to, is an entrepreneur that bases his company on knowledge of science and technology in order to create novel products that benefit him, other people, and the welfare of his country (Hartono, 2011; Nasution et al., 2007). A few studies related to the goal of technopreneurship have been conducted, including research (Fathonah et al., 2020; Nurhayati et al., 2020; Tran & Von Korfflesch, 2016). An internal source of motivation is also necessary for technopreneurs. Motivation can be defined as an individual's desire to perform a task as well as possible and accomplish personal objectives through accomplishments (Munawar & Supriatna, 2018). Numerous studies have already examined the connection between student motivation and technopreneurial aim ((Fathonah et al., 2020; Koe et al., 2018; Mursityo et al., 2017).

Many SMK graduates still haven't found employment, according to observations given to the head of SMKS Wiratama 45 2 Wonosobo. This provides insight into the graduates' low level of technological entrepreneurship or, alternatively, their lack of faith that entrepreneurship or becoming an entrepreneur is necessary, as evidenced by their lack of a more substantial company plan following their graduation from SMK. Technopreneurial purpose is influenced by a number of elements, including

# The Influence of Entrepreneurial Knowledge and ICT Self Efficacy on Technopreneurial Intention Mediated Entrepreneurial Motivation

entrepreneurial knowledge (Bae et al., 2014). It is an investment in human capital to provide SMK students with the experience, abilities, and knowledge necessary to launch and grow a new company (Atmaja & Margunani, 2016). SMK students' insights about entrepreneurship will be more receptive the more entrepreneurial information they possess (Laia, 2022; Widiyaastuti & Syuhad, 2022; Wijaya, 2019).

Self-efficacy is another aspect that influences the aim of technopreneurs. The four primary information sources that form the basis of this self-efficacy hypothesis are mastery experience, vicarious experience, social persuasion, and physiological and emotional variables that either directly or indirectly contribute to increased self-ability (Alahakoon & Somaratne, 2018). strong self-efficacy mastery ICT can assist people in acquiring the technical know-how and resources required to launch and run a profitable business (Fathonah et al., 2020; Marti'ah, 2017; Pirdaus & Kusnendi, 2022; Savalia et al., 2011; Wiklund & Shepherd, 2005). In light of the background information and other studies, the author is eager to revisit the subject and is conducting study on "The Effect of Entrepreneurial Knowledge and ICT Self-Efficacy on Technopreneurial Intention Mediated by Entrepreneurial Motivation in SMK Department of TJKT Wonosobo Regency".

## II. METHOD

This study uses a quantitative technique and is verifiable descriptive in nature. An overview of students' entrepreneurial knowledge, ICT self-efficacy, entrepreneurial motivation, and technopreneurial purpose was obtained by descriptive study. Propotional random sampling is the sampling strategy employed in this study since each participant has an equal probability of being sampled in accordance with their proportions (Sugiyono, 2019). 155 students used as the unit of analysis in this study after the number of samples was determined using the Slovin formula.

Likkert scale questionnaires for entrepreneurial knowledge variables and self-efficacy, technopreneurial intention, and entrepreneurial motivation questionnaires for ICT variables were used as data collection procedures. The path analysis technique is the data analysis method that is employed. Pathway analysis was used in this study to assess the extent to which independent variables of ICT self-efficacy (X2) and entrepreneurial knowledge (X1) indirectly influenced dependent variables of technopreneurial intention (Y) through intervening variables (students' entrepreneurial motivation) (M). In addition, to determine whether or not exogenous variables have a substantial impact.

## III. RESULTS AND DISCUSSION

The analysis test results are used to determine whether direct influence or indirect influence has a higher impact and to determine whether the presence of this mediating variable can increase or decrease the influence of the independent variable on the dependent variable (Ghozali, 2016). Once descriptive analysis was performed on the data gathered for this investigation, the following table displays the findings.

### Result

#### A. Description of Entrepreneurial Knowledge Variables

The Entrepreneurship Knowledge variable was measured using 20 question items that had a true score of 5 and a false score of 0. The test questions were given to the respondents. The Entrepreneurship Knowledge variable got the maximum score of 100 and the lowest score of 60, according to the study's results. The Entrepreneurial Knowledge variable's descriptive analysis yielded the following results: a mean of 78.71, a median of 80, a mode of 65, and a standard deviation of 12.15. Additionally, the data on entrepreneurial knowledge variable is categorized into three groups: high, medium, and poor. The table below shows how entrepreneurial knowledge is categorized.

**Table 1. Categorization of Entrepreneurial Knowledge Tendencies**

Interval	Category	F	%
$X \geq 86$	Tall	80	48,4
$72 \leq X < 86$	Medium	75	51,6
$X < 12$	Low	0	0,0

#### B. Description of ICT Self-Efficacy Variables

Data on the self-efficacy ICT variable were gathered from surveys given to participants. These questionnaires had eight statement items, with a maximum score of five and a minimum score of one. The ICT Self-Efficacy variable got the maximum score of 30 and the lowest score of 16 according to the study's findings. The ICT Self-Efficay variables' descriptive analysis yielded the following results: a mean of 21.71, a median of 21, a mode of 18, and a standard deviation of 1.87. In addition, there are three



## The Influence of Entrepreneurial Knowledge and ICT Self Efficacy on Technopreneurial Intention Mediated Entrepreneurial Motivation

categories for the ICT Self Efficacy variable data: high, medium, and low. The following table displays the ICT Self Efficacy classification:

**Table 2. Categorization of ICT Self-Efficacy Tendencies**

Interval	Category	F	%
$X \geq 22$	Tall	66	42,6
$14 < X < 22$	Medium	89	57,4
$X < 12$	Low	0	0,0

### C. Description of Entrepreneurial Motivation Variables

Eight statement items in questionnaires that were given to respondents were used to collect data on entrepreneurial motivation factors. A modified Likert scale with five alternative answer values was used to create the questionnaire. a minimum of one and a maximum of five points. The study's findings revealed that the entrepreneurial motivation variable had the maximum score of 40 and the lowest score of 19. Descriptive analysis of the entrepreneurial motivation factors yielded the following results: a mean of 31.86, a median of 32, a mode of 32, and a standard deviation of 2.89. Moreover, there are three categories into which the variable data on entrepreneurial motivation is divided: high, medium, and low. The table below shows how entrepreneurial motivation is categorized:

**Table 3. Categorization of Entrepreneurial Motivation Tendencies**

Interval	Category	F	%
$X \geq 29,3$	Tall	111	71,6
$18,7 \leq X < 29,3$	Medium	44	28,4
$X < 18,7$	Low	0	0,0

### D. Description of Technopreneurial Intention Variables

Technopreneurial intention factors were measured using nine statement items on questionnaires, where a response might be as low as one and as high as five. The technopreneurial intention variable obtained the maximum score of 43 and the lowest score of 22, according to the study's results. The findings revealed that the technopreneurial intention had a standard deviation of 4.01, a mean of 35.29, a median of 33, and a mode of 33. Additionally, there are three categories for the technopreneurial intention variable: high, medium, and low. The table below shows how technopreneurial intention is categorized:

**Table 4. Categorization of Technopreneurial Intention**

Interval	Category	F	%
$X \geq 33$	Tall	73	47,1
$21 \leq X < 33$	Medium	82	52,9
$X < 21$	Low	0	0,0

### E. Normality Test

Following computations, the findings of the normality test on the variables measuring entrepreneurial knowledge, ICT self-efficacy, entrepreneurial motivation, and technopreneurial intention are compiled in the following table:

**Table 5. Normality Test Results**

Variable	Asymp. Sig. (2 tailed)	Information
Entrepreneurial Knowledge	0,053	Normal
ICT Self Efficacy	0,060	Normal
Entrepreneurial Motivation	0,210	Normal
Technopreneurial Intention	0,261	Normal

The regression model's model normality requirements have been satisfied since the significance value of Asymp.Sig (2-tailed) for each of the four variables is larger than 0.05, as can be seen from the above table.

### F. Hypothesis Test

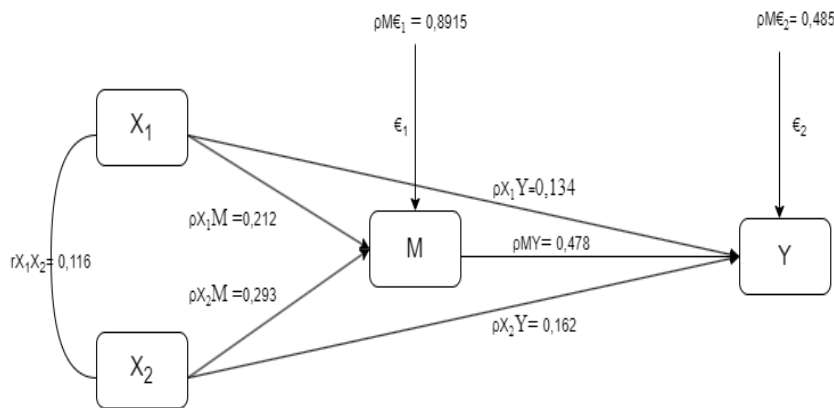
*The direct and indirect effects of the independent variable on the dependent variable were ascertained using the path diagram in the hypothetical test of this study (Ghozali, 2016). These are the outcomes of the path analysis exam.*

# The Influence of Entrepreneurial Knowledge and ICT Self Efficacy on Technopreneurial Intention Mediated Entrepreneurial Motivation

**Table 6. Path Analysis Test Results**

Variable	Direct	Indirect	Total
Entrepreneurial Knowledge → Entrepreneurial Motivation	0,212		0,212
ICT Self-Efficacy → Entrepreneurial Motivation	0,293		0,293
Entrepreneurial Knowledge → Technopreneurial Intention	0,134	0,101	0,235
ICT Self-Efficacy → Technopreneurship Intention	0,162	0,140	0,302
Entrepreneurial Motivation → Technopreneurial Intention	0,478		0,478

Technopreneurial intention mediated by entrepreneurial motivation was found to be positively influenced by ICT self-efficacy, with a direct influence of 0.293 and an indirect influence of 0.140 (0.293 > 0.140) in the computation of the analysis. Thus, it can be said that the theory that claims that "entrepreneurial motivation mediates a positive and significant influence of ICT self-efficacy on Technopreneurial intention" is false. The calculation can then be completed following analysis. Three influences are computed: total influence, indirect influence, and direct influence (Ghozali, 2016).



**Figure 1. Sub Structure**

To calculate the direct influence, the following formula is used:

- The influence of entrepreneurial knowledge variables on *technopreneurial intention*.  
 $X1 \rightarrow Y = \rho_{X1Y} \times \rho_{X1M} = (0,134 \times 0,212) = 0,0284 = 2,84\%$
- Effect of *ICT Self-efficacy* variable on *technopreneurial intention*.  
 $X2 \rightarrow Y = \rho_{X2Y} \times \rho_{X2M} = (0,162 \times 0,293) = 0,0475 = 4,75\%$
- The influence of learner motivation variables on *technopreneurial intention*.  
 $M \rightarrow Y = \rho_{MY} \times \rho_{MY} = (0,478 \times 0,478) = 0,2285 = 22,85\%$

To calculate indirect influence, the following formula is used:

- The influence of entrepreneurial knowledge variables on *technopreneurial intention* through entrepreneurial motivation.  
 $X1 \rightarrow M \rightarrow Y = 0,212 \times 0,478 = 0,1014 = 10,14\%$
- The effect of *ICT Self-efficacy* variables on *technopreneurial intention* through entrepreneurial motivation.  
 $X2 \rightarrow M \rightarrow Y = 0,293 \times 0,478 = 0,1401 = 14,01\%$

Total Effect

- The influence of entrepreneurial knowledge variables on *technopreneurial intention*.  
 Direct influence + indirect influence =  $0,0284 + 0,1014 = 0,1298 = 12,98\%$
- Effect of *ICT Self-efficacy* variable on *technopreneurial intention*.  
 Direct influence + indirect influence =  $0,0475 + 0,1401 = 0,1876 = 18,76\%$
- The total influence on *technopreneurial intention* from the three variables, namely: entrepreneurial knowledge, *ICT self-efficacy* and entrepreneurial motivation was =  $0,1298 + 0,1876 + 0,2285 = 0,5459 = 54,59\%$
- The effect of other variables on M beyond Variables X1 and X2 (Residue  $\epsilon_1$  on M) can be determined through:  $1 - 0,5459 = 0,4541 = 45,41\%$ .

## DISCUSSION

Based on the path analysis as above, hypothesis testing in this study can be described as follows.

## **The Influence of Entrepreneurial Knowledge and ICT Self Efficacy on Technopreneurial Intention Mediated Entrepreneurial Motivation**

### **A. Test the First Hypothesis: Entrepreneurial knowledge affects students' entrepreneurial motivation**

Based on the findings of multiple linear regression analysis, which indicate that the regression coefficient value is 0.071, the first hypothesis test is conducted. This demonstrates the positive relationship between entrepreneurial knowledge and motivation, i.e., greater entrepreneurial knowledge will lead to greater drive for entrepreneurship and vice versa. With a significance level of 0.006 (sig.  $0.006 < 0.05$ ), it can be concluded that entrepreneurial motivation and knowledge are significantly influenced. Therefore, it can be said that the theory states "Entrepreneurial knowledge has a positive and significant effect on entrepreneurial motivation" is accepted.

The study's findings indicate that Wonosobo Regency's SMK TJKT Department has strong entrepreneurship knowledge. Learning about entrepreneurship has the ability to greatly boost students' motivation to pursue their own ventures. They feel more comfortable seeking business prospects and have a greater understanding of business and entrepreneurship as a result of this expertise. Thus, the growth of driven and prosperous entrepreneurs can be greatly aided by a robust and comprehensive entrepreneurship education. The findings of this investigation are consistent with studies carried by Puspitaningsih (2014) which found that motivation is influenced by entrepreneurial knowledge. Additionally, studies carried out by Widiyaastuti & Syuhad (2022) asserts that entrepreneurial motivation is directly influenced by entrepreneurial expertise. Also endorsing the study's conclusions by Laia (2022) studies showing that entrepreneurial motivation is positively and significantly impacted by entrepreneurial expertise.

### **B. Test the Second Hypothesis: ICT self-efficacy affects students' entrepreneurial motivation**

Multiple linear regression analysis testing revealed a regression coefficient value of 0.385 and a calculated t value of 3.884. These results indicate a positive relationship between ICT self-efficacy and entrepreneurial motivation, meaning that higher ICT self-efficacy will lead to higher levels of motivation for entrepreneurship and vice versa. And the significance value of 0.000 (sig.  $0.000 < 0.05$ ) means that there is a significant effect, so it can be concluded that the hypothesis stating "ICT self-efficacy has a positive and significant effect on entrepreneurial motivation" is accepted.

The study's findings indicate that Wonosobo Regency's SMK TJKT Department students have high ICT self-efficacy. However, as ICT self-efficacy can boost students' entrepreneurial motivation, it is important to work toward raising ICT self-efficacy by providing them with more advanced ICT equipment and enhancing their ability to manage technology-based firms successfully. To become successful entrepreneurs in the current digital era, individuals with high entrepreneurial motivation can be formed through education and training that involves the development of ICT self-efficacy. The findings of this investigation are consistent with studies carried by Techatassanasoontorn & Tanvisuth (2008) which suggests that ICT Self-Efficacy has a positive effect on entrepreneurial motivation. This finding is supported by Fathonah et al., (2020) which suggests that ICT Self-Efficacy has a positive effect on entrepreneurial motivation.

### **C. Test the Third Hypothesis: Entrepreneurial knowledge affects technopreneurial intention**

The multiple linear regression analysis test results revealed a regression coefficient value of 0.043 and a calculated t value of 1.987. This indicates a positive relationship between entrepreneurial knowledge and technopreneurial intention, meaning that greater entrepreneurial knowledge will lead to higher technopreneurial intention and vice versa. And the significance value of 0.049 (sig.  $0.049 < 0.05$ ) means that there is a significant influence, so it can be concluded that the hypothesis that states "entrepreneurial knowledge has a positive and significant effect on technopreneurial intention" is accepted.

The study's findings indicate that Wonosobo Regency's SMK TJKT Department students have solid entrepreneurship understanding. Through greater technopreneurial intention, learners who possess entrepreneurial knowledge are more likely to succeed in becoming technopreneurs. This aids students in creating cutting-edge technologies as well as successful business management. Students that possess strong entrepreneurial understanding are already well-positioned to become technopreneurs. The findings of this investigation are similarly consistent with studies carried out by Manullang (2022) which claims that the intention to pursue technopreneurship is positively and significantly impacted by entrepreneurial expertise. This conclusion is further validated by Wijaya (2019) which shows that entrepreneurial knowledge has a positive and significant effect on entrepreneurial intentions.

### **D. Test Fourth Hypothesis: ICT self-efficacy affects technopreneurial intention**

Multiple linear regression analysis testing revealed a regression coefficient value of 0.206 and a calculated t value of 2.356. These results indicate a positive relationship between ICT self-efficacy and technopreneurial intention, meaning that higher ICT self-efficacy will lead to higher technopreneurial intention and vice versa. And the significance value of 0.020 (sig.  $0.020 < 0.05$ ) means that there is a significant effect, so it can be concluded that the hypothesis stating "ICT self-efficacy has a positive and significant effect on technopreneurial intention" is accepted.

## **The Influence of Entrepreneurial Knowledge and ICT Self Efficacy on Technopreneurial Intention Mediated Entrepreneurial Motivation**

The study's findings indicate that the ICT self-efficacy of Kabuapaten Wonosobo's SMK TJKT Department is high. A technopreneurial aim might gain a competitive edge in managing a firm in a digital world that is changing quickly by increasing their ICT self-efficacy. The degree of confidence a person has in handling information and technology can have an impact on a number of factors of their business's success and performance. Consequently, a key tactic in facilitating the effective growth of technopreneurism is the enhancement and development of ICT self-efficacy. It can be ingrained and have a beneficial impact if students have high ICT self-efficacy and already possess the means to become technopreneurial intentions. The findings of this investigation are similarly consistent with studies carried out by Wiklund & Shepherd (2005) which shows ICT self-efficacy has a positive relationship with technopreneurship intention. Furthermore, research by Fathonah et al., (2020) revealed that ICT self-efficacy has a positive and significant effect on technopreneurship intention. The findings of this study are also supported by Pirdaus & Kusnendi (2022) research that ICT self-efficacy has a positive and significant effect on technopreneurship intentions.

### **E. Test the Fifth Hypothesis: Learning motivation affects technopreneurial intention**

The results of multiple linear regression analysis testing showed that a regression coefficient value of 0.463 and a calculated t value of 6.782 were obtained, this shows that the influence of entrepreneurial motivation on technopreneurial intention is positive which means that the better the entrepreneurial motivation, the technopreneurial intention will increase, and vice versa. And the significance value of 0.000 (sig. 0.000 < 0.05) means that there is a significant influence, so it can be concluded that the hypothesis stating "entrepreneurial motivation has a positive and significant effect on technopreneurial intention" is accepted.

According to the study's findings, Kabuapaten Wonosobo's SMK Department of TJKT exhibits strong entrepreneurial motivation. The path to effective technopreneurship can be significantly influenced by the entrepreneurial motivation of learners. This drive may encourage the growth of abilities, mindsets, and conduct that enhance their propensity to integrate technology and business to produce significant breakthroughs in the field of technopreneurship. Thus, promoting entrepreneurial motivation through education and initiatives can be crucial to helping the next generation of technopreneurs grow. It can be ingrained and have a beneficial impact if students have strong entrepreneurial motivation and the means to become technopreneurs. The findings of this investigation are similarly consistent with studies carried out by Marti'ah (2017) It demonstrated that students' intention to pursue technology entrepreneurship increased with their level of entrepreneurial motivation. Furthermore, research by Bhardwaj (2021) states that there is a positive and significant influence of entrepreneurial motivation on entrepreneurial intentions.

### **F. Test the Sixth Hypothesis: Entrepreneurial knowledge affects technopreneurial intention mediated by student motivation in entrepreneurship**

The calculated t value is 2.621 and the p value is 0.008 (p value < 0.05), so the hypothesis stating "Entrepreneurial knowledge has a positive and significant effect on technopreneurial intention mediated by entrepreneurial motivation" is accepted. The study's findings indicate that Wonosobo Regency's SMK TJKT Department students have solid entrepreneurship understanding. Learning about entrepreneurship via the lens of entrepreneurial motivation can be crucial in helping students become successful technopreneurs. While entrepreneurial desire serves as the engine that propels people to take specific activities in growing technology enterprises and producing important breakthroughs, entrepreneurial knowledge offers a strong foundation. Thus, incorporating these two elements throughout education and training can improve the outcomes for developing future technopreneurs. The results of this study strengthen research conducted by Puspitaningsih (2014) This shown how motivation acts as a moderator between entrepreneurial interest and entrepreneurial expertise. Then research conducted by Fernanda & Ibrahim (2022) demonstrated that, with entrepreneurial motivation acting as a mediating factor, entrepreneurship education has a favorable and significant impact on entrepreneurial intentions.

### **G. Seventh Hypothesis Test: ICT self-efficacy affects technopreneurial intention mediated by student motivation in entrepreneurship**

The calculated t value is 3.377 and the p value is 0.001 (p value < 0.05), so the hypothesis that states "ICT self-efficacy has a positive and significant effect on technopreneurial intention mediated by entrepreneurial motivation" is accepted. Based on the results of the study, SMK TJKT Department in Wonosobo Regency has good ICT self-efficacy. It's critical to realize that the positive effects of ICT self-efficacy on learners' roles in the technopreneurship environment can be amplified by entrepreneurial motivation. In the constantly changing digital era, technopreneurs can become more successful and powerful by combining their faith in technology with their entrepreneurial spirit to build and run technology companies. Thus, future technopreneurs can benefit substantially from education and training that integrates these two aspects. Entrepreneurial motivation can be fostered and have a favorable effect if students have excellent ICT self-efficacy, meaning they already have the means to become an entrepreneur. The results of this study also strengthen research conducted by Savalia et al., (2011) This demonstrates how technopreneurship intention and motivation are positively and significantly influenced by ICT self-efficacy as mediation variables. Research conducted by Marti'ah

## The Influence of Entrepreneurial Knowledge and ICT Self Efficacy on Technopreneurial Intention Mediated Entrepreneurial Motivation

(2017) claims that, through motivation, ICT Self-Efficacy influences Technopreneurship Intention. Then research conducted by Fathonah et al., (2020) demonstrated that technopreneurship intention is positively and significantly influenced by ICT self-efficacy, and that this link is mediated by motivation.

### V. CONCLUSIONS

According to the problem formulation, the study's hypothesis testing and data analysis results indicated that students' entrepreneurial motivation acted as a mediating factor between the positive and significant influence of entrepreneurial knowledge on technopreneurial intention. Therefore, the stronger the entrepreneurial motivation that influences students' intention to pursue technopreneurial endeavors, the better the students' entrepreneurial knowledge, as measured by their mastery of actualizing entrepreneurial attitudes and behaviors and planning micro small businesses of SMK TJKT Department in Wonosobo Regency. The hypothetical test's results support the notion that ICT self-efficacy has a positive and significant impact on learners' entrepreneurial motivation through technopreneurial intention. Therefore, the more the entrepreneurial motive that influences students' intention to pursue technopreneurial endeavors, the better the ICT self-efficacy—that is, computer and internet self-efficacy—that they master in Wonosobo Regency's SMK TJKT Department. The findings demonstrated that the category's entrepreneurial knowledge was excellent, but students needed to concentrate more on learning how to identify business opportunities that matched their information and technology expertise because the questions pertaining to analyzing business opportunities had the lowest value. One way to boost technopreneurial intent is to boost confidence in technology use as well as raise technopreneurial intent. As a result, it is envisaged that educational institutions will organize and host conferences, exhibitions, and trainings on entrepreneurship. The school should employ school facilities since they play a significant role in encouraging pupils to pursue entrepreneurial endeavors.

### VI. ACKNOWLEDGMENT

The author would like to thank several parties who have supported the completion of this research: (1) Dean of the Faculty of Economics and Business, Yogyakarta State University, (2) Study Program Coordinator of the Department of Economic Education, Yogyakarta State University, (3) Supervisor who has taken the time to guide me in writing this article.

### REFERENCES

- 1) Alahakoon, C. N. K., & Somaratne, S. (2018). *Development of a conceptual model of ICT self-efficacy and the use of electronic information resources*.
- 2) Atmaja, A. T., & Margunani, M. (2016). Pengaruh Pendidikan Kewirausahaan dan Aktivitas Wirausaha terhadap Minat Berwirausaha Mahasiswa Universitas Negeri Semarang. *Economic Education Analysis Journal*, 5(3), 774.
- 3) Bae, T. J., Qian, S., Miao, C., & Fiet, J. O. (2014). The relationship between entrepreneurship education and entrepreneurial intentions: A meta-analytic review. *Entrepreneurship Theory and Practice*, 38(2), 217–254.
- 4) Basmar, E., & Sugeng, R. (2020). Respon fluktuasi tingkat upah terhadap perubahan tingkat pengangguran di Indonesia. *Jurnal Mirai Management*, 5(3), 38–50.
- 5) Bhardwaj, B. R. (2021). Adoption, diffusion and consumer behavior in technopreneurship. *International Journal of Emerging Markets*, 16(2), 179–220.
- 6) Fathonah, W. N., Machmud, A., & Suwatno, S. (2020). Pengaruh ICT Self Efficacy terhadap Technopreneurship Intention dimediasi Motivasi Siswa. *SOCIA: Jurnal Ilmu-Ilmu Sosial*, 17(1), 71–80.
- 7) Fernanda, R., & Ibrahim, R. (2022). Pengaruh pendidikan kewirausahaan terhadap niat berwirausaha yang di mediasi oleh motivasi dan sikap pada mahasiswa S1 Manajemen Fakultas Ekonomi dan Bisnis Universitas Syiah Kuala Angkatan 2016. *Jurnal Ilmiah Mahasiswa Ekonomi Manajemen*, 7(1), 218–240.
- 8) Ghozali, I. (2016). *Aplikasi analisis multivariete dengan program IBM SPSS 23*.
- 9) Hartono, W. (2011). Pengembangan technopreneurship: Upaya peningkatan daya saing bangsa di era global. *Semantik*, 1(1).
- 10) Koe, W.-L., Alias, N. E., Ismail, S., & Mahphoth, M. H. (2018). A suggested model for studying technopreneurial intention in Malaysia. *KnE Social Sciences*, 788–796.
- 11) Laia, R. (2022). Pengaruh pengetahuan kewirausahaan terhadap motivasi berwirausaha pada mahasiswa Program Studi Manajemen Stie Nias Selatan. *Jurnal Ilmiah Mahasiswa Nias Selatan*, 5(2), 213–221.
- 12) Marti'ah, S. (2017). Kewirausahaan berbasis teknologi (technopreneurship) dalam perspektif ilmu pendidikan. *Jurnal Ilmiah Edutic: Pendidikan Dan Informatika*, 3(2), 75–82.

## The Influence of Entrepreneurial Knowledge and ICT Self Efficacy on Technopreneurial Intention Mediated Entrepreneurial Motivation

- 13) Mursityo, Y. T., Astuti, E. S., & Suharsono, E. G. (2017). Technopreneurship intentions in faculty of computer science brawijaya university students. *Jurnal Aplikasi Manajemen*, 15(2), 320–329.
- 14) Nasution, A. H., Noer, B. A., & Suef, M. (2007). *Entrepreneurship: membangun spirit teknopreneurship*.
- 15) Nurhayati, D., Machmud, A., & Waspada, I. (2020). Technopreneurship Intention: Studi Kasus Pada Mahasiswa Dipengaruhi Entrepreneurial Learning. *Jurnal Ekonomi Pendidikan Dan Kewirausahaan*, 8(1), 79–92.
- 16) Pirdaus, R. Y., & Kusnendi, K. (2022). ICT self efficacy dan creativity sebagai determinasi technopreneurship intention. *Edunomic Jurnal Pendidikan Ekonomi*, 10(1), 1–10.
- 17) Puspitaningsih, F. (2014). Pengaruh efikasi diri dan pengetahuan kewirausahaan terhadap minat berwirausaha melalui motivasi. *Jurnal Ekonomi Pendidikan Dan Kewirausahaan*, 2(2), 223–235.
- 18) Savalia, J. R., Patel, J. D., & Trivedi, R. H. (2011). An empirical study for developing scale and profiling technopreneurs based upon their technopreneurial motive. *International Journal of Management and Enterprise Development*, 11(1), 1–19.
- 19) Sugiyono. (2019). *Metode Penelitian Kuantitatif, Kualitatif dan R&D*. Alfabeta.
- 20) Techatassanasoontorn, A. A., & Tanvisuth, A. (2008). The integrated self-determination and self-efficacy theories of ICT training and use: the case of the socio-economically disadvantaged. *GlobDev 2008*, 19.
- 21) Tran, A. T. P., & Von Korfflesch, H. (2016). A conceptual model of social entrepreneurial intention based on the social cognitive career theory. *Asia Pacific Journal of Innovation and Entrepreneurship*, 10(1), 17–38.
- 22) Widiyaastuti, K., & Syuhad, S. (2022). Pengaruh keterampilan berwirausaha, pengetahuan kewirausahaan dan sikap mandiri terhadap motivasi berwirausaha siswa SMKN 2 Jambi. *Jurnal Manajemen Pendidikan dan Ilmu Sosial*, 3(2), 696–707.
- 23) Wijaya, T. T. (2019). Analisis Pengaruh Pengetahuan Kewirausahaan Terhadap Niat Berwirausaha Mahasiswa Melalui Komponen Theory Of Planned Behavior. *Journal Unad*.
- 24) Wiklund, J., & Shepherd, D. (2005). Entrepreneurial orientation and small business performance: a configurational approach. *Journal of Business Venturing*, 20(1), 71–91.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Development of an Integrated Public Policy Model for Combating Marine Pollution



**Pranyoto**

Politeknik Ilmu Pelayaran Semarang, Jl. Singosari No.2A, Semarang City, Central Java 50242, Indonesia

**ABSTRACT:** Marine pollution poses a significant threat to global ecosystems, necessitating the development of comprehensive public policy models to address its multifaceted challenges. This study aims to unravel the tapestry of marine pollution by identifying key factors and primary sources, navigating the complex policy waters to assess current regulations, and proposing innovative strategies and technologies for sustainability. Employing qualitative research methods using secondary data, the research findings are structured into four main themes: "Unravelling the Tapestry of Marine Pollution," "Navigating Policy Waters," "Innovating for Sustainability," and "Empowering Change."

The study concludes by integrating these findings into a cohesive public policy model for combating marine pollution. This model emphasizes the need for holistic approaches, incorporating stringent regulations, innovative technologies, and public awareness campaigns. The research underscores the importance of a synergistic approach in mitigating marine pollution and advocates for adopting integrated policies to ensure a sustainable future for marine ecosystems.

**KEYWORDS:** integrated approach, marine pollution, public policy, regulations, sustainability

### I. INTRODUCTION

Marine pollution significantly threatens our oceans' health and global ecosystems' sustainability. As our planet faces increasing environmental challenges, developing effective public policies becomes imperative to combat this growing issue (Alpizar et al., 2020). This research aims to analyze and explore the possibilities of developing an integrated public policy model to address the multifaceted challenges associated with marine pollution. This essay will delve into the key components of such a model while referencing relevant studies and research to support our arguments.

The complexity of marine pollution, which results from numerous and connected factors, highlights the need for developing an integrated public policy model. A comprehensive approach is necessary to tackle pollution sources, including land-based activities, offshore industries, shipping, and illegal dumping (Yao et al., 2023). Additionally, climate change impacts and the need for sustainable development further emphasize the importance of a holistic policy framework.

One key aspect of the proposed model involves improved regulation and enforcement mechanisms. Gunningham (2011) highlights the necessity for stringent regulations on waste discharge from industries and the implementation of penalties for non-compliant entities. Municipalities play a crucial role in enacting proper waste management policies to prevent pollutants from entering water bodies. These measures are essential in reducing pollution inputs and promoting responsible practices. The Pollution Prevention Program Area contains guidance, tools, examples, and analyses of products and processes that can be substituted for existing products/processes or added to existing processes to reduce/eliminate pollution (Zhang et al., 2016).

Another significant component of an integrated public policy model is collaborative governance. It involves coordination among multiple stakeholders, such as government agencies, non-governmental organizations, research institutions, and local communities. By working together, these entities can develop strategies, share technical expertise, and facilitate the implementation of effective policies (Kanter et al., 2020). Establishing joint task forces and regular stakeholder consultations can support collective decision-making processes.

Moreover, integrating economic incentives can foster sustainable practices and encourage responsible behaviours. Cap-and-trade systems and taxes on pollution have proven successful in various environmental contexts (Calel & Dechezleprêtre, 2016). Financial resources generated through these mechanisms can be allocated towards pollution prevention initiatives, research, and developing eco-friendly technologies.

## Development of an Integrated Public Policy Model for Combating Marine Pollution

Education and awareness programs also play a vital role within the integrated public policy framework. By raising public consciousness about the consequences of marine pollution, individuals can actively participate in preserving marine ecosystems and reducing their environmental footprint. Educational initiatives may target schools, local communities, and various media platforms to ensure widespread dissemination of information (Henderson & Green, 2020).

Developing an integrated public policy model holds immense potential in addressing the challenges associated with marine pollution. Comprehensive solutions can be achieved by incorporating stringent regulations and enforcement mechanisms, fostering collaborative governance, integrating economic incentives, and implementing education programs. The role of policymakers and stakeholders in facilitating the adoption and implementation of these strategies cannot be understated. This research topic offers promising avenues to combat marine pollution and pave the way for a sustainable future.

### A. Statement of the problem, research objectives, and research questions

Marine pollution significantly threatens our ecosystems, marine biodiversity, and public health. To effectively combat this pressing issue, it is crucial to develop an integrated public policy model that brings together various stakeholders and addresses the complex challenges of marine pollution. This essay aims to outline the statement of the problem, research objective, and research questions for the research project focused on the development of an integrated public policy model for combating marine pollution.

#### Statement of the Problem:

Marine pollution is a global concern that requires immediate attention. Existing public policies and regulations on marine pollution tend to be fragmented and lack a holistic approach. Consequently, the enforcement and implementation of these policies become challenging, resulting in limited progress in addressing marine pollution. Therefore, there is an urgent need to develop an integrated public policy model that can effectively combat marine pollution while considering the interests and cooperation of multiple stakeholders.

#### Research Objective:

The primary objective of this research is to develop an integrated public policy model that can adequately combat marine pollution. This model will aim to improve the current policy landscape by addressing the limitations of existing approaches, enhancing coordination among stakeholders, and ensuring comprehensive enforcement of regulations. The research aims to provide decision-makers with valuable insights and practical recommendations to guide policy development and implementation.

#### Research Questions:

What are the key factors contributing to marine pollution, and what are the primary sources of such pollution?

What are the current public policies and regulations in place to combat marine pollution? What are the gaps and limitations in their enforcement and implementation?

What innovative strategies and technologies can be incorporated into the integrated public policy model to promote sustainable practices and prevent further marine pollution?

How can public awareness and education campaigns be integrated into the proposed public policy model to foster a sense of responsibility and change behaviour regarding marine pollution?

Developing an integrated public policy model for combating marine pollution is vital to protecting our oceans and safeguarding the future of our planet. By addressing the problem statement, setting a research objective, and formulating research questions, this study aims to contribute to filling the gaps in current policies and regulations. Through extensive research and analysis, decision-makers can be guided toward creating effective policies that foster collaboration, ensure comprehensive enforcement, and promote sustainable practices to combat marine pollution and preserve our marine ecosystems for generations.

## II. METHODS

The development of an Integrated Public Policy Model for combating marine pollution necessitates a comprehensive understanding of existing frameworks, challenges, and potential solutions. Utilizing qualitative research techniques, particularly those that Creswell promotes, offers a structured method for analyzing secondary data to create an efficient policy model.

As Creswell & Creswell (2017) advocated, qualitative research methods offer a systematic and rigorous approach to analyzing secondary data in developing an Integrated Public Policy Model for combating marine pollution. Researchers can extract valuable insights from existing literature, policies, and reports by employing content analysis, documentary analysis, comparative case studies, and thematic analysis. These insights contribute to creating a robust and comprehensive policy model that addresses the multifaceted challenges of marine pollution.



## Development of an Integrated Public Policy Model for Combating Marine Pollution

### III. RESULT

#### **A. Unravelling the Tapestry of Marine Pollution: Identifying Key Factors and Primary Sources**

Marine pollution is an escalating global concern with profound implications for aquatic ecosystems and human well-being. As we strive to comprehend and address this complex issue, it becomes imperative to unravel the key factors contributing to marine pollution and pinpoint the primary sources responsible for the degradation of our oceans. This essay delves into the multifaceted nature of marine pollution, drawing upon pertinent research to shed light on the primary factors and sources that perpetuate this environmental crisis.

##### Contributing Factors to Marine Pollution

**Anthropogenic Activities:** Human activities stand as a pivotal contributor to marine pollution. Industrial discharges, sewage disposal, and agricultural runoff release many pollutants, including chemicals, nutrients, and heavy metals, into marine environments (Derraik, 2002).

**Plastic Pollution:** The surge in plastic production and inadequate waste management practices have led to a significant influx of plastic debris into the oceans. Microplastics, resulting from the breakdown of more oversized plastic items, further exacerbate the issue, posing a threat to marine life and ecosystems (Jambeck et al., 2015).

**Oil Spills:** Accidental oil spills and chronic oil discharges from shipping activities contribute to the contamination of marine environments. These events devastate marine life, affecting organisms across various trophic levels (Board et al., 2003).

**Climate Change:** The impacts of climate change, such as rising sea temperatures and ocean acidification, can exacerbate the effects of other pollutants on marine ecosystems. Climate-induced changes influence the distribution and behaviour of marine species, making them more vulnerable to pollution (Harley et al., 2006).

##### Primary sources of marine pollution

**Land-Based Sources:** Runoff from agricultural lands carrying pesticides, fertilizers, and sediment significantly contributes to marine pollution. Additionally, untreated sewage and industrial effluents released into rivers find their way into oceans, compounding pollution issues (UNEP, 2005).

**Shipping and Maritime Activities:** The maritime industry plays a central role in marine pollution through oil spills, ballast water discharges, and the release of hazardous substances. Large volumes of pollutants, including plastics, are transported across oceans, contributing to the global spread of marine pollution (Koga, 2018).

**Aquaculture and Mariculture:** Expanding aquaculture and mariculture practices introduce excess nutrients, antibiotics, and chemicals into coastal waters. Escapes of farmed species and the use of antifouling agents contribute to the degradation of marine ecosystems (Halpern et al., 2008).

**Atmospheric Deposition:** Airborne pollutants, such as mercury and persistent organic pollutants, can be deposited into oceans from the atmosphere. This pollution poses a global challenge as pollutants can be transported long distances before settling into marine environments (Erickson, 2018).

The enigma of marine pollution is rooted in a complex interplay of factors, each emanating from diverse sources. Anthropogenic activities, plastic pollution, oil spills, and the ramifications of climate change collectively contribute to the deterioration of marine ecosystems. By understanding these key factors and recognizing the primary sources of marine pollution, policymakers, scientists, and society can forge effective strategies to mitigate and prevent further harm to our oceans.

#### **B. Navigating Policy Waters: Assessing Current Regulations to Combat Marine Pollution**

As the urgency to address the escalating threat of marine pollution intensifies, governments worldwide have implemented various public policies and regulations to mitigate the impact on oceans and marine ecosystems. This discussion examines the current landscape of policies combating marine pollution, shedding light on their strengths while critically evaluating the gaps and limitations that impede effective enforcement and implementation.

##### Current Public Policies and Regulations

**International Maritime Organization (IMO) Regulations:** The IMO, a specialized agency of the United Nations, has implemented several conventions to address shipping-related pollution. Notably, the MARPOL Convention regulates oil spills, noxious liquid substances, garbage disposal, and ballast water management (IMO, 2004).

**The European Union's Marine Strategy Framework Directive (MSFD):** The MSFD outlines a comprehensive strategy to achieve or maintain good environmental status in European marine waters. It addresses multiple aspects of marine pollution, including nutrient enrichment, underwater noise, and marine litter (Directive, 2008).

**United States Clean Water Act:** The Clean Water Act in the United States empowers the Environmental Protection Agency (EPA) to regulate and enforce pollution control programs. It targets point-source pollution, including industrial discharges, and non-point-source pollution, like agricultural runoff (EPA, 1972).

## Development of an Integrated Public Policy Model for Combating Marine Pollution

### Gaps and Limitations in Enforcement and Implementation

**Weak International Enforcement Mechanisms:** Despite international conventions such as MARPOL, enforcement remains challenging due to the lack of a centralized enforcement body. Implementation varies among nations, and some countries may lack the resources or political will to enforce regulations rigorously (UNEP/GPA, 2006).

**Inadequate Monitoring and Reporting Systems:** Many policies lack monitoring and reporting mechanisms. Inconsistent data collection and reporting hinder the assessment of policy effectiveness and the identification of emerging pollution threats (Ryan et al., 2009).

**Lack of Coordination and Harmonization:** The global nature of marine pollution necessitates coordinated efforts among nations. However, there is often a lack of harmonization in regulations, making it challenging to address pollution that originates from multiple sources and crosses international boundaries (Vidas, 2000).

**Insufficient Penalties and Deterrents:** Some policies lack teeth regarding penalties and deterrents. Inadequate fines and enforcement measures may not effectively discourage polluters, allowing violations to persist without sufficient consequences (Sydnes, 2017).

**Limited Scope and Emerging Pollutants:** Some policies focus on well-known pollutants, leaving emerging contaminants, such as microplastics and pharmaceuticals, unaddressed. The evolving nature of pollution necessitates policies that can adapt to new challenges (Ryan et al., 2009).

While significant strides have been made in establishing policies to combat marine pollution, the road to effective regulation is fraught with challenges. Weak international enforcement, inadequate monitoring systems, coordination issues, insufficient penalties, and the evolving nature of pollution highlight the need for continuous improvement and adaptation in the regulatory landscape. Policymakers must address these gaps to ensure the sustained health of our oceans and the ecosystems they support.

### ***C. Innovating for Sustainability: Strategies and Technologies in an Integrated Public Policy Model to Prevent Marine Pollution***

As the menace of marine pollution continues to escalate, the need for innovative strategies and technologies within an integrated public policy model becomes increasingly evident. This discussion explores forward-thinking approaches that can be incorporated into policies to foster sustainable practices and proactively prevent further marine pollution. Drawing on cutting-edge research and technological advancements, these strategies aim to create a comprehensive and adaptable framework for safeguarding our oceans.

#### Innovative Strategies

**Circular Economy Principles:** Embracing the principles of a circular economy involves rethinking traditional linear production and consumption models. Policies can incentivize businesses to reduce waste, promote recycling, and adopt circular supply chain practices (Ryan et al., 2009).

**Eco-labelling and Certification Programs:** Introducing eco-labelling and certification programs for marine-friendly products can guide consumers toward sustainable choices. These programs create market incentives for businesses to adopt environmentally responsible practices, aligning economic interests with environmental goals (Cooper et al., 2007).

**Extended Producer Responsibility (EPR):** EPR policies can be expanded to cover a wider array of products, making manufacturers responsible for the entire lifecycle of their goods, including proper disposal and recycling. This approach encourages the design of products with minimal environmental impact (Gupt & Sahay, 2015).

**Community-Based Initiatives:** Engaging local communities in marine conservation efforts can be a powerful strategy. Public policies should support and fund community-led initiatives, encouraging citizen participation in beach clean-ups, waste reduction programs, and environmental education (Gelcich et al., 2010).

#### Innovative Technologies

**Advanced Waste Management Technologies:** Implementing state-of-the-art waste management technologies, such as waste-to-energy systems, smart waste bins, and advanced recycling facilities, can significantly reduce the amount of plastic and other pollutants entering marine ecosystems (Rossi et al., 2015).

**Autonomous Vehicles for Ocean Cleanup:** Leveraging autonomous vehicles equipped with sensors and collection mechanisms can aid in systematically removing marine debris. Initiatives like the "Ocean Cleanup" project showcase the potential of technological solutions to address large-scale pollution (Evans-Pughe, 2017).

**Innovative Filtration Systems:** Developing and deploying innovative filtration systems for stormwater runoff and industrial discharges can prevent pollutants from reaching the oceans. Green infrastructure, such as permeable pavements and constructed wetlands, can act as natural filters (Dietz & Clausen, 2005).

## Development of an Integrated Public Policy Model for Combating Marine Pollution

**Blockchain Technology for Supply Chain Transparency:** Blockchain technology can enhance transparency in global supply chains. By enabling real-time tracking of products from source to consumer, it becomes easier to identify and hold accountable those contributing to marine pollution (Narayanan et al., 2016).

### Blueprint for Change: Presentation of an Integrated Public Policy Model for Combating Marine Pollution

In the face of escalating threats to our oceans and marine ecosystems, the need for a comprehensive and integrated public policy model to combat marine pollution is more pressing than ever. This essay presents a detailed blueprint for such a model, synthesizing diverse strategies, incorporating key elements, and leveraging innovative mechanisms. Drawing on existing research and established frameworks, this model aims to regulate and inspire collective action and sustainable practices.

### Core Elements of the Integrated Model

**Holistic Regulatory Framework:** At the heart of the proposed model is a holistic regulatory framework that transcends national boundaries. Drawing from international conventions such as the MARPOL Convention (IMO, 2004), this framework unifies diverse policies, ensuring a harmonized and comprehensive approach to combating marine pollution.

**Edu-Activism Initiatives:** The model strongly emphasizes edu-activism, recognizing the pivotal role of public awareness and education. By integrating marine pollution education into school curricula (Braun et al., 2018) and fostering community engagement programs (Gelcich et al., 2010), the model seeks to empower individuals to become advocates for change.

**Technological Advancements:** Leveraging cutting-edge technologies is a cornerstone of the model. Autonomous vehicles for ocean cleanup (Emery, 2022), advanced waste management systems, and innovative filtration technologies (Rossi et al., 2015) constitute the technological backbone of the model, ensuring efficiency and adaptability.

### Key Components of the Model

**Collaborative Governance Structures:** The model incorporates collaborative governance structures that involve a spectrum of stakeholders, from governmental bodies to non-governmental organizations (NGOs) and local communities. This multi-stakeholder approach fosters inclusivity, shared responsibility, and collective decision-making (Gelcich et al., 2010).

**Adaptive Monitoring and Reporting Mechanisms:** Robust monitoring and reporting mechanisms are integral. Regular assessments, data-driven evaluations, and real-time reporting on pollution levels (Ryan et al., 2009) ensure the model remains responsive to emerging threats and adapts swiftly to changing circumstances.

**Incentive Systems for Sustainability:** The model incorporates incentive systems to motivate sustainable practices. Recognition programs, tax incentives, and eco-certifications (Schleich et al., 2013) encourage industries and individuals to adopt environmentally friendly behaviors, aligning economic interests with environmental goals.

### Operational Mechanisms Driving Change

**Strategic Policy Enforcement:** Operational mechanisms within the model include strategic policy enforcement. The model ensures accountability and deters irresponsible practices by implementing stringent penalties for non-compliance and periodic audits (Sydnes, 2017).

**Continuous Innovation and Adaptation:** The model operates on continuous innovation and adaptation principles. Regular feedback loops and stakeholder consultations (McKenzie-Mohr, 2011) enable policymakers to refine strategies, address loopholes, and integrate emerging technologies and best practices.

**Public-Private Partnerships:** Public-private partnerships are instrumental in the operationalization of the model. Collaborations with private industries, research institutions, and NGOs facilitate resource-sharing, technological innovation, and the implementation of large-scale initiatives (Bucknall, 2020).

### Unpacking the Model: Elements, Components, and Mechanisms for Combatting Marine Pollution

In pursuing a comprehensive approach to combating marine pollution, formulating a model that integrates various elements, components, and mechanisms is imperative. This discussion aims to elucidate and explore the intricacies of such a model, delving into the core elements, the interconnected components, and the mechanisms that drive its efficacy. Drawing on existing research and established frameworks, this analysis seeks to provide a nuanced understanding of how these elements work to address the multifaceted challenges of marine pollution.

### Elements of the Model

**Regulatory Frameworks:** A robust regulatory framework lies at the core of the model. This encompasses international, national, and regional policies governing activities contributing to marine pollution. International conventions like the MARPOL Convention provide a foundation for regulating shipping-related pollution (IMO, 2004).

**Public Awareness and Education:** A key element involves fostering public awareness and education. Through targeted campaigns and educational initiatives, individuals gain knowledge about the impacts of marine pollution and are empowered to make sustainable choices (Kollmuss & Agyeman, 2002).

## Development of an Integrated Public Policy Model for Combating Marine Pollution

**Technological Solutions:** Technological advancements form a critical element of the model. Innovative filtration systems, waste management technologies, and autonomous vehicles contribute to the prevention and cleanup of marine pollution (Rossi et al., 2015).

### Components of the Model

**Integrated Policy Framework:** The model comprises an integrated policy framework that combines diverse regulations, ensuring coherence and synergy. This includes harmonizing international conventions, aligning national policies, and incorporating emerging issues like plastic pollution and climate change (Basu et al., 2020).

**Community Engagement Programs:** Recognizing the importance of local communities, the model incorporates community engagement programs. These initiatives involve local stakeholders in cleanup efforts, awareness campaigns, and implementing sustainable practices (Gelcich et al., 2010).

**Monitoring and Reporting Mechanisms:** The model includes robust monitoring and reporting mechanisms to ensure accountability and effectiveness. Regular assessments and reporting on pollution levels, policy compliance, and the impact of interventions enable informed decision-making (Ryan et al., 2009).

### Mechanisms Driving the Model

**Policy Enforcement and Penalties:** The model's effectiveness relies on strong policy enforcement mechanisms. Implementing penalties for non-compliance incentivizes adherence to regulations, reinforcing the accountability of industries and individuals (Sydnes, 2017).

**Incentivizing Sustainable Practices:** Incentive mechanisms are crucial in encouraging sustainable practices. Policies that reward businesses and individuals adopting eco-friendly behaviours, such as tax incentives or certification programs, drive positive change (Ayres et al., 2013).

**Adaptive Governance Structures:** The model incorporates adaptive governance structures facilitating flexibility and responsiveness to emerging challenges. Regular evaluations, stakeholder consultations, and feedback loops ensure that the model evolves to address new forms of pollution and changing circumstances (Recht, 2017).

**Justifying the Chosen Model:** Unlocking the Potential Effectiveness of an Integrated Public Policy Approach to Combat Marine Pollution

Addressing the escalating marine pollution crisis demands a well-crafted and compelling model. This essay delves into the justification for the chosen integrated public policy model designed to combat marine pollution, outlining its core elements, comprehensive components, and operational mechanisms. Drawing on existing research and empirical evidence, this analysis aims to illuminate the chosen model's potential effectiveness in safeguarding our oceans' health and resilience.

**Holistic Approach to Regulation:** The chosen model's emphasis on a holistic regulatory framework is a key justification. International conventions such as the MARPOL Convention (IMO, 2004) set the stage for a unified global response to marine pollution, ensuring that regulations transcend geopolitical boundaries. This holistic approach addresses the interconnectedness of marine ecosystems, recognizing that effective solutions must extend beyond individual nations.

**Edu-Activism Initiatives and Behavioral Change:** Including edu-activism initiatives represents a strategic choice in the model. By integrating marine pollution education into school curricula, the model aims to instill a sense of environmental stewardship in future generations. Empowering individuals through education and community engagement (Gelcich et al., 2010) is pivotal for fostering a collective commitment to sustainable practices and behavioural change.

**Technological Advancements for Efficiency:** Integrating cutting-edge technologies into the model is another justification for its potential effectiveness. Autonomous vehicles for ocean cleanup, advanced waste management systems, and innovative filtration technologies signify a commitment to efficiency and adaptability. These technologies address the practical challenges of cleaning up existing pollution and preventing further degradation.

**Collaborative Governance for Inclusivity:** The choice of collaborative governance structures is rooted in the understanding that marine pollution requires a collective effort. Involving various stakeholders, from governmental bodies to NGOs and local communities, ensures inclusivity and shared responsibility (Gelcich et al., 2010). Such collaborations enhance the model's adaptability and responsiveness to varying contexts.

**Incentive Systems and Strategic Enforcement:** Incorporating incentive systems and strategic enforcement mechanisms further justifies the model's potential effectiveness. By aligning economic interests with environmental goals through incentives like tax breaks and certifications (Ayres et al., 2013), the model creates tangible motivations for industries and individuals to adopt sustainable practices. Simultaneously, strategic policy enforcement, including stringent penalties and regular audits (Sydnes, 2017), strengthens accountability and ensures adherence to regulations.

**Continuous Innovation and Adaptation:** The commitment to continuous innovation and adaptation is crucial to justifying the model's potential effectiveness. By integrating feedback loops, stakeholder consultations (McKenzie-Mohr, 2011), and adaptive

## Development of an Integrated Public Policy Model for Combating Marine Pollution

governance structures, the model remains responsive to emerging threats and evolving circumstances. This commitment to ongoing improvement ensures the model's relevance and sustainability over time.

### ***D. Empowering Change: Integrating Public Awareness and Education Campaigns into a Comprehensive Public Policy Model for Combating Marine Pollution***

Addressing the complex challenge of marine pollution requires more than just regulatory measures; it necessitates a profound shift in public attitudes and behaviours. This essay explores the integration of public awareness and education campaigns into a comprehensive public policy model as a powerful means to foster a sense of responsibility and induce behavioural change regarding marine pollution. By drawing on empirical evidence and established frameworks, we will elucidate the key strategies and considerations essential for the success of these campaigns.

#### Importance of Public Awareness and Education

**Understanding the Impact:** Public awareness campaigns play a pivotal role in ensuring that individuals comprehend the gravity of marine pollution. By disseminating information on the consequences of pollution on marine ecosystems and human well-being, campaigns create a foundation for informed decision-making (Bank et al., 2021).

**Behavioural Change:** Education campaigns are instrumental in altering individual behaviors contributing to marine pollution. By providing knowledge about sustainable practices, waste reduction, and responsible consumption, these campaigns empower individuals to make eco-conscious choices in their daily lives (Kollmuss & Agyeman, 2002).

**Community Engagement:** Public awareness initiatives build a sense of community responsibility by emphasizing the collective impact of individual actions. Engaging communities in clean-up activities, awareness events, and collaborative projects fosters a shared commitment to marine conservation (Gelcich et al., 2010).

#### Integration into the Public Policy Model

**Incorporating Environmental Education in Schools:** Including marine pollution topics in school curricula ensures that future generations have the knowledge and values necessary for sustainable living. Collaborating with educational institutions and updating curricula to include environmental literacy is essential (Kwan & Stimpson, 2003).

**Multimedia Campaigns:** Leveraging multimedia channels, including social media, television, and online platforms, enables wide-reaching awareness campaigns. Engaging and visually impactful content can capture diverse audiences, disseminating information in a compelling and accessible manner (Yang et al., 2020).

**Partnerships with Non-Governmental Organizations (NGOs):** Collaborating with NGOs and environmental organizations amplifies the reach and impact of public awareness campaigns. These partnerships can facilitate the development of educational materials, organize community events, and contribute resources to bolster campaign effectiveness (Lewis et al., 2020).

**Incentivizing Sustainable Practices:** Public policies should incentivise businesses and individuals to adopt sustainable practices. Recognition programs, tax incentives, or certification schemes can motivate stakeholders to participate actively in pollution reduction efforts (Carriazo et al., 2020).

**Regular Evaluations and Feedback Loops:** Continuous evaluation of the effectiveness of awareness campaigns is crucial. Implementing feedback mechanisms allows policymakers to refine strategies based on the campaign's impact, ensuring relevance and resonance with the target audience (McKenzie-Mohr, 2011).

## IV. CONCLUSIONS

Marine pollution is a global issue causing harm to aquatic ecosystems and human well-being. Factors include human activities, plastic pollution, oil spills, and climate change. Primary sources include agricultural runoff, untreated sewage, industrial effluents, shipping, aquaculture, and atmospheric deposition. Recognizing these sources can help develop effective strategies to mitigate and prevent further ocean harm.

Incorporating innovative strategies and technologies into an integrated public policy model is crucial for combating marine pollution sustainably. Circular economy principles, eco-labelling, extended producer responsibility, and community-based initiatives empower stakeholders to make informed choices and actively participate in conservation efforts. Advanced waste management technologies, autonomous vehicles, innovative filtration systems, and blockchain technology contribute to the technical arsenal for preventing pollution at its source. By integrating these forward-thinking approaches, policymakers can shape a resilient and adaptive framework capable of safeguarding marine ecosystems for future generations.

The proposed integrated public policy model for combating marine pollution represents a visionary and pragmatic blueprint for change. The model transcends traditional approaches by combining regulatory frameworks, activism initiatives, technological advancements, and collaborative governance structures. Adaptive monitoring, incentive systems, and strategic enforcement

## Development of an Integrated Public Policy Model for Combating Marine Pollution

mechanisms ensure operational effectiveness. As we stand at the intersection of environmental conservation and human responsibility, this model provides a roadmap for fostering sustainable practices and safeguarding the health of our oceans.

In crafting a model to combat marine pollution, it is imperative to consider the interconnected elements, components, and mechanisms that drive its effectiveness. A harmonized regulatory framework, coupled with public awareness initiatives, technological solutions, and community engagement, forms the foundation of this model. Integrated policy frameworks, monitoring mechanisms, and incentive structures are the components that bind these elements together. The mechanisms of policy enforcement, sustainable practice incentivization, and adaptive governance structures provide the driving force for the model's success. By understanding and optimizing this complex interplay, policymakers can develop a resilient and adaptive model capable of addressing the ever-evolving challenges of marine pollution.

The integrated public policy model for combating marine pollution is a comprehensive and forward-thinking strategy. Its justification lies in recognizing the interconnected nature of marine ecosystems, the importance of education and behavioural change, the integration of cutting-edge technologies, collaborative governance, incentive structures, and a commitment to continuous innovation. By addressing these facets, the model has the potential to be a powerful catalyst for change, fostering a harmonious relationship between human activities and the marine environment.

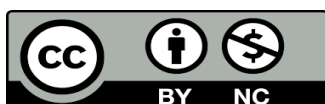
Integrating public awareness and education campaigns into the fabric of a public policy model is paramount for fostering a sense of responsibility and instigating behavioural change regarding marine pollution. By emphasizing the environmental impact, promoting sustainable practices, and engaging communities, these campaigns become catalysts for a cultural shift toward marine conservation. Through partnerships, multimedia channels, and incentivizing sustainable behaviours, policymakers can create a comprehensive strategy that regulates and empowers individuals to actively contribute to preserving our oceans.

## REFERENCES

- 1) Alpizar, F., Carlsson, F., Lanza, G., Carney, B., Daniels, R. C., Jaime, M., Ho, T., Nie, Z., Salazar, C., Tibesigwa, B., & Wahdera, S. (2020). A framework for selecting and designing policies to reduce marine plastic pollution in developing countries. *Environmental Science & Policy*, 109, 25–35. <https://doi.org/10.1016/J.ENVSCI.2020.04.007>
- 2) Ayres, I., Raseman, S., & Shih, A. (2013). Evidence from two large field experiments that peer comparison feedback can reduce residential energy usage. *The Journal of Law, Economics, & Organization*, 29(5), 992–1022.
- 3) Bank, M. S., Peter W. Swarzenski, Carlos M. Duarte, Matthias C. Rillig, Albert A. Koelmans, Marc Metian, & Stephanie Wright. (2021). Global plastic pollution observation system to aid policy. *Environmental Science & Technology*, 55(12), 7770–7775.
- 4) Basu, M. S. S., Boz, M. E., Gopinath, M. G., Roch, M. F., & Unsal, M. F. D. (2020). A conceptual model for the integrated policy framework. *International Monetary Fund*.
- 5) Board, M., Board, O. S., & Council, N. R. (2003). *Oil in the sea III: inputs, fates, and effects*. national academies Press.
- 6) Braun, T., Cottrell, R., & Dierkes, P. (2018). Fostering changes in attitude, knowledge and behavior: Demographic variation in environmental education effects. *Environmental Education Research*, 24(6), 899–920.
- 7) Bucknall, D. G. (2020). Plastics as a materials system in a circular economy. *Philosophical Transactions of the Royal Society A*, 378(2176), 20190268.
- 8) Calel, R., & Dechezleprêtre, A. (2016). Environmental policy and directed technological change: evidence from the European carbon market. *Review of Economics and Statistics*, 98(1), 173–191.
- 9) Carriazo, F., Labarta, R., & Escobedo, F. J. (2020). Incentivizing sustainable rangeland practices and policies in Colombia's Orinoco region. *Land Use Policy*, 95, 104203.
- 10) Cooper, T., Ludlow, M., & Clift, T. (2007). Examining the Role of Eco-labels in changing the Approach to Sustainability in the Commercial Fisheries. *Greener Management International*, 57, 27–42.
- 11) Derraik, J. G. B. (2002). The pollution of the marine environment by plastic debris: a review. *Marine Pollution Bulletin*, 44(9), 842–852.
- 12) Dietz, M. E., & Clausen, J. C. (2005). A field evaluation of rain garden flow and pollutant treatment. *Water, Air, and Soil Pollution*, 167, 123–138.
- 13) Directive, S. F. (2008). Directive 2008/56/EC of the European Parliament and of the Council. *Journal*. Council Decision Of.
- 14) Emery, K. L. (2022). *Supercritical Water Gasification and Pyrolysis—Cleaning up the Great Pacific Garbage Patch*.
- 15) EPA. (1972). Clean water act. *Texas Tech Law Review*, 47, 585.
- 16) Erickson, M. D. (2018). *Analytical chemistry of PCBs*. Routledge.
- 17) Evans-Pughe, C. (2017). All at sea cleaning up the Pacific garbage. *Engineering & Technology*, 12(1), 52–55.

## Development of an Integrated Public Policy Model for Combating Marine Pollution

- 18) Gelcich, S., Hughes, T. P., Olsson, P., Folke, C., Defeo, O., Fernández, M., Foale, S., Gunderson, L. H., Rodríguez-Sickert, C., & Scheffer, M. (2010). Navigating transformations in governance of Chilean marine coastal resources. *Proceedings of the National Academy of Sciences*, 107(39), 16794–16799.
- 19) Gunningham, N. (2011). Enforcing environmental regulation. *Journal of Environmental Law*, 23(2), 169–201.
- 20) Gupt, Y., & Sahay, S. (2015). Review of extended producer responsibility: A case study approach. *Waste Management & Research*, 33(7), 595–611.
- 21) Halpern, B. S., Walbridge, S., Selkoe, K. A., Kappel, C. V., Micheli, F., d'Agrosa, C., Bruno, J. F., Casey, K. S., Ebert, C., & Fox, H. E. (2008). A global map of human impact on marine ecosystems. *Science*, 319(5865), 948–952.
- 22) Harley, C. D. G., Randall Hughes, A., Hultgren, K. M., Miner, B. G., Sorte, C. J. B., Thornber, C. S., Rodriguez, L. F., Tomanek, L., & Williams, S. L. (2006). The impacts of climate change in coastal marine systems. *Ecology Letters*, 9(2), 228–241.
- 23) Henderson, L., & Green, C. (2020). Making sense of microplastics? Public understandings of plastic pollution. *Marine Pollution Bulletin*, 152, 110908.
- 24) IMO. (2004, January). International convention for the control and management of ships' ballast water and sediments. BWM/CONF./36.
- 25) Jambeck, J. R., Geyer, R., Wilcox, C., Siegler, T. R., Perryman, M., Andrady, A., Narayan, R., & Law, K. L. (2015). Plastic waste inputs from land into the ocean. *Science*, 347(6223), 768–771.
- 26) Kanter, D. R., Chodos, O., Nordland, O., Rutigliano, M., & Winiwarter, W. (2020). Gaps and opportunities in nitrogen pollution policies around the world. *Nature Sustainability*, 3(11), 956–963.
- 27) Koga, H. (2018). Global Sulphur Cap 2020. *Marine Engineering*, 53(1), 48–55.
- 28) Kollmuss, A., & Agyeman, J. (2002). Mind the gap: why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental Education Research*, 8(3), 239–260.
- 29) Kwan, F. W. B., & Stimpson, P. (2003). Environmental education in Singapore: a curriculum for the environment or in the national interest? *International Research in Geographical and Environmental Education*, 12(2), 123–138.
- 30) Lewis, D., Kanji, N., & Themudo, N. S. (2020). *Non-governmental organizations and development*. Routledge.
- 31) McKenzie-Mohr, D. (2011). *Fostering sustainable behavior: An introduction to community-based social marketing*. New society publishers.
- 32) Narayanan, A., Bonneau, J., Felten, E., Miller, A., & Goldfeder, S. (2016). *Bitcoin and cryptocurrency technologies: a comprehensive introduction*. Princeton University Press.
- 33) Recht, R. (2017). Regulating Marine Environmental Pollution: When and How Do Policies Work? 85, 1–8.
- 34) Rossi, V., Cleeve-Edwards, N., Lundquist, L., Schenker, U., Dubois, C., Humbert, S., & Jolliet, O. (2015). Life cycle assessment of end-of-life options for two biodegradable packaging materials: sound application of the European waste hierarchy. *Journal of Cleaner Production*, 86, 132–145.
- 35) Ryan, P. G., Moore, C. J., Van Franeker, J. A., & Moloney, C. L. (2009). Monitoring the abundance of plastic debris in the marine environment. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 364(1526), 1999–2012.
- 36) Schleich, J., Klobasa, M., Götz, S., & Brunner, M. (2013). Effects of feedback on residential electricity demand—Findings from a field trial in Austria. *Energy Policy*, 61, 1097–1106.
- 37) Sydnes, M. O. (2017). Enforcement of maritime environmental regulations – Obstacles, barriers and bridges. *Marine Policy*, 83, 170–176.
- 38) UNEP. (2005). *Marine litter: an analytical overview*.
- 39) UNEP/GPA. (2006). *The state of the marine environment: trends and processes*. UNEP/GPA The Hague.
- 40) Vidas, D. (2000). *Protecting the Polar Marine Environment: Law and Policy for Pollution Prevention*. Cambridge University Press.
- 41) Yang, J., L., Calic, G., & Shevchenko, A. (2020). How multimedia shape crowdfunding outcomes: The overshadowing effect of images and videos on text in campaign information. *Journal of Business Research*, 117, 6–18.
- 42) Yao, C., Sun, M., & Liu, L. (2023). Evaluation of policy synergy in coastal ocean pollution prevention and control: The case from China. *Frontiers in Marine Science*, 10, 1131590.
- 43) Zhang, H., Wang, S., Hao, J., Wang, X., Wang, S., Chai, F., & Li, M. (2016). Air pollution and control action in Beijing. *Journal of Cleaner Production*, 112, 1519–1527



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) <https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Level of Knowledge about the Effects of Radiation on Pregnant Women among Medical Imaging Techniques Program Students



Suat Çakina<sup>1</sup>, Gülsen Gül<sup>2</sup>

<sup>1,2</sup>Çanakkale Onsekiz Mart University, Health Service Vocational College, Çanakkale-Turkey

**ABSTRACT:** For this purpose, this study will examine the level of knowledge about the effects of radiation on pregnant women among the students of Medical Imaging Techniques at the Vocational School of Health Services of Çanakkale Onsekiz Mart University in the province of Çanakkale and compare the level of knowledge about the effects of radiation on pregnant women between the 1st grade students who have just started school and the 2nd grade students who are more experienced both theoretically and practically compared to the 1st grade students.

The knowledge level of the students who do practice/internship/skill training in diagnostic radiology units of hospitals from Çanakkale Onsekiz Mart University Vocational School of Health Services, which provides Medical Imaging and Radiology education in Çanakkale, will be determined by applying a 24-question survey.

When the answers given to the question "Do you know the time period when the fetus is most sensitive to radiation?" were analyzed, it was reported that 67.8% of the 2nd grade students knew it compared to 50.8% of the 1st grade students ( $p=0.04$ ). When the answers to the question "Do you know the threshold radiation doses for pregnancy termination?" were analyzed; 52.5% of the 1st grade students did not know the threshold radiation dose for pregnancy termination, whereas only 40.7% of the 2nd grade students did not ( $p=0.02$ ).

Although 2nd year Medical Imaging Techniques students have more knowledge about the pregnancy-related effects of radiation than 1st year students in terms of both theory and practice, there is still room for improvement.

**KEYWORDS:** Radiation, Pregnancy, Biological effect

### I. INTRODUCTION

The use of radiation in medicine is increasing day by day. Radiation, fast-moving energy that is emitted as particles or waves, is in two forms non-ionizing radiation (NIR) and ionizing radiation (IR). NIR is low frequency radiation that disperses energy through heat and increased molecular movement such as ultraviolet rays (part of it), visible light, infrared rays, and radio waves. IR, which includes alpha and beta particles and some electromagnetic radiations (e.g., gamma and X-rays), can, directly and indirectly, alter the normal structure of a living cell (Bahrami Asl et al., 2023). Ionizing radiation is used in diagnostic devices such as X-rays, computed tomography (CT) and dental X-rays used in Medical Imaging (Amare & Dagne, 2020; Applegate et al., 2021). The choice of the most appropriate imaging modality in pregnant women is a common clinical question and the choice of imaging modality for such patients is a multifaceted issue. Pregnant women are often concerned about the fetus and the various risks or malformations associated with radiation exposure. Radiation exposure, which is strongly related to the stage of pregnancy and the absorbed dose, is a risk factor affecting the entire pregnancy process (Guilbaud et al., 2019; Kappas, 2022). To avoid these harmful effects of radiation and to protect radiation workers and the public from radiation, the risk/benefit concept has been developed by the International Commission on Radiological Protection (ICRP) since 1977, which recommends that radiation exposure should be kept as low as reasonable and possible for all patients. (ALARA principle "As Low as Reasonably Achievable") (Musolino, DeFranco, & Schlueck, 2008). All necessary techniques should be applied to minimize the absorbed dose. Most of the biological responses to radiation occur in the first two weeks of pregnancy, when the mother is unaware that she is pregnant, and these responses can lead to miscarriage (Belaguthi, Prashanth, Dasegowda, Sadaf, & Mirmire, 2022; Guilbaud et al., 2019; Kappas, 2022). Pregnant women should not undergo radiography unless absolutely necessary. Studies have shown that the radiation dose that can be harmful to the fetus is 5 rad (50mGy), and if the fetus is exposed to less than this amount of radiation, it is unlikely to be harmed (Belaguthi et al., 2022; Eskandar, Eckford, & Watkinson, 2010; Kappas, 2022).



## Level of Knowledge about the Effects of Radiation on Pregnant Women among Medical Imaging Techniques Program Students

The pregnancy status of all women of childbearing age should be questioned by both the physician and the radiology technician who will perform radiological imaging before the procedures to be performed with ionizing radiation. Unlike other studies, this study will examine the level of knowledge about the effects of radiation on pregnant women among the students of Medical Imaging Techniques at the Vocational School of Health Services of Çanakkale Onsekiz Mart University in the province of Çanakkale and compare the level of knowledge about the effects of radiation on pregnant women between the 1st grade students who have just started school and the 2nd grade students who are more experienced both theoretically and practically compared to the 1st grade students.

### II. RESEARCH METHODS

This descriptive study was conducted between May 01, 2023 and August 30, 2023. A questionnaire form created by the researchers in line with the literature review was used to obtain the study data (Mahabob et al., 2021). The questionnaire form was delivered to the participants as an online survey. Prior to the study, approval was obtained from the Republic of Turkey Çanakkale Onsekiz Mart University Rectorate Graduate Education Institute Ethics Committee / Scientific Research Ethics Committee with the decision number 2023-YÖNP-0306, dated 14.04.2023 and E-84026528-050.01.04 document registration number. The questionnaire form consisted of 24 questions aiming to measure the demographic characteristics of the participants (age, gender, department and grade) and their knowledge about the effects of radiation on pregnant women. Previous research suggests that the study population should be at least 5 and at most 20 times the total number of items (Bryant & Yarnold, 2001; Hair, Black, Babin, & Anderson, 2019). The population of the study consisted of Çanakkale Onsekiz Mart University Vocational School of Health Services students (n=120) who went to diagnostic radiology units of hospitals in Çanakkale province for internship/practice/skill training. No sample was selected and the entire study population was included in the study. Participants were asked to answer the questions in the form created by the responsible workers. The questionnaire form was not opened on the screen of those who did not accept online consent.

**Statistical analysis:** The data obtained from the study were analyzed using SPSS 19.0 software package (SPSS Inc., Chicago, IL, USA). In the analyses, descriptive findings, number and percentage distributions, mean and standard deviations were given; analytical statistics will be evaluated with Independent Groups t Test, Chi-Square Tests.  $p < 0.05$  will be considered statistically significant and the data were evaluated at 95% confidence interval.

### III. RESULTS

In this cross-sectional study, 61 (50.8%) of the students included in the study were 1st year students and 59 (49.2%) were 2nd year students of Çanakkale Onsekiz Mart University Vocational School of Health Services, Medical Imaging Techniques. The mean age of the participants was  $20.34 \pm 1.57$  years. It was observed that 30.0% of the participants were male and 70.0% were female.

When evaluating the knowledge about the effects of radiation on pregnant women among the students, 100% of the 1st grade students reported that X-rays were harmful for pregnant women, while only 98.3% of the 2nd grade students reported that X-rays were harmful for pregnant women and the difference was not significant ( $p=0.49$ ) (Table 1). When the answers to the question "Do you know the time period when the fetus is most sensitive to radiation?" were analyzed, it was reported that 67.8% of the 2nd grade students knew, compared to 50.8% of the 1st grade students ( $p=0.04$ ). Another interesting observation was seen in the responses to the question "Do you know the threshold radiation doses for pregnancy termination?"; 52.5% of the 1st grade students did not know the threshold radiation dose for pregnancy termination, whereas only 40.7% of the 2nd grade students did not ( $p=0.02$ ). The responses to other questions related to the level of knowledge are shown in Table 1.

**Table 1. Level of knowledge about the effects of radiation on pregnant women among students (\* statistically significant)**

Question	Answer	1st Grade (n,%)	2nd Grade (n,%)	p value
Are X-rays harmful for pregnant women?	Yes	61 (%100)	58 (%98.3)	0.49
	No	0 (%0)	1 (%1.7)	
Do radiographs have deterministic and stochastic effects on pregnancy?	Yes	61 (%100)	58 (%98.3)	0.49
	No	0 (%0)	1 (%1.7)	
Does radiation cause preterm labor and low birth weight in the fetus?	Yes	59 (%96.7)	57 (%96.6)	0.68
	No	2 (%3.3)	2 (%3.4)	
Do you know the safe radiation dose?	Yes	53 (%86.9)	55 (%90.0)	0.20

## Level of Knowledge about the Effects of Radiation on Pregnant Women among Medical Imaging Techniques Program Students

I have knowledge about X-rays.	No	8 (%13.1)	4 (%10.0)	0.26
	Yes	59 (%96.7)	59 (%100.0)	
Do you know the ALARA-protection principle?	No	2 (%3.3)	0 (%0.0)	0.62
	Yes	57 (%93.4)	55 (%93.3)	
Are you aware of safety methods such as lead aprons, digital radiography?	No	4 (%6.6)	4 (%6.7)	0.51
	Yes	59 (%96.7)	58 (%98.7)	
Do you know when the fetus is most sensitive to radiation?	No	30 (%49.2)	19 (%32.2)	0.04*
	Yes	31 (%50.8)	40 (%67.8)	
Do you know the threshold radiation doses for pregnancy termination?	No	38 (%52.5)	24 (%40.7)	0.02*
	Yes	23 (%37.7)	35 (%59.3)	

When the attitude towards the effects of radiation on pregnant women was examined (Table 2.), 79.7% of 2nd year students agreed with the question "Do you think that dental and medical clinics using radiography should be compulsorily accredited and monitored by regulatory bodies?" (p=0.04). Both 42.6% of 1st grade students and 66.1% of 2nd grade students "strongly disagreed" with the statement "Radiation-related examinations can be performed during certain periods of pregnancy" (p=0.04).

**Table 2. Attitudes among students regarding the effects of radiation on pregnant women (\* statistically significant)**

Answer	Grade	Strongly Agree (n,%)	Agree (n,%)	Neither agree nor disagree (n,%)	Disagree (n,%)	Strongly Disagree (n,%)	p value
Do you think X-rays should be taken during pregnancy?	1	1 (%1.6)	3 (%4.9)	5 (%8.2)	19 (%31.1)	33 (%54.1)	0.35
	2	0 (%0.0)	0 (%0.0)	7 (11.9)	21 (%35.6)	31 (%52.5)	
X-rays should only be taken with appropriate protection techniques if absolutely necessary.	1	23 (%37.7)	32 (%52.5)	2 (%3.3)	3 (%4.9)	1 (%1.6)	0.66
	2	18 (%30.5)	32 (%54.2)	4 (%6.8)	2 (%3.4)	3 (%5.1)	
Education and training programs should be conducted to raise awareness among radiology students about the effects of radiation in pregnant women.	1	27 (%44.3)	26 (%42.6)	3 (%4.9)	2 (%3.3)	3 (%4.9)	0.24
	2	27 (%45.8)	30 (%50.8)	2 (%3.4)	0 (%0.0)	0 (%0.0)	
Do you think there should be mandatory accreditation and monitoring of dental and medical clinics using radiography by regulatory bodies?	1	20 (%32.8)	33 (%54.1)	6 (%9.8)	1 (%1.6)	1 (%1.6)	0.04*
	2	8 (%13.6)	47 (%79.7)	4 (%6.8)	0 (%0.0)	0 (%0.0)	
Pregnant women are allowed to enter radiation fields.	1	1 (%1.6)	2 (%3.3)	1 (%1.6)	8 (%13.1)	49 (%80.3)	0.50
	2	0 (%0.0)	1 (%1.7)	1 (%1.7)	14 (%23.7)	43 (%72.9)	
Radiation-related examinations can be performed during certain periods of pregnancy.	1	3 (%5.1)	7 (%11.5)	14 (%23.0)	26 (%42.6)	12 (%19.7)	0.01*
	2	0 (%0.0)	12 (%20.3)	3 (%5.1)	39 (%66.1)	5 (%8.5)	

## IV. DISCUSSION

Cancerous conditions, miscarriage, mutagenic changes in the fetus, cataracts, etc. are strongly associated with radiation exposure. The radiation effect can be stochastic, leading to the emergence of biological hazards. Therefore, radiation protection protocol should be followed and healthcare personnel should limit radiation exposure with the concept of the ALARA principle

## Level of Knowledge about the Effects of Radiation on Pregnant Women among Medical Imaging Techniques Program Students

keeping it "As Low As Reasonably Achievable" (Kappas, 2022; Shaw, Duncan, Vouyouka, & Ozsvath, 2011). Therefore, a rigorous knowledge of the biological hazards of X-rays is required, and with this in mind, this study assessed the knowledge of medical imaging techniques students of the vocational school of health services regarding the impact of radiation among pregnant women. Existing studies have revealed that the majority of medical and medical imaging techniques students think that X-rays are harmful. This percentage is particularly higher for medical imaging techniques students compared to dental students and this may be due to a strong course on radiology with special emphasis on biological hazards and different methods of protection. In this study, 96.7% of 1st year medical imaging techniques students and 96.6% of 2nd year medical imaging techniques students knew that X-rays cause preterm labor and low birth weight. The results do not support the study by Mortazavi SMJ et al. which found no statistically significant difference between the mean weights of newborn babies whose mothers were and were not exposed to some common sources of ionizing and non-ionizing radiation (Mortazavi, Shirazi, & Mortazavi, 2013). In the present study, 86.9% of 1st year medical imaging techniques students and 90.0% of 2nd year medical imaging techniques students were aware of the safe radiation dose. This means that approximately 10% of medical imaging technics students are unaware of the biological hazards of radiation. Even existing studies show that the first period is mainly the vulnerable period during pregnancy and exposure can lead to certain defects (Guilbaud et al., 2019; Kappas, 2022). In this study, both medical imaging techniques 1st year students and medical imaging techniques 2nd year students stated that radiographic procedures should not be performed on pregnant women unless there is an absolute necessity, and if the procedure is necessary, all necessary precautions should be taken to minimize the radiation dose and its effects. It was also observed that the majority of 2nd year medical imaging techniques students had a positive attitude towards mandatory accreditation and monitoring of dental and medical clinics using radiography by regulatory bodies. Although students have moderate knowledge and positive attitudes towards radiation protection measures, there is still room for improvement. Awareness training programs should be planned to increase their knowledge about the safety of radiographic procedures and the use of protective techniques in pregnant women.

## V. CONCLUSION

Although 2nd year Medical Imaging Techniques students are more knowledgeable about the pregnancy-related effects of radiation than 1st year students, both theoretically and practically, there is still room for improvement. In fact, continuous education and training programs should be conducted at intervals to strictly follow the protocols of different radiographic protection regulations for pregnant women.

## REFERENCES

- 1) Amare, D. E., & Dagne, H. (2020). Knowledge and Associated Factors of Medical Students Regarding Radiation Exposure from Common Diagnostic Imaging Procedures at the University of Gondar, Ethiopia. *Ethiop J Health Sci*, 30(4), 589-598. doi:10.4314/ejhs.v30i4.14
- 2) Applegate, K. E., Findlay, Ú., Fraser, L., Kinsella, Y., Ainsbury, L., & Bouffler, S. (2021). Radiation exposures in pregnancy, health effects and risks to the embryo/foetus-information to inform the medical management of the pregnant patient. *J Radiol Prot*, 41(4). doi:10.1088/1361-6498/ac1c95
- 3) Bahrami Asl, F., Islami-Seginsara, M., Ebrahimi Kalan, M., Hemmatjo, R., Hesam, M., & Shafiei-Irannejad, V. (2023). Exposure to ionizing radiations and changes in blood cells and interleukin-6 in radiation workers. *Environ Sci Pollut Res Int*, 30(13), 35757-35768. doi:10.1007/s11356-022-24652-8
- 4) Belaguthi, P. P. K., Prashanth, S., Dasegowda, G., Sadaf, S., & Mirmire, S. (2022). Radiation exposure in pregnancy: need for awareness. *International Journal Of Community Medicine And Public Health*, 9(7), 2987-2991. doi:10.18203/2394-6040.ijcmph20221771
- 5) Bryant, F., & Yarnold, P. (2001). Principal-component analysis and exploratory and confirmatory factor analysis.
- 6) Eskandar, O., Eckford, S., & Watkinson, T. (2010). Safety of diagnostic imaging in pregnancy. Part 1: X-ray, nuclear medicine investigations, computed tomography and contrast media. *The Obstetrician & Gynaecologist*, 12(2), 71-78. doi:https://doi.org/10.1576/toag.12.2.71.27571
- 7) Guilbaud, L., Beghin, D., Dhombres, F., Blondiaux, E., Friszer, S., Ducou Le Pointe, H., . . . Jouannic, J.-M. (2019). Pregnancy outcome after first trimester exposure to ionizing radiations. *European Journal of Obstetrics & Gynecology and Reproductive Biology*, 232, 18-21. doi:https://doi.org/10.1016/j.ejogrb.2018.11.001
- 8) Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). *Multivariate Data Analysis*: Cengage.

## Level of Knowledge about the Effects of Radiation on Pregnant Women among Medical Imaging Techniques Program Students

- 9) Kappas, C. (2022). Pregnancy and medical radiation. *Radiation Physics and Chemistry*, 201, 110478. doi:<https://doi.org/10.1016/j.radphyschem.2022.110478>
- 10) Mahabob, M. N., Alabdulsalam, M., Alabduladhem, A., Alfayz, S., Alzurriq, A., & Almomin, A. M. (2021). Knowledge, Attitude and Practice about radiation safety among the undergraduates in Eastern province dental college. *J Pharm Bioallied Sci*, 13(Suppl 2), S1442-s1447. doi:10.4103/jpbs.jpbs\_248\_21
- 11) Mortazavi, S. M., Shirazi, K. R., & Mortazavi, G. (2013). The study of the effects of ionizing and non-ionizing radiations on birth weight of newborns to exposed mothers. *J Nat Sci Biol Med*, 4(1), 213-217. doi:10.4103/0976-9668.107293
- 12) Musolino, S. V., DeFranco, J., & Schlueck, R. (2008). The ALARA principle in the context of a radiological or nuclear emergency. *Health Phys*, 94(2), 109-111. doi:10.1097/01.HP.0000285801.87304.3f
- 13) Shaw, P., Duncan, A., Vouyouka, A., & Ozsvath, K. (2011). Radiation exposure and pregnancy. *Journal of Vascular Surgery*, 53(1, Supplement), 28S-34S. doi:<https://doi.org/10.1016/j.jvs.2010.05.140>



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## The Influence of Celebrity Endorsement, Brand Image, Brand Trust and Lifestyle on Purchase Decisions for Geoff Max Brand Shoes (Study on Students in Purwokerto City)



Evan Fauzan Putra<sup>1</sup>, Tri Septin Muji Rahayu<sup>2</sup>, Arini Hidayah<sup>3</sup>, Purnadi<sup>4</sup>

<sup>1,2,3,4</sup> Faculty Economics and Business, Muhammadiyah Purwokerto University

**ABSTRACT:** Local brand shoes in Indonesia have been in great demand by young people, both men and women because the quality and model are not inferior to foreign-made products. The purpose of this study was to examine the influence of celebrity endorsement, brand image, brand trust, and lifestyle on purchase decisions for Geoff Max brand shoes. The population of this study were students at three universities, namely Jendral Soedirman University, Muhammadiyah Purwokerto University, and K.H Saifuddin Zuhri State Islamic University Purwokerto. The method used in this research was quantitative method with purposive sampling with a total of 100 students who are processed using five Likert scale with multiple regression analysis using SPSS Version 26. The results of this study indicated that celebrity endorsement and brand image have no significant influence on purchase decisions, while brand trust and lifestyle have a positive and significant influence on purchase decisions. The results of the t-value test calculated on lifestyle variables of (4,303) and a significance value of 0.000, thus lifestyle is more dominant in influencing the purchase decision of Geoff Max brand shoes compared to brand trust.

**KEYWORDS:** Celebrity Endorsement, Brand Image, Brand Trust, Lifestyle, and Purchase Decisions

### I. INTRODUCTION

The fashion industry in the modern era is increasing and has become a lifestyle that is in great demand by all circles. One important part of fashion is shoes, nowadays shoes have become a stylish trend in clothing that is used to clarify one's identity to the surrounding environment (Rahmani et al., 2022). Many shoe brands are popular in Indonesia, both local brands and foreign brands. However, nowadays many people choose to use shoes from local brands, and this is commonly referred to as local pride, this phenomenon cannot be separated from the buzz of local shoe manufacturers through shoe exhibition events held in various regions in Indonesia to get the attention of domestic and foreign communities, by trying to build awareness from consumers that local brands are not inferior to foreign brands (Alamsyah & Budiarti, 2022).

One of the shoe products made in Indonesia that is in great demand and able to compete with products made in other countries is Geoff Max, this local shoe brand was founded by Yusuf Ramadhani and Fauzan Efwanda in 2012. They created Geoff Max because they were concerned about the number of young people who liked foreign-made shoe products and ended up buying replicas (Respati, 2023). Geoff Max shoes have a price range of IDR 160,000 - IDR 755,000 which is still quite affordable, besides that Geoff Max shoes are also included in the Top 10 best local sneakers in Indonesia in 2023. This shoe brand is in third place after the first order, namely the NAH Project shoe brand, and the second order of the Compass shoe brand (Tokopedia, 2023). In facing competition GeoffMax must have a strategy in order to increase market share by knowing the factors that influence purchase decisions.

Geoff Max's company strategy to attract consumers to make purchases is to promote its products using Ariel Noah as a celebrity endorsement. Celebrity endorsement is one of the communication media used by celebrities to express and promote brands based on the popularity of their personality (Andini & Rizal, 2022). Based on interviews conducted by researchers with consumers, it shows that not all consumers make purchases influenced by a celebrity endorsement, because some consumers do not know that Ariel Noah is a celebrity endorsement of Geoff Max brand shoes. Previous research conducted by Finthariasari et al. (2022), Safira & Alimuddin (2023), and Muhani & Sabillah (2022) show that celebrity endorsement has a positive and significant influence on purchase decisions. On the contrary, Rahmawati et al. (2023) stated that celebrity endorsement has a negative

## **The Influence of Celebrity Endorsement, Brand Image, Brand Trust and Lifestyle on Purchase Decisions for Geoff Max Brand Shoes (Study on Students in Purwokerto City)**

influence on purchase decisions. Research conducted by Prayogi (2022) and Rahmawati et al. (2022) also shows the result that celebrity endorsement has no significant influence on purchase decisions.

Brand image also influences consumer purchase decisions. The thoughts that exist in a person's mind about a good or service that they know and have used or consumed are known as a brand image. (Miati, 2020). Based on interviews conducted by researchers with consumers, it shows that some consumers do not pay attention to the brand image of Geoff Max shoes before they decide to make a purchase. The results of previous research conducted by Tyas et al. (2023), Alfifto et al. (2023), and Safira & Alimuddin (2023) found that brand image has a positive and significant influence on purchase decisions. On the contrary, Rasyid & Karya (2021) show the result that brand image has a negative influence on purchase decisions. Research conducted by Salam & Abdiyanti (2022) and Nadiah et al. (2023) also shows that brand image has no significant influence on purchase decisions.

In determining consumer purchase decisions, it can be influenced by brand trust. Brand trust is an attitude or action of consumers who always believe in the company's product brand so that there is no doubt in themselves when buying and selling goods with the company. (Ferdiansyah et al., 2022). Based on interviews conducted by researchers with consumers, shows that some consumers tend to buy Geoff Max shoes because they believe that the product can meet their needs and desires because of its quality and model. According to research conducted by Efendi et al. (2022), Agustina et al. (2023), and Titania & Yulianto (2023) stated that brand trust has a positive and significant influence on purchase decisions. On the contrary, Santoso et al. (2020) stated that brand trust has a negative influence on purchase decisions. Research conducted by Anjaswati & Istiyanto (2023) and Nadiah et al. (2023) also show the result that brand trust has no significant influence on purchase decisions.

Consumer lifestyle also influences purchase decisions. Lifestyle has more to do with how a person uses money and utilizes the time they have which can change at any time, but changes that occur are not due to changes in needs. (Solihin et al., 2020). Based on interviews conducted by researchers with consumers, it shows that some consumers make purchase decisions because the model of Geoff Max brand shoes matches their preferences and lifestyle. According to research conducted by Tyas et al. (2023), Asmi & Zaini (2023), and Latifah & Maskur (2023) stated the result that lifestyle has a positive and significant influence on purchase decisions. On the contrary, Suciani & Ayuni (2022) and Safitri & Basiya (2022) stated the result that lifestyle has a negative influence on purchase decisions. Research conducted by Damayanti & Sulaeman (2023) also shows the results that lifestyle has no significant influence on purchase decisions.

The purpose of this study was to examine the influence of celebrity endorsement, brand image, brand trust, and lifestyle and their subsequent impact on purchase decisions for Geoff Max shoes for students in Purwokerto City.

## **II. LITERATURE REVIEW AND RESEARCH DEVELOPMENT**

### **Consumer Behavior**

According to Sangadji & Sopiah (2013), Consumer behavior is the study of individual, group, or organizational behavior and the processes used by consumers to select products, services, and experiences or ideas to achieve and meet their needs both when consuming, and spending goods and services, including decisions made before and after. The impact of these processes on consumers and society ends with feelings of satisfaction or dissatisfaction after purchase. According to Priansa (2017), consumer behavior is the behavior shown by consumers who search for, buy, use, evaluate, and spend products to meet their needs and desires.

### **Theory of Cognition**

According to Peter & Olson (2018), states that cognition refers to what they think about such as belief in a product, cognition refers to the mental structures and processes that exist in thinking, understanding, and interpreting stimuli and events. According to Tjiptono (2015), cognition reflects a consumer's thoughts and knowledge such as beliefs about a particular product.

### **Theory of Affection**

According to Tjiptono (2015), states that affection refers to consumer feelings which include emotions, feeling states, moods, and attitudes towards surrounding stimuli and events such as likes and dislikes towards a specific product. According to Peter & Olson (2018), affection refers to the things they feel about stimuli and events, such as how they like or dislike a product.

### **Purchase Decisions**

According to Peter & Olson (2018), when consumers use integration to evaluate two or more alternatives and choose one of them, it is called consumer decision-making. According to Sangadji & Sopiah (2013), consumer behavior affects the purchase decision-making process, the process is a problem-solving process with the aim of meeting consumer wants or needs. According to Kotler and Armstrong (2019), the five indicators of purchase decisions are problem introduction, information quest, alternative valuation, buying decisions, and behavior after purchase (Inggasari & Hartati, 2022).

# **The Influence of Celebrity Endorsement, Brand Image, Brand Trust and Lifestyle on Purchase Decisions for Geoff Max Brand Shoes (Study on Students in Purwokerto City)**

## **Celebrity Endorsement**

According to Kotler & Keller (2016), celebrity endorsement is the use of a spokesperson as a feature to convey an interesting or popular message in advertising, with the aim of getting attention and memory of the brand image in the minds of customers. According to Fongo (2021), celebrity endorsement is an individual who is well known by the public and promotes a certain product by making testimonials, written or oral statements that show the goodness of the product and introduce the product to the wider community. According to Shimp and Andrews (2017), there are several indicators that can be used to measure celebrity endorsement, namely credibility, attractiveness, and strength (Magfiroh & Rufial, 2022).

By choosing the right celebrity endorser and in accordance with product features, consumers can be convinced to make purchase decisions. The main factor in choosing a celebrity endorser is the popularity of the celebrity, the more often a celebrity models a product, the more likely consumers are to buy products owned by that celebrity (Martha & Maini, 2022). Therefore, celebrity endorsement has an impact on consumer choice in determining purchase decisions for Geoff Max brand shoes. This is in line with previous research from Finthariasari et al. (2022), Safira & Alimuddin (2023), and Muhani & Sabillah (2022) which proves the result that celebrity endorsement has a positive and significant influence on purchase decisions.

H1: Celebrity endorsement has a positive and significant influence on purchase decisions.

## **Brand Image**

According to Swasty (2016), brand image refers to customers' perceptions of a brand which is explained through brand associations stored in their memories, these brand associations serve as a source of information about brands of interest to customers, and this relationship can be diverse and related to various product features. According to Fongo (2021), explains that the image or perception of customers towards a particular brand that is built in their memory after they have used it or listened to what other people say about the brand is called a brand image. According to Keller (2013), the benefit of brand association, the power of brand association, and the diversity of brand association as supporting indicators for the formation of brand image in brand association (Sinaga & Hutapea, 2022).

Confidence in a product or service based on the belief that the product or service meets consumer needs and provides a higher level of satisfaction can be helped by a brand that can help sellers and build relationships with consumers. If the brand image is handled well, it will be beneficial, such as making customers more aware of the various behavioral aspects associated with making purchase decisions. (Latifah & Maskur, 2023). In this case, customer perceptions about the brand can influence purchase decisions for Geoff Max shoes made by consumers. This is in line with previous research from Tyas et al. (2023), Alfifto et al. (2023), and Safira & Alimuddin (2023) which proves the result that brand image has a positive and significant influence on purchase decisions.

H2: Brand Image has a positive and significant influence on purchase decisions.

## **Brand Trust**

According to Sangadji & Sopiah (2013) define the strength of knowledge and all conclusions made by consumers about a product that is believed to have attributes, objects, and benefits as brand trust. According to Tjiptono (2015), states that brand trust is the ability of a brand to be trusted and relied upon based on customer confidence that the product can prioritize consumer interests. According to Buchory and Saladin (2018), there are four indicators to measure brand trust which consist of trust, reliance, honesty, and security (Kasiha et al., 2023).

Trust is very important to turn buyers or consumers into first customers. Consumers will always buy a product to fulfill their needs, but what products they buy and how they make decisions will greatly affect how they feel about the brand they choose. (Maulana & Marista, 2021). Therefore, brand trust has an important role in making consumer purchase decisions in buying Goff Max brand shoes. This is in line with previous research from Efendi et al. (2022), Titania & Yulianto (2023), and Agustina et al. (2023) which proves the result that brand trust has a positive and significant influence on purchase decisions.

H3: Brand Trust has a positive and significant influence on purchase decisions

## **Lifestyle**

According to Priansa (2017), a person's life pattern shown through various activities, interests, and opinions as a general description of how they interact with their environment is called a lifestyle. According to Kotler & Keller (2016), states that lifestyle is a person's life pattern expressed in the form of activities, interests, and opinions. According to Kotler and Keller (2014), there are three indicators to assess lifestyle which consist of activities, interests, and opinions (Ramadhoani & Haryanti, 2023).

Lifestyle is a term used to describe how a person spends most of their time with others and is a clear indication of an individual's lifestyle. If someone is more interested in following the latest trends in their lifestyle, they will most likely try to follow those trends in terms of the items they buy. As sellers, they should be able to understand how the products they sell relate to people's lifestyles. (Latifah & Maskur, 2023). Therefore, consumer lifestyles also have an influence in considering purchase decisions for

# The Influence of Celebrity Endorsement, Brand Image, Brand Trust and Lifestyle on Purchase Decisions for Geoff Max Brand Shoes (Study on Students in Purwokerto City)

Geoff Max brand shoes. This is in line with previous research from Tyas et al. (2023), Latifah & Maskur (2023), and Asmi & Zaini (2023) which proves the result that lifestyle has a positive and significant influence on purchase decisions.

H4: Lifestyle has a positive and significant influence on purchase decisions.

### III. RESEARCH METHODS

This research uses quantitative methods using Google Forms which are distributed online to facilitate respondents as primary data. The population in this study was 100 with the criteria of active students in Purwokerto City with an age range of 18-25 years who have purchased Geoff Max brand shoes from three universities, namely Jendral Soedirman University, Muhammadiyah Purwokerto University, and K.H. Saifuddin Zuhri State Islamic University Purwokerto. The sampling technique used purposive sampling method, by dividing the respondents using the ratio of the number of students in each college to the total number of students in the three colleges multiplied by 100% with a percentage result of 61% for Jendral Soedirman University, 27% for Muhammadiyah Purwokerto University and 12% for K.H. Saifuddin Zuhri Purwokerto State Islamic University. The analysis method in this study used five Likert scales and then processed with multiple regression analysis using SPSS Version 26.

### IV. RESULTS AND DISCUSSION

#### Results

##### Respondent Characteristics

**Table 1. Respondent Characteristics**

Variables	Category	F	%
Gender	Male	56	56%
	Female	44	44%
Age	<18 - 21 Years	86	86%
	22 - 24 Years	14	14%
Higher Education	Jendral Soedirman University	61	61%
	Muhammadiyah Purwokerto University	27	27%
	K.H. Saifuddin Zuhri Purwokerto State Islamic University	12	12%
Pocket Money	< IDR 1,000,000	76	76%
	> IDR 3,000,000	2	2%
	2.000.000 - 3.000.000	22	22%

(Source: Data processed by SPSS 26)

From the table above, it can be said that male respondents are more dominant, namely 56 respondents or (56%) of 100 respondents, this is because Geoff Max shoes have a trendy and contemporary design that is more suitable for use by men. The majority of respondents' ages are dominated by the age range <18-21 years as many as 86 respondents or (86%), this is because most students have ages in general, namely <18-21 years. Respondents from Jendral Soedirman University Purwokerto totaled 61 respondents or (61%), Muhammadiyah University Purwokerto totaled 27 respondents or (27%), and K.H. Saifuddin Zuhri State Islamic University Purwokerto totaled 12 respondents or (12%). Most respondents get an average pocket money <Rp 1,000,000 with 76 respondents or (76%).

##### Validity Test

The results of testing the validity of all questionnaire statements of each variable that have been carried out can be declared valid because they have  $r_{count} > r_{table}$  where none of the  $r_{count}$ s are smaller than 0.1638.

##### Reliability Test

The results of reliability testing on all variables that have been carried out can be declared reliable because they have a Cronbach alpha value for each variable above 0.70.

##### Normality Test

**Table 2. Normality Test Results**

	Unstandardized Residual
N	100
Normal Parameters <sup>a,B</sup>	.0000000
	3.03238841



**The Influence of Celebrity Endorsement, Brand Image, Brand Trust and Lifestyle on Purchase Decisions for Geoff Max Brand Shoes (Study on Students in Purwokerto City)**

Most Extreme Differences	.116
	.067
	-.116
Test Statistic	.116
Asymp. Sig. (2-Tailed)	.002 <sup>C</sup>
	.130 <sup>D</sup>
Monte Carlo Sig. (2-Tailed)	.121
	.138

(Source: Data processed by SPSS 26)

From the results of the table above after the normality test with the Monte Carlo method, according to the rules with a significance value greater than 0.5, namely 0.130, it can be said that the data is normally distributed.

Multicollinearity Test

**Table 3. Multicollinearity Test Results**

Variables	Tolerance(1/VIF)	VIF	Conclusion
Celebrity Endorsement	0.513	1.950	No Multicollinearity
Brand Image	0.335	2.984	No Multicollinearity
Brand Trust	0.222	4.496	No Multicollinearity
Lifestyle	0.270	3.705	No Multicollinearity

(Source: Data processed by SPSS 26)

From the test results table above, it can be seen that the variables that affect and are affected by the tolerance value above 0.10 and the VIF value below 10, so it can be said that the data does not occur in multicollinearity.

Heteroscedasticity Test

**Table 4. Heteroscedasticity Test Results**

Model		T	Sig.
1	Constant	-0.261	0.795
	Celebrity Endorsement	0.135	0.893
	Brand Image	-0.469	0.640
	Brand Trust	1.220	0.225
	Lifestyle	-0.154	0.878

(Source: Data processed by SPSS 26)

The calculation results state that the significance value for all variables is above 0.05. So it can be stated that in the regression model, there is no heteroscedasticity between variables.

Multiple Linear Regression Analysis

**Table 5. Multiple Linear Regression Test Results**

Dependent Variable	Independent Variable	Regression Coefficients	t value	Sig.
Y Purchase Decision	Constant	5.018	1.882	.063
	Celebrity Endorsement (X1)	.178	1.401	.164
	Brand Image (X2)	.010	.058	.954
	Brand Trust (X3)	.467	2.960	.004
	Lifestyle(X4)	.810	4.303	.000
	F Value		59.701	.000
	R Square		.715	

(Source: Data processed by SPSS 26)

## **The Influence of Celebrity Endorsement, Brand Image, Brand Trust and Lifestyle on Purchase Decisions for Geoff Max Brand Shoes (Study on Students in Purwokerto City)**

The test results based on the table above, it can be concluded :

### **Celebrity Endorsement on Purchase Decisions**

From the table above, it shows  $t_{count} < t_{table}$  ( $1.401 < 1.660$ ) with a significance value of 0.164 greater than 0.05. So the first hypothesis reads "Celebrity Endorsement has no influence on Purchase Decisions", meaning that the first hypothesis is rejected.

### **Brand Image on Purchase Decisions**

From the table above, it shows  $t_{count} < t_{table}$  ( $0.058 < 1.660$ ) with a significance of 0.954 greater than 0.05. So the second hypothesis reads "Brand Image has no influence on Purchase Decisions", meaning that the second hypothesis is rejected.

### **Brand Trust on Purchase Decisions**

From the table above, it shows  $t_{count} > t_{table}$  ( $2.960 > 1.660$ ) with a significance value of 0.004 smaller than 0.05. So the third hypothesis reads "Brand Trust has a positive and significant influence on Purchase Decisions", meaning that third hypothesis is accepted.

### **Lifestyle on Purchase Decisions**

From the table above, it shows  $t_{count} > t_{table}$  ( $4.303 > 1.660$ ) with a significance value of 0.000 smaller than 0.05. So the fourth hypothesis reads "Lifestyle has a positive and significant influence on Purchase Decisions", meaning that the fourth hypothesis is accepted.

### **Discussion**

In this study, the results show that celebrity endorsement has no influence on purchase decisions for Geoff Max brand shoes. This research is not in accordance with the Cognition Theory put forward by Peter & Olson (2018) because when a celebrity advertises or endorses a product, it will not make consumers buy it, and shows that consumers are not affected by the popularity or fame of a celebrity when deciding to buy a product. These results are the same as research conducted by Prayogi (2022), Utami & Ellyawati (2021), and Rahmawati et al. (2022) which gives the result that celebrity endorsement has no influence on purchase decisions.

Furthermore, this study also found that brand image does not influence purchase decisions for Geoff Max brand shoes. This research is not in accordance with the Cognition Theory put forward by Peter & Olson (2018) because the perception or brand image that consumers have of a brand does not influence purchase decisions. Even though a brand has a strong or positive image, it will not encourage consumers to buy the product. These results are the same as research conducted by Salam & Abdiyanti (2022), Wardani & Maskur (2022), and Rifky et al. (2021) which gives the result that brand image has no influence on purchase decisions.

However, this study shows that brand trust has a positive and significant influence on purchase decisions for Geoff Max brand shoes. This research is in accordance with the Cognition Theory put forward by Peter & Olson (2018) because consumer trust in a brand or product can increase their likelihood of buying it. Consumers tend to choose brands that they trust and feel comfortable using these products. These results are in line with research conducted by Efendi et al. (2022), Asmi & Zaini (2023), and Agustina et al. (2023) prove that brand trust has a positive and significant influence on purchase decisions.

In addition, this study also found that lifestyle has a positive and significant influence on purchase decisions for Geoff Max brand shoes. This research is in accordance with the Theory of Affection put forward by Peter & Olson (2018) because a person's lifestyle can influence their purchase decisions. If the product or brand matches the consumer's lifestyle, then they are more likely to buy it. These results are in line with research conducted by Tyas et al. (2023), Finthariasari et al. (2022), and Latifah & Maskur (2023) prove that lifestyle has a positive and significant influence on purchase decisions.

### **V. CONCLUSIONS**

According to this study, it was found that celebrity endorsement and brand image have no influence on purchase decisions for Geoff Max brand shoes. However, brand trust and lifestyle have a positive and significant influence on purchase decisions for Geoff Max brand shoes.

Advice to companies, that companies need to build stronger brand trust through promotions such as on social media and advertising media and provide positive reviews and testimonials so that consumers know and feel confident that the Geoff Max brand is reliable and can meet their needs. The company also needs to conduct market research to adjust to the latest fashion trends. By adding design elements that are currently popular to increase consumer appeal to Geoff Max brand shoe models, so that consumers have more options to choose from according to their preferences. In addition, the company can also consider using other marketing strategies besides celebrity endorsement and brand image, such as influencer marketing or promotion through more relevant social media.

## The Influence of Celebrity Endorsement, Brand Image, Brand Trust and Lifestyle on Purchase Decisions for Geoff Max Brand Shoes (Study on Students in Purwokerto City)

Future research is recommended to better understand what consumers think about brands by identifying what aspects make the Geoff Max shoe brand trusted by consumers and measuring the influenceiveness of positive and negative trends in Geoff Max shoe brand trust as an effort to make improvements and conduct research on the latest fashion trends to help understand shoe models that match consumer lifestyles. In addition, further research can also be conducted to analyze other variables that are likely to have an influence on purchase decisions for Geoff Max brand shoes among students in Purwokerto city such as social media marketing and E-WOM, further research can also re-examine those that have no influence on this study. In addition, research is also recommended to expand the scope of the sample used, such as not only involving students in one city but also from other cities.

### REFERENCES

- 1) Agustina, R., Hinggo, H. T., & Zaki, H. (2023). Pengaruh Brand Ambassador, E-WOM dan Brand Trust Terhadap Keputusan Pembelian Produk Erigo. *Jurnal Ilmiah Mahasiswa Merdeka EMBA*, 2(1).
- 2) Alamsyah, I., & Budiarti, A. (2022). Pengaruh Brand Image, Kualitas Produk, dan Harga Terhadap Keputusan Pembelian Sepatu Lokal Compass. *Jurnal Ilmu Dan Riset Manajemen*, 11.
- 3) Alfifto, Salqaura, S. A., Amelia, W. R., & Hasman, H. C. P. (2023). Analysis of Purchasing Decisions for Adidas Sportswear Based on Celebrity Endorsers and Brand Image. *International Journal of Economic, Business, Accounting, Agriculture Management and Sharia Administration*, 3(4).
- 4) Andini, P. K., & Rizal, A. R. (2022). Membangun Brand Awareness melalui Celebrity Endoser dan Social Media Marketing Pada Pelanggan E-Commerce Shopee. *SEIKO: Journal of Management & Business*, 5(1), 2022–2257. <https://doi.org/10.37531/sejaman.v5i1.1390>
- 5) Anjaswati, D. P., & Istiyanto, B. (2023). Pengaruh Brand Trust, E-wom, dan Gaya Hidup Terhadap Keputusan Pembelian Melalui Aplikasi Shopee di Solo Raya The Effect of Brand Trust, E-wom, and Lifestyle on Purchase Decision Through The Shopee Application in Solo Raya. *Jurnal Riset Ekonomi Dan Akuntansi*, 1(2), 51–61. <https://doi.org/10.54066/jrea-itb.v1i2.259>
- 6) Asmi, M. I., & Zaini, M. (2023). Pengaruh Gaya Hidup, Brand Trust, Kualitas Pelayanan Terhadap Keputusan Pembelian Pada Tokopedia. *Investasi Dan Syariah (EKUITAS)*, 5(1), 93. <https://doi.org/10.47065/ekuitas.v5i1.3688>
- 7) Damayanti, E. R., & Sulaeman, E. (2023). Pengaruh Citra Merek, Harga dan Gaya Hidup Terhadap Keputusan Pembelian Kopi Janji Jiwa di Kota Karawang. *Jurnal Ilmiah Wahana Pendidikan*, 1–15.
- 8) Efendi, B., Nurhayati, E. C., & Hidayatullah, M. F. (2022). Pengaruh Brand Trust, E-Service Quality, E-Promotion, Dan Lifestyle Terhadap Keputusan Pembelian Pada Traveloka. *JPEKBM (Jurnal Pendidikan Ekonomi, Kewirausahaan, Bisnis, Dan Manajemen)*, 6, 1–14.
- 9) Ferdiansyah, H., Azhmy, M. F., & Nasution, A. A. (2022). Pengaruh Brand Image dan Product Quality Terhadap Brand Loyalty Dimediasi Brand Trust. *Jurnal Ekonomi Bisnis Digital*, 1 (2).
- 10) Finthariasari, M., Ratnawili, & Halim, N. (2022). Purchasing Decisions: The Analysis Effect Of The Variables Life Style, Celebrity Endorser, And Brand Image. *Jurnal Ekombis Review*, 10(2), 661–672. <https://doi.org/10.37676/ekombis.v10i12>
- 11) Fongo, P. (2021). *Celebrity Endorser & Daya Tarik Iklan Terhadap Minat Belanja Online Kaum Milenial*. Literasi Nusantara.
- 12) Inggasari, S. M., & Hartati, R. (2022). Pengaruh Celebrity Endorser, Brand Image, dan Brand Trust Terhadap Keputusan Pembelian Produk Scarlett Whitening. *Cakrawangsa Bisnis*, 3, 1–22.
- 13) Kasiha, W. N. T., Lumanauw, B., & Raintung, M. C. (2023). The Effect Of Brand Experience, Affective Commitment, and Brand Trust on Brand Loyalty on Caf Ngopijo Consumers In Manado. *Jurnal EMBA*, 11(3), 644–655.
- 14) Kotler, & Keller. (2016). *Marketing Management*. Pearson Education.
- 15) Latifah, V. U., & Maskur, A. (2023). Pengaruh Brand Image, Persepsi Harga, Dan Lifestyle Terhadap Keputusan Pembelian Pakaian Preloved Di Thriftshop Online Instagram (Studi Pada Konsumen @kenangan.mantann Di Kota Kendal). *Jurnal Media Wahana Ekonomika*, 20, 409–420.
- 16) Magfiroh, I., & Rufial. (2022). Pengaruh Kualitas Produk, Persepsi Harga, dan Celebrity Endorsement Terhadap Keputusan Pembelian Skincare (produk serum) di PT. AVO Innovation Technology (Avoskin) (Survey pada Mahasiswa FEB UPI YAI). *Jurnal Ikraith-Ekonomika*, 5 (3). <http://journals.upi-yai.ac.id/index.php/IKRAITH-EKONOMIKA>
- 17) Martha, L., & Maini, D. (2022). Pengaruh Celebrity Endorser, Brand Image, dan Kepercayaan Merek Terhadap Keputusan Pembelian Sepeda Motor Yamaha Nmax Di CV. Tjahaja Baru Surantih. *Jurnal Valuasi: Jurnal Ilmiah Ilmu Manajemen Dan Kewirausahaan*, 2(2). <https://doi.org/10.46306/vls.v2i2>

## The Influence of Celebrity Endorsement, Brand Image, Brand Trust and Lifestyle on Purchase Decisions for Geoff Max Brand Shoes (Study on Students in Purwokerto City)

- 18) Maulana, S. Y., & Marista, M. (2021). The Effect of Brand Image and Brand Trust on Oppo Cellphones Purchasing Decisions In Banjar City. *Jurnal Manajemen Bisnis*, 8(2).
- 19) Miati, I. (2020). Pengaruh Citra Merek (Brand Image) Terhadap Keputusan Pembelian Kerudung Deenay (Studi pada Konsumen Gea Fashion Banjar). *Jurnal Abiwara*, 1(2), 71–83. <http://ojs.stiami.ac.id>
- 20) Muhani, & Sabillah, H. S. (2022). Pengaruh Celebrity Endorser, Brand Image, Word Of Mouth, Kualitas Website, dan Persepsi Harga Terhadap Keputusan Pembelian pada E-Commerce Tokopedia. *Jurnal Ilmiah Akuntansi Dan Keuangan*, 4(Spesial Issue 3).
- 21) Nadiyah, Z., Hidayati, N., & Rahman, F. (2023). Peran Brand Image, Brand Trust Dan Kualitas Informasi Terhadap Keputusan Pembelian Di Tiktok Shop (Studi Kasus Remaja Kota Malang). *E – Jurnal Riset Manajemen*, 12 (2).
- 22) Peter, & Olson. (2018). *Perilaku Konsumen Dan Strategi Pemasaran* (M. Masykur, Ed.; 9th ed.). Salemba Empat.
- 23) Prayogi, A. Z. (2022). Pengaruh Pengaruh Celebrity Endorser, Strategi Diferensiasi, Brand Image dan Persepsi Harga Terhadap Keputusan Pembelian Handphone Vivo Di Lumajang. *Journal of Organization and Business Management*, 5 (2), 102–109.
- 24) Priansa. (2017). *Perilaku Konsumen Dalam Persaingan Bisnis Kontemporer*. Alfabeta.
- 25) Rahmani, G. R., Bursan, R., Mahrinasari, M. S., & Wiryawan, D. (2022). Pengaruh Celebrity Endorsement, Brand Image Dan Brand Trust Terhadap Keputusan Pembelian Produk (Studi pada Somethinc by Irene Ursula). *Jurnal Ekombis Review - Jurnal Ilmiah Ekonomi Dan Bisnis*, 10(Spesial Issue DNU 14 TH), 431–438.
- 26) Rahmawati, D. A., Kustiyah, E., & Marwati, F. S. (2023). Keputusan Pembelian Ditinjau Dari Celebrity Endorser, Desain Dan Kualitas Produk Air Minum Dalam Kemasan Merek Le Minerale (Studi Kasus Pada Mahasiswa Aktif Prodi Manajemen Universitas Islam Batik Surakarta). *Jurnal Edueco*, 6 (1). [www.topbrand-award.com](http://www.topbrand-award.com),
- 27) Rahmawati, W. N., Udayana, I., & Maharani, B. M. (2022). Pengaruh Celebrity Endorser, Brand Image, Online Customer Review Dan E-Trust Terhadap Keputusan Pembelian pada Marketplace Shopee. *Reslaj: Religion Education Social Laa Roiba Journal*, 4(4). <https://doi.org/10.47476/reslaj.v4i4.1055>
- 28) Ramadhoni, P., & Haryanti, I. (2023). Pengaruh Brand Ambassador Dan Lifestyle Terhadap Minat Belanja Online Melalui Marketplace Shopee. *Journal of Student Research*, 1 (5).
- 29) Rasyid, R. A., & Karya, D. F. (2021). Peran Consumtive Lifestyle, Beauty Vlogger, Brand Image, Brand Trust Terhadap Keputusan Pembelian Kosmetik Korea (Innisfree) Di Surabaya. *Media Mahardhika*, 19 (2). [www.mix.co.id](http://www.mix.co.id)
- 30) Respati, A. R. (2023, June 12). *Cerita Sukses Geoff Max, Sepatu Lokal yang Lahir dari Keprihatinan*. Kompas.Com. [https://money.kompas.com/komentar/2023/06/12/130500926/cerita-sukses-geoff-max-sepatu-lokal-yang-lahir-dari-keprihatinan-?\\_gl=1\\*7ci3yu\\*\\_ga\\*OTkyNTQxNTkyLjE2Nzk5Mjk2NjA.\\*\\_ga\\_77DJNQ0227\\*MTY5MzEyOTY1MjY4xLjEuMTY5MzEzMDkyNi4wLjAuMA..](https://money.kompas.com/komentar/2023/06/12/130500926/cerita-sukses-geoff-max-sepatu-lokal-yang-lahir-dari-keprihatinan-?_gl=1*7ci3yu*_ga*OTkyNTQxNTkyLjE2Nzk5Mjk2NjA.*_ga_77DJNQ0227*MTY5MzEyOTY1MjY4xLjEuMTY5MzEzMDkyNi4wLjAuMA..)
- 31) Rifky, H. R. A., Fadhilah, M., & Maharani, B. D. (2021). Meningkatkan Keputusan Pembelian Make Up Brand Lokal Wardah Melalui Celebrity Endorser, Brand Image dan Product Quality Pada Mahasiswi S1 Universitas Sarjanawiyata Tamansiswa. *Jurnal Produktivitas*, 8. [www.openjurnal.unmuhpnk.ac.id/index.php/jp](http://www.openjurnal.unmuhpnk.ac.id/index.php/jp)
- 32) Safira, A. N., & Alimuddin, R. (2023). The Impact Of Brand Image, Celebrity Endorser And Shopping Lifestyle On Purchase Decisions At E-Commerce Shopee Pengaruh Brand Image, Celebrity Endorser Dan Shopping Lifestyle Terhadap Keputusan Pembelian Di E-Commerce Shopee. *Management Studies and Entrepreneurship Journal*, 4(5), 5229–5238. <http://journal.yrpiaku.com/index.php/msej>
- 33) Safitri, A. N., & Basiya, R. (2022). YUME : Journal of Management Pengaruh Brand Image, Lifestyle, dan Promosi Media Sosial Terhadap Keputusan Pembelian di Toko 3Second. *YUME : Journal of Management*, 5(2), 450–458. <https://doi.org/10.37531/yume.vxix.3463>
- 34) Salam, A., & Abdiyanti, S. (2022). Analisis Pengaruh Celebrity Endorser, Brand Image dan Brand Trust Terhadap Keputusan Pembelian (Studi Kasus Pada Konsumen Wanita Produk Skin Care Merek Ms Glow Di Kecamatan Sumbawa). *Accounting and Management Journal*, 6 (1).
- 35) Sangadji, & Sopiah. (2013). *Perilaku Konsumen*.
- 36) Santoso, R., Erstiawan, M. S., & Kisworo, A. Y. (2020). Inovasi Produk, Kreatifitas Iklan Dan Brand Trust Mendorong Keputusan Pembelian. *Jurnal Nusantara Aplikasi Manajemen Bisnis*, 5(2), 133–145. <https://doi.org/10.29407/nusamba.v5i2.14369>
- 37) Sinaga, R. P. Y. B., & Hutapea, Y. (2022). Analisis Pengaruh Brand Image, Harga, dan Review Product Terhadap Keputusan Pembelian Skincare Wardah Pada Mahasiswa Unai. *INTELEKTIVA : Jurnal Ekonomi, Sosial Dan Humaniora* , 3.

## The Influence of Celebrity Endorsement, Brand Image, Brand Trust and Lifestyle on Purchase Decisions for Geoff Max Brand Shoes (Study on Students in Purwokerto City)

- 38) Solihin, W. A., Tawal, B., & Wenas, R. (2020). The Influence Of Consumer Attitude And Lifestyle On Smartphone Purchase Decition (Study On Unsrat In Manado). *Jurnal EMBA*, 8(1), 511–520.
- 39) Suciani, L. P. E., & Ayuni, N. M. S. (2022). Pengaruh Persepsi Harga, Lifestyle, Perchieved Ease Of Use and Trust Terhadap Keputusan Pembelian Produk Herbalife Nutrition Pada Rumah Sehat Ratu Yuye Singaraja. *Jurnal Daya Saing*, 8, 1–7.
- 40) Swasty. (2016). *Branding*. PT Remaja Rosdakarya.
- 41) Titania, N. P. H., & Yulianto, A. E. (2023). Pengaruh Celebrity Endorser, Brand Image dan Brand Trust Terhadap Keputusan Pembelian Pada Produk Scarlett Whitening (Studi Pada Konsumen Mahasiswi Stiesia Surabaya). *Jurnal Riset Manajemen*, 12 (4).
- 42) Tjiptono, F. (2015a). *Pemasaran Jasa*. Gramedia.
- 43) Tjiptono, F. (2015b). *Strategi Pemasaran Edisi 4*. Penerbit ANDI.
- 44) Tokopedia. (2023). *10 Pilihan Sneakers Lokal Terbaik, Bangga Karya Anak Bangsa*. Tokopedia. <https://www.tokopedia.com/blog/top-sneakers-lokal-terbaik-fsp>
- 45) Tyas, Y. R. N., Mursito, B., & Marwati, F. S. (2023). The Purchase Decision of Samsung By Generation Z In Laweyan District Viewed From Lifestyle, Brand Image, and Brand Awareness. *Business and Accounting Research (IJEBAR) Peer Reviewed-International Journal*, 7(1). <https://jurnal.stie-aas.ac.id/index.php/IJEBAR>
- 46) Utami, A. T., & Ellyawati, J. (2021). Peran Citra Merek, Celebrity Endorser, Kualitas Produk Dalam Keputusan Pembelian The Role of Brand Image, Celebrity Endorser, Product Quality in Purchase Decision. *Jurnal Ilmiah Manajemen Dan Bisnis*, 22(1), 140–150. <https://doi.org/10.30596/jimb.v22i1.6200>
- 47) Wardani, D. S. D., & Maskur, A. (2022). Pengaruh Celebrity Endorser, Citra Merek Dan Kepercayaan Terhadap Keputusan Pembelian Produk Scarlett Whitening (Studi Kasus Pengguna Scarlett Whitening). *Jurnal Ekonomi & Ekonomi Syariah*, 5(2), 1148–1160. <https://doi.org/10.36778/jesya.v5i2.689>



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Effect of Petai Skin Extract Gel Administration on MITF Gene Expression and Melanin Count (in Vivo Experimental Study on Hyperpigmented Wistar Mice Exposed to UVB Exposed Hyperpigmentation)



Maya Rianti Amalia<sup>1</sup>, Prasetyowati Subchan<sup>2</sup>

<sup>1</sup>Postgraduate student of Biomedical Sciences, Faculty of Medicine, Universitas Islam Sultan Agung, Jl Kaligawe KM 4 Semarang 50012

<sup>2</sup>Department of Biomedical Sciences, Faculty of Medicine, Universitas Islam Sultan Agung, Jl Kaligawe KM 4 Semarang 50012

**ABSTRACT:** Prolonged exposure to high intensity UVB rays can induce the formation of Reactive Oxygen Species (ROS) which causes MITF activation thereby inducing melanin synthesis. Compounds contained in petai peel extract are known to play a role in inhibiting ROS production due to exposure to UVB rays. This study aims to determine the effect of administering petai peel extract gel on MITF gene expression and the amount of melanin in the skin tissue of mice exposed to high-intensity UVB. The research design was posttest only control group with a completely randomized design method. The samples studied were 24 mice exposed to UVB light with a wavelength of 302 nm and an energy of 390 mJ/cm<sup>2</sup>/day 3 times a week for 2 weeks. This research was carried out in four groups, namely the healthy group (K1), the negative control group (K2), treatment 1 (K3) with 10% petai peel extract gel and treatment 2 (K4) with 20% petai peel extract gel. MITF gene expression was analyzed using qRT-PCR and melanin was observed by specific staining with fontana-masson. qRT-PCR analysis showed that there was a significant decrease in MITF gene expression between groups K4 and K3 compared to group K2. Analysis of the amount of melanin also showed that there was a significant decrease in the mean in the K3 and K4 groups compared to K2 with a p value <0.05. Administration of petai peel extract gel can reduce the expression of the MITF gene and the amount of melanin in hyperpigmentation mice exposed to UVB light.

**KEYWORDS:** UVB exposure, petai peel extract, MITF, melanin

### I. INTRODUCTION

Ultraviolet B (UVB) radiation is the main factor causing hyperpigmentation, cessation of collagen synthesis and inflammation of the skin.<sup>1-3</sup> Hyperpigmentation is a condition in which there is an increase in the amount of melanin in the skin which can be visually observed in the presence of brownish pigment then blackening.<sup>4,5</sup> Hyperpigmentation caused by exposure to UVB light is controlled by certain genes, proteins, and enzymes, such as tyrosinase, a transcription factor associated with *melanocyte inducing transcription factor (MITF)*, tyrosinase-related protein 1 (TRP-1), and dopachrome tautomerase (TRP-2).<sup>6</sup> Activation of MITF leads to increased excessive melanin production in the skin.<sup>7</sup>

Increased exposure to UVB rays due to ozone layer damage in recent years and lifestyle changes have become important concerns as they can induce hyperpigmentation that increases cases of skin aging.<sup>1-3</sup> People with fair skin and older age have a higher risk of the effects of hyperpigmentation.<sup>4,5</sup> Although little research has been done on the specific incidence of hyperpigmentation, the incidence of melasma in men is 10%, while women prevalence is greater, especially at the age of 20-45 years. The ratio of melasma cases in women and men in Indonesia is 24:1.<sup>5</sup> Among the most common symptoms of aging, hyperpigmentation and facial wrinkles are the most common, this condition can affect a person's social interactions.<sup>6</sup> Until now, treatment with several chemical agents such as arbutin, azelaic acid, kojic acid, and hydroquinone was the main choice for preventing or treating skin hyperpigmentation and inducing collagen synthesis.<sup>7,8</sup> 9-11 9-11 12,13

Traditionally, petai seeds have been used by local people as a treatment for various ailments, especially skin diseases.<sup>14,15</sup> Based on the explanation above, petai seeds have been widely used. However, petai skin by the community is just thrown away and has

## Effect of Petai Skin Extract Gel Administration on MITF Gene Expression and Melanin Count (in Vivo Experimental Study on Hyperpigmented Wistar Mice Exposed to UVB Exposed Hyperpigmentation)

not been widely used. Therefore, petai skin is used in the form of innovation into petai skin extract gel which acts as an antioxidant and anti-inflammatory. *Petai skin* also contains various types of polyphenols and flavonoids which are believed to be potential sources of bioactive compounds that are beneficial to health.<sup>16</sup> According to Isromi,<sup>12</sup> Petai bark (*Parkia speciosa*) contains flavonoids, phenols, and tannins that can be used as topical anti-inflammatories.<sup>13</sup> According to Rianti,<sup>17</sup> Petai skin contains flavonoids and phenols that can act as antioxidants. Other studies have also reported that petai has antioxidant properties<sup>18-20</sup> and anti-inflammatory.<sup>16,21</sup>

Previous studies have also reported that hyperpigmentation caused by exposure to UVB rays is regulated by various genes, proteins, and enzymes such as tyrosinase, and MITF.<sup>22</sup> In the melanin production pathway, tyrosinase plays a role in converting L-tyrosine to L-3,4-dihydroxyphenylalanine (L-DOPA).<sup>23</sup> L-DOPA is then oxidized to *L-DOPAquinone*, which then forms eumelanin and pheomelanin.<sup>24</sup> Other studies have also shown that chronic UVB exposure can cause oxidative stress, which activates phosphorylation of *mitogen-activated protein kinases* (MAPK) such as ERK, JNK, and p53 that accelerate melanin production.<sup>26,29</sup> Activation of these pathways increases transcription of MITF, which is a key factor in the activation of the enzymes tyrosinase, TRP-1, and TRP-2, which play a role in melanin production.<sup>29,30</sup> The flavonoid content in petai extract can inhibit ROS, which leads to suppression of MITF expression.<sup>31,32</sup> Other studies report that flavonoid compounds can increase the expression of antioxidants such as *superoxide dismutase* (SOD) so that it can inhibit the MITF pathway causing melanin production to decrease.<sup>33</sup> Flavonoid compounds contained in petai skin extract are thought to have the ability to reduce melanin production through antioxidant mechanisms.<sup>34,35</sup> However, studies on the effect of topical gels of petai skin extract on melanin and MITF in hyperpigmentation models due to UVB exposure have not been conducted. Based on this background, the researchers wanted to analyze the effect of petai skin extract in the form of a topical gel on MITF gene expression and the amount of melanin in the skin of hyperpigmented mice exposed to UVB.

## II. MATERIAL AND METHOD

### Study Design and Experimental Animals

The study was a post test only control group with a randomized design method complete with five repetitions per treatment. The study subjects used male rats of the wistar strain, aged 2-3 months with a body weight of 200-250 grams that fit the inclusion and inclusion criteria, adapted for 5 days. This study used 4 treatment groups, a group of healthy mice without UVB irradiation (K1), a negative control group, UVB-induced mice with base gel treatment (K2), a UVB-induced rat treatment group with a 10% topical dose of petai skin extract gel treatment (K3), and a UVB-induced rat treatment group with a 20% topical dose of petai skin extract gel treatment (K4).

### Research Materials

Research materials consist of materials for treatment such as water base gel, ketamine, xylazine, ethanol, aquades, rat feed, and chloroform.

### Research Equipment

This research uses several equipment to make animal models including UV light (broadband with a peak emission of 302 nm) with an energy of 390 mJ/cm<sup>2</sup>, razors, exposure cages, maintenance cages, drinking water for rats and hair cutters. The tools used for data collection are vacutainer, hematocrit tube, 5 mL pot, 6 mm biopsy punch, centrifuge, micropipette, 1000 uL micropipette tip, and 1.5 mL vial tube. Tools used for data analysis include microplate readers, microscopes, staining jars, coated desk glass, cover glass, and laptops.

### How to Make Petai Skin Extract Gel

±600 grams of petai peel is cut into small pieces, dried at 50-60°C and mashed into a dry powder. The process of making petai bark extract uses maceration techniques. Dried coolie petai powder is extracted using 70% ethanol then filtered and the filtrate is accommodated, the residue then macerated again by the same method. The choice of this solvent is because ethanol is able to filter active ingredients that are polar, semipolar and nonpolar. It is expected to produce an optimal amount of extract. The ethanol content is evaporated using a rotary evaporator to obtain a viscous extract. The results of evaporation are then thickened using a waterbath. The resulting viscous extract is used for the manufacture of gels. Gelling is done by mixing a hydrogel gel base (Katecho) of 200 mg with thick petai peel extract at P1 as much as 10% and P2 as much as 20%. Furthermore, to remove the aroma on pete added essential oil of lemon fruit. Stirring is carried out under aseptic conditions to form a homogeneous mixture of characteristics observed under a microscope.

# Effect of Petai Skin Extract Gel Administration on MITF Gene Expression and Melanin Count (in Vivo Experimental Study on Hyperpigmented Wistar Mice Exposed to UVB Exposed Hyperpigmentation)

Table 1. Petai bark extract gel formula.

Composition	Dosage 10%	Dosage 20%
Hydrogel (Catecho) <a href="https://www.katecho.com/hydrogel/">https://www.katecho.com/hydrogel/</a>	180 mg	160 mg
The mapi leather eprint	20 mg	40 mg

## Dosage Assignment

Before the study is carried out, the dosage to be used for research is first determined. Previous research using extract gels containing flavonoids at a dose of 20% for topical use can reduce melanin levels<sup>91</sup>. The use of petai skin extract gel was carried out every day as much as 200 mg / rat so that the extra dose of petai peel used was 20 mg of extract in 180mg of gel per rat for a dose of 10% and 40 mg of extract in 160 mg of gel per rat for a dose of 20% (Table 1)<sup>92</sup>.

## UV-B Display

(1) Mice that had been adapted for 1 week were anesthetized with a mixture of ketamine (60 mg / kgbb) and xylazine (20 mg / kgbb). (2) The hair on the dorsal part of the rat shaved clean with a size of 5x5 cm. (3) Rats' backs were exposed to UV light (broadband with peak emission 302 nm) with a minimum dose of erythema 390 mJ/cm<sup>2</sup> 15 minutes six times in two weeks. (4) Rat Behaviour 1 (10% dose skin extract gel) and Behavior 2 (20% dose skin extract gel) were then treated topically using a mapi skin extract gel given once a day for 14 days after UV-B irradiation.

## Paraffin Block Making

(1) Dehydration: input pieces of tissue in alcohol stratified from 30%, 40%, 60%, 50%, 70%, 80%, 90%, 96% (stratified) to remove fluid from the tissue. Put the tissue into the alcohol-xylol solution for 1 hour then put the tissue in the pure xylol solution for 2 x 2 hours. (2) Paraffinization and Embedding: tissue input in liquid paraffin for 2 x 2 hours. Wait until the paraffin solidifies, cut the tissue in paraffin 4 microns thick with microtomes. The result of the tissue piece is attached to a glass object that has previously been smeared with polylysine as an adhesive. Put the tissue on the glass of the deparaffination object in the incubator and heated to a temperature of 56-58°C until the paraffin melts.

## Validation and analysis of post-UVB Melanin painting and treatment

(1) Melanin painting is done using the Masson Fontana painting method with the following stages: (1) The tissue slide is deparaffinized. (2) The slide is incubated in Working Silver Solution for 2 minutes, then rinse with water. (3) The slide is incubated in a 0.1% solution of Gold chloride 10 minutes, then rinsed with water. (4) The slide is incubated in a 5% solution of Hypo for 5 minutes then rinsed with water. (5) The slide is incubated in Nuclear-fast red solution for 5 minutes, then rinsed with water. (6) The slide is carried out by dehydration process, then install the desk glass.

Analysis of the amount of melanin was carried out using a digital analysis method based on where the slides were photographed using an Olympus CX41 microscope (Olympus, Japan) at a magnification of 400 times using the Optilab Pro camera (Miconos, Indonesia). Each preparation was photographed as many as 3 fields of view using JPEG format. The photos were edited using Adobe Photoshop CS3 software version 10.0.1 (Adobe Systems Inc., San Jose, CA, U.S.A) to select the epidermis layer using the *Polygonal Lasso tool*. The calculation of epidermal area in *pixels* was done using ImageJ software version 1.47t (National Institutes of Health, Bethesda, MD) using the *red channel* in the *RGB stack* by setting the *threshold* to near the maximum. An area of the epidermis is necessary to normalize the amount of melanin. The calculation of the amount of melanin in *pixels* was done using ImageJ software version 1.47t using the *red channel* by setting the *threshold*. The normalized amount of melanin is calculated according to the following formula for per field of view:<sup>92</sup>.

## Quantitative Analysis of MITF Gene Expression using RT-PCR

(1) RNA extraction and cDNA synthesis: RNA isolation of skin tissue was performed using TRIzol<sup>®</sup> reagent, (Invitrogen Life Technologies) and cDNA manufacturing using iScript cDNA Synthesis Kit (Bio-Rad iScript gDNA Clear cDNA synthesis Kit Catalog) using Reverse Transcriptase PCR (RT-PCR) thermal cycler C1000 (Bio-Rad). (2) MITF Gene Expression Determination: MITF was amplified using PCR-RFLP Technique, using PCR 2x PCR Master mix solution (iNtRON,<sup>®</sup> catalog number 25027) in a 0.2 mL vial tube with a total volume of 50 uL for 1 sample. PCR was performed using the thermal cycle of DNA: Applied Veriti Biosystems 96.

Table 2. PCR Mix CXCL8 Components.

Component	Kind
Primer	Forward MITF 5'-GCTGGAGACGGAAGCTCTGCT-3'
	Reverse MITF



# Effect of Petai Skin Extract Gel Administration on MITF Gene Expression and Melanin Count (in Vivo Experimental Study on Hyperpigmented Wistar Mice Exposed to UVB Exposed Hyperpigmentation)

	5'-GAGTGGGAGGGAGAGTGAGG-3'
Reagent	Trizol Reagen
Rna Transcribed	High Capacity cDNA Reverse Transcription
cDNA	SYBR Green

## Network Sampling and Storage

Mice after 24 hours of the last treatment were turned off by cervical dislocation for tissue retrieval. Skin tissue is taken using a 6 mm punch biopsy in the induced part of the skin. Skin tissue samples are preserved in a later RNA solution to maintain RNA quality. Skin samples in RNA are stored at -20oC until the PCR analysis process is carried out.

## III. RESULT

### Petai Skin Extraction

Petai peel extract in this study was obtained by maceration method using ethanol solvent and produced an extract yield of 8.00%. The phytochemical screening results of petai bark extract show that petai skin is positive for phenol, phenolic, tannin, flavonoid, terpenoid, and saponin group compounds (Appendix. In this study, the total flavonoids and phenolics in petai bark extract were also determined using spectrophotometric methods. In 1 gram of petai bark extract contains flavonoids of 65.27mg ± 1.20 and phenolics of 44.70mg± 1.22. These results prove that most of the compounds contained in petai bark extract are flavonoids.

### Hyperpigmentation Model Validation

In this study using a hyperpigmentation model. Animal models induced hyperpigmentation with 302 nm UVB irradiation with an energy intensity of 390mJ/cm2 for three times a week for two weeks. Validation of hyperpigmentation is observed on day 14. In coloring *Fontana masson* shows that there is a significant increase in melanin production which is characterized by brown pigment in the epidermis (melanocyte cells). In the group given UVB irradiation (negative control) the amount of melanin increased by 46.5% (Figure 1).

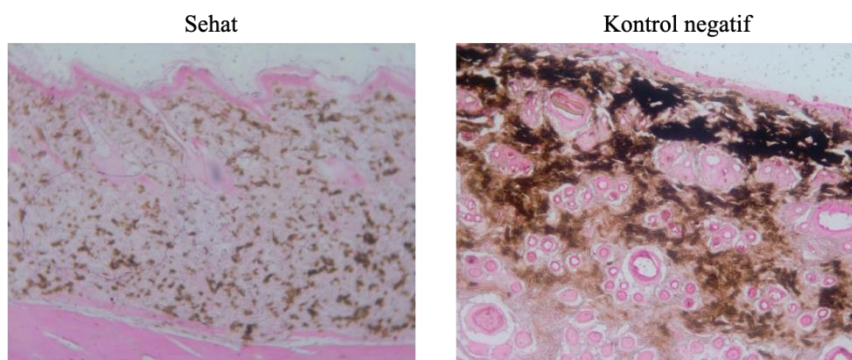


Figure 1. Validation of hyperpigmentation by masson fontane staining (A) Healthy mice and (B) UVB irradiated mice.

### Effects of 10% and 20% Doses of Petai Skin Extract Gel on MITF Gene Expression

In this study, researchers found that petai peel extract gel was able to reduce MITF gene expression and melanin count in hyperpygemntation model mice significantly dose-dependent (Table 3; Figure 2).

Table 3. Data from MITF and Melanin Gene Expression Research

Variable	Group			
	Sehat=5 Mean±SD K1	Negative control n=5 Mean±SD K2	Gel Extract Kulit Petai Dosage 10% n=5 Mean±SD K3	Gel Extract Kulit Petai Dosage 20% n=5 Mean±SD K4
Expressive has MITF	1.03±0.01	3.52±0.84	0.84±0.05	0.80±0.15
<i>Saphiro wilk</i>	0,415*	0,723*	0,181	0,362
<i>Levene test</i>				0,001**

## Effect of Petai Skin Extract Gel Administration on MITF Gene Expression and Melanin Count (in Vivo Experimental Study on Hyperpigmented Wistar Mice Exposed to UVB Exposed Hyperpigmentation)

<i>One way ANOVA</i>					0,000***
Total Melanin	10.95±2.48	32.36±3.92	\$27.98±2.58	28.34±2.24	
<i>Saphiro wilk</i>	0,627	0,251	0,963	0,675	
<i>Levene test</i>				0,687	
<i>Kruskal-Wallis Test</i>					0,000***

Information:

\*Saphiro Wilk test ( $p < 0.05$  = abnormal)

\*\* Levene's Test ( $p < 0.05$  = not homogeneous)

Kruskal Wallis ( $p < 0.05$  = different meanings)

Based on the results of the study shown in table 3. The mean expression of the MITF gene in the gel group of petai skin extract dose was the lowest dose of 20% (K4) ( $0.80 \pm 0.15$ ), then followed by the average expression of the MITF gene in the gel group of petai skin extract dose of 10% (K3) ( $0.84 \pm 0.05$ ). The highest ratio in the negative control treatment group (K2) was  $3.52 \pm 0.84$ . The MITF gene expression data of all groups are normally distributed, shown by *Shapiro Wilk* results obtained a value of  $p > 0.05$  and also have inhomogeneous data variants indicated by the results of *Levene's Test* with a value of  $p = 0.001$  ( $p < 0.05$ ). The distribution and variant of MITF gene expression data are normal and inhomogeneous, so parametric statistical analysis with *One way-ANOVA* produces a value of  $p = 0.000$  ( $p < 0.05$ ) so that there is a significant difference in the average expression of MITF genes between the four groups. The significant *One way ANOVA* test results were followed by the *Tamhane Post Hoc* test to see which group was the most influential.

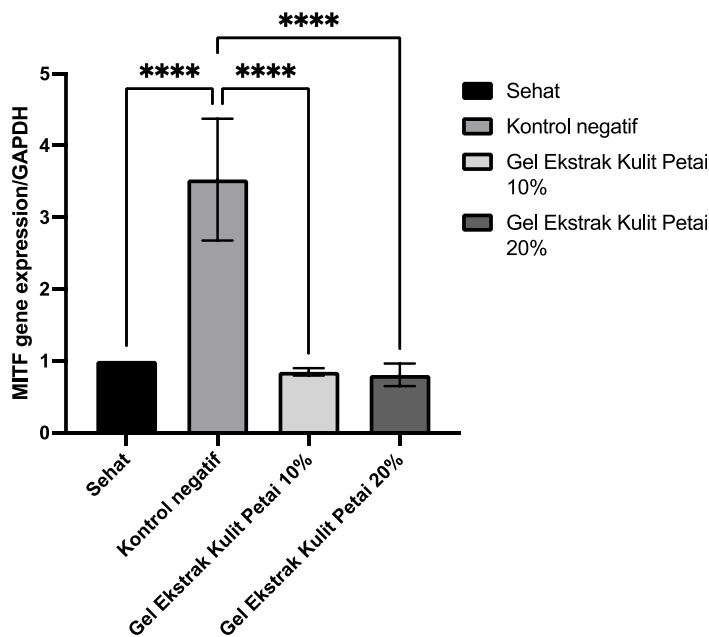


Figure 2. Graph of MITF gene expression across research groups

Table 4. Post Hoc Tamhane Test of MITF Gene Expression in Each Group

Group	Comparison Group	Say.	95% confidence interval	
			Lower Limit	Upper Limit
K1	K2	0,005*	-3,9532	-1,0502
	K3	0,002*	0,0891	0,2642
	K4	0,111	-0,0561	0,4883
K2	K3*	0,003*	1,2298	4,1269
	K4	0,003*	1,2936	4,1464
K3	K4*	0,993	-0,2182	0,3015

Sign \* ( $p < 0.05$ ) indicates a significantly different group

## Effect of Petai Skin Extract Gel Administration on MITF Gene Expression and Melanin Count (in Vivo Experimental Study on Hyperpigmented Wistar Mice Exposed to UVB Exposed Hyperpigmentation)

Based on the data above, the average comparison between the K2 group with K3 (0.003) and K2 with K4 (0.003) showed a significant difference, while the comparison between the K3 and K4 groups (0.993) there was no significant difference. In the comparison of K1 and K2 obtained a value of 0.005 ( $p < 0.05$ ) so that there is a significant difference between the two groups. The most significant decrease in MITF gene expression was shown in the administration of 20% petai peel extract with a lower limit value of 1.2936 and an upper limit value of 4.1464. The results of the *post hoc tamhane* test on MITF gene expression data showed that the administration of petai skin extract gel that can reduce MITF gene expression in male rats wistar strain hyperpigmentation model.

### Effects of Petai Skin Extract Gel Doses of 10% and 20% on Melanin Expression

In this study, researchers found that petai skin extract gel was able to reduce the amount of melanin in hyperpigmentation mice significantly depending on dose (Table 3; Figure 3). Based on the results of the study shown in table 3. The average amount of melanin in the K3 group ( $27.98 \pm 2.58$ ) was the lowest, then followed by the average amount of melanin in the K4 group ( $28.34 \pm 2.24$ ). The highest amount of melanin data was in the negative control group of  $32.36 \pm 3.92$ . Data on the amount of melanin of all normally distributed groups ( $p > 0.05$ ) based on *Shapiro Wilk's results*. Based on homogeneity analysis with Levene test shows homogeneous data ( $p > 0.05$ ). The distribution of data on the amount of normal melanin and homogen so that parametric statistical analysis with *one way ANOVA* resulted in a value of  $p = 0.000$  ( $p < 0.05$ ) so that it was stated that there was a significant difference in the average amount of melanin between the four groups. The results of a *significant one-way ANOVA* test were followed by a *post hoc LSD* test to see which group was the most influential.

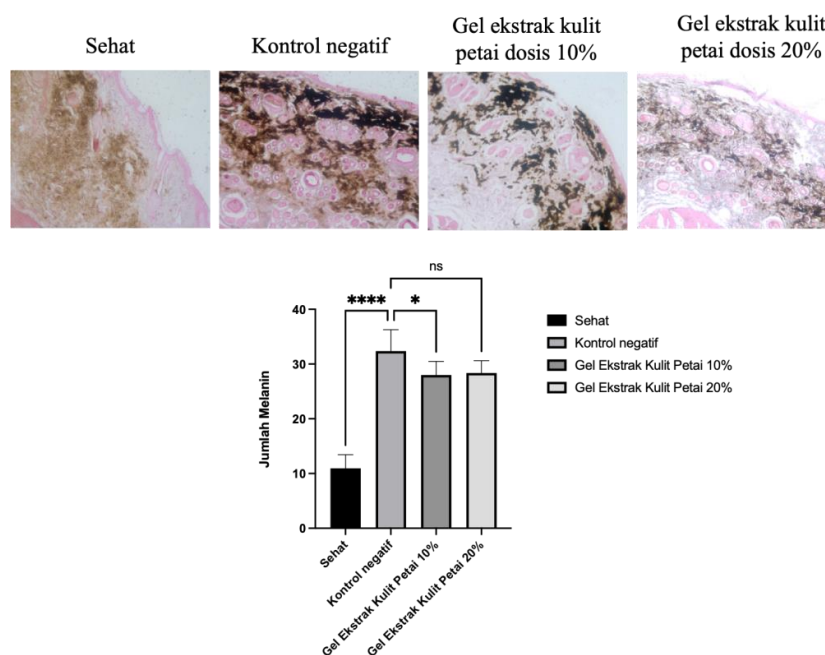


Figure 3. (A) Melanin staining picture in all treatment groups and (B) Graph of melanin count in all study groups

Table 5. *Post Hoc LSD* Test on Melanin Count in Each Group

Group	Comparison Group	Say.	95% confidence interval	
			Lower Limit	Upper Limit
K1	K2*	0,001*	-24,8654	17,9580
	K3	0,001*	-20,4904	-13,5830
	K4	0,001*	-20,8520	-13,9446
K2	K3*	0,016*	0,9213	7,8287
	K4*	0,025*	0,5596	7,4670
K3	K4	0,829	-3,8154	3,0920

Sign \* indicates a significantly different group.

## Effect of Petai Skin Extract Gel Administration on MITF Gene Expression and Melanin Count (in Vivo Experimental Study on Hyperpigmented Wistar Mice Exposed to UVB Exposed Hyperpigmentation)

Based on the data above, an average comparison of K2 (negative control) with K3 (10% petai skin extract gel) (0.016) and K4 (20% petai skin extract gel) (0.025) was obtained, which means that there is a significant difference, while K3 and K4 (0.829) have no significant difference. In the comparison of groups K1 and K2 obtained a value of 0.001 ( $p < 0.05$ ) so that there is a significant difference between the two groups. The highest value of melanin amount was most significantly shown in the administration of 10% petai skin extract gel with a lower limit value of 0.9213 and an upper limit value of 7.8187. The results of the *LSD post hoc test* on melanin count data showed that the administration of petai skin extract gel that can reduce the amount of melanin in male rats of the Wistar strain hyperpigmentation model.

### IV. DISCUSSION

UVB exposure is a major risk factor for skin hyperpigmentation characterized by increased expression of melanin-forming proteins such as MITF.<sup>93</sup> UVB light irradiation induces DNA damage through the formation of oxidative ROS, resulting in activation of several melanogenesis pathways.<sup>94</sup> Recent research proves that petai bark extract which contains various secondary metabolite compounds such as flavonoids, alkaloids, tannins, and saponins can suppress ROS formation because it has antioxidant activity. The ability of extracts that can suppress ROS may prevent melanin production.<sup>35,95</sup> This study aimed to determine the effect of petai skin extract gel administration on MITF gene expression and melanin amount in hyperpigmented mouse models. This study used male rats of the wistar strain because it includes mammalian vertebrata with skin structures similar to human skin. Test animals were induced exposure to UVB light 302 nm with an energy intensity of 390mJ/cm<sup>2</sup> three times a week for 2 weeks<sup>93</sup>.

This study showed that MITF gene expression in the K3 (10% petai skin extract gel) and K4 (20% petai skin extract gel) groups decreased significantly compared to the hyperpigmented rat group that did not receive therapy (negative control). This suggests that decreased expression of the MITF gene can prevent hyperpigmentation. Flavonoid compounds derived from petai bark extract may inhibit TGF- $\beta$  thereby inhibiting MITF activity through inhibition of the PI3K/Akt pathway.<sup>96</sup> TGF- $\beta$  suppression has the potential to inhibit melanin biosynthesis in B16 melanoma cells. The ability of flavonoid compounds to inhibit TGF- $\beta$  has also been reported to inhibit the cAMP/protein kinase A pathway and induce GLI2, which then suppresses MITF, the central transcription factor of melanogenesis.<sup>97</sup> Meanwhile, through the SMAD pathway, TGF- $\beta$  suppression in inhibiting the process of melanogenesis by sending signals through ligand-specific heteromeric receptors, namely serine / threonine kinase receptors that function for phosphorylation and activation of (R)-Smad receptors, which leads to the formation of complexes with (Co)-Smad, Smad4, and transcriptional regulation of target genes so as to suppress MITF expression<sup>98</sup>.

This study further demonstrated the inhibitory effect of petai skin extract gel on the amount of melanin. This is due to petai bark extract which inhibits MITF so that it blocks TRP-1 activity and TRP-2 correlates with activation of eumelanin and pheomelanin formation pathways. Suppression of excessive TRP-1 expression can inhibit melanin synthesis<sup>99</sup>. Previous research reported that increased TRP-1 expression correlated with increased amounts of melanin due to UVB irradiation. However, increased TRP-2 expression is associated with melanoma cell proliferation<sup>100</sup>. In this study, the administration of petai skin extract gel significantly and dose-dependent decreased the amount of melanin. This shows that the administration of petai skin extract gel through MITF downregulation thus prevents melanin formation in melanocyte cells.

### V. CONCLUSION

1. Administration of petai bark extract at doses of 10% and 20% significantly decreased MITF gene expression in male rats of Wistar strain model UVB-induced hyperpigmentation.
2. Administration of petai bark extract at doses of 10% and 20% significantly decreased the amount of melanin in male rats of Wistar strain model of UVB-induced hyperpigmentation.

### ACKNOWLEDGEMENT

The authors declare no conflict of interest and no involvement of sponsors or funding for this research.

### REFERENCES

- 1) Dale Wilson B, Moon S, Armstrong F. Comprehensive review of ultraviolet radiation and the current status on sunscreens. *J Clin Aesthet Dermatol*. 2012 Sep;5(9):18–23.
- 2) Merin KA, Shaji M, Kameswaran R. A Review on Sun Exposure and Skin Diseases. *Indian J Dermatol*. 2022;67(5):625.
- 3) Amaro-Ortiz A, Yan B, D’Orazio J. Ultraviolet Radiation, Aging and the Skin: Prevention of Damage by Topical cAMP Manipulation. *Molecules*. 2014 May 15;19(5):6202–19.

## Effect of Petai Skin Extract Gel Administration on MITF Gene Expression and Melanin Count (in Vivo Experimental Study on Hyperpigmented Wistar Mice Exposed to UVB Exposed Hyperpigmentation)

- 4) Durai PC, Thappa DM, Kumari R, Malathi M. Aging in elderly: chronological versus photoaging. *Indian J Dermatol.* 2012 Sep;57(5):343–52.
- 5) Hughes MCB, Williams GM, Pigeon H, Fourtanier A, Green AC. Dietary Antioxidant Capacity and Skin Photoaging: A 15-Year Longitudinal Study. *Journal of Investigative Dermatology.* 2021 Apr;141(4):1111-1118.e2.
- 6) Samson N, Fink B, Matts PJ. Visible skin condition and perception of human facial appearance. *Int J Cosmet Sci.* 2010 Nov 3;32(3):167–84.
- 7) Solano F. Photoprotection and Skin Pigmentation: Melanin-Related Molecules and Some Other New Agents Obtained from Natural Sources. *Molecules.* 2020 Mar 27;25(7):1537.
- 8) Markiewicz E, Idowu O. <p>Melanogenic Difference Consideration in Ethnic Skin Type: A Balance Approach Between Skin Brightening Applications and Beneficial Sun Exposure</p>. *Clin Cosmet Investig Dermatol.* 2020 Mar; Volume 13:215–32.
- 9) Tangau MJ, Chong YK, Yeong KY. Advances in cosmeceutical nanotechnology for hyperpigmentation treatment. Vol. 24, *Journal of Nanoparticle Research.* Springer Science and Business Media B.V.; 2022.
- 10) Couteau C, Coiffard L. Overview of Skin Whitening Agents: Drugs and Cosmetic Products. *Cosmetics.* 2016 Jul 25;3(3):27.
- 11) Saeedi M, Khezri K, Seyed Zakaryaei A, Mohammadamini H. A comprehensive review of the therapeutic potential of  $\alpha$ -arbutin. *Phytotherapy Research.* 2021 Aug 16;35(8):4136–54.
- 12) Isromi T, Winahyu DA, Tutik T. Uji Efektivitas Ekstrak Kulit Petai (*Parkia Speciosa*) Sebagai Antiinflamasi Terhadap Tikus Putih (*Rattus Novergicus*) Jantan Galur Wistar Yang Di Induksi Karagenan. *Jurnal Ilmu Kedokteran dan Kesehatan.* 2023 Apr 9;10(3):1605–14.
- 13) Maulana I, Kurniati Roddu A, Suriani S. Uji Efektifitas Ekstrak Kulit Petai (*Parkia speciosa* Hassk) Terhadap Mencit (*Mus musculus*) Sebagai Anti Inflamasi. *Lambung Farmasi: Jurnal Ilmu Kefarmasian.* 2020 Jul 20;1(2):80.
- 14) Azemi AK, Nordin ML, Hambali KA, Noraldin NA, Mokhtar SS, Rasool AHG. Phytochemical Contents and Pharmacological Potential of *Parkia speciosa* Hassk. for Diabetic Vasculopathy: A Review. *Antioxidants.* 2022 Feb 21;11(2):431.
- 15) Kamisah Y, Othman F, Qodriyah HMS, Jaarin K. *Parkia speciosa* Hassk.: A Potential Phytomedicine. *Evidence-Based Complementary and Alternative Medicine.* 2013;2013:1–9.
- 16) Azemi AK, Nordin ML, Hambali KA, Noraldin NA, Mokhtar SS, Rasool AHG. Phytochemical Contents and Pharmacological Potential of *Parkia speciosa* Hassk. for Diabetic Vasculopathy: A Review. *Antioxidants (Basel).* 2022 Feb 21;11(2).
- 17) Rianti A, Parassih EK, Novenia AE, Christpoher A, Lestari D, Kiyat W El. Potensi Ekstrak Kulit Petai (*Parkia speciosa*) Sebagai Sumber Antioksidan. *Jurnal Dunia Gizi.* 2018 Nov 15;1(1):10.
- 18) Saleh MSM, Jalil J, Zainalabidin S, Asmadi AY, Mustafa NH, Kamisah Y. Genus *Parkia*: Phytochemical, Medicinal Uses, and Pharmacological Properties. *Int J Mol Sci.* 2021 Jan 9;22(2):618.
- 19) Mustafa Khalid N, Babji AS. Antioxidative and Antihypertensive Activities of Selected Malaysian ulam (salad), Vegetables and Herbs. *J Food Res.* 2018 Mar 30;7(3):27.
- 20) Ghasemzadeh A, Jaafar HZE, Bukhori MFM, Rahmat MH, Rahmat A. Assessment and comparison of phytochemical constituents and biological activities of bitter bean (*Parkia speciosa* Hassk.) collected from different locations in Malaysia. *Chem Cent J.* 2018 Dec 7;12(1):12.
- 21) Gui JS, Jalil J, Jubri Z, Kamisah Y. *Parkia speciosa* empty pod extract exerts anti-inflammatory properties by modulating NF $\kappa$ B and MAPK pathways in cardiomyocytes exposed to tumor necrosis factor- $\alpha$ . *Cytotechnology.* 2019 Feb 1;71(1):79–89.
- 22) Wawrzyk-Bochenek I, Rahnema M, Stachura M, Wilczyński S, Wawrzyk A. Evaluation of the Reduction of Skin Hyperpigmentation Changes under the Influence of a Preparation Containing Kojic Acid Using Hyperspectral Imaging—Preliminary Study. *J Clin Med.* 2023 Apr 1;12(7).
- 23) Hori I, Nihei K ichi, Kubo I. Structural criteria for depigmenting mechanism of arbutin. *Phytotherapy Research.* 2004 Jun;18(6):475–9.
- 24) Galván I, Wakamatsu K, Alonso-Alvarez C, Solano F. Buthionine sulfoximine diverts the melanogenesis pathway toward the production of more soluble and degradable pigments. *Bioorg Med Chem Lett.* 2014 May;24(9):2150–4.
- 25) Cano M, Guerrero-Castilla A, Nabavi SM, Ayala A, Argüelles S. Targeting pro-senescence mitogen activated protein kinase (Mapk) enzymes with bioactive natural compounds. *Food and Chemical Toxicology.* 2019 Sep;131:110544.
- 26) Lee YI, Choi S, Roh WS, Lee JH, Kim TG. Cellular Senescence and Inflammation in the Skin Microenvironment. *Int J Mol Sci.* 2021 Apr 8;22(8):3849.

## Effect of Petai Skin Extract Gel Administration on MITF Gene Expression and Melanin Count (in Vivo Experimental Study on Hyperpigmented Wistar Mice Exposed to UVB Exposed Hyperpigmentation)

- 27) López-Camarillo C, Aréchaga Ocampo E, López Casamichana M, Pérez-Plasencia C, Álvarez-Sánchez E, Marchat LA. Protein Kinases and Transcription Factors Activation in Response to UV-Radiation of Skin: Implications for Carcinogenesis. *Int J Mol Sci.* 2011 Dec 23;13(1):142–72.
- 28) Luchetti F, Betti M, Canonico B, Arcangeletti M, Ferri P, Galli F, et al. ERK MAPK activation mediates the antiapoptotic signaling of melatonin in UVB-stressed U937 cells. *Free Radic Biol Med.* 2009 Feb;46(3):339–51.
- 29) Lee SJ. Suppression of  $\alpha$ -MSH and IBMX-induced melanogenesis by cordycepin via inhibition of CREB and MITF, and activation of PI3K/Akt and ERK-dependent mechanisms. *Int J Mol Med.* 2011 Oct 3;
- 30) Kim DS, Park SH, Park KC. Transforming growth factor- $\beta$ 1 decreases melanin synthesis via delayed extracellular signal-regulated kinase activation. *Int J Biochem Cell Biol.* 2004 Aug;36(8):1482–91.
- 31) Hwang YP, Oh KN, Yun HJ, Jeong HG. The flavonoids apigenin and luteolin suppress ultraviolet A-induced matrix metalloproteinase-1 expression via MAPKs and AP-1-dependent signaling in HaCaT cells. *J Dermatol Sci.* 2011 Jan;61(1):23–31.
- 32) Butarbutar RH, Robiyanto R, Untari EK. Potensi Ekstrak Etanol Daun Petai (*Parkia speciosa* Hassk.) Terhadap Kadar Superoksida Dismutase (SOD) Pada Plasma Tikus yang Mengalami Stres Oksidatif. *Pharmaceutical Sciences and Research.* 2016 Aug;3(2):97–106.
- 33) Zhan JYX, Wang XF, Liu YH, Zhang ZB, Wang L, Chen JN, et al. Andrographolide sodium bisulfate prevents uv-induced skin photoaging through inhibiting oxidative stress and inflammation. *Mediators Inflamm.* 2016;2016.
- 34) Siow HL, Gan CY. Extraction of antioxidative and antihypertensive bioactive peptides from *Parkia speciosa* seeds. *Food Chem.* 2013;141(4):3435–42.
- 35) Izzah Ahmad N, Abdul Rahman S, Leong YH, Azizul NH. A Review on the Phytochemicals of *Parkia Speciosa*, Stinky Beans as Potential Phytomedicine. *J Food Sci Nutr Res.* 2019;02(03).
- 36) Iqbal IY. Pemberian krim ekstrak etanol biji petai (*Parkia speciosa*) 20% sama efektif dengan krim Hidrokuinon 4% dalam menghambat Pembentukan jumlah melanin pada kulit Marmut (*Cavia porcellus*) yang dipapar sinar Ultraviolet B. [Denpasar]: Universitas Udaya; 2019.
- 37) Wijayanti A. Karakteristik Ekstrak Kulit Petai (*Parkia speciosa* Hassk) dengan Pelarut Ethanol 70% dan etil Asetat. *Jurnal Ilmu Kesehatan Bhakti Setya Medika.* 2021 Dec 25;6(2):123–7.
- 38) Al Batran R, Al-Bayaty F, Jamil Al-Obaidi MM, Abdulkader AM, Hadi HA, Ali HM, et al. In Vivo Antioxidant and Antiulcer Activity of *Parkia speciosa* Ethanolic Leaf Extract against Ethanol-Induced Gastric Ulcer in Rats. *PLoS One.* 2013 May 28;8(5):e64751.
- 39) Chen YS, Lee SM, Lin CC, Liu CY. Hispolon Decreases Melanin Production and Induces Apoptosis in Melanoma Cells through the Downregulation of Tyrosinase and Microphthalmia-Associated Transcription Factor (MITF) Expressions and the Activation of Caspase-3, -8 and -9. *Int J Mol Sci.* 2014 Jan 17;15(1):1201–15.
- 40) Wei B, Zhang YP, Yan HZ, Xu Y, Du TM. Cilostazol promotes production of melanin by activating the microphthalmia-associated transcription factor (MITF). *Biochem Biophys Res Commun.* 2014 Jan;443(2):617–21.
- 41) Hsiao JJ, Fisher DE. The roles of microphthalmia-associated transcription factor and pigmentation in melanoma. *Arch Biochem Biophys.* 2014 Dec;563:28–34.
- 42) Lee SE, Park SH, Oh SW, Yoo JA, Kwon K, Park SJ, et al. Beauvericin inhibits melanogenesis by regulating cAMP/PKA/CREB and LXR- $\alpha$ /p38 MAPK-mediated pathways. *Sci Rep.* 2018 Oct 8;8(1):14958.
- 43) D’Mello S, Finlay G, Baguley B, Askarian-Amiri M. Signaling Pathways in Melanogenesis. *Int J Mol Sci.* 2016 Jul 15;17(7):1144.
- 44) Baxter LL, Pavan WJ. The etiology and molecular genetics of human pigmentation disorders. *Wiley Interdiscip Rev Dev Biol.* 2013 May;2(3):379–92.
- 45) Videira IF dos S, Moura DFL, Magina S. Mechanisms regulating melanogenesis\*. *An Bras Dermatol.* 2013 Feb;88(1):76–83.
- 46) Hida T, Kamiya T, Kawakami A, Ogino J, Sohma H, Uhara H, et al. Elucidation of Melanogenesis Cascade for Identifying Pathophysiology and Therapeutic Approach of Pigmentary Disorders and Melanoma. *Int J Mol Sci.* 2020 Aug 25;21(17):6129.
- 47) Lee SJ, Lee WJ, Chang SE, Lee GY. Antimelanogenic effect of ginsenoside Rg3 through extracellular signal-regulated kinase-mediated inhibition of microphthalmia-associated transcription factor. *J Ginseng Res.* 2015 Jul;39(3):238–42.
- 48) Wang JH, Hwang SJ, Lee SK, Choi Y, Byun CK, Son CG. Anti-Melanogenic Effects of Fractioned *Cynanchum atratum* by Regulation of cAMP/MITF Pathway in a UVB-Stimulated Mice Model. *Cells.* 2023 May 14;12(10):1390.

## Effect of Petai Skin Extract Gel Administration on MITF Gene Expression and Melanin Count (in Vivo Experimental Study on Hyperpigmented Wistar Mice Exposed to UVB Exposed Hyperpigmentation)

- 49) Jablonski NG, Chaplin G. Human skin pigmentation as an adaptation to UV radiation. *Proceedings of the National Academy of Sciences*. 2010 May 11;107(supplement\_2):8962–8.
- 50) Lin JY, Fisher DE. Melanocyte biology and skin pigmentation. *Nature*. 2007 Feb 21;445(7130):843–50.
- 51) Kumari S, Thng S, Verma N, Gautam H. Melanogenesis Inhibitors. *Acta Dermato Venereologica*. 2018;98(10):924–31.
- 52) Pillaiyar T, Namasivayam V, Manickam M, Jung SH. Inhibitors of Melanogenesis: An Updated Review. *J Med Chem*. 2018 Sep 13;61(17):7395–418.
- 53) Nguyen NT, Fisher DE. MITF and UV responses in skin: From pigmentation to addiction. *Pigment Cell Melanoma Res*. 2019 Mar 3;32(2):224–36.
- 54) Vance KW, Goding CR. The Transcription Network Regulating Melanocyte Development and Melanoma. *Pigment Cell Res*. 2004 Aug;17(4):318–25.
- 55) Xu W, Gong L, Haddad MM, Bischof O, Campisi J, Yeh ETH, et al. Regulation of Microphthalmia-Associated Transcription Factor MITF Protein Levels by Association with the Ubiquitin-Conjugating Enzyme hUBC9. *Exp Cell Res*. 2000 Mar;255(2):135–43.
- 56) Alam MB, Bajpai VK, Lee J, Zhao P, Byeon JH, Ra JS, et al. Inhibition of melanogenesis by jineol from *Scolopendra subspinipes mutilans* via MAP-Kinase mediated MITF downregulation and the proteasomal degradation of tyrosinase. *Sci Rep*. 2017 Apr 10;7(1):45858.
- 57) Hong Y, Song B, Chen HD, Gao XH. Melanocytes and Skin Immunity. *Journal of Investigative Dermatology Symposium Proceedings*. 2015 Jul;17(1):37–9.
- 58) Nishio T, Usami M, Awaji M, Shinohara S, Sato K. Dual effects of acetylsalicylic acid on ERK signaling and Mitf transcription lead to inhibition of melanogenesis. *Mol Cell Biochem*. 2016 Jan 23;412(1–2):101–10.
- 59) Wellbrock C, Arozarena I. Microphthalmia-associated transcription factor in melanoma development and MAP-kinase pathway targeted therapy. *Pigment Cell Melanoma Res*. 2015 Jul 17;28(4):390–406.
- 60) Kawai T, Akira S. Signaling to NF- $\kappa$ B by Toll-like receptors. *Trends Mol Med*. 2007 Nov;13(11):460–9.
- 61) Thawabteh AM, Jibreen A, Karaman D, Thawabteh A, Karaman R. Skin Pigmentation Types, Causes and Treatment—A Review. *Molecules*. 2023 Jun 18;28(12):4839.
- 62) Moolla S, Miller-Monthrope Y. Dermatology: how to manage facial hyperpigmentation in skin of colour. *Drugs Context*. 2022 May 31;11:1–14.
- 63) Nguyen NT, Fisher DE. MITF and UV responses in skin: From pigmentation to addiction. *Pigment Cell Melanoma Res*. 2019 Mar;32(2):224–36.
- 64) Integrated Taxonomic Information System. Taxonomic Hierarchy : *Parkia speciosa* Hassk. 2023.
- 65) Choy KW, Murugan D, Leong XF, Abas R, Alias A, Mustafa MR. Flavonoids as Natural Anti-Inflammatory Agents Targeting Nuclear Factor-Kappa B (NF $\kappa$ B) Signaling in Cardiovascular Diseases: A Mini Review. *Front Pharmacol*. 2019 Oct 31;10.
- 66) Qin Z, Balimunkwe RM, Quan T. Age-related reduction of dermal fibroblast size upregulates multiple matrix metalloproteinases as observed in aged human skin *in vivo*. *British Journal of Dermatology*. 2017 Nov;177(5):1337–48.
- 67) Martinez-Esparza M, Jimenez-Cervantes C, Solano F, Lozano JA, Garcia-Borron JC. Mechanisms of melanogenesis inhibition by tumor necrosis factor- $\alpha$  in B16/F10 mouse melanoma cells. *Eur J Biochem*. 1998 Jul 1;255(1):139–46.
- 68) Kim DS, Park SH, Park KC. Transforming growth factor- $\beta$ 1 decreases melanin synthesis via delayed extracellular signal-regulated kinase activation. *Int J Biochem Cell Biol*. 2004 Aug;36(8):1482–91.
- 69) Liu F, Fu Y, Meyskens FL. MITF regulates cellular response to reactive oxygen species through transcriptional regulation of APE-1/Ref-1. *Journal of Investigative Dermatology*. 2009 Feb;129(2):422–31.
- 70) Kaminski K, Kazmierczak U, Kolenda T. Oxidative stress in melanogenesis and melanoma development. Vol. 26, *Wspolczesna Onkologia*. Termedia Publishing House Ltd.; 2022. p. 1–7.
- 71) Ishikawa Y, Bächinger HP. A molecular ensemble in the rER for procollagen maturation. *Biochimica et Biophysica Acta (BBA) - Molecular Cell Research*. 2013 Nov;1833(11):2479–91.
- 72) Zhao W, Wang X, Sun KH, Zhou L.  $\alpha$ -smooth muscle actin is not a marker of fibrogenic cell activity in skeletal muscle fibrosis. *PLoS One*. 2018 Jan 10;13(1):e0191031.
- 73) Wölfle U, Esser PR, Simon-Haarhaus B, Martin SF, Lademann J, Schempp CM. UVB-induced DNA damage, generation of reactive oxygen species, and inflammation are effectively attenuated by the flavonoid luteolin *in vitro* and *in vivo*. *Free Radic Biol Med*. 2011;50(9):1081–93.

## Effect of Petai Skin Extract Gel Administration on MITF Gene Expression and Melanin Count (in Vivo Experimental Study on Hyperpigmented Wistar Mice Exposed to UVB Exposed Hyperpigmentation)

- 74) Arab Sadeghabadi Z, Abbasalipourkabir R, Mohseni R, Ziamajidi N. Investigation of oxidative stress markers and antioxidant enzymes activity in newly diagnosed type 2 diabetes patients and healthy subjects, association with IL-6 level. *J Diabetes Metab Disord*. 2019;18(2):437–43.
- 75) Ahmed SMU, Luo L, Namani A, Wang XJ, Tang X. Nrf2 signaling pathway: Pivotal roles in inflammation. *Biochim Biophys Acta Mol Basis Dis* [Internet]. 2017;1863(2):585–97. Available from: <http://dx.doi.org/10.1016/j.bbadis.2016.11.005>
- 76) Shin JM, Kim MY, Sohn KC, Jung SY, Lee HE, Lim JW, et al. Nrf2 negatively regulates melanogenesis by modulating PI3K/Akt signaling. *PLoS One*. 2014 Apr 24;9(4).
- 77) Garufi A, Pistritto G, D'orazi V, Cirone M, D'orazi G. The Impact of NRF2 Inhibition on Drug-Induced Colon Cancer Cell Death and p53 Activity: A Pilot Study. *Biomolecules*. 2022 Mar 1;12(3).
- 78) Addor FAS. Antioxidants in dermatology. *An Bras Dermatol*. 2017;92(3):356–62.
- 79) Arauz J, Ramos-Tovar E, Muriel P. Redox state and methods to evaluate oxidative stress in liver damage: From bench to bedside. *Ann Hepatol*. 2016;15(2):160–73.
- 80) Addor FAS. Antioxidants in dermatology. *An Bras Dermatol*. 2017;92(3):356–62.
- 81) A. Satyanarayana D, K. Kulkarni P, G. Shivakumar H. Gels and Jellies as a Dosage Form for Dysphagia Patients: A Review. *Curr Drug Ther*. 2011;6(2):79–86.
- 82) Bowlby M, Blume P, Schmidt B, Donegan R. Safety and efficacy of Becaplermin gel in the treatment of diabetic foot ulcers. *Chronic Wound Care Management and Research*. 2014;11.
- 83) Mayori H, . K, . M, Purnama D, Maulina Sari R. Systematic Review Efektivitas Limbah Kulit Petai (*Parkia speciosa* Hassk) sebagai Fitomedicine untuk Mengobati Masalah Kesehatan Tertentu. *JURNAL BIOSHELL*. 2023 Apr 27;12(1):66–76.
- 84) Varela MT, Ferrarini M, Mercaldi VG, Sufi B da S, Padovani G, Nazato LIS, et al. Coumaric acid derivatives as tyrosinase inhibitors: Efficacy studies through in silico, in vitro and ex vivo approaches. *Bioorg Chem*. 2020 Oct;103:104108.
- 85) Ke Y, Wang XJ. TGF $\beta$  Signaling in Photoaging and UV-Induced Skin Cancer. *Journal of Investigative Dermatology*. 2021 Apr;141(4):1104–10.
- 86) Pandel R, Poljšak B, Godic A, Dahmane R. Skin photoaging and the role of antioxidants in its prevention. *ISRN Dermatol*. 2013 Sep 12;2013:930164.
- 87) Speeckaert R, Van Gele M, Speeckaert MM, Lambert J, van Geel N. The biology of hyperpigmentation syndromes. *Pigment Cell Melanoma Res*. 2014 Jul;27(4):512–24.
- 88) Rinnerthaler M, Bischof J, Streubel M, Trost A, Richter K. Oxidative Stress in Aging Human Skin. *Biomolecules*. 2015 Apr 21;5(2):545–89.
- 89) Domaszewska-Szostek A, Puzianowska-Kuźnicka M, Kuryłowicz A. Flavonoids in Skin Senescence Prevention and Treatment. *Int J Mol Sci*. 2021 Jun 25;22(13):6814.
- 90) Wu PY, Lyu JL, Liu YJ, Chien TY, Hsu HC, Wen KC, et al. Fisetin regulates Nrf2 expression and the inflammation-related signaling pathway to prevent UVB-induced skin damage in hairless mice. *Int J Mol Sci*. 2017;18(10).
- 91) Zhu W, Gao J. The use of botanical extracts as topical skin-lightening agents for the improvement of skin pigmentation disorders. In: *Journal of Investigative Dermatology Symposium Proceedings*. Nature Publishing Group; 2008. p. 20–4.
- 92) Iqbal IY. Pemberian Krim Ekstrak Etanol Biji Petai (*Parkia Speciosa*) 20% Sama Efektif Dengan Krim Hidrokuinon 4% Dalam Menghambat Pembentukan Jumlah Melanin Pada Kulit Marmut (*Cavia Porcellus*) Yang Dipapar Sinar Ultraviolet B Irah Yunita Iqbal. Denpasar, Indonesia;
- 93) You YJ, Wu PY, Liu YJ, Hou CW, Wu CS, Wen KC, et al. Sesamol inhibited ultraviolet radiation-induced hyperpigmentation and damage in C57BL/6 mouse skin. *Antioxidants*. 2019;8(7):1–16.
- 94) Kim HY, Sah SK, Choi SS, Kim TY. Inhibitory effects of extracellular superoxide dismutase on ultraviolet B-induced melanogenesis in murine skin and melanocytes. *Life Sci* [Internet]. 2018;210:201–8. Available from: <https://doi.org/10.1016/j.lfs.2018.08.056>
- 95) Chhikara N, Devi HR, Jaglan S, Sharma P, Gupta P, Panghal A. Bioactive compounds, food applications and health benefits of *Parkia speciosa* (stinky beans): A review. Vol. 7, *Agriculture and Food Security*. BioMed Central Ltd.; 2018.
- 96) Gui JS, Jalil J, Jubri Z, Kamisah Y. *Parkia speciosa* empty pod extract exerts anti-inflammatory properties by modulating NF $\kappa$ B and MAPK pathways in cardiomyocytes exposed to tumor necrosis factor- $\alpha$ . *Cytotechnology*. 2019 Feb 15;71(1):79–89.
- 97) Lee SE, Park SH, Oh SW, Yoo JA, Kwon K, Park SJ, et al. Beauvericin inhibits melanogenesis by regulating cAMP/PKA/CREB and LXR- $\alpha$ /p38 MAPK-mediated pathways. *Sci Rep*. 2018;8(1):1–12.



## Effect of Petai Skin Extract Gel Administration on MITF Gene Expression and Melanin Count (in Vivo Experimental Study on Hyperpigmented Wistar Mice Exposed to UVB Exposed Hyperpigmentation)

- 98) Pierrat MJ, Marsaud V, Mauviel A, Javelaud D. Expression of microphthalmia-associated transcription factor (MITF), which is critical for melanoma progression, is inhibited by both transcription factor GLI2 and transforming growth factor- $\beta$ . *Journal of Biological Chemistry*. 2012;287(22):17996–8004.
- 99) Kim SS, Kim MJ, Choi YH, Kim BK, Kim KS, Park KJ, et al. Down-regulation of tyrosinase, TRP-1, TRP-2 and MITF expressions by citrus press-cakes in murine B16 F10 melanoma. *Asian Pac J Trop Biomed*. 2013;3(8):617–22.
- 100) Nishioka E, Funasaka Y, Kondoh H, Chakraborty AK, Mishima Y, Ichihashi M. Expression of tyrosinase, TRP-1 and TRP-2 in ultraviolet-irradiated human melanomas and melanocytes: TRP-2 protects melanoma cells from ultraviolet B induced apoptosis. Vol. 9, *Melanoma Research*. 1999. p. 433–43.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Sources and Levels of Natural Growth Promotants for Redbro Chicken



Mark Reagan B Ablog

Ilocos Sur Polytechnic State College

**ABSTRACT:** Fortification of animals' diets with antibiotics in promoting the growth and development has increased the public's concern about the safety of animal products and their adverse effects on human health and natural immunity.

The study conducted at Mabilbila Sur, Santa, Ilocos Sur from January 12, 2021 to February 28, 2021. The study determined the best sources (garlic, oregano, turmeric) and levels (2g, 4g, 6g) of natural growth promotants and their interaction as an alternative to antibiotics. It aimed to determine the effects on the growth performance, carcass trait, sensory traits, and economic analysis of red broiler chicken. One hundred eighty (180) experimental birds were distributed into nine treatments (6 chicken/pen) including one floating control replicated thrice in a Strip-Split Plot Design.

Supplementation of four grams turmeric infusion resulted to the heaviest chicken thus, higher profit above feed cost. Most efficient feed conversion attained with the supplementation of two grams garlic and oregano.

**KEYWORDS:** natural growth promotants, phytochemical, red broiler, sensory trait

### INTRODUCTION

#### Situation Analysis

Corona virus creates a huge impact on human life where it excuses no one, from less fortunate to the highest class of the community. From a single city, it become widely spread to many countries where millions of casualties and many people were infected. The world became stagnant, and hunger commit to universal problem due to global lockdown caused by pandemic. Worst scenario when sufficient supply of food is badly needed, many industries collapsed, businesses turned down to bankruptcy, food security and supply chain interrupted from farm to transportation to the market. One of the affected sectors is the animal industry, where it ruins the livestock production worldwide particularly pig and poultry. Producers were encouraged to slow growth rates, and some had to cull animals on farm in ways that likely included suffering and caused considerable upset to owners and workers. The global poultry production in 2019 expanded to 130 million tons, growing by 3.7% from 2018 and expected to continue its growth for succeeding years. With a combined 45% share of global production, the countries recorded the highest volumes of poultry production in 2019 were: The US (23 million tons), China (20 million tons) and Brazil (16 million tons). According to the global forecast of Food and Agriculture Organization (FAO) in 2020, global poultry meat production is estimated to reach 137 million tons, with growth anticipated in China, the EU, Britain, Brazil and Mexico. It is expected to increase the production in the EU and the UK because of new investments for processing capacity. However, this positive outlook can possibly turn to negative fall due to new cases of HPAI that could hinder production growth and the terrible impact of Covid-19 pandemic as stated in the IndexBox report

Global poultry market in 2019 increased by 6% to US\$ 231.5 billion, rising for the 3<sup>rd</sup> consecutive year. Global consumption peaked in 2019 and a continued upward consumption trend is expected, according to an IndexBox report. Based with the combined 40% share of global consumption, the countries with the highest volumes of poultry consumption in 2019 were China (20 million tons), the US (19 million tons) and Brazil (12 million tons). The countries that recorded the highest levels of poultry per capita consumption in 2019 were Malaysia (63 kg per person), the US (58 kg per person) and Brazil (57 kg per person).

On the latest report of Philippine Statistics Authority (PSA) as of July 1, 2020, the total inventory of chicken was recorded at 186.47 million birds, decreased by 2.7 percent from the 191.70 million birds recorded in the same period of 2019. Stocks of broiler chicken and layer chicken lower by 11.1 percent and 1.4 percent, respectively. On the other hand, native/improved chicken inventory increased by 3.6 percent.

Among the regions, the highest inventory of native/improved chicken of 13.13 million birds or 15.4 percent of the total native/improved chicken inventory was recorded in Western Visayas. Broiler chicken inventory was highest in Central Luzon at 18.86 million birds or 30.8 percent of the total broiler chicken inventory. Meanwhile, CALABARZON shared the highest inventory of layer chicken of 14.35 million birds or 36.2 percent of the total layer chicken inventory.

Redbro (red broiler) is a breed surpassed other hybrid species of congeners in quality, for which it became popular in all continents. The flagship in breeding the breed is the Hubbard Company and it was originally bred in England. It is a crossbred between Cornish and Malaysian fighting. This breed of chicken is admired because of its ability to accept easily adverse conditions, it have young survival rate, strong immunity and great endurance, they produce 300 eggs per year, moderate feed consumption and it has attractive exterior. Farmers find the Redbro breed profitable, because it only requires little effort and material costs applied to produce the final product. Redbro chickens look attractive, and they are characterized by such signs: big head, dark color of the eye iris (usually black or brown), neat yellow beak, developed lobes and painted in bright red, massive torso with bulging breasts and round belly, strong lower limbs yellowish and thick plumage. They are born in light brown down and they reach 40 grams in weight. They are freedom-loving, and a spacious coop is required for keeping.

Redbro are among the most popular broilers in Europe and America particularly raised for both meat and egg. These crosses are bred on a personal plot and on poultry farm. The feeding habit of an adult bird consumes as many calories per day (about 3.5 thousand kcal) and needs of plenty of clean water. The correct ratio of feed and water is 1:1.7. Give chicken 1 kg of feed and provide 1.7 liters of water. Adult females grow up to 3 kg while males up to 4.5 kg and they both gain in weight quickly. In the age of one month, individual birds reaches 1200 g, and the same

## Sources and Levels of Natural Growth Promotants for Redbro Chicken

increase is noted the next 30 days. Thus, the maintenance and feeding of redbro chicken can be compared with both broilers and ordinary domestic chickens.

The chicken industry is one of the most successful sectors especially broiler production that began from being fragmented and locally oriented backyard enterprise and evolved into a sophisticated integrated contract farming operations which increasingly supplying customers nationwide and around the globe. Broiler production is a promising business venture because of its optimistic considerations such as: chicken is an in demand good source of protein, broiler are efficient converters of feeds into meat, quick return of investment, and presence of organized market niche. However, one of the arising threats in the poultry industry and even in the different livestock sector is the emergence and re-emergence of zoonotic disease in relation to improper utilization of antibiotics. Now this became the worldwide challenge to many animal health practitioners and livestock raisers on how they will address the issue on rampant misuse of antibiotics and the possible alternatives (natural growth promoters) to boost the immunity and improved the health of chickens in the absence of antibiotics and for safe human consumption.

The discovery of antibiotics was a success in controlling infectious pathologies and increasing feed efficiencies (Engberg *et al.* 2000). Antibiotics are practically used to prevent proliferation and destroy bacteria either natural or synthetic origin. However, scientific evidence found out that the massive use of these compounds is the driven factor of antibiotic resistance (Forgetta *et al.*, 2012).

Antibiotic tolerance in humans and animals (especially bacteria) is now a common topic, and it is expected to be continuous public health hazard. Fortification of animals' diets with antibiotics to promote growth has increased the public's concern about the safety of animal products and their adverse effects on human health and natural immunity. The impact of antibiotic on the gut flora leads to enhanced digestion and absorption, and, thus, the availability of nutrients for production due to an improved gut ecosystem that favors beneficial microorganisms. Nonetheless, antibiotics can also amplify the occurrence of drug-tolerant bacteria.

Generally, when an antibiotic is used in any setting, it eliminates the susceptible bacterial strains leaving behind those with traits that can resist the drug. These resistant bacteria then multiply and become the dominating population and as such, are able to transfer both horizontally and vertically the genes responsible for their resistance to other bacteria (Madigan *et al.*, 2014). Resistant bacteria can be transferred from poultry products to humans via consuming or handling meat contaminated with pathogens. Once these pathogens are in the human system, they could colonize the intestines and resistant genes that could be shared or transferred to the endogenous intestinal flora, jeopardizing future treatments of infections caused by such organisms (Marshall *et al.*, 20011).

There are heightened concerns globally on emerging drug-resistant superbugs and the lack of new antibiotics for treating human and animal diseases. In agricultural industry, there is an urgent need to develop strategies to replace antibiotics for food-producing animals, especially poultry and livestock. The 2<sup>nd</sup> International Symposium on Alternatives to Antibiotics was held at the World Organization for Animal Health in Paris, France, December 2016 they discuss recent scientific developments on strategic antibiotic-free management plans, to evaluate regional differences in policies regarding the reduction of antibiotics in animal agriculture and to develop antibiotic alternatives to combat global increase in antibiotic resistance. They discussed recent research and promising novel technologies that could provide alternatives to antibiotics for use in animal health and production: assess challenges associated with their commercialization; and devise actionable strategies to facilitate the development of alternatives to antibiotic growth promoters (AGPs) without hampering animal production. Scientists from industry and academia and government research institutes shared their experience in developing and applying potential antibiotic-alternative phytochemicals commercially to reduce AGPs and to develop a sustainable animal production system in the absence of antibiotics (Lillehoj *et al.* 2018). In 2013, the US Food and Drug Administration (FDA) called for major manufacturers of medically important animal drugs to voluntarily stop labeling them for animal growth promotion and published its final rule of the Veterinary Feed Directive (VFD) in 2015.

On the article released by the National Chicken Council, as of April 2019, more than 50% of U.S. broiler chicken production is raised without any antibiotics. They support FDA's proposed Veterinary Feed Directive (VFD) that ensures that all antibiotics administered to food producing animals are only done under the supervision and prescription of licensed veterinarians. In fully cooperating with FDA on these measures, both chicken producers and animal health companies continue to preserve the value and effectiveness of antibiotics used to treat human illness and decrease the resistance of foodborne pathogens.

The quest for alternative products has clearly intensified in recent years with the increase in regulations regarding the use of antibiotic growth promoters (AGPs) and the rise in consumer demand for poultry products from "Raised Without Antibiotics" or "No Antibiotics Ever" flocks (Gadde *et al.*, 2017).

Phytochemicals, also referred to as phytobiotics or phytochemicals, are natural bioactive compounds that are derived from plants and incorporated into animal feed to enhance productivity (Gadde *et al.*, 2017). Ideal antibiotic alternatives should have the same effects of AGPs, ensure optimum animal performance, increase nutrient availability and practical alternative should exert a positive impact of feed conversion and growth. Phytochemicals can be used in solid, dried and ground form or as extracts (crude or concentrated) and can be classified as essential oils (EOs: volatile lipophilic substances obtained by cold extraction or steam/alcohol distillation) and oleoresins (extracts derived by non-aqueous solvents) depending on the process used to derive the active ingredients. The main bioactive compounds of the phytochemicals are polyphenols, and their composition and concentration vary according to the plant, plant parts, geographical origin, harvesting season, environmental factors, storage conditions, and processing techniques (Lillehoj *et al.*, 2018).

In recent years, phytochemicals have been used as natural growth promoters in the poultry, swine and ruminants' industries. A wide variety of herbs and spices (e.g. thyme, oregano, rosemary, marjoram, yarrow, garlic, ginger, green tea, black cumin, coriander and cinnamon) have been used in poultry for their potential application as AGP alternatives. In addition, various EOs (thymol, carvacrol, cinnamaldehyde, and eugenol, coriander, star anise, ginger, garlic, turmeric, basil, caraway, lemon, and sage) have been used individually or as blends to improve animal health performance (Gadde *et al.*, 2017).

Various research conducted on the mechanisms of the botanical powder and extract mainly exert their beneficial effects are as follows: (1) Disrupt cell membrane of microbes; (2) Interfere with virulence properties of the microbes by increasing the hydrophobicity, which may influence the surface characteristics of microbial cells; (3) stimulates and proliferate the growth of beneficial bacteria (e.g., lactobacilli and bifidobacteria) in the gut; (4) Act as an immune stimulants; (5) Protects intestines from microbial attack; (6) Stimulate the proliferation and growth of absorptive cells (villus and crypt) in the gastrointestinal tract and (7) Enhances the production and activity of the digestive enzymes (Jamroz *et al.*, 2003; Vidanarachi *et al.*, 2006).

Garlic, oregano and turmeric are just some of the ideal and locally available plants that can be used as source of natural growth promotants for chickens.

## Sources and Levels of Natural Growth Promotants for Redbro Chicken

### Garlic

Garlic (*Allium sativum*) belongs to the Lillaceae family has been popularly known since ancient times for their medicinal potentials. Garlic and other *Allium* species, such as onions, leek, shallot, scallion and chives, have been characterized to contain a plethora of bioactive compounds such as organosulfur, polyphenols, saponins, fructans, and fructo-oligosaccharides (Kothari *et al.*, 2019). *Allium sativum* is the king of medicinal plants that have growth promoting effect in chicken production. It has reported for its antimicrobial, antibacterial, antiviral, antifungal and antiprotozoal properties in poultry (Rehman *et al.*, 2015).



Fig. 1. Garlic bulbs

Garlic consider one of the most important spices in medicinal system due to its multi-functional properties. It possesses at least 33 sulphur containing compounds, several enzymes, amino acid, and minerals (Aarti *et al.*, 2020). Allicin (allyl 2-propenethiosulfinate or diallyl thiosulfinate) is the major bioactive compound present in the raw garlic homogenate or aqueous extract (Bayan *et al.*, 2013).

Eltazi *et al.* (2014), studied the effect of feeding broiler chicks on diets containing different levels of garlic powder as natural feed additive on productive performance, carcass characteristics, and economical efficiency. Results showed that, the diet with 3% garlic powder had significantly ( $P<0.05$ ) heaviest body weight gain, highest feed intake, best feed conversion ratio with highest dressing, and breast percentages. The birds fed on control group produced significantly ( $P<0.05$ ) highest abdominal fat percentage. The mortality rate was not affected significantly by the addition of garlic powder in broiler diet. The profitability ratio (1.30) was recorded by the diet with 3% garlic powder as compared to other experimental diets.

An experiment conducted by Khan *et al.*, (2017) on the effect of garlic extract on growth performances and hematological parameters of broilers were studied. Live weight and weight gain of the treatment group were significantly ( $P<0.05$ ) higher than that of the control group. Significant ( $P<0.05$ ) higher values also observed in terms of weight of heart, live, spleen, and pancreas for the treatment group. The results suggest that better growth performance could be achieved in broilers with feed supplemented with garlic extract.

### Oregano

Oregano (*Origanum vulgare*) is considered a staple herb in many cuisines around the world. It is popularly known for its strong flavor, which bring warmth and aroma to dishes, along with a hint of subtle sweetness. It can be found raw, fermented or as an oil, and all are said to have significant health benefits. Oregano is high in antioxidants, which are compounds that help fight damage from harmful free radicals in the body (Link 2017).

Oregano is an erectly spreading perennial herb and member of the plant family Lamiaceae that has been cultivated for centuries in the Mediterranean area, although it now can be found on most continents. It has fleshy stem and a heart-shaped leaves with toothed edges, and which grow for up to 9 meters in length. Oregano flowers are purple, 3–4 mm long, produced in erect spikes. Oregano also used in traditional medicines for such ailments as asthma, cramping, diarrhea and indigestion (Singletary 2010).



Figure 2. Oregano leaves

Oregano contains thymol and carvacrol, both of which have shown to inhibit the growth of bacteria, including *Pseudomonas aeruginosa* and *Staphylococcus aureus*. As reported by The World Healthiest Food ([www.whfoods.com](http://www.whfoods.com)) in Mexico, researchers have compared oregano to tinidazol, a commonly used prescription drug to treat infection from amoeba *Giardia lamblia*. These researchers found oregano to be more effective against *Giardia* than the commonly used prescription drug.

*Origanum vulgare* as a feed supplement has antimicrobial, antioxidant, antiviral, immunodulatory and antiparasitic effect. The potential advantages of utilizing oregano extracts, in poultry diets include improved feed intake and feed conversion, enhanced digestion, expanded productive performance, down-regulated disease incidence and economic losses. The average inclusions of oregano essential oil up to 600 mg/kg in broiler diets increased body weight gain. Using 1% oregano oil in broiler diets improved feed conversion ratio and feed utilization. Inclusion of 240 mg oregano supplementation per kg diet appears to give optimum level for protecting broiler chickens from *C. perfringens* infections. Bioactive components extracted from *O. vulgare* parts could be used in poultry diets levels of 10-30 g/kg. To maximize the overall productivity

## Sources and Levels of Natural Growth Promotants for Redbro Chicken

of poultry, oregano may be used as a natural alternative to antibiotics and drugs due to the absence of side effects and residues (Alagawany *et al.*, 2019)

Many studies suggested that oregano is an excellent natural replacement for antibiotics. There are few ways to provide oregano to chickens, one of it in the form of tea. Put fresh oregano in a glass or heat-proof container then pour the hot water over the oregano. Oregano tea is a great way to help a sick chicken. A chicken that is sick will often quit eating but will continue drinking. Oregano tea can help them get over an illness by fighting off what's making them sick. It has some vitamins and nutritional value to keep them going until they start eating again which strongly claimed in similar studies that oregano may improve feed intake, the growth rate of broilers and overall body condition in meat carcasses (DeVore 2019).

In a study conducted by Giannenas, *et al.* (2016), the results of the trial showed that the group of broilers received oregano or the mixture of oregano and laurel presented better Body Weight (BW) and Feed Conversion Ratio (FCR) and mortality compared to control group. Bacterial counts for the Lactobacilli and Bifidobacteria were higher in the experimental groups compared to the control group at both ileum and caecum, and total coliforms were lower in caecum in the experimental groups compared to control or laurel ones. Oregano supplemented groups showed higher antioxidant capacity of breast and thigh meat compared to control and laurel groups. In conclusion, oregano essential oil alone or as a mixture with laurel essential oil can be used to improve growth performance and gut health in broiler chicken.

### Turmeric

Turmeric (*Curcuma longa*) is a perennial herb having a short stem with large simple oblong leaves which belong to family Zingiberaceae. Its tubers (rhizomes) are oblong or ovate or pyriform and are often branched. Externally, the rhizomes are yellowish brown, while internal surface is orange in color. They possess the characteristic odor and are slightly pungent bitter to taste (Hegde 2013). Turmeric has been used for long history as traditional medicine. This spice is indigenously cultivated from rhizome or roots of flowering plant in India and other parts of Southeast Asia (Jurenka 2009).



Fig. 3. Turmeric plants and rhizomes

Turmeric contains protein (6.3%), fat (5.1%), minerals (3.5%), carbohydrates (69.4%) and moisture (13.1%) (Yadav *et al.*, 2013). It is also a rich source of phenolic compounds, such as curcumin which is responsible for its yellow color, demethoxycurcumin, and bisdemethoxy curcumin and tetrahydrocurcumin metabolites. This polyphenolic compound has the wide range of biological properties such as antioxidant, anti-inflammatory, antiviral, antibacterial, antifungal, antihypertensive and anti-carcinogenic activities (Mahesh 2018; Masuda *et al.*, 2001).

A study on the effect of inclusion of different levels of turmeric (*Curcuma longa*) powder on broiler performance, carcass characteristics and bacterial count conducted by Al-Mashhadani (2015) showed that supplementing broiler diets with 0.4 % curcuma powder improved significantly ( $P < 0.05$ ) final body weight, weight gain and lactobacillus count and could be used as growth promoter.

An experiment conducted by Isroli *et al.* (2017) on the effect of decocted turmeric on performance, hematological parameters and carcass traits of broiler chicken were studied. Result showed, providing decocted turmeric through drinking water helped to improve stress responses and increased the weight of breast meat of broiler chickens.

It has been a repeated practice for decades the use of antibiotics as growth promoter (GPA) in animal feeds to prevent from diseases and enhance their production performance in modern animal husbandry. In the present time, due to the unreasonable and improper utilization of antibiotics there is now a concern in increasing risk of bacterial resistance where prompted efforts to develop alternative antibiotics (Cheng 2014). Therefore, the search for new plant origin alternatives to replace the GPA's such as herbs, spices, plant extracts and/or essential oils to be use as antimicrobials and to also make them available to contribute to animal nutrition (Castillo-Lopez *et al.*, 2017). However, alternatives to antibiotics must deeply analyzed and studied if it can be possibly and evidently used as substitute natural antibiotic in veterinary medicine in the foreseeable future.

### OBJECTIVES OF THE STUDY

This study was conducted to determine the growth performance, carcass traits, profit above feed medicine and stock cost, and sensory traits of redbro chicken as affected by different sources of natural growth promotants at different levels.

Specifically, it aimed to:

1. Determine the performance of redbro chicken as influenced by different sources (garlic, oregano, turmeric) of natural growth promotants in terms of final weight, gain in weight, feed consumption, feed conversion ratio, dressing percentage, percent leaf fat, liver weight and gizzard weight and profit above feed, medicine and stock cost;
2. Determine the performance of redbro chicken as influenced by the different levels (2g, 4g, 6g) of natural growth promotants in terms of final weight, gain in weight, feed consumption, feed conversion ratio, dressing percentage, percent leaf fat, liver weight and gizzard weight and profit above feed, medicine and stock cost;
3. Determine the interaction effects of different sources of natural growth promotants at different levels of herbal plant tea on the growth performance and carcass traits of broilers; and
4. Determine the sensory traits and acceptability of the steamed meat samples from the different treatment combinations.

# Sources and Levels of Natural Growth Promotants for Redbro Chicken

## TIME AND PLACE OF THE STUDY

The study was conducted at the researcher’s residence Barangay Mabilbila Sur, Santa, Ilocos Sur from January 12, 2021 to February 28, 2021 (45 days).

## DEFINITION OF TERMS

- For a better understanding of this research, the following terms were operationally defined:
- Ad libitum feeding* refers to giving unlimited amount of feed to the experimental animals.
- Antibiotic* refers to a medicine used to prevent and treat bacterial infections.
- Antibiotic resistance* refers to the ability of bacteria and other microorganisms to resist the effects of an antibiotic to which they were once sensitive
- Broiler* refers to any chicken that is bred and raised specifically for meat production.
- Brooding* is the management of chicks from one day old to about 8 weeks of age, and it involves the provision of heat and other necessary care during chicks’ early growing period.
- Carcass traits* refer to the dressing percentage, percent leaf fat, liver weight and gizzard weight of the broilers.
- Culling* is the process of eliminating undesirable birds or those birds which do not possess the qualities for giving enough benefit in return for their culture.
- Efficacy* the ability to produce a desired or intended result.
- Garlic Bulb* is a bulb-like modified underground stem and covered with whiteish papery outer scale.
- Feed conversion ratio (FCR)* refers to the efficiency of an animal’s body to convert utilized feed into the desired output.
- Natural Growth Promoters (NGP)* refer to plant derived products (leaves, roots, tubers or spices) with antimicrobial properties added to feed in order to improve broiler’s performance.
- Herbal plant infusion* refers to the powdered herbal plants like turmeric, oregano and garlic infused to cold or hot water.
- Infusion* the process of or result of extracting flavors from plant materials in a water by letting the material to remain suspended in the solvent over time.
- Probiotics* are beneficial bacteria for chickens that are commonly added to poultry feed or drinking water to help support birds’ health, performance and growth.
- Redbro chicken* a red feathered bird with both broiler and layer characteristics This breed has clearly defined head features with short beak, regular straight red comb and bright ear lobes.
- Rhizomes* are fleshy underground stem and elongated usually horizontal often thickened that produces shoots above and roots below this includes turmeric and ginger.

## METHODOLOGY

### Research Design

The study was laid out in a Strip-Split Plot Design. Strip-Split Plot Design was used to determine the significant difference between levels of each factor and their interactions. A total of 180 heads day-old chicks were distributed into nine treatments (6 chicken/pen) including one floating control replicated thrice.

The following treatments were used:

Factor A – Sources of Natural Growth Promotants

- A<sub>1</sub> – Garlic (bulbs)
- A<sub>2</sub> – Oregano (leaves)
- A<sub>3</sub> – Turmeric/Yellow Ginger (rhizome)

Factor B – Levels of Natural Growth Promotants

- B<sub>1</sub> - 2 grams Pulverized herbal plant infusion + 1 Liter
- B<sub>2</sub> - 4 grams Pulverized herbal plant infusion + 1 Liter
- B<sub>3</sub> - 6 grams Pulverized herbal plant infusion + 1 Liter

Floating Control – Antibiotics

Interactions:

- A<sub>1</sub>B<sub>1</sub> - 2 grams Pulverized Garlic Bulb Infusion
- A<sub>1</sub>B<sub>2</sub> – 4 grams Pulverized Garlic Bulb Infusion
- A<sub>1</sub>B<sub>3</sub> – 6 grams Pulverized Garlic Bulb Infusion
- A<sub>2</sub>B<sub>1</sub> – 2 grams Pulverized Oregano Leaves Infusion
- A<sub>2</sub>B<sub>2</sub> – 4 grams Pulverized Oregano Leaves Infusion
- A<sub>2</sub>B<sub>3</sub> – 6 grams Pulverized Oregano Leaves Infusion
- A<sub>3</sub>B<sub>1</sub> – 2 grams Pulverized Turmeric Rhizome Infusion
- A<sub>3</sub>B<sub>2</sub> – 4 grams Pulverized Turmeric Rhizome Infusion
- A<sub>3</sub>B<sub>3</sub> – 6 grams Pulverized Turmeric Rhizome Infusion

### Experimental Layout

I	II	III
A <sub>1</sub> B <sub>1</sub>	A <sub>1</sub> B <sub>1</sub>	A <sub>1</sub> B <sub>1</sub>
A <sub>1</sub> B <sub>2</sub>	A <sub>1</sub> B <sub>2</sub>	A <sub>1</sub> B <sub>2</sub>
A <sub>1</sub> B <sub>3</sub>	A <sub>1</sub> B <sub>3</sub>	A <sub>1</sub> B <sub>3</sub>
A <sub>2</sub> B <sub>1</sub>	A <sub>2</sub> B <sub>1</sub>	A <sub>2</sub> B <sub>1</sub>
A <sub>2</sub> B <sub>2</sub>	A <sub>2</sub> B <sub>2</sub>	A <sub>2</sub> B <sub>2</sub>
A <sub>2</sub> B <sub>3</sub>	A <sub>2</sub> B <sub>3</sub>	A <sub>2</sub> B <sub>3</sub>
A <sub>3</sub> B <sub>1</sub>	A <sub>3</sub> B <sub>1</sub>	A <sub>3</sub> B <sub>1</sub>

## Sources and Levels of Natural Growth Promotants for Redbro Chicken

A <sub>3</sub> B <sub>2</sub>	A <sub>3</sub> B <sub>2</sub>	A <sub>3</sub> B <sub>2</sub>
A <sub>3</sub> B <sub>3</sub>	A <sub>3</sub> B <sub>3</sub>	A <sub>3</sub> B <sub>3</sub>
C	C	C

### Experimental Treatments and Descriptions

Treatments	Descriptions
C - Antibiotics	Drinking water with antibiotics following the recommended dosage
A <sub>1</sub> B <sub>1</sub> - Pulverized Garlic Bulb Infusion (2g)	2g of pulverized garlic bulb infusion for every liter of water
A <sub>1</sub> B <sub>2</sub> - Pulverized Garlic Bulb Infusion (4g)	4g of pulverized garlic bulb infusion for every liter of water
A <sub>1</sub> B <sub>3</sub> - Pulverized Garlic Bulb Infusion (6g)	6g of pulverized garlic bulb infusion for every liter of water
A <sub>2</sub> B <sub>1</sub> - Pulverized Oregano Leaves Infusion (2g)	2g of pulverized oregano leaves infusion for every liter of water
A <sub>2</sub> B <sub>2</sub> - Pulverized Oregano Leaves Infusion (4g)	4g of pulverized oregano leaves infusion for every liter of water
A <sub>2</sub> B <sub>3</sub> - Pulverized Oregano Leaves Infusion (6g)	6g of pulverized oregano leaves infusion for every liter of water
A <sub>3</sub> B <sub>1</sub> - Pulverized Turmeric Rhizome Infusion (2g)	2g of pulverized turmeric rhizome infusion for every liter of water
A <sub>3</sub> B <sub>2</sub> - Pulverized Turmeric Rhizome Infusion (4g)	4g of pulverized turmeric rhizome infusion for every liter of water
A <sub>3</sub> B <sub>3</sub> - Pulverized Turmeric Rhizome Infusion (6g)	6g of pulverized turmeric rhizome infusion for every liter of water

### MATERIALS AND PROCEDURES

#### Materials:

The materials used in the research study were: 180 heads redbro chicken, poultry house/cage, commercial feeds, vetracin, feeding troughs, waterers, electric wire with bulb, old sacks, old newspapers, placards, record notebook, weighing scale.

For the treatment process: oregano (leaves), turmeric (rhizomes), garlic (bulb), knife, container, blender, and chopping board.

#### PROCEDURES:

##### Collection of Plant Materials

Oregano leaves were gathered from Mabilbila Sur, Santa, Ilocos Sur. Yellow ginger rhizomes were purchased from Cervantes, Ilocos Sur. Garlic bulbs were purchased from Duyayat, Sinait, Ilocos Sur. The plant materials were washed with tap water to remove the foreign materials that might have adhered to it.

##### Preparation of the Herbal Infusion

Freshly collected plant materials were chopped into tiny pieces and sundried until it became crisp in texture for 5 days. Yellow ginger rhizomes, oregano and garlic were pulverized using a blender. Pulverized plant materials were stored in clean and dry containers. Pulverized oregano, turmeric and garlic were place into transparent plastic with their recommended measurement. The pulverized treatments were infused in ½ liter hot water for 10 minutes and were mixed in ½ liter cold water for their drinking formulation.



Fig. 6. Flowchart in the Preparation of Native Garlic Bulbs Treatment

## Sources and Levels of Natural Growth Promotants for Redbro Chicken



Fig. 7. Flowchart in the Preparation of Oregano Leaves Treatment.



Fig. 8. Flowchart in the Preparation of Turmeric Rhizomes

### Construction of Experimental Cages

The experimental cages were constructed following the recommended space allowance 1 x 1 square meter per cage, made of steel bars enclosed with fish net. The cages were cleaned thoroughly using soap and water, sundried and disinfected five days before the arrival of the experimental animals. Electric bulbs were individually installed in the brooding cages. Old sacks were placed along the walls to avoid the effect of draft.

### Care and Management Practices

**Pre-treatment Procedure.** Upon the arrival of chicks, electrolytes were supplied to their drinking water for 3 days.

**Feeding Management.** *Ad libitum* feeding was employed. The chicks were fed with commercial chick booster during the first two weeks. Starter feeds were given after two weeks and finisher feed thereafter until the termination of the study. Feeding troughs were regularly checked to always ensure the availability of feeds.

**Water Management.** The experimental chicks were supplied with freshwater *ad libitum* after the 21 days implementation of the treatments. Feeding troughs and plastic waterers were cleaned regularly.

**Sanitation.** Old sacks were placed underneath the cages to facilitate the collection of bird droppings. Collection and disposal of the chicken manure was done twice a day, at around 6 o'clock in the morning and 5 o'clock in the afternoon.



## Sources and Levels of Natural Growth Promotants for Redbro Chicken

### Source of the Stocks

Experimental birds were purchased from Bounty Fresh 179 Mariano Ponce St., Caloocan City. The chicks are uniform in sizes, with active eyes, and equal sizes of beak and shank upon arrival.

### Sensory Evaluation

Ten adult (5 males, 5 females) and ten teenager (5 males, 5 females) were selected as panelists. The 20 panelists were asked to independently evaluate each sample for juiciness, texture, taste, aroma and general acceptability. Each panelist was instructed to rinse his/her mouth with water after evaluating each sample.

### DATA GATHERED

The following parameters were gathered:

**Initial Weight.** The initial weight of the experimental broilers was taken at day-old before placing them in the experimental cages.

**Weight at 21 Days.** The chicken weight was taken after the implementation of treatments in 21 days.

**Final Weight.** The final weight of the broilers was taken after the termination of the study.

**Gain Weight.** This was determined by subtracting the initial weight from the final weight.

**Feed Consumption.** Feed consumption refers to the total amount of feed consumed by the experimental broilers from day-old until the termination of the study.

**Feed Conversion Ratio.** This was computed by dividing the amount of feed consumed by the gain in weight of the experimental chicken.

**Dressing Percentage.** Dressing percentage was computed by dividing the dressed weight by the live weight, multiplied by 100.

**Leaf Fat Percentage.** This was obtained by dividing the weight of leaf fat by the total dressed weight, multiplied by 100.

**Liver Weight.** This was obtained by weighing and recording the individual liver of the experimental animals.

**Gizzard Weight.** This was obtained by weighing and recording the individual gizzard of the experimental animals.

**Profit above Feed, Medicine and Stock Cost.** This was obtained by subtracting the cost of feeds, herbal plants and stocks, from the total sales.

**Sensory Traits.** The following parameters were gathered: tenderness, juiciness, texture, aroma, and general acceptability, using hedonic scale.

### Data Analysis

Gathered data on growth performance and dressing percentage, leaf fat, liver weight and gizzard weight were analysed using Analysis of Variance (ANOVA) in Strip-Split Plot Design using Statistical Tool for Agricultural Research (STAR). Significant differences between and among treatments were subjected to Least Significant Difference (LSD) Test.

## RESULTS AND DISCUSSION

### Initial Weight

The initial mean weight of the experimental birds assigned to the different treatments was 74 grams. Analysis of Variance revealed no significant differences among the treatment means.

### Effects of Different Sources of Natural Growth Promotants on Growth Performance

#### Weight at 21 Days

After the consumption of the different sources of natural growth promotants, A<sub>3</sub> (0.67 kg) receives the heaviest weight at 21 days, A<sub>1</sub> (0.63) follows thereafter whereas A<sub>2</sub> (0.62 kg) gains the lowest. The data gathered in Table 1 manifested a highly significant differences between A<sub>3</sub> and A<sub>2</sub> and A<sub>3</sub> and A<sub>1</sub> but do not show significance between A<sub>1</sub> and A<sub>2</sub>. This implies that chicken received with pulverized turmeric rhizome infusion at 21 days significantly performed better than those given with pulverized oregano leaves infusion and pulverized garlic bulb infusion.

The result of the study is in agreement with the findings of El-Rayes et al. 2018, their experiment was carried out to evaluate the impact of different levels of turmeric (*Curcuma longa*) as a phytobiotic on the performance and bacterial count of broiler chickens. Results showed that final body weight and weight gain were significantly increased in birds fed diet supplemented with different levels of turmeric powder as compared to control group.

Table 1. Effects of Different Sources of NGP on the Weight of Redbro Chicken at 21 days

Sources of Natural Growth Promotants	Weight at 21 Days (kg)**
A <sub>1</sub> – Garlic	0.63 <sub>b</sub>
A <sub>2</sub> - Oregano	0.62 <sub>b</sub>
A <sub>3</sub> - Turmeric	0.67 <sub>a</sub>

Means with the same letter are not significantly different.

### Final Weight

The final weight of the redbro chicken as exposed to the sources of natural growth promotants as illustrated in the table 2, suggests that there is a high significance between A<sub>3</sub> and A<sub>2</sub>; and A<sub>3</sub> and A<sub>1</sub> but do not show any significant difference between A<sub>1</sub> and A<sub>2</sub>. As shown in the table, A<sub>3</sub> (1.55 kg) obtains the largest weight increase, with A<sub>2</sub> (1.47 kg.) comes afterward and A<sub>1</sub> (1.46 kg.) the least.

Table 2. Effects of Different Sources of NGP on the Final Weight of Redbro Chicken

Sources of Natural Growth Promotants	Final Weight (kg)**
A <sub>1</sub> – Garlic	1.46 <sub>b</sub>
A <sub>2</sub> - Oregano	1.47 <sub>b</sub>
A <sub>3</sub> - Turmeric	1.55 <sub>a</sub>

Means with the same letter are not significantly different.

The present result of the study corroborates the findings of Kumari et al. (2007) that the addition of turmeric as feed additive resulted in better growth rate in the treated broilers. It also justified the result by the findings on the study of Labay, et al. (2003) that oregano extract significantly improved the average live body weight of broilers.

## Sources and Levels of Natural Growth Promotants for Redbro Chicken

### Gain Weight

As revealed in Table 3, the gain weight of the redbro chicken after the consumption of the different treatments show a high level of significant differences between A<sub>3</sub> and A<sub>2</sub>; and A<sub>3</sub> and A<sub>1</sub>, however, treatments A<sub>1</sub> and A<sub>2</sub> do not show any difference. Moreover, A<sub>3</sub> (1.47 kg) attains the heaviest gain weight as opposed to A<sub>1</sub> (1.39) and A<sub>2</sub> (1.39) which obtains the least.

Based on Ukoha and Onunkwo (2016) recorded the highest muscle weight of breast meat in poultry fed with diet containing 3% turmeric powder which stimulates protein synthesis by the enzymatic system of birds and can increase the amount of lean meat (Hussein 2013).

**Table 3. Effects of Different Sources of NGP on the Gain in Weight of Redbro Chicken**

Sources of Natural Growth Promotants	Gain Weight (kg)**
A <sub>1</sub> – Garlic	1.39 <sub>b</sub>
A <sub>2</sub> - Oregano	1.39 <sub>b</sub>
A <sub>3</sub> - Turmeric	1.47 <sub>a</sub>

Means with the same letter are not significantly different.

### Feed Consumption

As shown in Table 4, redbro chicken that received Turmeric (A<sub>3</sub>) as a source of natural growth promotants consumed the highest (4.30 kgs) which is significantly different to the redbro chicken of A<sub>1</sub> (Garlic) and A<sub>2</sub> (Oregano) which consumes 1.29 kgs.

**Table 4. Effects of Different Sources of NGP on Feed Consumption of Redbro Chicken**

Sources of Natural Growth Promotants	Feed Consumption*
A <sub>1</sub> – Garlic	4.29 <sub>b</sub>
A <sub>2</sub> - Oregano	4.29 <sub>b</sub>
A <sub>3</sub> - Turmeric	4.30 <sub>a</sub>

Means with the same letter are not significantly different.

Results supported the findings of Rodriguez, et. al. (2016) supplementation of turmeric extract in the drinking water of broilers significantly affects their feed consumption. Same findings of Kumari et al. (2007) that the addition of turmeric as feed additive also resulted in better feed consumption in the treated broilers.

### Feed Conversion Ratio (FCR)

On feed conversion ratio on redbro chicken, shows comparable results that A<sub>1</sub> and A<sub>2</sub> gains the best (1.47) conversion ratio which registered a high level of significant difference to the redbro chicken of A<sub>3</sub> in a span of 45 days.

The results agreed on the findings of Attia (2016) wherein turmeric supplementation at 1 g/kg feed significantly improved feed conversion ratio of broilers. Based on the study of Raguindin (2018) it shows that NGP's used including turmeric and oregano revealed not significant results on the conversion of feeds into meat. Though, broilers given with turmeric were the most efficient in the conversion ratio among the other treatments given. Results on the study of Urusan (2017) states that turmeric powder improved the feed conversion ratio.

**Table 5. Effects of Different Sources of NGP on Feed Conversion Ratio of Redbro Chicken**

Sources of Natural Growth Promotants	Feed Conversion Ratio (FCR)**
A <sub>1</sub> – Garlic	1.47 <sub>a</sub>
A <sub>2</sub> - Oregano	1.47 <sub>a</sub>
A <sub>3</sub> - Turmeric	1.55 <sub>b</sub>

Means with the same letter are not significantly different.

### Effects of Different Sources of Natural Growth Promotants on Carcass Trait

As gleaned in Table 6, the dressing percentage of the redbro chicken is almost identical to one another which ranges from 72.86 to 73.58 % with A<sub>2</sub> registering the highest (73.58%) followed by A<sub>1</sub> (73.49%) and A<sub>2</sub> (72.86%), the smallest. This supports the outcomes from the analysis of variance which clearly illustrates that there is no significant difference between and among the treatments A<sub>1</sub>, A<sub>2</sub> and A<sub>3</sub> that were given to the redbro chicken. This finding agreed by the study of Mehala and Moorthy (2008) reported that supplementation of turmeric had no significant impact on carcass parameters.

The leaf fat percentage to redbro chicken's sources of natural growth promotants is presented in table 3. The analysis of variance shows that there's no significant differences with 0.11 between and among treatments, A<sub>1</sub> (given with Garlic), A<sub>2</sub> (given with Oregano) and A<sub>3</sub> (given with Turmeric).

Nouzarian et al. (2011) agrees of the results which there is significant decrease in abdominal fat pad in chickens fed with diets supplemented with turmeric powder. Emadi and Kermanshahi (2006) observed the same findings that dietary inclusion of turmeric powder in broilers significantly decreased the abdominal fats.

The Table 6 revealed that there's no significant differences on the liver weight among the sources of treatment given to redbro chicken. The result of the present study corroborates with the findings of Raguindin (2018); Aglipay and Rodriguez (2017) revealed that the liver weight of experimental chicken was not significantly influenced by the addition of lemon grass, oregano and turmeric in their diet.

Result on the analysis of variance on the gizzard weight revealed that there are no significant differences with 0.06% between and among the sources of treatments (garlic, oregano, turmeric) on the redbro chicken. The result of the study agrees with the findings of Raguindin (2018) that no significant influence on gizzard weight of the experimental chicken supplemented with lemon grass, oregano and yellow ginger.

## Sources and Levels of Natural Growth Promotants for Redbro Chicken

**Table 6. Effects of Different Sources of NGP on Carcass Trait of Redbro Chicken**

Sources of Natural Growth Promotants	Dressing Percentage (ns)	Leaf Fat Percentage (ns)	Liver Weight (ns)	Gizzard Weight (ns)
A <sub>1</sub> – Garlic	73.49 <sub>a</sub>	0.11 <sub>a</sub>	0.08 <sub>a</sub>	0.06 <sub>a</sub>
A <sub>2</sub> - Oregano	73.58 <sub>a</sub>	0.11 <sub>a</sub>	0.08 <sub>a</sub>	0.06 <sub>a</sub>
A <sub>3</sub> - Turmeric	72.86 <sub>a</sub>	0.11 <sub>a</sub>	0.08 <sub>a</sub>	0.06 <sub>a</sub>

Means with the same letter are not significantly different.

### Effects of Different Sources of NGP on the Profit above Feed, Medicine and Stock Cost

Observing further at Table 7, the net income reveals that A<sub>3</sub> obtained the highest income with a mean of Php 102.24 bearing a highly significant differences to the redbro chicken given with A<sub>2</sub> and A<sub>1</sub> which received the lowest income with a mean of Php.84.96.

**Table 7. Profit above Feed, Medicine and Stock Cost as Affected by Different Sources of NGP on Redbro Chicken**

Sources of Natural Growth Promotants	Profit (Php)**
A <sub>1</sub> – Garlic	84.96 <sub>b</sub>
A <sub>2</sub> - Oregano	89.11 <sub>b</sub>
A <sub>3</sub> - Turmeric	102.24 <sub>a</sub>

Means with the same letter are not significantly different.

### Effects of Different Levels of Natural Growth Promotants on Growth Performance

#### Weight at 21 Days

The Analysis of variance test clearly manifests that treatments B<sub>1</sub> and B<sub>2</sub> show significant difference. The weight at 21 days when the different treatments of herbal plant infusion are given to the redbro chicken, B<sub>2</sub> (0.66 kg) obtains the heaviest increase, followed by B<sub>3</sub> (0.64 kg) with B<sub>1</sub> (0.62 kg) getting the least.

On the study of Al-Sultan (2003), the same results he found out that higher body weight gain (1344.5 g) was observed in birds fed diet contained turmeric at level of 0.5% followed by birds received 0.25% (1329.8 g), 1% (1306 g) and control (1268.2 g).

**Table 8. Effects of Different Levels of NGP on the Weight of Redbro Chicken at 21 days**

Levels of Natural Growth Promotants	Weight at 21 Days (kg)*
B <sub>1</sub> – 2 grams	0.62 <sub>b</sub>
B <sub>2</sub> – 4 grams	0.66 <sub>a</sub>
B <sub>3</sub> – 6 grams	0.64 <sub>ab</sub>

Means with the same letter are not significantly different.

#### Final Weight

As indicated by the analysis of variance, the final weight of the redbro chicken has significant difference between and among the treatments B<sub>1</sub>, B<sub>2</sub> and B<sub>3</sub> with a mean that ranges from 1.45 to 1.53 kg. Additionally, B<sub>2</sub> (1.53 kgs) has the heaviest final weight, B<sub>3</sub> (1.50 kgs) follows and B<sub>1</sub> (1.45 kgs) gains the least.

**Table 9. Effects of Different Levels of NGP on the Final Weight of Redbro Chicken**

Levels of Natural Growth Promotants	Final Weight (kg)*
B <sub>1</sub> – 2 grams	1.45 <sub>c</sub>
B <sub>2</sub> – 4 grams	1.53 <sub>a</sub>
B <sub>3</sub> – 6 grams	1.50 <sub>b</sub>

Means with the same letter are not significantly different.

The result of the study justified by the findings of Ukoha and Ononkwo (2016) that recorded the highest drained weight and muscle weight of breast meat in birds fed with an additive containing 3% turmeric powder, this may be due to optimal antioxidant activity of turmeric (curcumin a phenolic group, tetrahydro curcumin, cinnamic acid, curcumin alone, and niacin) as cited to Phuoc *et al.* (2019). Supplementing with turmeric can increase the amount of lean meat.

#### Gain Weight

The result in Table 10 emphasizes that there is a significant difference between and among B<sub>1</sub>, B<sub>2</sub> and B<sub>3</sub> in terms of gain weight. This indicates that B<sub>1</sub> (1.45 kgs.) which achieves the heaviest gain weight, followed by B<sub>3</sub> (1.422 kgs.) and B<sub>2</sub> (1.33 kgs) the lowest, there is no difference in gain weight of the redbro chicken which is exposed to different treatments of herbal tea.

The findings of the study corroborate the on the study of Sethy *et al.* (2016) who reported that addition of *Curcuma longa* powder at 0.5% and 1% caused significant increase in body weight gain. Rajput *et al.* (2013) also found that 0.20 g/kg supplementation of pure curcumin – phytochemicals derived from turmeric increased body weight gain of broiler chickens. It also reported on the findings of Arslan *et al.*, 2017 that higher dose (1.0 and 1.5%) of turmeric supplementation improved body weight gains of broilers.

**Table 10. Effects of Different Levels of NGP on the Gain in Weight of Redbro Chicken**

Levels of Natural Growth Promotants	Gain Weight (kg)**
B <sub>1</sub> – 2 grams	1.33 <sub>c</sub>
B <sub>2</sub> – 4 grams	1.45 <sub>a</sub>
B <sub>3</sub> – 6 grams	1.42 <sub>b</sub>

Means with the same letter are not significantly different.

## Sources and Levels of Natural Growth Promotants for Redbro Chicken

### Feed Consumption

Looking at the Table 11, shows that feed consumption of the redbro chicken which received different levels of herbal plant infusion is almost similar to each other wherein 6g (B<sub>3</sub>) receives the heaviest (4.30 kgs.). Moreover, B<sub>3</sub> (given with 6g) registers a high significant difference to the redbro chicken of B<sub>1</sub> (given with 2g) but comparable to the redbro chicken of B<sub>2</sub> (given with 4g).

Corroborates Halle *et al.* (2004) showed that supplementation of diet for male broiler chicks with graded levels of oregano herb (0, 2, 4, 10, and 20g/kg) significantly decreased feed intake and improved body weight and improved feed efficiency.

**Table 11. Effects of Different Levels of NGP on Feed Consumption of Redbro Chicken**

Levels of Natural Growth Promotants	Feed Consumption**
B <sub>1</sub> – 2 grams	4.29 <sub>b</sub>
B <sub>2</sub> – 4 grams	4.30 <sub>ab</sub>
B <sub>3</sub> – 6 grams	4.30 <sub>a</sub>

Means with the same letter are not significantly different.

### Feed Conversion Ratio (FCR)

The different levels of herbal plant infusion given to redbro chicken for a 45-day treatment presented in the table 12, manifest a feed conversion ratio that ranges from 1.45 to 1.53 %. Treatment B<sub>1</sub> obtains the best FCR (1.45%) while B<sub>2</sub> (1.53%) attains the least. This is further elaborated with the result of the analysis of variance indicating that there is a significant difference between and among the redbro chicken that received treatments B<sub>1</sub>, B<sub>2</sub> and B<sub>3</sub>.

The result of the study agrees of Gianenas *et al.* (2005) showed that broiler BW, daily BW gain, and FCR were improved in birds fed dehydrated oregano plant (5 g/kg) as a single supplement or in combination with  $\alpha$ -tocopheryl acetate. However, the effects of oregano at 5.0 and 7.5 g/kg were higher than those at 2.5 and 10.0g/kg of the diet. The present results also agreed by Al-sultan and Gameel (2004) observed that addition of turmeric meal at the rate of 5.0 g/kg increased body weight and feed conversion ratio of broiler chickens.

**Table 12. Effects of Different Levels of NGP on Feed Conversion Ratio of Redbro Chicken**

Levels of Natural Growth Promotants	Feed Conversion Ratio (FCR)*
B <sub>1</sub> – 2 grams	1.45 <sub>a</sub>
B <sub>2</sub> – 4 grams	1.53 <sub>c</sub>
B <sub>3</sub> – 6 grams	1.50 <sub>b</sub>

Means with the same letter are not significantly different.

### Effects of Different Levels of Natural Growth Promotants on Carcass Trait

Treatment B<sub>1</sub> (73.95%) achieving the highest dressing percentage, followed by B<sub>2</sub> (73.22%) and B<sub>3</sub> (72.76 %), respectively, result of the analysis of variance proves that there is no significant difference between and among the treatments B<sub>1</sub>, B<sub>2</sub> and B<sub>3</sub> given to the redbro chicken.

The result of present study corroborates Kafi, *et al.* (2017) they didn't find any significant differences in dressing percentages after using ginger and turmeric at 1.0 and 2.0 g/kg in broiler ration as feed additives. Contradictory to the results, Raghdad and Al-Jaleel (2012) used turmeric powder found dressing percentage significantly increased by using 0% to 1.5%.

Result on the analysis of variance on the leaf fat percentages discloses that there is no significant differences with 0.11% between and among the levels of herbal plant infusion, B<sub>1</sub> (given with 2G), B<sub>2</sub> (given with 4g) and B<sub>3</sub> (given with 6g) on the redbro chicken. Sugihart *et al.*, (2011) made similar findings that birds fed with different levels of turmeric extract had no effect on the relative weight of abdominal fat.

Table 13 revealed that there are no significant differences on the liver weight among the levels of herbal plant infusion given to redbro chicken. The result of the present study corroborates with the findings of Raguindin (2018) that 0.1% to 0.3% of herbal plant meal revealed no significant difference. Same findings by Aglipay and Rodriguez (2017) which stated that addition of different levels of herbal plants to broiler's ration showed no significant difference on the liver weight.

Result on the analysis of variance on the gizzard weight revealed that there are no significant differences with 0.06% between and among the levels of herbal plant infusion, B<sub>1</sub>, B<sub>2</sub> and B<sub>3</sub> on the redbro chicken. The result of the study agrees with the findings of Aglipay and Rodriguez (2017) that supplementation of different levels of herbal plant meals (lemon grass, oregano and turmeric) did not significantly improve the gizzard weight of broilers.

**Table 13. Effects of Different Levels of NGP on Carcass Trait of Redbro Chicken**

Levels of Natural Growth Promotants	Dressing Percentage (ns)	Leaf Fat Percentage (ns)	Liver Weight (ns)	Gizzard Weight (ns)
B <sub>1</sub> – 2 grams	73.95 <sub>a</sub>	0.11 <sub>a</sub>	0.08 <sub>a</sub>	0.06 <sub>a</sub>
B <sub>2</sub> – 4 grams	73.22 <sub>a</sub>	0.11 <sub>a</sub>	0.08 <sub>a</sub>	0.06 <sub>a</sub>
B <sub>3</sub> – 6 grams	72.76 <sub>a</sub>	0.11 <sub>a</sub>	0.08 <sub>a</sub>	0.06 <sub>a</sub>

Means with the same letter are not significantly different.

### Effect of Different Levels of NGP on the Profit above Feed, Medicine and Stock Cost

Table 14 shows by the analysis of variable which discloses that B<sub>2</sub> (4g) having the largest income with a mean of Php 99.03 is significantly differed to the redbro chicken fed with 2g (B<sub>1</sub>) which registers the lowest income with a mean of Php 85.66 but comparable to the redbro chicken fed with 6g (B<sub>3</sub>) with a mean of Php 91.79. This implies that 4g had significant effect on the profit.

## Sources and Levels of Natural Growth Promotants for Redbro Chicken

**Table 14. Profit above Feed, Medicine and Stock Cost as Affected by Different Levels of NGP on Redbro Chicken**

Levels of Natural Growth Promotants	Profit (Php)*
B <sub>1</sub> – 2 grams	85.66 <sub>b</sub>
B <sub>2</sub> – 4 grams	99.03 <sub>a</sub>
B <sub>3</sub> – 6 grams	91.79 <sub>ab</sub>

Means with the same letter are not significantly different.

### Interaction Effects of Different Sources and Levels of NGP on Growth Performance

#### Weight at 21 Days

The analysis of variance result showed that A<sub>3</sub>B<sub>2</sub> obtains the highest (0.68 kg) weight at 21 days which illustrates that it recorded a high level of significant difference from the redbro chicken of A<sub>1</sub>B<sub>1</sub>, A<sub>1</sub>B<sub>3</sub>, A<sub>2</sub>B<sub>1</sub> and A<sub>2</sub>B<sub>3</sub> having a mean that ranges from 0.59 to 0.63 kg. but similar to the redbro chickens of A<sub>1</sub>B<sub>2</sub>, A<sub>2</sub>B<sub>2</sub>, A<sub>3</sub>B<sub>1</sub> and A<sub>3</sub>B<sub>3</sub> garnering a mean that ranges from 0.64 to 0.66 kg.

**Table 15. Interaction Effects of Different Sources and Levels of NGP on the Weight of Redbro Chicken at 21 days.**

Sources x Levels of Natural Growth Promotants	Weight at 21 Days (kg)**
C-Control	0.63 <sub>bcd</sub>
A <sub>1</sub> B <sub>1</sub> – 2 grams Garlic	0.61 <sub>cd</sub>
A <sub>1</sub> B <sub>2</sub> – 4 grams Garlic	0.65 <sub>abc</sub>
A <sub>1</sub> B <sub>3</sub> – 6 grams Garlic	0.63 <sub>bcd</sub>
A <sub>2</sub> B <sub>1</sub> – 2 grams Oregano	0.59 <sub>d</sub>
A <sub>2</sub> B <sub>2</sub> – 4 grams Oregano	0.64 <sub>abc</sub>
A <sub>2</sub> B <sub>3</sub> – 6 grams Oregano	0.63 <sub>bcd</sub>
A <sub>3</sub> B <sub>1</sub> – 2 grams Turmeric	0.66 <sub>ab</sub>
A <sub>3</sub> B <sub>2</sub> – 4 grams Turmeric	0.68 <sub>a</sub>
A <sub>3</sub> B <sub>3</sub> – 6 grams Turmeric	0.66 <sub>ab</sub>

Means with the same letter are not significantly different.

The findings corroborate with the study of Raguindin (2018) that varying levels of lemon grass, oregano and yellow ginger significantly influenced the gain in weight of broilers. Also supported by the study of Aglipay and Rodriguez (2017) that the gain weight was significantly influenced by the interaction of different herbal plants at different levels.

#### Final Weight

As indicated in the table 16, the different mixture of concentrations derived from the different sources and different levels of natural growth promotants achieved a final weight mean rating of 1.69 kgs in which 4 g turmeric (A<sub>3</sub>B<sub>2</sub>) obtained the highest (1.57 kgs) final weight. The data gathered from the table also show that A<sub>3</sub>B<sub>2</sub> acquired a high significant difference to the redbro chicken of A<sub>1</sub>B<sub>1</sub> and A<sub>2</sub>B<sub>1</sub> which recorded a mean of 1.42 kgs., however, it is corresponding to the redbro chicken of A<sub>1</sub>B<sub>2</sub>, A<sub>1</sub>B<sub>3</sub>, A<sub>2</sub>B<sub>2</sub>, A<sub>2</sub>B<sub>3</sub>, A<sub>3</sub>B<sub>1</sub> and A<sub>3</sub>B<sub>3</sub> which receives a mean that ranges from 1.46 to 1.56 kgs.

**Table 16. Interaction Effects of Different Sources and Levels of NGP on the Final Weight of Redbro Chicken.**

Sources x Levels of Natural Growth Promotants	Final Weight (kg)**
C-Control	1.46 <sub>ab</sub>
A <sub>1</sub> B <sub>1</sub> – 2 grams Garlic	1.42 <sub>b</sub>
A <sub>1</sub> B <sub>2</sub> – 4 grams Garlic	1.50 <sub>ab</sub>
A <sub>1</sub> B <sub>3</sub> – 6 grams Garlic	1.48 <sub>ab</sub>
A <sub>2</sub> B <sub>1</sub> – 2 grams Oregano	1.42 <sub>b</sub>
A <sub>2</sub> B <sub>2</sub> – 4 grams Oregano	1.51 <sub>ab</sub>
A <sub>2</sub> B <sub>3</sub> – 6 grams Oregano	1.46 <sub>ab</sub>
A <sub>3</sub> B <sub>1</sub> – 2 grams Turmeric	1.51 <sub>ab</sub>
A <sub>3</sub> B <sub>2</sub> – 4 grams Turmeric	1.57 <sub>a</sub>
A <sub>3</sub> B <sub>3</sub> – 6 grams Turmeric	1.56 <sub>a</sub>

Means with the same letter are not significantly different.

The findings justified by Raguindin (2018) that significant result was observed on the final weight of broilers as affected by the combined supplementation of different growth promotants and different levels of herbal plant meal.

#### Gain Weight

Table 17 revealed that the redbro chicken's gain weight mean is 2.37 kgs. It shows that the redbro chicken that received 4g Turmeric (A<sub>3</sub>B<sub>2</sub>) and 6g Turmeric (A<sub>3</sub>B<sub>3</sub>) obtained the heaviest gain weight (1.48 kgs.) which registered a high significant difference between the redbro chicken of A<sub>1</sub>B<sub>1</sub> and A<sub>2</sub>B<sub>1</sub> with a gain weight of 1.35 kgs. but comparable to the redbro chicken of A<sub>1</sub>B<sub>2</sub>, A<sub>1</sub>B<sub>3</sub>, A<sub>2</sub>B<sub>2</sub>, A<sub>2</sub>B<sub>3</sub>, A<sub>3</sub>B<sub>1</sub> which ranges from 1.39 to 1.44 kgs.

**Table 17. Interaction Effects of Different Sources and Levels of NGP on the Gain in Weight of Redbro Chicken.**

Sources x Levels of Natural Growth Promotants	Gain Weight (kg)**
C-Control	1.39 <sub>ab</sub>
A <sub>1</sub> B <sub>1</sub> – 2 grams Garlic	1.35 <sub>b</sub>
A <sub>1</sub> B <sub>2</sub> – 4 grams Garlic	1.43 <sub>ab</sub>

## Sources and Levels of Natural Growth Promotants for Redbro Chicken

A <sub>1</sub> B <sub>3</sub> – 6 grams Garlic	1.40 <sub>ab</sub>
A <sub>2</sub> B <sub>1</sub> – 2 grams Oregano	1.35 <sub>b</sub>
A <sub>2</sub> B <sub>2</sub> – 4 grams Oregano	1.43 <sub>ab</sub>
A <sub>2</sub> B <sub>3</sub> – 6 grams Oregano	1.39 <sub>ab</sub>
A <sub>3</sub> B <sub>1</sub> – 2 grams Turmeric	1.44 <sub>ab</sub>
A <sub>3</sub> B <sub>2</sub> – 4 grams Turmeric	1.48 <sub>a</sub>
A <sub>3</sub> B <sub>3</sub> – 6 grams Turmeric	1.48 <sub>a</sub>

Means with the same letter are not significantly different.

The findings of the present study corroborate by Raguindin (2018) shows significant result was noted on gain in weight of broilers, it was observed that as the level of herbal plant meal added to yellow ginger increases, gain in weight also increases. It is also noted that broiler supplemented in the diet with oregano provide highest gain in weight. Aglipay and Rodriguez (2017) also agreed based on their findings that the gain in weight was significantly influenced by the interaction of herbal plants at different levels (1%, 2% and 3%).

### Feed Consumption

The mixture of treatments using the sources and levels of natural growth promotants shown in the table indicates that 6 g Turmeric (A<sub>3</sub>B<sub>3</sub>), 4g Turmeric (A<sub>3</sub>B<sub>2</sub>), 2g Turmeric (A<sub>3</sub>B<sub>1</sub>), 6g Oregano (A<sub>2</sub>B<sub>3</sub>), 4g Oregano (A<sub>2</sub>B<sub>2</sub>) and 6g Garlic (A<sub>1</sub>B<sub>3</sub>) consumed the highest (4.30 kgs) by the redbro chicken. Analysis of variance also discloses that there is a high significant difference on feed consumption between A<sub>3</sub>B<sub>3</sub> and A<sub>2</sub>B<sub>1</sub> and A<sub>3</sub>B<sub>3</sub> and A<sub>1</sub>B<sub>1</sub> which consumes 4.28 and 4.29 kgs, respectively. On the other hand, A<sub>3</sub>B<sub>3</sub> is comparable with the redbro chicken which consumed treatments, A<sub>1</sub>B<sub>2</sub>, A<sub>1</sub>B<sub>3</sub>, A<sub>2</sub>B<sub>2</sub>, A<sub>2</sub>B<sub>3</sub>, A<sub>3</sub>B<sub>1</sub> and A<sub>3</sub>B<sub>2</sub>.

The present result agrees in the findings of Wang *et al.*, (2015) that dietary turmeric rhizome extract (TRE) supplementation had a significant effect (P<0.05) on the average daily feed intake of birds throughout the trial period.

**Table 18. Interaction Effects of Different Sources and Levels of NGP on Feed Consumption of Redbro Chicken.**

Sources x Levels of Natural Growth Promotants	Feed Consumption**
C -Control	4.30 <sub>ab</sub>
A <sub>1</sub> B <sub>1</sub> – 2 grams Garlic	4.29 <sub>bc</sub>
A <sub>1</sub> B <sub>2</sub> – 4 grams Garlic	4.29 <sub>abc</sub>
A <sub>1</sub> B <sub>3</sub> – 6 grams Garlic	4.30 <sub>ab</sub>
A <sub>2</sub> B <sub>1</sub> – 2 grams Oregano	4.28 <sub>c</sub>
A <sub>2</sub> B <sub>2</sub> – 4 grams Oregano	4.30 <sub>ab</sub>
A <sub>2</sub> B <sub>3</sub> – 6 grams Oregano	4.30 <sub>ab</sub>
A <sub>3</sub> B <sub>1</sub> – 2 grams Turmeric	4.30 <sub>ab</sub>
A <sub>3</sub> B <sub>2</sub> – 4 grams Turmeric	4.30 <sub>ab</sub>
A <sub>3</sub> B <sub>3</sub> – 6 grams Turmeric	4.30 <sub>ab</sub>

Means with the same letter are not significantly different.

### Feed Conversion Ratio (FCR)

The redbro chicken which consumes A<sub>1</sub>B<sub>1</sub> (given with 2g Garlic) and A<sub>2</sub>B<sub>1</sub> (given with 2g Oregano) convert weight (1.42 %) the most efficient with a high significant difference between the redbro chicken of A<sub>3</sub>B<sub>3</sub> and A<sub>3</sub>B<sub>2</sub> which ranges from 1.56 to 1.57% but comparable with the redbro chicken of A<sub>1</sub>B<sub>2</sub>, A<sub>1</sub>B<sub>3</sub>, A<sub>2</sub>B<sub>2</sub>, A<sub>2</sub>B<sub>3</sub>, and A<sub>3</sub>B<sub>1</sub> spanning from 1.46 to 1.52 %.

The results justify on the findings of Akyildiz and Denli (2016) and Yarru *et al.*, (2009) that the addition of garlic or turmeric powder at 0.5% to chickens' diet, can improve of broiler growth and feed conversion ratio (FCR) and decreased mortality rate. The improvement in yield may be related to the presence of various important alkaloids that have a positive effect on the health of broilers Krauze (2021).

**Table 19. Interaction Effects of Different Sources and Levels of NGP on Feed Conversion Ratio of Redbro Chicken.**

Sources x Levels of Natural Growth Promotants	Feed Conversion Ratio (FCR)**
C -Control	1.46 <sub>ab</sub>
A <sub>1</sub> B <sub>1</sub> – 2 grams Garlic	1.42 <sub>a</sub>
A <sub>1</sub> B <sub>2</sub> – 4 grams Garlic	1.50 <sub>abc</sub>
A <sub>1</sub> B <sub>3</sub> – 6 grams Garlic	1.48 <sub>abc</sub>
A <sub>2</sub> B <sub>1</sub> – 2 grams Oregano	1.42 <sub>a</sub>
A <sub>2</sub> B <sub>2</sub> – 4 grams Oregano	1.51 <sub>abc</sub>
A <sub>2</sub> B <sub>3</sub> – 6 grams Oregano	1.46 <sub>ab</sub>
A <sub>3</sub> B <sub>1</sub> – 2 grams Turmeric	1.52 <sub>abc</sub>
A <sub>3</sub> B <sub>2</sub> – 4 grams Turmeric	1.57 <sub>c</sub>
A <sub>3</sub> B <sub>3</sub> – 6 grams Turmeric	1.56 <sub>bc</sub>

Means with the same letter are not significantly different.

### Interaction Effects of Different Sources and Levels of NGP on Carcass Traits

Result of the analysis of variance reveals that there are no significant differences between and among the treatments given to the redbro chicken's dressing percentage. The results also agreed by Raguindin (2018) that there is no significant interaction observed on the dressing percentage of broilers as affected by the interaction of different sources and levels on growth promotants. The result is also the same on the findings of Zomrawi, *et al.*, (2012) that there is no significant differences were noted among the broilers fed with varying levels of ginger powder from 0% to 1.5% in the dressing percentage.

## Sources and Levels of Natural Growth Promotants for Redbro Chicken

The percent leaf fat of redbro chicken as affected by the interaction of different sources of natural growth promotants at different levels obtained 0.11g. No significant interaction effect was observed. This claim agrees with the findings of Rodriguez (2016), as cited by Aglipay and Rodriguez (2017) that different levels of turmeric powder from 1% to 3% as supplement to broilers significantly lowered the percent leaf fat.

**Table 20. Interaction Effects of Different Sources and Levels on Carcass Trait of Redbro Chicken**

Sources x Levels of Natural Growth Promotants	Dressing Percentage (ns)	Leaf Percentage (ns)	Fat (ns)	Liver Weight (ns)	Gizzard Weight (ns)
C-Control	73.44	0.11		0.08	0.06
A <sub>1</sub> B <sub>1</sub> – 2 grams Garlic	73.22	0.11		0.08	0.06
A <sub>1</sub> B <sub>2</sub> – 4 grams Garlic	73.84	0.11		0.08	0.06
A <sub>1</sub> B <sub>3</sub> – 6 grams Garlic	73.42	0.11		0.08	0.06
A <sub>2</sub> B <sub>1</sub> – 2 grams Oregano	74.73	0.11		0.08	0.06
A <sub>2</sub> B <sub>2</sub> – 4 grams Oregano	73.61	0.11		0.08	0.06
A <sub>2</sub> B <sub>3</sub> – 6 grams Oregano	72.39	0.11		0.08	0.06
A <sub>3</sub> B <sub>1</sub> – 2 grams Turmeric	73.90	0.11		0.08	0.06
A <sub>3</sub> B <sub>2</sub> – 4 grams Turmeric	72.22	0.11		0.08	0.06
A <sub>3</sub> B <sub>3</sub> – 6 grams Turmeric	72.47	0.11		0.08	0.06

The liver weight of redbro chicken as affected by the interaction of different sources and levels of natural growth promotants obtained 0.08g. Insignificant interaction effect was observed on the liver weight of experimental chicken. This implies that interaction of different sources at different levels of natural growth promotants did not significantly improve the liver weight of redbro chicken.

The gizzard weight of redbro chicken as affected by the interaction of different sources at different levels of natural growth promotants obtained 0.06 g. No significant interaction effect was noted. This implies that the different sources of natural growth promotants at any level (2g, 4g, 6g) did not significantly influence the gizzard weight of redbro chicken. This agrees to the findings of the study of Raguindin (2018) that the broiler fed with different sources and levels of herbal plant meal did not significantly affect the gizzard weight of chicken. Same findings by Hernandez *et al.*, (2004) which states the gizzard weight of the experimental broilers is insignificantly influenced by oregano extracts.

### Interaction Effects of Different Sources and Levels of NGP on the Profit above Feed, Medicine and Stock Cost

As observed in the Table 21, the overall mean of the income generated by selling the redbro chicken was Php 542.43. Moreover, a high coefficient of variation (7.77) indicates that the means of income generated by selling the redbro chicken after a 45-day treatment varied. This was indicated by the high significant outcome wherein redbro chicken fed with A<sub>3</sub>B<sub>2</sub> (4g Turmeric) gains the highest net income with a mean of Php 637.50 which differed to the redbro chicken fed with A<sub>1</sub>B<sub>1</sub>, A<sub>1</sub>B<sub>3</sub> and A<sub>2</sub>B<sub>1</sub> with means ranges from Php 465.17 to Php 509.33.

The result of the study corroborates the findings of Raguindin (2018) that the interaction of the different sources of natural growth promotants and different levels of herbal plant meal significantly affected the profit above feeds, medicines and stock costs.

**Table 21. Profit above Feed, Medicine and Stock Cost as Affected by the Interaction of Different Levels of NGP on Redbro Chicken**

Sources x Levels of Natural Growth Promotants	Profit (Php)**
C-Control	75.07 <sub>e</sub>
A <sub>1</sub> B <sub>1</sub> – 2 grams Garlic	77.57 <sub>de</sub>
A <sub>1</sub> B <sub>2</sub> – 4 grams Garlic	92.48 <sub>abcde</sub>
A <sub>1</sub> B <sub>3</sub> – 6 grams Garlic	84.88 <sub>bcde</sub>
A <sub>2</sub> B <sub>1</sub> – 2 grams Oregano	81.23 <sub>cde</sub>
A <sub>2</sub> B <sub>2</sub> – 4 grams Oregano	97.86 <sub>abcd</sub>
A <sub>2</sub> B <sub>3</sub> – 6 grams Oregano	88.25 <sub>abcde</sub>
A <sub>3</sub> B <sub>1</sub> – 2 grams Turmeric	98.23 <sub>abc</sub>
A <sub>3</sub> B <sub>2</sub> – 4 grams Turmeric	106.25 <sub>a</sub>
A <sub>3</sub> B <sub>3</sub> – 6 grams Turmeric	102.23 <sub>ab</sub>

Means with the same letter are not significantly different.

### Sensory Traits and Acceptability of Steamed Meat Samples

**Juiciness.** The use of the different treatment combinations, sources of natural plant growth promotants and levels of herbal tea fed to the redbro chicken was observed in table 6. The juiciness acceptability values ranged from 3.67 to 5.00 with an overall response of 4.33 which was appraised as “very much acceptable”. Analysis of variance results reveal that there was no significant differences between and among redbro chicken wherein those that were fed with 4 g Turmeric (A<sub>3</sub>B<sub>2</sub>) and 6 g Turmeric (A<sub>3</sub>B<sub>3</sub>) obtains the highest juiciness acceptability score (5.00) which is “very much acceptable”, whereas, redbro chicken fed with 2 mg Oregano (A<sub>2</sub>B<sub>1</sub>) attains the lowest (3.67) which is “much acceptable” in the Likert Scale. In terms of juiciness acceptability, treatment combinations, A<sub>1</sub>B<sub>1</sub>, A<sub>1</sub>B<sub>2</sub>, A<sub>1</sub>B<sub>3</sub>, A<sub>2</sub>B<sub>2</sub>, A<sub>2</sub>B<sub>3</sub>, A<sub>3</sub>B<sub>1</sub>, garnered a score that ranges from 4.00 to 4.67 which is “very much acceptable”. This may imply that the treatment combinations that were given to the redbro chicken produces juiciness that were comparatively acceptable to the consumers’ panel.

**Texture.** As presented in table 9, the mean score of the texture acceptability of the treatments fed to the redbro chicken ranges from 4.00 to 4.67 with an overall surface mean of 4.37 evaluated as “very much acceptable”. This suggests that the treatment combinations fed to the redbro chicken did not show any difference wherein those that were given 6 g Garlic (A<sub>1</sub>B<sub>3</sub>), 6 g Oregano (A<sub>2</sub>B<sub>3</sub>), 4 g Turmeric (A<sub>2</sub>B<sub>3</sub>) in a 45-day treatment received a mean score of 4.67 which was described as “very much acceptable”, but redbro chicken fed with 4 g Oregano (A<sub>2</sub>B<sub>2</sub>) registered the lowest mean score of 4.00 which was evaluated as “much acceptable”. Other Treatment combinations that were introduced to the redbro chicken, 2 g Garlic (A<sub>1</sub>B<sub>1</sub>), 4 g Garlic (A<sub>1</sub>B<sub>2</sub>), 2 g Oregano (A<sub>2</sub>B<sub>1</sub>), 2 g Turmeric (A<sub>3</sub>B<sub>1</sub>) and 6 g Turmeric (A<sub>3</sub>B<sub>3</sub>) registered a mean score of 4.33 which

## Sources and Levels of Natural Growth Promotants for Redbro Chicken

was appraised as “very much acceptable”. This means that the treatment combinations fed to the redbro chicken has desirable and acceptable texture to the consumers.

**Taste.** As indicated in the table, the different treatment combinations given to the redbro chicken in a 45-day rearing did not significantly affect the taste acceptability with the highest mean of 5.00 appraised as “very much acceptable” obtained by those fed with 2 g Garlic, 4 g Garlic, 6 g Garlic and 6 g Turmeric. On the other hand, redbro chicken fed with A<sub>2</sub>B<sub>2</sub> (4 g Oregano) and A<sub>2</sub>B<sub>3</sub> (6 g Oregano) obtained the lowest mean score of 4.00 assessed as “much acceptable”. Other treatment combinations, A<sub>2</sub>B<sub>1</sub>, A<sub>3</sub>B<sub>1</sub> and A<sub>3</sub>B<sub>2</sub> had a mean score that ranged from 4.33 to 4.37 which was interpreted as “very much acceptable”. The overall mean responses was 4.60 and was dubbed as “very much acceptable”. This indicates that the taste acceptability as evaluated by the consumers was reasonably acceptable.

**Table 22. Sensory traits and acceptability of the steamed meat samples from the different treatment combinations.**

Treatments	Juiciness	Texture	Taste	Aroma	General Acceptability
C – Control	3.67 <sub>ma</sub>	4.00 <sub>ma</sub>	4.33 <sub>vma</sub>	3.67 <sub>ma</sub>	4.00 <sub>ma</sub>
A <sub>1</sub> B <sub>1</sub> -2 g Garlic	4.33 <sub>vma</sub>	4.33 <sub>vma</sub>	5.00 <sub>vma</sub>	5.00 <sub>vma</sub>	4.67 <sub>vma</sub>
A <sub>1</sub> B <sub>2</sub> -4 g Garlic	4.33 <sub>vma</sub>	4.33 <sub>vma</sub>	5.00 <sub>vma</sub>	5.00 <sub>vma</sub>	4.33 <sub>vma</sub>
A <sub>1</sub> B <sub>3</sub> -6 g Garlic	4.67 <sub>vma</sub>	4.67 <sub>vma</sub>	5.00 <sub>vma</sub>	5.00 <sub>vma</sub>	5.00 <sub>vma</sub>
A <sub>2</sub> B <sub>1</sub> -2 g Oregano	3.67 <sub>ma</sub>	4.33 <sub>vma</sub>	4.67 <sub>vma</sub>	4.33 <sub>ma</sub>	4.00 <sub>ma</sub>
A <sub>2</sub> B <sub>2</sub> -4 g Oregano	4.33 <sub>vma</sub>	4.00 <sub>ma</sub>	4.00 <sub>ma</sub>	4.67 <sub>ma</sub>	4.33 <sub>vma</sub>
A <sub>2</sub> B <sub>3</sub> -6 g Oregano	4.33 <sub>vma</sub>	4.67 <sub>vma</sub>	4.00 <sub>ma</sub>	4.33 <sub>ma</sub>	4.67 <sub>vma</sub>
A <sub>3</sub> B <sub>1</sub> -2 g Turmeric	4.00 <sub>ma</sub>	4.33 <sub>vma</sub>	4.33 <sub>vma</sub>	4.00 <sub>ma</sub>	5.00 <sub>vma</sub>
A <sub>3</sub> B <sub>2</sub> -4 g Turmeric	5.00 <sub>vma</sub>	4.67 <sub>vma</sub>	4.67 <sub>vma</sub>	5.00 <sub>vma</sub>	4.67 <sub>vma</sub>
A <sub>3</sub> B <sub>3</sub> -6 g Turmeric	5.00 <sub>vma</sub>	4.33 <sub>vma</sub>	5.00 <sub>vma</sub>	5.00 <sub>vma</sub>	5.00 <sub>vma</sub>

Legend: 4.1-5.0 - Very much acceptable

3.1-4.0 - Much acceptable

2.1-3.0 - Moderately acceptable

1.1-2.0 - Less acceptable

0.1-1.0 - Unacceptable

**Aroma.** As presented in the table, the redbro chicken that were tended with the different treatment combinations had a mean which ranges from 4.00 to 5.00 with an overall response mean of 4.60 appraised as “very much acceptable”. Results in the table also disclose that there was a high significant result to the treatment combinations which affected the aroma acceptability wherein A<sub>1</sub>B<sub>1</sub>, A<sub>1</sub>B<sub>2</sub>, A<sub>1</sub>B<sub>3</sub>, A<sub>3</sub>B<sub>2</sub> and A<sub>3</sub>B<sub>3</sub> obtained the highest mean of 5.00 evaluated as “very much acceptable” but comparable to the redbro chicken of A<sub>2</sub>B<sub>1</sub>, A<sub>2</sub>B<sub>2</sub>, A<sub>2</sub>B<sub>3</sub> and A<sub>3</sub>B<sub>1</sub> which attained means which ranges from 4.00 to 4.67 described as “much acceptable and very much acceptable”, respectively.

**General Acceptability.** The table reveals that the different treatment concentrations did not significantly affect the general acceptability of the redbro chicken with means that ranges from 4.33 to 5.00 wherein the overall mean of the responses was 4.57. On the other hand, redbro chicken reared with 6 g Garlic, 2 g Turmeric and 6 g Turmeric achieved the highest acceptability with a mean of 5.00 whereas those that were fed with 2 g Oregano registered the lowest acceptability with a mean of 4.00. Other treatment combinations, A<sub>1</sub>B<sub>1</sub> (2 g Garlic), A<sub>1</sub>B<sub>2</sub> (4 g Garlic), A<sub>2</sub>B<sub>2</sub> (4 g Oregano), A<sub>2</sub>B<sub>3</sub> (6 g Oregano) and A<sub>3</sub>B<sub>2</sub> (4 g Turmeric) attained a mean score which ranges from 4.33 to 4.67. All the mean scores of general acceptability were evaluated as “very much acceptable” which suggests that the outcomes of the exposure of the redbro chicken to the treatment combinations were sensibly acceptable to the consumers.

### Other Observations

During the conduct of the study no mortality rate and no incidence of any disease was observed among all the experimental birds. Redbro chicken also showed heavy weight and during the testing of meat samples it was observed that it contains a lot of oils/fats.

During the whole duration of the study, no flies and other insects were attracted to the chicken dung.

## SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

### Summary

This study was conducted at Mabilbila Sur, Santa, Ilocos Sur from January 12, 2021 to February 28, 2021. The study laid out in a Strip-Split Plot Design. The research design was used to determine the significant difference between sources and levels of natural growth promotants and their interactions on the growth performance, carcass trait, profit and sensory traits. A total of 180 heads day-old chicks were distributed into nine treatments (6 chicken/pen) including one floating control replicated thrice.

The following are the salient findings of the study:

1. The heaviest weight at 21 days, final and gain weights of the redbro chicken was achieved by those fed with Turmeric (A<sub>3</sub>) 0.63 kg, 1.55 kgs and 1.47 kgs, respectively. The least amount of consumed feeds were achieved by both A<sub>1</sub> (Garlic) and A<sub>2</sub> (Oregano) with 4.29 kgs. Moreover, the most efficient redbro chicken in converting the feeds they consumed to carcass were seen from those with the lowest FCR such as the redbro chicken given with both A<sub>1</sub> and A<sub>2</sub> with 1.47%. The highest dressing percentage was registered by A<sub>2</sub> with 73.58 %. Leaf fat percentage, liver weight and gizzard weight obtained the same result in all sources with 0.11g, 0.08g and 0.06g, respectively. The highest profit above feed, medicine and stock cost was administered by those received with A<sub>3</sub> with Php 102.24 per redbro chicken.

2. In terms of the levels of herbal plant infusion, the weight at 21 days, final and gain weights was obtained the heaviest by the redbro chicken fed with B<sub>2</sub> (4 g) with 0.66 kg, 1.53 kgs and 1.45 respectively. The least amount of consumed feeds were achieved by B<sub>1</sub> with 4.29 kgs. The most efficient redbro chicken in converting the feeds they consumed to carcass were observed from those with the lowest FCR such as the redbro chicken received with B<sub>1</sub> with 1.45%. The highest dressing percentage was attained by B<sub>1</sub> with 73.95%. The leaf fat percentage, liver weight and gizzard weight obtained the same result in all levels with 0.11g, 0.08g and 0.06g, respectively. The highest profit above feed was administered by those fed with B<sub>2</sub> with Php 99.03 per redbro chicken.

3. The heaviest weight at 21 days and final weight of the redbro chicken was achieved by those fed with A<sub>3</sub>B<sub>2</sub> (4 g Turmeric) 0.68 kg and 1.57 kgs, respectively. Heaviest gain weight both fed with A<sub>3</sub>B<sub>2</sub> (4 g Turmeric) and A<sub>3</sub>B<sub>3</sub> (6 g Turmeric), respectively, with 1.48 kgs. The least amount of consumed feeds were obtained by A<sub>2</sub>B<sub>1</sub> (2 g Oregano) with 4.28 kg. Additionally, the most efficient redbro chicken in converting the feeds they consumed to carcass were seen from those with the lowest FCR such as the redbro chicken given with both A<sub>1</sub>B<sub>1</sub> (2 g Garlic) and A<sub>2</sub>B<sub>1</sub> (2 g



## Sources and Levels of Natural Growth Promotants for Redbro Chicken

Oregano) with 1.42%. The highest dressing percentage was gained by A<sub>2</sub>B<sub>1</sub> (2 g Oregano) with 74.73%. The leaf fat percentage, liver weight and gizzard weight on the interaction of different sources and different levels of natural growth promotants revealed equal result with 0.11g, 0.08 g and 0.06, respectively. The highest profit above feed was administered by those fed with A<sub>3</sub>B<sub>2</sub> (4g Turmeric) with Php 106.25 per redbro chicken.

4. The sensory traits and acceptability of the steamed meat samples from the different treatment combinations in terms of juiciness, texture, taste, aroma and general acceptability with means 4.33, 4.37, 4.60, 4.60, and 4.57 as evaluated by the consumers' panel indicate a "very much acceptable" level.

### CONCLUSIONS

Based on the result of the study, the following conclusions were derived:

1. The source of natural growth promotants, in which both Garlic and Oregano are used in the growth performance of redbro chickens increase the efficiency of converting feeds into carcass and higher feed consumption, wherein the latter enable better dressing percentage. However, Turmeric enhances heaviest weight and delivers highest profit.

2. The utilization of 4 grams of natural growth promotants result to better growth performance of redbro chickens such as heaviest weight, highest feed consumed and thus, highest profit. 2 grams revealed the best feed conversion and highest dressing percentage

3. Supplementation with treatment combinations given to the redbro chicken with 4 grams Turmeric gave the heaviest gain weights which result in highest profit above feed at the same time. Lowest leaf fat and dressing percentages attained when supplemented with 4 grams turmeric, but 2 grams Garlic and Oregano were the most efficient feed conversion.

4. The steamed meat samples from the different treatment combinations in terms of juiciness, texture, taste, aroma and general acceptability as evaluated by consumers bear a "very much acceptable".

### RECOMMENDATIONS

Based on the conclusions, the following are hereby recommended:

1. The use of Turmeric (A<sub>3</sub>) for broiler production is recommended

2. For better growth performance, 4 grams (B<sub>2</sub>) of herbal plant infusion is recommended.

3. In terms of treatment combinations, 4 grams Turmeric (A<sub>3</sub>B<sub>2</sub>) is recommended to achieve and enhance growth performance of redbro.

4. Six grams (A<sub>3</sub>B<sub>2</sub>) is recommended in terms of acceptability of steamed meat.

### REFERENCES

- 1) Aarti C., Khusro A. (2020). Role of garlic (*Allium sativum*) as feed supplements in poultry industries: An overview. *Worlds News of Natural Sciences* 29(3), 151-161.
- 2) Aglipay, M. & Rodriguez C.M. (2017). Selected Herbal Plants as Feed Supplement for Broilers. Unpublished MS Thesis. Don Mariano Marcos Memorial State University. College of Graduate Studies. North La Union Campus.
- 3) Akbarian, A., Golian A., Kermanshahi H., Gilani A. & Moradi S. (2012). Influence of Turmeric Rhizome and Black Pepper on Blood Constituents and Performance of Broiler Chickens. *African Journal of Biotechnology*.
- 4) Alagawany M., Abd El-Hack M.E., Farag M.R., Shaheen H.M., Abdel-Latif M.A., Noreldin A.E., Patra A.K. (2019). The usefulness of oregano and its derivatives in poultry nutrition. *World's Poultry Science Journal*.
- 5) Al-Jaleel R.A. (2012). Use of turmeric (*Curcuma longa*) on the performance and some physiological traits on the broiler diets. *The Iraqi Journal of Veterinary Medicine*.
- 6) Al-Mashhadani H.E. (2015). Effect of Different Levels of Turmeric (*Curcuma longa*) Supplementation on Broiler Performance, Carcass Characteristics and Bacterial Count. *Animal Resource Dept., College of Agriculture, University of Baghdad, Baghdad, Iraq. IRAQI Academic Scientific Journals*.
- 7) Al Sultan S.I. (2013). The Effect of *Curcuma longa* (turmeric) on overall performance of broiler chickens. *Journal of Veterinary Science*.
- 8) Attia G., El-Eraky W., Hassanein E., El-Gamal M., Farahat M. & Hernandez-Santana A. (2017). Effect of Dietary Inclusion of a Plant Extract Blend on Broiler Growth Performance, Nutrient Digestibility, Caecal Microflora and Intestinal Histomorphology. *International Journal of Poultry Science*. Accessed from <http://docsdrive.com/pdfs/ansinet/ijps/2017/344-353.pdf> on January 18, 2022
- 9) Attia, Youssef A. (2016). Turmeric (*Curcuma longa* Linn.) as a phytogetic growth promoter alternative for antibiotic and comparable to mannan oligosaccharides for broiler chicks. Retrieved from <http://cienciaspecuarias.inifap.gob.mx/index.php/Pecurias/article/view/4309> on February 8, 2022.
- 10) Bayan L., Koulivand P.H, Gorji A. (2014). Garlic: A Review of Potential Therapeutic Effects. *Avicenna J Phytomed*. 2014 Jan-Feb;4(1):1-14. PMID: 25050296
- 11) Castillo-Lopez R.I., Gutierrez-Grijalva E.P., Leyva-Lopez N., Lopez-Martinez L.X. and Heredia J.B. (2017). Natural alternatives to growthpromoting antibiotics (GPA) in animal production. *The Journal of Animal and Plant Sciences*, 27(2):2017, Page: 349-359 ISSN: 1018-7081
- 12) Cheng G., Hao H., Yuan Z. (2014). Antibiotic alternatives: the substitution of antibiotics in animal husbandry? 2014;5:217. DOI. 10.3389/fmicb.2014.00217
- 13) Dingfa Wang, et al. (2016). Effects of Dietary Supplementation with Turmeric Rhizome Extract on Growth Performance, Carcass Characteristics, Antioxidant Capability, and Meat Quality of Wenchang Broiler Chickens.
- 14) Doley, S., Gupta J.J. & Reddy P.B. (2009). Effect of Supplementation of ginger, garlic and turmeric in broiler chicken. *Indian Vet. J*. Access from <https://www.cabdirect/abstract/20093186251> on February 28, 2022.
- 15) Durrani F.R., Mohammed I., Asal S., Shhail S.M., Naila C., Durrani Z. (2006). Effect of different levels of feed added turmeric (*Curcuma longa*) on the performance of broiler chicks. *J. Agr. Biol. Sci.* 1:9-11.
- 16) Edens, F.W. (2003). An alternative for antibiotics use in poultry; probiotics. *Revista Brasileira de Ciencia Avicola* Vol. 5 No. 2 Campinas May/Aug. 2003. Retrieved from <http://dx.doi.org/10.1590/S1516-635X2003000200001> on April 1, 2022.
- 17) Eltazi, S.M.A., Mohamed K.A., Mukhtar M.A. (2014). Effect of using garlic powder as natural feed additive on performance and carcass quality of broiler chicks. *Assiut Veterinary Medical Journal* 60:45-53.
- 18) Emadi, M. & Kermanshahi, H. (2006). Effect of turmeric rhizome powder on performance and carcass characteristics of broiler chickens. *International Journal of Poultry Science*. Retrieved from <https://scialert.net/abstarct/?doi=ijps.2006.1069.1072>

## Sources and Levels of Natural Growth Promotants for Redbro Chicken

- 19) Engberg R.M., Hedemann M.S., Leser T.D., Jensen B.B. (2000). Effect of zinc bacitracin and salinomycin on intestinal microflora and performance of broiler. *Poult Sci*, 79(2000), pp. 1311-1319
- 20) Forgetta V., Rempel H., Malouin F., Vaillancourt R. Jr., Topp E., Dewar K. (2012). Pathogenic and multidrug-resistant *Escherichia fergusonii* from broiler chicken. *Poult Sci*, 91(2012), pp. 512-525
- 21) Gadde U., Kim W.H., Oh S.T., Lillehoj H.S. (2017). Alternatives to antibiotics for maximizing growth performance and feed efficiency in poultry: a review. *Anim Health Res Rev* 18:26-45.
- 22) Giannenas I, Tzora A, Sarakatsianos I., Karamoutsios A., Skoufos S., Papaioannou N., Anastasiou I., Skoufos I. (2016). The Effectiveness of the use of oregano and laurel essential oils in chickens' feeding, *Annals of Animal Science*, DOI:10.1515/aoas-2015-0099
- 23) Hegde K, Haniadka R., Alva A., Reriera-Colaco M.M., Baliga M.S. (2013). Turmeric (*Curcuma longa* L.) the Golden Curry Spice as a Nontoxic Gastroprotective Agent: A review. *Bioactive Food as Dietary Interventions for Liver and Gastrointestinal Disease*.
- 24) Hosseini-Vashan, S.J., Goilian A., Yaghoobar A., Zarban A., Afzali N. & Esmaeilinasab P. (2012). Antioxidant status, immune system, blood metabolites and carcass characteristic of broiler chickens fed turmeric rhizome powder under heat stress. *Afr. J. Biotech.*11(94): 16118-16125.
- 25) Hussein, Salih. N. (2013). Effect of Turmeric (*Curcuma longa*) powder on growth performance, carcass traits, meat quality, and serum biochemical parameter in broilers. Retrieved from <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.887.1905&rep=rep1&type=pdf> on March 1, 2022.
- 26) Isroli, T. Yudiarta, Widiastuti E., Sugiharto S. (2017). Effect of decocted turmeric on performance, hematological parameters and carcass traits of broiler chickens. *Journal of the Indonesian Tropical Animal Agriculture* 42(4):263 DOI:10.14710/jitaa.42.4.263-269
- 27) Jamroz, D., Orda J., Kamel C., Wiliczekiewicz A., Wartelecki T. and Skorupinska J. (2003). The influence of phytochemical extracts on performance, nutrients digestibility, carcass characteristics, and gut microbial status in broiler chickens. *J. Anim. Feed Sci.* 12:583-596.
- 28) Jurenka J. (2009). Anti-Inflammatory Properties of Curcumin, a major Constituent of *Curcuma longa*: A Review of Preclinical and Clinical Research. *Alternative Medicine Review*.
- 29) Kothari D., Lee W-D., Niu K-M., Kim S.K. (2019). The Genus *Allium* as Poultry Feed Additive: A Review. *Animals* 2019, 9, 1032.
- 30) Kafi, A., Uddin M.N., Uddin M.J., Khan M.M.H. & Haque M.E. (2017). Effect of Dietary Supplementation of Turmeric (*Curcuma longa*), Ginger (*Zingiber officinale*) and their Combination as Feed Additives on Feed Intake, Growth Performance and Economics of Broiler. *International Journal of Poultry Science*, 16: 257-265
- 31) Labay, Marlyn H., Carmencita Mateo & Jezie A. Acorda. (2003). Comparative Evaluation of Oregano Extract and Zinc Bacitracin as Growth Enhancer for Broilers. *Philippine Journal of Veterinary and Animal Sciences*. June 2003. Vol.29 No.1
- 32) Lillehoj H., Liu Y., Calsamiglia S. et al. Phytochemicals as antibiotic alternatives to promote growth and enhance host health. *Vet Res* 49, 76 (2018).
- 33) Lambert R.J.W, Skandamia P.N., Coote P.J., & Nychas G.J.E.. (2001). A study of the minimum inhibitory concentration and mode of action of oregano essential oil, thymol and carvacrol. *Journal of Applied Microbiology*.
- 34) Link R., MS, RD. 6 Science-Based Health Benefits of Oregano. October 27, 2017
- 35) Madigan M.T., Martinko J.M., Bender K.S., Buckley F.H., Stahl D.A. *Brock Biology of Microorganisms*. 14<sup>th</sup> ed. Illinois: Pearson International; 2014. P. 1006
- 36) Mahesh M.G., Prabhakar Bhandary Y. (2018). Natural antibiotic effect of turmeric in poultry management. *Int J Poul Fish Sci.*2(2):1-2. DOI:10.15226/2578-1898/2/2/00109
- 37) Marshall B.M., Levy S.B. (2011). Food animals and antimicrobials: Impacts on human health. *Clinical Microbiology Reviews*. 2011;24:718-733
- 38) Masuda T., Maekawa T., Hidaka K., Bando H., Takeda Y., Yamaguchi H. (2001). Chemical studies on antioxidant mechanism of curcumin: Analysis of oxidative coupling products from curcumin and linoleate. *J Agric Food Chem*. 2001;49(5):2539-2547.
- 39) Mehala C., & Moorthy M. (2008). Effect of Aloe vera and *Curcuma longa* (turmeric) on carcass characteristics and biochemical parameters of broilers. *International Journal of Poultry Science*.
- 40) Mondal, M.A., Yeasmin T., Karim R. & Siddiky M.N.A. (2015). Effect of Dietary Supplementation of Turmeric (*Curcuma longa*) powder on the growth performance and carcass traits of broilers. Accessed from [https://www.researchgate.net/publication/281452200\\_Effect\\_of\\_dietary\\_supplementation\\_of\\_turmeric\\_Curcuma\\_longa\\_powder\\_on\\_the\\_growth\\_performance\\_and\\_carcass\\_traits\\_of\\_broilers\\_chicks](https://www.researchgate.net/publication/281452200_Effect_of_dietary_supplementation_of_turmeric_Curcuma_longa_powder_on_the_growth_performance_and_carcass_traits_of_broilers_chicks) on March 1, 2022.
- 41) Noguera, (2017). Lemon grass essential oil on productive characteristics of broiler chickens. Accessed from [http://www.researchgate.net/publication/318088014\\_Lemon\\_grass\\_essential\\_oil\\_on\\_productive\\_characteristics\\_of\\_broiler\\_chickens](http://www.researchgate.net/publication/318088014_Lemon_grass_essential_oil_on_productive_characteristics_of_broiler_chickens) on March 1, 2022.
- 42) Nouzarian, R. et al. (2011). Effect of turmeric powder on performance, carcass traits, humoral immune responses, and serum metabolites in broiler chickens. Accessed from [https://www.researchgate.net/publication/2645564\\_Effect\\_of\\_turmeric\\_powder\\_on\\_performance\\_carcass\\_traits\\_humoral\\_immune\\_responses\\_and\\_serum\\_metabolites\\_in\\_broiler\\_chickens](https://www.researchgate.net/publication/2645564_Effect_of_turmeric_powder_on_performance_carcass_traits_humoral_immune_responses_and_serum_metabolites_in_broiler_chickens) on March 1, 2022.
- 43) Oliveros, M.C., Batungbacal M.R., Roxas N.P, Sevilla C.C. & Acda S.P. (2006). Performance of Broiler Chickens Fed Diets Supplemented with either Alpha-Tocopherol Acetate, or Oregano Extract. *Philippine Journal of Veterinary and Animal Sciences*. June 2006. Vol.32 No.1.
- 44) Panda, Arun. (2009). Phytobiotics, a natural growth promoter for poultry. Retrieved from <http://www.wattagnet.com/articles/3346-phytobiotics-a-natural-growth-promoter-for-poultry> on February 20, 2022.
- 45) Peng, Q.Y. et al. (2016). Effects of dietary supplementation with oregano essential oil on growth performance, carcass traits and jejunal morphology in broiler chickens. Accessed from <https://www.sciencedirect.com/science/article/pii/S0377840116300608> on February 20, 2022.
- 46) Rajput. N., Muhammad N., Yan R., Zhong X. & Wang T. (2013). Effect of dietary supplementation of curcumin on growth performance, intestinal morphology and nutrients utilization of broiler chicks. *J. Poultry. Sci.*, 50:44-52.
- 47) Rodriguez, Cynthia M., Libunao L.P., Aglipay M., Hufalar P., Sagun E.O. & Libong C.S. (2016). Turmeric (*Curcuma longa*) for Broilers. Terminal Report. Don Mariano Marcos Memorial State University. North La Union Campus. Bacnotan La Union.
- 48) Rehman Z, Munir MT. Effect of garlic on the health and performance of broilers. *Veterinaria* 2015;3(1): 32-39.

## Sources and Levels of Natural Growth Promotants for Redbro Chicken

- 49) Singletary K.W., PhD. Oregano: Overview of the Literature on Health Benefits. University of Illinois, Urbana-Champaign (UIUC), Department of Food Science and Human Nutrition. 2010;44(3):129-138. DOI: 10.1097/NT.0b013e3181dec789
- 50) Vidanarachchi, J.K., Mikkelsen L.L., Sims I.M, Iji P.A. and Choct M. (2006). Selected plant extracts modulate the gut microflora in broilers. Aust. Poult. Sci. Symp., 18:145-148.
- 51) Wang, D., Huang H., Zhou L., Li W., Zhou H., Hou G., Liu J. & Hu L. (2015). Effects of Dietary Supplementation with turmeric rhizome extract on growth performance, carcass characteristics, antioxidant capability, and meat quality of wenchang broiler chickens. Accessed from <https://www.tandfonline.com/doi/full/10.4081/ijas.20153870> on March 16, 2022.
- 52) Yadav D, Yadav SK, Khar RK, Mujeed M, Akhtar M. Turmeric (*Curcuma longa* L.): A promising spice for phytochemical and pharmacological activities. Int J Green Pharm 2013;7:85-9.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Effect of Serum Breadfruit Leaf Extract (*Artocarpus Altilis*) on TNF- $\alpha$ and Sod Levels (Experimental Study on Guinea Pigs Exposed to UVB Light)



Nani Winarni<sup>1</sup>, Pasid Harlisa<sup>2</sup>, Prasetyowati Subchan<sup>3</sup>

<sup>1</sup>Postgraduate student of Biomedical Sciences, Faculty of Medicine, Universitas Islam Sultan Agung, Jl Kaligawe KM 4 Semarang 50012

<sup>2,3</sup>Department of Biomedical Sciences, Faculty of Medicine, Universitas Islam Sultan Agung, Jl Kaligawe KM 4 Semarang 50012

**ABSTRACT:** Continuous exposure to ultraviolet B (UVB) light can increase the amount of melanin, causing hyperpigmentation on the skin. This process involves the important role of *Tumor Necrosis Factor- $\alpha$*  (TNF- $\alpha$ ) and *Superoxide Dismutase* (SOD). *Artocarpus Altilis* contain flavonoids that have anti-inflammatory potential, can reduce TNF- $\alpha$  levels and increase SOD which affects the melanogenesis process. To determine the effect of administering *Artocarpus Altilis* extract serum on TNF- $\alpha$  and SOD levels in guinea pigs exposed to UVB. This research is an *in vivo* experimental study with *Post Test Only Group design*, which was conducted at the IBL FK Laboratory (*Integrated Biomedical Laboratory* Faculty of Medicine) Unissula. A total of 30 male guinea pigs were divided into 5 groups, namely: Group 1 sham, group 2 negative control, group 3 treated with 2% *Artocarpus Altilis* extract serum, group 4 treated with 4% serum and group 5 treated with 6% serum. Then analyzed using the One-way ANOVA test to determine differences between groups. The lowest mean TNF- $\alpha$  levels were found in group P2 (4.958), other values were P1 (5.820), P3 (5.964), KS (6.069) and KN (5.811). Meanwhile, the average SOD levels in all groups were not much different, P2 (5.802), P1 (5.975), P3 (5.906), KS (6.054) and KN (6.000). In the One-way ANOVA test on TNF- $\alpha$  and SOD there was no significant difference,  $p > 0.05$ . Administration *Artocarpus Altilis* extract serum, especially 4%, caused a decrease in TNF- $\alpha$  levels but was not significant, and there was no increase in SOD levels, in guinea pigs exposed to UVB light.

**KEYWORDS:** *Artocarpus Altilis* extract, TNF- $\alpha$ , SOD

### I. INTRODUCTION

Environmental factors that are very influential in the aging process of the skin are ultraviolet light radiation. Continuous exposure to ultraviolet B (UVB) light can cause skin changes, such as hyperpigmentation.<sup>1</sup> Hyperpigmentation is one of the signs of aging of the skin, which occurs due to an increase in the amount of melanin.<sup>2-4</sup> Melanogenesis that triggers pigmentation cannot be separated from the role of *Necrosis Tumor Factor- $\alpha$*  (TNF- $\alpha$ ) which is formed due to inflammation in the aging process due to sun exposure. Proinflammatory cytokines such as TNF- $\alpha$  play an important role in inflammation-aging caused by chronic inflammation. The interrelationship between proinflammatory cytokines and cellular aging exacerbates inflammatory aging.<sup>5</sup>

Hyperpigmentation is also influenced by an increase in *Reactive Oxygen Species* (ROS) due to UVB radiation, DNA damage, activating p53, and triggering melanogenesis.<sup>6</sup> Superoxide Dismutase (SOD) is one of the enzymatic antioxidants, which works to capture free radicals ROS.<sup>7</sup> Research conducted by Kim HY, *et al*, 2018, revealed that SOD suppresses UVB-induced ROS production, and inhibits melanin synthesis in melanocyte cells.<sup>8</sup>

Currently, skin lightening ingredients that are widely used to treat hyperpigmentation problems work as *tyrosinase inhibitors*,<sup>9</sup> among them are ascorbic acid, arbutin, kojic acid, and hydroquinone. 4% hydroquinone cream has been the gold standard for the treatment of hyperpigmentation for more than 50 years,<sup>10</sup> however, hydroquinone has side effects such as allergic or irritant dermatitis and ochronosis.<sup>11-13</sup> Therefore, the use of hydroquinone has now begun to be severely restricted.<sup>6</sup> Based on this, it is necessary to look for other skin lightening ingredients that are natural with minimal side effects.<sup>10</sup>

One of the natural skin lightening ingredients that can affect skin pigmentation is breadfruit plants, because these plants produce antioxidant compounds.<sup>14</sup> Breadfruit plants are one of the plants that are easily obtained and empirically have been used in certain

## Effect of Serum Breadfruit Leaf Extract (*Artocarpus Altilis*) on TNF-A and Sod Levels (Experimental Study on Guinea Pigs Exposed to UVB Light)

communities in Indonesia as traditional medicine.<sup>10</sup> Breadfruit leaves (*Artocarpus altilis*) contain flavonoid compounds,<sup>15</sup> which acts as an antioxidant inhibitor of ROS, anti-inflammatory and inhibits the activity of tyrosinase enzyme which is efficacious as a skin lightener.<sup>16</sup> Flavonoids are natural phenolic compounds from secondary metabolites found in many other green plants.<sup>17</sup> Several studies show the potential of flavonoid compounds with their ability as anti-inflammatory to reduce TNF- $\alpha$  levels through its mechanism as an anti-oxidant. Based on research conducted by Yang CY *et al.*, 2022 : *Artocarpus Altilis* woody bark extract contains flavonoid compounds, can reduce intracellular ROS overproduction, reduce the expression of inflammatory proteins, including TNF- $\alpha$  and TNF-1 receptors (TNFR1).<sup>18</sup>

Experimental studies *in vivo* and *in vitro* conducted by Tiraravesit *et al.*, 2015, reported: *Artocarpus altilis* wood stem extract contains flavonoid compounds, topically can suppress structural changes in skin damaged by UVB radiation, decreased production of MMP-1 in fibroblasts, and decreased production of TNF- $\alpha$  and IL-6 in keratinocytes.<sup>19</sup>

Research by Yang *et al.*, 2022, reports : topical *Artocarpus Altilis* extract has the potential to be developed as an anti-oxidant active ingredient to prevent skin oxidation, inflammation and aging, and restore the skin's protective function.<sup>18</sup>

The use of serum preparations as cosmetic products to lighten the skin is widely found, because serum has the advantages that the active substances contained in it are more, high absorption, and official spreadability. Serum has small particles, comfortable, and easy to apply, so serum is faster and more effective in overcoming skin problems.<sup>20</sup>

So in this study will be examined on the influence of sukun leaf extract (*Artocarpus Altilis*) on the rate of TNF- $\alpha$  and SOD on UVB ray-shown marmots, which are given in the form of topical preparations in the form of serum.

## II. MATERIAL AND METHOD

### Study Design and Experimental Animals

This research is an *in vivo* experimental study with *Post Test Only Group design*, which was conducted at the IBL FK Laboratory (*Integrated Biomedical Laboratory* Faculty of Medicine) Unissula. Study subjects used guinea pigs (*Cavia porcellus*) males, aged 2-3 months with a body weight of 300-350 grams that fit the criteria of inclusion and inclusion, adapted for 7 days. This study used 5 groups, namely: Sham control group 1, *healthy* guinea pigs that were not exposed to UVB and were not treated (KS); group 2 negative control, guinea pigs applied serum base 20 minutes before exposure to UVB light, dose 65 mJ/cm<sup>2</sup> for 130 seconds, after 4 hours of exposure reapplied serum base, UVB exposure was carried out 3x a week for a period of 28 days, so that the total dose is 780 mJ/cm<sup>2</sup>; group 3 P1 treatment, such as the process on KN, which uses 2% breadfruit leaf extract serum; group 4 P2 treatment, using 4% breadfruit leaf extract serum; and group 5 P3 treatment, using 6% breadfruit leaf extract serum. On the 29th day, a termination was carried out to take samples of skin tissue.

### Research Materials

The research material used parafilm, 3% H<sub>2</sub>O<sub>2</sub> solution, ethanol concentration 70%, 80%, 90%, 100% I, 100% II, xylene, PBS, citrate buffer, ELISA Kit SOD, ELISA Kit TNF- $\alpha$ , guinea pig skin tissue samples, and aquades.

### Research Equipment

This research uses equipment consisting of *microplate reader*, 37°C incubator, micropipette, tip, beaker glass, 1.5 ml microtube, tissue, *marker ink*, slides rack, dip rack, *humidity chamber*, microwave, *deck glass*, *entellan*, *tissue*, and *timer*.

### Screening and Flavonoid Test

Flavonoid screening and testing are carried out by: **(1)** Flavonoid analysis is carried out using quercetin standard solution reagents Concentrations of 2ppm, 4ppm, 6ppm, 8ppm, and 10 ppm. **(2)** Absorbance measurement using UV-Vis spectrophotometer with wavelength 415 nm. **(3)** Absorbance carried out for flavonoid testing was carried out with variations in ethanol concentrations, namely 60%, 70%, 80%, 90% and 99.8% and variations in massification time of 24 hours, 30 hours, 36 hours, 42 hours and 48 hours. **(4)** The result of the absorbance value is entered as the value of x in the standard curve regression equation. **(5)** Obtained flavonoid levels from breadfruit leaves.

### How to Make Breadfruit Leaf Extract

Making breadfruit leaf extract is massed with 70% ethanol. The procedure is as follows: **(1)** Selection of breadfruit leaves to be extracted, drying with a 35°C temperature oven. **(2)** Making masseration by grinding breadfruit leaves with a blender up to 40 messes. **(3)** After obtaining breadfruit leaf powder, extraction is carried out using 70% ethanol. **(4)** Filtering process with filter paper until filtration is obtained. **(5)** Evaporation of ethanol with a *rotary vacuum evaporator* to separate flavonoids from ethanol. **(6)** Obtained flavonoid results from breadfruit leaves.

## Effect of Serum Breadfruit Leaf Extract (*Artocarpus Altilis*) on TNF- $\alpha$ and Sod Levels (Experimental Study on Guinea Pigs Exposed to UVB Light)

### How to Make Breadfruit Leaf Extract Serum,<sup>21</sup>

Procedures : (1) Carbomer (base) is weighed according to the amount and then developed with hot water temperature 80 ° C for 5 hours. (2) The fluffy carbomer is stirred and added TEA until thickened. (3) Sodium benzoate and disodium EDTA are dissolved into glycerin and then mixed into the base. (4) Breadfruit leaf extract (made *base serum and* preparation of 3 serum formulas of breadfruit leaf extract with concentrations of 2%, 4% and 6%), dissolved with 5 mL of 70% ethanol then added to the base mixture and stirred until homogeneous. (5) The serum formed is carried out various tests, namely pH, viscosity, dispersion and adhesion

### Dosage Assignment

The dose of topical breadfruit leaf serum extract was determined before the study was conducted based on literature studies. Previous research stated: giving breadfruit leaf extract cream (*Artocarpus altilis*) 3% can prevent an increase in skin melanin in guinea pigs (*Cavia procellus*) exposed to UVB light. The application of breadfruit leaf extract cream (*Artocarpus altilis*) 3% is as effective as the 4% hydroquinone cream in preventing an increase in the amount of melanin in guinea pig skin.<sup>10</sup> In another experimental *in vitro* study conducted by Sholikh M, et al., confirmed that: breadfruit extract gel levels of 2%, 4%, and 6% inhibited tyrosinase with L-Dopa substrate, with formula respectively 40.35%, 39.11% and 37.21%.<sup>16</sup> In this study using doses of 2%, 4% and 6% breadfruit leaf extract serum applied topically on guinea pig skin exposed to UVB light.

### Network Sampling for ELISA Examination

Guinea pigs on the 29th day are terminated using chloroform liquid that has been moistened on a cotton swab, then put in a closed container. Furthermore, tissue samples were taken by biopsy on the back with a size of 1x1 cm to subcutaneous, thickness of approximately 2 mm.<sup>2,22</sup> The tissue sample is put into a tube and soaked with PBS liquid, then stored in a freezer at -80° so that the ELISA analysis process can be carried out.

### ELISA TNF- $\alpha$ and SOD Inspection Procedures

Procedures : (1) Prepare all reagents, standard solutions and samples according to instructions. Bring all reagents to room temperature before use. Tests are carried out at room temperature. (2) Determine the number of strips required for testing. Put the remaining strips in a zipped aluminum for storage. (3) Unused strips should be stored at 2-8°C. (4) Add standard 50 $\mu$ l to standard wells. Note: Do not add antibodies to the standard because standard solutions contain biotin labeled antibodies. (5) Add 40 $\mu$ l of sample that has been sonicated, and lysed with PBS to the sample well and then add 10 $\mu$ l of anti-TNF- $\alpha$  or SOD antibodies to the sample well, then add 50 $\mu$ l of streptavidin-HRP to the sample well and standard well (Not a blank well). Mix well. Cover the plate with a sealer. Incubation 60 minutes at 37°C. (6) Remove sealer and wash well 5 times with wash buffer of at least 0.3 ml for 30 seconds to 1 minute for each wash. (7) Add 50 $\mu$ l of substrate A solution to each well and then add 50 $\mu$ l of substrate B solution to each sump. (8) Incubation plate covered with new sealer for 10 minutes at 37°C in a dark place. (9) Add 50 $\mu$ l Stop Solution to each sump, the blue color will instantly change to yellow. (10) Determine the OD value of each well using a microplate reader set at 450 nm within 10 minutes after adding the stop solution.

## III. RESULT

### Determination and Extraction of Breadfruit Leaf Serum

The breadfruit leaves (*Artocarpus Altilis*) used in this study were obtained from local plantations in the city of Semarang. Material determination was carried out at the Biology Laboratory of Semarang State University.

Breadfruit leaves are dried and macerated with 70% ethanol for 3 days, then filtered using filter paper, the residue obtained is remacerated with the remaining ethanol solvent for 2 days to extract the active substance in breadfruit leaves. The filtrate obtained is evaporated using a *rotary evaporator* and *waterbath* so that a thick extract of breadfruit leaves is obtained. At the end of the formulation the oil phase chosen is *carbomer*, because it has good base-forming properties in the process of making serum. The preparation is made into 1 *serum base and* 3 other doses, namely 2%, 4% and 6%. Phytopharmaceutical tests have been carried out, the results show: breadfruit leaf extract serum is positive for alkaloids, flavonoids, saponins and tannins.

### The effect of giving breadfruit leaf extract serum (*Artocarpus Altilis*) on TNF- $\alpha$ levels in guinea pig skin exposed to UVB light

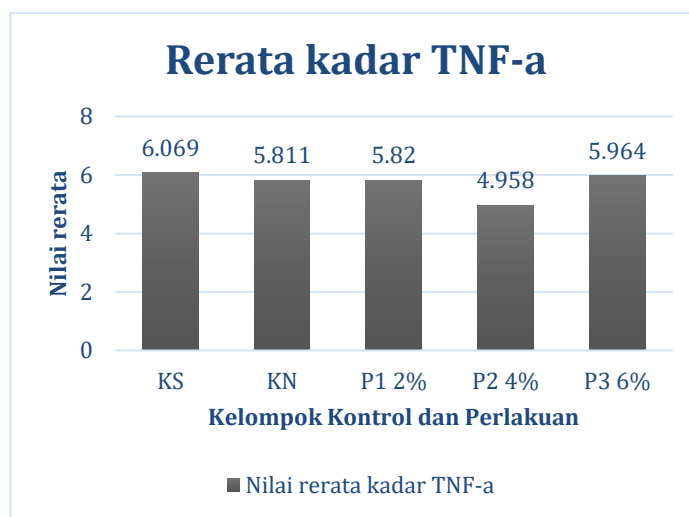
After 28 days of UVB exposure and treatment, after another 24 hours on the 29th day, guinea pigs were terminated and skin tissue samples were taken and analyzed using the ELISA examination method to measure TNF- $\alpha$  and SOD levels in each group.

## Effect of Serum Breadfruit Leaf Extract (*Artocarpus Altilis*) on TNF-A and Sod Levels (Experimental Study on Guinea Pigs Exposed to UVB Light)

**Table 1. Test of normality and homogeneity of TNF- $\alpha$  levels between research groups after treatment**

Group	Average	SD	Shaphiro Wilk	Levene test	Oneway ANOVA
KS	6,069	1,40	0,200	0,725	0,508
KN	5,811	1,04	0,200		
P1	5,820	0,88	0,200		
P2	4,958	1,04	0,200		
P3	5,964	1,42	0,096		

Mark \* = Significant meaning ( $p < 0.05$ )



**Graph 1. Mean value of TNF- $\alpha$  levels between study groups after treatment**

Based on table 1. and Graph 1. above, the lowest average value of TNF- $\alpha$  levels in the P2 treatment group (serum breadfruit leaf extract 4%) was  $4.958 \pm SD 1.04$ ; while the average TNF- $\alpha$  levels in the *Sham* Group (KS) were  $6.069 \pm SD 1.40$ ; and Negative control group (KN)  $5.811 \pm SD 1.04$ . Normal distributed data in all study groups with a value of  $p > 0.05$ , homogeneous data variant with a *Levene test value of 0.725* ( $p > 0.05$ ). In the One-way ANOVA test, a value of 0.508 ( $p > 0.05$ ) was obtained, meaning that although TNF- $\alpha$  levels in the P2 treatment group (4% breadfruit leaf extract serum) were the lowest, there was no significant difference in TNF- $\alpha$  levels between research groups.

### The effect of serum giving of sukun leaf extract (*Artocarpus Altilis*) on SOD levels on the skin of marmots exposed to UVB rays

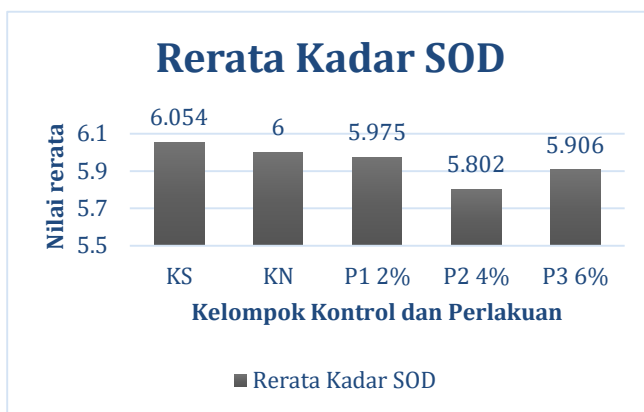
Results of ELISA test analysis of SOD levels between study groups after treatment as seen in the table below.

**Table 2. Test of normality and homogeneity of SOD levels between study groups after treatment**

Group	Average	SD	Shaphiro Wilk	Levene test	One-way ANOVA
KS	6,054	0,84	0,895	0,709	0,979
KN	6,000	0,79	0,967		
P1	5,975	0,45	0,901		
P2	5,802	0,81	0,980		
P3	5,906	0,68	0,898		

Mark \* = Significant meaning ( $p < 0.05$ )

## Effect of Serum Breadfruit Leaf Extract (*Artocarpus Altilis*) on TNF-A and Sod Levels (Experimental Study on Guinea Pigs Exposed to UVB Light)



Graph 2. Average values of SOD levels between study groups after treatment

Based on table 2. and Graph 2. above, the average value of SOD levels was not much different in all groups, both in the control and treatment groups. The average SOD levels in the P2 group (4% breadfruit leaf extract serum) were  $5.802 \pm SD 0.81$ ; while the average SOD level in the *Sham* Group (KS):  $6,054 \pm SD 0.84$ ; and the KN Group:  $6,000 \pm SD 0.79$ . Normal distributed data in all groups with  $p > 0.05$  value, homogeneous data variant with *Levene test value* 0.709 ( $p > 0.05$ ). In the One-way ANOVA test, a value of 0.979 ( $p > 0.05$ ) was obtained, meaning that there was no significant difference in SOD levels between research groups.

#### IV. DISCUSSION

Continuous exposure to UVB rays can cause skin changes, namely epidermal thickness, dermal elastase, decreased amount of ECM protein, increased MMP activity and collagen fragmentation, increased inflammatory infiltrates and *telangiectasia*. In addition, UVB can trigger keratinocyte DNA damage that initiates the release of inflammatory mediators, such as cytokines IL-1 $\alpha$ , IL-6, and TNF- $\alpha$ . UVB also directly induces p53 which will affect the amount of skin melanin.<sup>1</sup>

UVB radiation also triggers increased ROS causing an increase in inflammatory cytokines, *Growhwt Factor* and reseptop activator (increase in NF-kB and AP1, decrease in TGF- $\beta$ ), resulting in decreased collagen production, increased collagen breakdown, increased elastin accumulation characterized as photoaging, solar elastosis, wrinkel, telangiectasis and pigmentation.<sup>23</sup>

UVB radiation induces melanogenesis via p53 triggering increased proopiomelanocortin (POMC) expression to secrete  $\alpha$ MSH which regulates MITF expression, further triggering the enzymes tyrosinase, Tyrp1 and Tyrp2. In addition, UVB radiation increases the production of reactive oxygen species (ROS) in keratin and melanocyte cells, and at high concentrations ROS causes DNA damage, activates p53 further, and thus triggers melanogenesis.<sup>6</sup>

An important thing to pay attention to, in the process of increasing skin melanin pigment (melanogenesis) as revealed in the article above is the presence of UVB radiation will trigger an increase in ROS and inflammatory mediators such as TNF- $\alpha$ . Therefore, this study specifically examined two relevant parameters, namely SOD as an inhibitor of ROS, and inflammatory mediators in the form of TNF- $\alpha$ , both of which are directly involved in the process of melanogenesis. The active ingredient object that we chose is breadfruit leaf extract serum because, which is believed to have a natural effect on inhibiting the process of melanogenesis.

Breadfruit leaves (*Artocarpus altilis*) contain flavonoid compounds that can act as antioxidants inhibitors of ROS, anti-inflammatory and inhibit the activity of tyrosinase enzymes which are efficacious as skin lighteners. Breadfruit leaf extract contains saponins, flavonoids, triterpenoids and steroid compounds. The presence of phenolic compounds and flavonoids that have been reported such as flavonols, stilbens, phenolic acids, and quercetin contribute to inhibiting tyrosinase activity so as to prevent skin hyperpigmentation.<sup>16</sup>

This study uses preparations in the form of serum, because one of the advantages is that the active substances contained in serum can be more than other cosmetic preparations so that serum is faster and more effective in overcoming skin problems.<sup>24</sup>

UVB exposure causes increased secretion of IL-1 and TNF- $\alpha$ , stimulating tyrosinase through a specific intracellular signaling cascade, which is activated after binding of endothelin-1 (EDN1) or stem cell factor (SCF) to either endothelin B receptor (EDNRB) or stem cell growth factor receptor, known as *proto-oncogen c-KIT* (c-KIT), then melanocyte activation occurs resulting in stimulation of epidermal pigmentation.<sup>25</sup>

The results of this study showed that the lowest average value of TNF- $\alpha$  levels in the P2 treatment group (serum breadfruit leaf extract 4%) was  $4.958 \pm SD 1.04$ ; however, it was not significantly different when compared to the control group of both KS and KN. While the average value of TNF- $\alpha$  levels in the P1 and P3 treatment groups was almost the same as the control group (KS and KN), and did not differ significantly. All treatment groups both P1, P2, and P3 when compared with each other were also not



## Effect of Serum Breadfruit Leaf Extract (*Artocarpus Altilis*) on TNF-A and Sod Levels (Experimental Study on Guinea Pigs Exposed to UVB Light)

significantly different.

The decrease in TNF- $\alpha$  levels due to the influence of breadfruit leaf extract serum in this study is in accordance with the theory expressed by Imokawa G, regarding the mechanism of inhibition of intracellular signaling pathways causing depigmentation.<sup>25</sup> The results of this study are in accordance with *in vivo and in vitro experimental studies conducted by Tiraravesit et al., in 2015, on the use of Artocarpus altilis wood stem extract topically can reduce TNF- $\alpha$  and IL-6 in keratinocyte tissue*.<sup>19</sup> In another study by Yang *et al.*, 2022, also reported that *Artocarpus Altilis extract* has anti-aging and anti-inflammatory effects by regulating phosphorylation of MAPK and NF-kB signaling proteins.<sup>18</sup>

This study also examined tissue SOD levels, The result was that the average value of SOD levels in all groups both control and treatment was almost the same, and there was no significant difference. The average value of SOD levels in the P2 group (serum breadfruit leaf extract 4%) was  $5.802 \pm SD 0.81$ ; not significantly different when compared to the control group both KS and KN. All treatment groups both P1, P2, and P3 when compared with each other were also not significantly different.

The decrease in TNF- $\alpha$  levels in this study occurred in the P2 treatment group, while in the other treatment groups (P1 and P3) there was no decrease. While SOD did not change in all treatment groups (P1, P2, and P3). This is a limitation in research, insignificant changes in TNF- $\alpha$  and SOD may be caused by: the small number of research samples, or the sensitivity of measuring instruments using ELISA examination skin tissue is less sensitive in detecting changes, especially SOD levels.

### V. CONCLUSION

1. Serum administration of breadfruit leaf extract (*Artocarpus Altilis*) can reduce TNF- $\alpha$  levels in guinea pig skin exposed to UVB rays, but not significantly.
2. Serum administration of breadfruit leaf extract (*Artocarpus Altilis*) did not have a significant effect on increasing SOD levels in guinea pig skin exposed to UVB rays.
3. Giving serum breadfruit leaf extract (*Artocarpus Altilis*) 4% can reduce TNF- $\alpha$  levels but not significantly, but there is no increase in SOD levels in guinea pig skin exposed to UVB light.

### ACKNOWLEDGEMENT

The authors declare no conflict of interest and no involvement of sponsors or funding for this research.

### REFERENCES

- 1) Gromkowska, et al. *The impact of ultraviolet radiation on skin photoaging - review of in vitro studies*. J Cosmet Dermatol. 2021;20(11):3427-3431. doi:10.1111/jocd.14033
- 2) Cristina Sitanggang T. *Krim Astaxanthin Mencegah Peningkatan Melanin Kulit Marmut (Cavia porcellus) yang Dipapar Sinar Ultraviolet B Astaxanthin Cream Prevents Increased Melanin in Guinea Pig Skin Exposed by Ultraviolet Light B*. Jurnal Media Sains 3 (2): 71-77. Published online 2019.
- 3) Puspitasari P, Putra Wiraguna A, Pangkahila W. *Krim Ekstrak Teh Hijau 20% (Camellia Sinensis) Mencegah Peningkatan Jumlah Melanin Sama Efektif Dengan Krim Hidrokuinon 4% Pada Kulit Marmut (Cavia Porcellus) Yang Dipajan Sinar Ultraviolet B*. Jurnal Biomedik (JBM), Volume 9, Nomor 2, Juli 2017, hlm. 101-106.
- 4) Rakhmawati I, Fentami NA. *Uji Aktivitas Penghambat Enzim Tirosinase Dari Fraksi Etil Asetat Daun Sukun (Artocarpus altilis (Park.) Fosberg)*. Jurnal Insan Farmasi Indonesia. 1(2):268-273.
- 5) Xia S, Zhang X, Zheng S, et al. *An Update on Inflamm-Aging: Mechanisms, Prevention, and Treatment*. J Immunol Res. 2016;2016. doi:10.1155/2016/8426874
- 6) Kumari S, Thng STG, Verma NK, Gautam HK. *Melanogenesis inhibitors*. Acta Derm Venereol. 2018;98(10):924-931. doi:10.2340/00015555-3002
- 7) Wahjuni, S. *Superoksida Dismutase (Sod) Sebagai Prekursor Antioksidan Endogen Pada Stress Oksidatif*. 1st ed. (Prof. Dr. Iwan H. Utama M, ed.). Udayana University Press, 2015
- 8) Kim HY, Sah SK, Choi SS, Kim TY. *Inhibitory effects of extracellular superoxide dismutase on ultraviolet B-induced melanogenesis in murine skin and melanocytes*. Life Sci. 2018;210:201-208. doi:10.1016/j.lfs.2018.08.056
- 9) Kwon. *In the Human Skin Inhibits Pigmentation, Probably through MITF Deg-Radation via Erk 1/2 Activation in Melanocytes*. Nutrients 2019, 11, 1341; doi:10.3390/nu11061341.
- 10) Riliani M, Pangkahila W, AAGP W. *Pemberian Krim Ekstrak Daun Sukun (Artocarpus altilis) Mencegah Peningkatan Jumlah Melanin Kulit Marmut (Cavia porcellus) yang Dipapar Sinar Ultraviolet B (UVB)*. Majalah Kesehatan Pharmamedika. 2018;9(2). doi:10.33476/mkp.v9i2.678.

## Effect of Serum Breadfruit Leaf Extract (*Artocarpus Altilis*) on TNF-A and Sod Levels (Experimental Study on Guinea Pigs Exposed to UVB Light)

- 11) Rahmadari DH, Ananto AD, Juliantoni Y. *Kandungan Hidrokuinon dan Merkuri dalam Krim Kecantikan yang Beredar di Kecamatan Alas A*. Spin Jurnal Kimia & Pendidikan Kimia Analysis Of Hydroquinone And Mercury In Beauty Creams Distributed In Alas District How to Cite. SPIN. 2021;3(1). doi:10.20414/spin.v3i1.3279
- 12) Indriaty S, Hidayati NR, Bachtiar A. *Bahaya Kosmetika Pemutih yang Mengandung Merkuri dan Hidroquinon serta Pelatihan Pengecekan Registrasi Kosmetika di Rumah Sakit Gunung Jati Cirebon*. Jurnal Surya Masyarakat. 2018;1(1):8. doi:10.26714/jsm.1.1.2018.8-11
- 13) Pangaribuan L. *Efek Samping Kosmetik Dan Penanganannya Bagi Kaum Perempuan*. Jurnal Keluarga Sehat Sejahtera. 15(2):2017.
- 14) Silalahi M. *Pemanfaatan Sukun (Artocarpus Altilis) Sebagai Obat Tradisional Dan Bahan Pangan Alternatif*. Best Journal (Biology Education Science & Tchnology. Vol 4.; 2021.
- 15) Kurniawati, Article Review: *The Potention Of Breadfruit Flowers (Artocarpus Altilis [Park. ] Fosberg) As Natural Antioxidant*, UNESA Journal of Chemistry Vol. 10, No. 1, January 2021
- 16) Sholikha M, Febriani A, Nirmala SA. *Formulasi Dan Evaluasi Gel Ekstrak Daun Sukun (Artocarpus altilis) Sebagai Antioksidan dan Inhibitor Tirosinase*. EjournalstnAcld. 2021;14(1).
- 17) Muzaffer U, Paul VI, Agilan B, Prasad NR. *Protective effect of Juglans regia L., against ultraviolet-B induced photoaging in human epidermal keratinocytes*. Biomedicine and Pharmacotherapy. 2019;111:724-732. doi:10.1016/j.biopha.2018.12.129
- 18) Yang CY, Pan CC, Tseng CH, Yen FL. *Antioxidant, Anti-Inflammation and Antiaging Activities of Artocarpus altilis Methanolic Extract on Urban Particulate Matter-Induced HaCaT Keratinocytes Damage*. Antioxidants. 2022;11(11). doi:10.3390/antiox11112304
- 19) Tiraravesit N, Yakaew S, Rukchay R, et al. *Artocarpus altilis heartwood extract protects skin against UVB in vitro and in vivo*. J Ethnopharmacol. 2015;175:153-162. doi:10.1016/j.jep.2015.09.023
- 20) Hermawan VA, Susanti A. *Serum Kulit Manggis dan Beras Putih Sebagai Antiaging dan Brightening*. Garina. 2022;14(1).
- 21) Khafifa IN, Shabrina A, Rochman MF. *Stability And Sunscreen Activity Of Nutmeg Seed Oil Emulgel With Carbopol 940 Variation As Gel Base*. Jurnal Farmasi Sains dan Praktis. Published online June 30, 2022:167-176. doi:10.31603/pharmacy.v8i2.6085
- 22) Gilaberte Y, Prieto-Torres L, Pastushenko I, Juarranz A. *Anatomy and Function of the Skin*. In: *Nanoscience in Dermatology*. Elsevier Inc.; 2016:114. doi:10.1016/B978-0-12-802926-8.00001-X
- 23) Andarina R, Djauhari T. *Antioksidan dalam dermatologi*. JKK. 2017;4(1):3948.
- 24) Thakre AD. *Formulation and Development of De Pigment Serum Incorporating Fruits Extract*. International Journal of Innovative Science and Research Technology, Volume 2, Issue 12, December 2017
- 25) Imokawa G, Ishida K. *Inhibitors of intracellular signaling pathways that lead to stimulated epidermal pigmentation: Perspective of anti-pigmenting agents*. Int J Mol Sci. 2014;15(5):8293-8315. doi:10.3390/ijms15058293



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Tiktok as Rhyming Media in Thematic Learning Platform: Phenomenological Study at SD Negeri 3 Duwet Tumpang Malang



Harun Ahmad<sup>1</sup>, Endang Sumarti<sup>2</sup>, Yunita Anas Sriwulandari<sup>3</sup>

**ABSTRACT:** This study explores the use of TikTok as a rhyming medium in a thematic learning platform at SD Negeri 3 Duwet Tumpang Malang with a phenomenological approach. The goal is to make a new contribution to the development of innovative and exciting learning methods in elementary schools. The results of the study show that the use of TikTok increases student engagement, motivation, and participation in learning. Students show a positive response to learning that is more fun and creative through rhyming videos. Teachers welcomed this innovation despite facing some challenges in class preparation and management. Supporting factors include student enthusiasm and opportunities to express creativity while inhibiting factors include the availability of technological infrastructure and potential distraction of non-academic content. Thus, TikTok can be considered an effective additional tool to improve the quality of thematic learning at the elementary school level.

**KEYWORDS:** Tiktok, pantun media, thematic learning platforms, SD Negeri 3 Duwet Tumpang Malang, phenomenological approach

### I. INTRODUCTION

Education plays a vital role in shaping individuals and the future of a nation (Idris, et al., 2012: 443). Elementary schools have a crucial role in imparting knowledge, skills, and values to students that they will apply daily. The application of a thematic learning approach is in an effort to enrich learning in elementary schools. This approach integrates several subjects within a particular theme or topic, providing opportunities for students to understand content holistically and contextually. At the same time, in the ever-evolving digital era, the use of social media has become an integral part of students' lives. One of the popular social media platforms among children and teenagers is TikTok. TikTok is a short video-sharing platform that allows users to create, share and watch videos of various genres and creativity.

Some research results show that the use of media in learning can increase student interest and involvement (Faradila and Aimah, 2018:508; Nurfadhillah, et al., 2021:254; Magdalena, et al., 2021:324). TikTok, as a social media platform that offers creative features, including short rhymes or rapping, has the potential to be utilized in the context of thematic learning in elementary schools. Using TikTok as a rhyming medium in a thematic learning platform can increase student motivation, facilitate active participation, and enrich their learning experience through different and interesting methods (Yélamos-Guerra, et al., 2022:83; Ferstephanie and Pratiwi, 2022:1).

Several other studies have discussed the use of TikTok in an educational context. Jacobs' research, et al., (2022), revealed that TikTok can increase student engagement in learning. Rahmawati and Anwar (2022), also highlight the potential educational value of TikTok from the perspective of students and teachers. Zulkifli, et al., (2022), explores the potential of TikTok as a learning tool. Purnami (2022), investigates the use of TikTok to explore users' language preferences and the global social media phenomenon.

Kusumandaru and Rahmawati (2022), exploring the use of TikTok as a creative thematic learning media in elementary schools, show that the use of TikTok in thematic learning can increase students' creativity and interest in learning. Nasa and Rizal (2022) and Napitupulu, et al., (2023), seek to explore the use of TikTok in thematic learning to improve students' critical thinking skills in elementary schools, showing that the use of TikTok can improve students' critical thinking skills by solving complex problems and reflection in thematic learning.

Aji and Setiyadi's research (2020), also explores the use of TikTok as a collaborative learning medium in thematic learning in elementary schools and finds that the use of TikTok can increase student collaboration and involvement in thematic learning through content sharing and discussion activities. Aji (2018), dissecting the use of TikTok in thematic learning to increase student

## **TikTok as Rhyming Media in Thematic Learning Platform: Phenomenological Study at SD Negeri 3 Duwet Tumpang Malang**

learning motivation in elementary schools, shows that the use of TikTok in thematic learning can increase student learning motivation through creative and interactive activities. Meanwhile, Sari, et al., (2023), revitalizing old literature for millennial students found that students were able to make video content that reciprocated rhymes with various concepts after attending lessons/training.

These studies provide a relevant understanding of the use of TikTok in thematic learning in elementary schools. However, there is relatively little research on TikTok as a rhyme media in thematic learning platforms at SD Negeri 3 Duwet Tumpang Malang. Therefore, this research will be a new contribution in that context. This study adopts a phenomenological approach to understand students' experiences in using TikTok as a rhyming medium in thematic learning. The phenomenological approach allows researchers to explore the world of students' subjective experiences, including the perceptions, emotions, and meaning they feel when using TikTok in a learning context. This research is expected to contribute to the development of innovative and interesting learning methods in elementary schools. The results of this research are also expected to provide practical guidance for teachers and schools in utilizing TikTok as an effective learning tool in accordance with technological developments and current student interests.

The phenomena observed in this study are based on the characteristics of the phenomenological approach, namely: description, reduction, essence, and intentionality (O'Donoghue & Punch, 2003:44). Thus, the phenomenon that is the focus of this study is formulated as follows.

- 1) Describe the use of TikTok as a rhyming medium in a thematic learning platform at SD Negeri 3 Duwet Tumpang Malang.
- 2) Analyze the impact of using TikTok in thematic learning on the motivation and participation of SD Negeri 3 Duwet Tumpang Malang students.
- 3) Exploring students' experiences in using TikTok as a rhyming medium in thematic learning at SD Negeri 3 Duwet Tumpang Malang.
- 4) Identify the supporting factors and obstacles in using TikTok as a rhyming medium in thematic learning at SD Negeri 3 Duwet Tumpang Malang.

### **LITERATURE REVIEW**

Thematic learning in elementary schools is a learning approach that involves integration between various subjects in one particular theme. Hidayah (2015:34), states that this method aims to increase the linkages between various concepts and motivate students in learning. Meanwhile, according to Muklis (2012:66), thematic learning is a learning activity by combining material from various subjects into one theme, which focuses on the active involvement of students in the learning process so that students are empowered in the process of solving problems and fostering creativity based on the potential and tendencies of each student.

Several studies have shown that thematic learning can increase students' learning motivation in elementary schools. Karli (2016) and Riwanti and Hidayati (2019), stated that students tend to be more enthusiastic and passionate about learning when material is taught in contexts that are meaningful and interesting to them. In addition, thematic learning methods can also improve students' critical thinking skills by solving complex problems related to learning themes.

However, the implementation of thematic learning is faced with several challenges, one of which is the teacher's lack of knowledge and understanding of thematic learning strategies and approaches. Wangid et al. (2014) and Nurfajariyah & Kusumawati (2023), suggest the need for adequate training and assistance for teachers so they can properly implement thematic learning methods. In addition, the role of media in learning is also a concern in the current digital era. Media can help facilitate communication and interaction between teachers and students, as well as improve student memory. Khotimah et al. (2019:17), emphasize that the use of relevant and diverse media in learning can strengthen information processing in students' long-term memory. However, it should also be noted that the use of media in learning needs to be done wisely, bearing in mind that excessive or undirected use can disrupt students' concentration and affect their learning outcomes (Sarnoto et al., 2023:82).

On the other hand, TikTok as a popular social media platform among teenagers and the younger generation has also attracted the attention of educators. Using TikTok in a learning context can be an effective tool for facilitating active and collaborative learning. Rahmana et al. (2022:403), state that teachers can submit challenges or projects to students to create short content related to learning materials so that they can encourage students to think creatively and apply the concepts they have learned. In addition, the use of TikTok in learning can also increase student motivation because students tend to be more interested and motivated in learning when they can use the platform they like (Kamaruddin, 2022:39). However, it is also important to pay attention to monitoring and controlling the use of TikTok in the learning context, as well as ensuring that the use of TikTok remains relevant to learning objectives and complies with school policies regarding the use of social media (Pujiono, 2021:1).

## Tiktok as Rhyming Media in Thematic Learning Platform: Phenomenological Study at SD Negeri 3 Duwet Tumpang Malang

Meanwhile, constructivism emphasizes the active role of students in building their own knowledge through interaction with the environment and personal experience. Individuals actively construct knowledge through mental processes involving the assimilation and accommodation of new concepts (Von Glasersfeld, 1989:27). Constructivism learning is seen as an active, mental, and social process in which students build their own understanding through interaction with the environment and other people (Jonassen, 1991:10). Constructivism also highlights the importance of social aspects in learning, where social interaction with others can gain new knowledge through collaboration, discussion and joint negotiation (Vygotsky, 1978:86). Learning media theory examines the use of media in learning contexts to improve understanding and retention of information (Mayer, 2005:2). Phenomenological theory focuses on direct observation of human subjective experience to understand the meaning and structure of phenomena (Husserl, 1962:25; Giorgi, 2009:36).

### II. METHOD

This study aims to understand the use of TikTok as a rhyming medium in thematic learning at SD Negeri 3 Duwet Tumpang Malang. Thus, it is a type of qualitative research with a phenomenological approach to explore students' experiences regarding the use of TikTok in rhyming learning. Data were collected through observation, interviews, and documentation from fifth-grade students at the school. The collected data were analyzed qualitatively by means of transcription, coding, grouping of thematic findings, and interpretation. The results of the analysis are presented in narrative form to support the research objectives.

### III. RESULTS

The results of observations and in-depth interviews with students are presented as follows.

TikTok as a rhyme media in a thematic learning platform has a positive impact on student involvement in learning. Videos with rhymes made with creativity invite students' interest, so they are more enthusiastic and active in participating in the learning process. In addition, visualization through video also helps students to better understand learning material in a fun and interactive way.

The majority of students showed a positive response to using Tiktok as a learning medium. They love different and fun ways of learning, especially since Tiktok allows them to actively participate in video creation. Some students also stated that the rhyme videos helped them remember information better and made it easier for them to compose rhymes as part of their learning assignments. One student when asked stated,

*"We all have TikToks, Mom. Sometimes we also make videos that are hit. Sometimes also edit videos together. Sometimes I also see videos of Malang artists who are currently going viral, ma'am. You can see all kinds of things on TikTok."*

The same thing was also conveyed by other students,

*"TikTok is fun, Mom. Can make watching funny videos and short videos. Usually, I also upload videos where I play games with other friends so that I can become famous."*

The use of TikTok in thematic learning also has a positive impact on student motivation. Creative videos made using Tiktok are able to attract students' interest and make them more enthusiastic about learning. One student stated,

*"I am more eager to learn because learning becomes more interesting and fun through using TikTok. I feel motivated to create creative videos and learn more."*

The use of TikTok in thematic learning also has a positive impact on student participation in the learning process. Students are actively involved in making videos, collaborating with classmates, and sharing their understanding through the platform. One student explained,

*"We can collaborate on making rhyming videos using TikTok. This makes us feel involved and contribute to learning. We can also watch our friends' videos and learn from them."*

Meanwhile, TikTok as a popular social media platform among students, offers the opportunity to apply creative and interactive learning methods. The students who had used TikTok in the thematic learning process were interviewed to gain insight into their experiences and views on this learning method. Most students show high enthusiasm for using TikTok in thematic learning. They stated that learning becomes more interesting and fun through media with rhymes with videos. One student said,

*"I love being able to learn by making rhyme videos. It feels like we are creating our own content and learning in a more fun way."*

The use of TikTok in thematic learning also increases student creativity. They feel compelled to think creatively in compiling rhymes and delivering learning materials. One student stated,

*"We have to think hard to find the right words for the rhymes. This makes us more creative in understanding the material."*

Students also said that using TikTok helped them understand the learning material better. Through making rhyming videos, they feel more involved and easier to remember information. One student explained,

## TikTok as Rhyming Media in Thematic Learning Platform: Phenomenological Study at SD Negeri 3 Duwet Tumpang Malang

*"When I make videos, I feel like I'm teaching myself the material. It helps me understand more deeply."*

The use of TikTok as a medium with rhymes also increases students' self-confidence. They feel proud of their work and have the courage to speak in front of the class. One student shared,

*"Before, I was shy about speaking in front of my friends. But after using TikTok, I feel more confident and dare to speak more clearly."*

The students' experience of using TikTok as a rhyming medium in thematic learning shows positive results. High enthusiasm, increased creativity, better understanding, and increased self-confidence are some of the things found in this study. Using TikTok as a learning tool can motivate students to be more engaged in learning and enhance their overall learning experience.

Based on interviews with students, the first factor that supports the use of TikTok as a rhyming medium in thematic learning is the high enthusiasm of students. The students showed high interest and enthusiasm in using TikTok for learning. One student stated, *"We are happy to be able to learn in a more fun way. TikTok makes us more enthusiastic to learn and participate in class."*

The use of TikTok allows students to express their creativity in learning. By making rhymes videos, students feel they have the freedom to convey learning material in a unique and creative way. One student shared,

*"I like making rhymes videos because we can show our creativity. I feel more challenged to make interesting and entertaining rhymes."*

TikTok as a rhyme media increases student involvement in learning. Videos with rhymes trigger discussion and collaboration among students, thus strengthening interactions in the classroom. However, there are several inhibiting factors. One of the inhibiting factors in using TikTok as a rhyme media is the availability of infrastructure and access to technology in the school environment. Some students have difficulty accessing the devices required to use TikTok. One student revealed,

*"We don't all have smartphones or devices to make videos at home. So it's sometimes difficult to fully participate in learning with TikTok."*

The use of TikTok as a rhyme media in thematic learning at SD Negeri 3 Duwet Tumpang Malang has supporting and inhibiting factors. Student enthusiasm, creativity in learning, and higher student involvement are positive supporting factors. However, the availability of infrastructure and access to technology, classroom management constraints, and potential distraction from non-academic content are some of the inhibiting factors that need to be overcome to maximize the benefits of using TikTok as an effective learning tool.

### DISCUSSION

In the digital era and the development of social media, this innovative approach is expected to increase student interest and participation in learning pantun art, which is part of the thematic curriculum. The results of this study indicate that the use of TikTok as a rhyming medium in thematic learning has a positive impact on students' responses and their active involvement in the learning process. According to cognitive learning theory, as proposed by Piaget (1972), learning occurs through the construction of knowledge through internal cognitive processes. The use of TikTok allows students to be actively involved in creating rhymes through an interesting short video format that is appropriate to their stage of cognitive development. Students become more enthusiastic about learning rhymes because they feel more involved in creating content and sharing their work with friends on familiar platforms (Vygotsky, 1978:86). This contributes to the formation of a deeper understanding of pantun art and increases their motivation in learning (Skinner, 1968:72).

The results of the study also found that the use of TikTok as a rhyming learning medium applies the principles of effective learning, especially through repetition and collaborative learning. The cognitive theory states that repetition helps improve information retention and students' memory (Ebbinghaus, 1885:25). In TikTok, rhyming videos can be repeated, so students have the opportunity to repeat their learning experience many times. In addition, TikTok also facilitates collaborative learning through social interaction between students (Bandura, 1977:123). They can comment, provide support, and collaborate in creating rhymes, which enhance social bonds in the learning environment.

The use of TikTok as a rhyme media also plays a role in developing students' creativity in creating and presenting their rhymes (Sternberg, 2003:64). Through this platform, students can combine elements of art, music, and visuals to create unique and interesting rhymes. The constructivist theory emphasizes the importance of learning that is relevant to everyday life and the application of knowledge in real contexts (Dewey, 1938:57). The use of TikTok allows students to express their creativity in a more modern format and in accordance with the context of their current life.

In addition, this study also found that the use of TikTok has a positive impact on student motivation. Maslow's Hierarchy of Needs motivational theory (1943:29) states that students' motivation is influenced by the fulfillment of their basic needs. The use of TikTok as a learning medium offers fun and excitement in the learning process, which can meet students' needs for a sense

## **TikTok as Rhyming Media in Thematic Learning Platform: Phenomenological Study at SD Negeri 3 Duwet Tumpang Malang**

of fun and creative exploration. On this platform, students can create and participate in interesting rhyming videos, which indirectly strengthen self-confidence and social acceptance. As a result, students are more motivated to be actively involved in learning activities and contribute to creating interesting educational content. Furthermore, the use of TikTok also increases student participation in learning. In the theory of participation, Vygotsky (1978:86) underlines the important role of social interaction in learning. The use of TikTok allows students to interact with each other with comments, support, and collaboration in making rhymes. This creates positive social bonds and an inclusive learning environment. In addition, the use of short and repetitive video formats on TikTok can also strengthen repetition and information retention, thus supporting student participation in understanding and remembering learning material better. The use of TikTok as a thematic learning medium has a positive impact on student motivation and participation, especially SD Negeri 3 Duwet Tumpang Malang students, which is supported by the theory of student motivation and participation.

In terms of students' experience in using TikTok as a rhyme learning tool, it is very positive and interesting. Based on cognitive learning theory, as proposed by Piaget (1972:15), the use of TikTok provides opportunities for students to be actively involved in learning, create creative content, and increase their understanding of pantun art. In the format of short repetitive videos, students can repeat their learning experience and strengthen their information retention (Ebbinghaus, 1885:25). In addition, social learning theory by Bandura (1977:123) also supports this finding that the experience of using TikTok facilitates social interaction between students, which contributes to collaborative learning and supports social bonds within the learning environment. The use of TikTok also encourages students to express their creativity in creating rhymes (Sternberg, 2003:64). By incorporating artistic, musical, and visual elements in their rhyming videos, students can create unique and engaging rhymes that enrich their overall learning experience. Students' experiences in using TikTok as a rhyme media, especially at SD Negeri 3 Duwet Tumpang Malang, show a positive impact, which is in accordance with cognitive learning theory, social learning, and the development of student creativity.

Meanwhile, the results of the identification of several factors that influence the use of TikTok as a rhyming learning tool were also found in terms of supporting factors, Piaget's cognitive learning theory (1972:15) asserts that students' active interaction with learning content can strengthen their understanding. In this context, the use of TikTok as a rhyming medium provides opportunities for students to be actively involved in creating creative content and expressing their ideas through short video formats. In addition, Deci and Ryan's (1985:32) motivational theory also supports this finding about enabling factors, because the use of TikTok offers intrinsic satisfaction for students through fun and meaningful learning experiences.

However, this study also identified several inhibiting factors in using TikTok as a rhyming medium in thematic learning. One of the inhibiting factors is limited access to technology and unstable internet connections in several areas (Berkowitz, 2020: 7). This can hinder students from fully participating in learning using TikTok. In addition, Vygotsky's constructivist theory (1978:86) also emphasizes the importance of social interaction in learning. However, some students may experience difficulties interacting online through TikTok, especially if they are not familiar with the social media platform or feel less confident about contributing actively. In addition, some teachers may also experience difficulties in integrating the use of TikTok in learning due to a lack of training and understanding of the platform's educational potential (Li, 2020:15). This can be an inhibiting factor in the application of TikTok as a rhyming medium in thematic learning.

Supporting factors include active student interaction and intrinsic satisfaction, which support cognitive and motivational learning theories. However, limited access to technology, social interaction, and teachers' knowledge of platforms can also be constraining factors, which are consistent with constructivist theories and social aspects of learning. Therefore, a deep understanding of these factors is important in planning and implementing the use of TikTok as an effective rhyming medium in thematic learning at the elementary school level.

## **IV. CONCLUSION**

This study shows that TikTok can be effectively used as a rhyming medium in thematic learning at SD Negeri 3 Duwet Tumpang Malang. The use of TikTok has a positive impact on student motivation and participation in learning. Students experience positive experiences in using TikTok as a rhyming medium, which increases their engagement and activity. Supporting factors such as support from teachers and classmates, accessibility of technology, and student creativity influence the use of TikTok as a learning medium. However, technical constraints and time constraints hindered the use of TikTok. Recommendations based on the results of this study are to expand the use of TikTok as a rhyming medium in thematic learning in other schools and consider the technical aspects and time required for effective implementation.

## Tiktok as Rhyming Media in Thematic Learning Platform: Phenomenological Study at SD Negeri 3 Duwet Tumpang Malang

### REFERENCES

- 1) Aji, W.N. & Setiyadi, D.B.P. (2020). Aplikasi Tik Tok sebagai Media Pembelajaran Keterampilan Bersastra. *Metafora: Jurnal Pembelajaran Bahasa dan Sastra*, 6(1), 147-157.
- 2) Aji, W.N. (2018). Aplikasi TikTok sebagai Media Pembelajaran Bahasa dan Sastra Indonesia. *Pertemuan Ilmiah Bahasa dan Sastra Indonesia (PIBSI) XL*, ISBN: 978-602-6779-21-2, 431-440.
- 3) Bandura, A. (1977). *Social learning theory*. Englewood Cliffs, NJ: Prentice Hall.
- 4) Berkowitz, L. (2020). *Aggression: Its causes, consequences, and control*. New York, NY: Springer Publishing Company.
- 5) Dewey, J. (1938). *Experience and education*. New York, NY: Macmillan.
- 6) Ebbinghaus, H. (1885). *Memory: A contribution to experimental psychology*. Leipzig, Germany: Duncker & Humblot.
- 7) Faradila, S.P., & Aimah, S. (2018). Analisis Penggunaan Media Pembelajaran untuk Meningkatkan Minat Belajar Siswa di SMA N 15 Semarang. *Prosiding Seminar Nasional Mahasiswa Unimus*, Vol. 1.
- 8) Ferstephanie, J., & Pratiwi, T.L. (2022). The Effect of TikTok to Develop Students' Speaking Skill: A Classroom Action Research. *Wiralodra English Journal (WEJ)*, 6(1), 1-12.
- 9) Giorgi, A. (2009). *The Descriptive Phenomenological Method in Psychology: A Modified Husserlian Approach*. Duquesne University Press.
- 10) Hidayah, N. (2015). Pembelajaran Tematik Integratif di Sekolah Dasar. *TERAMPIL: Pendidikan dan Pembelajaran Dasar*, 2(1), 34-59.
- 11) Husserl, E. (1962). *Ideas: General Introduction to Pure Phenomenology*. Collier Books.
- 12) Jacobs, A., Yu-Chun, P., & Yen-Chen, H. (2022). More than just engaging? TikTok as an effective learning tool". *UK Academy for Information Systems Conference Proceedings 2022*. 3.
- 13) Jonassen, D.H. (1991). Objectivism versus Constructivism: Do We Need a New Philosophical Paradigm? *Educational Technology Research and Development*, 39(3), 5-14.
- 14) Kamaruddin, N.F. (2022). Fenomena Media Sosial terhadap Minat Belajar Siswa Sekolah di Era Digitalisasi. *Al-Din: Jurnal Dakwah dan Sosial Keagamaan*, 8(2), 39-53.
- 15) Karli, H. (2016). Penerapan Pembelajaran Tematik SD di Indonesia. *EduHumaniora: Jurnal Pendidikan Dasar*, 1(2), 1-11.
- 16) Khotimah, H., Supena, A., & Hidayat, N. (2019). Meningkatkan attensi belajar siswa kelas awal melalui media visual. *Jurnal Pendidikan Anak*, 8(1), 17-28.
- 17) Kusumandaru, A.D., & Rahmawati, F.P. (2022). Implementasi Media Sosial Aplikasi TikTok sebagai Media Menguatkan Literasi Sastra dalam Pembelajaran Tematik di Sekolah Dasar. *Jurnal Basicedu*, 6(3), 4876-4886.
- 18) Li, C. (2020). The role of metacognition in language learning. *Language Teaching Research*, 24(3), 311-332.
- 19) Magdalena, I., Shodikoh, A.F., Pebrianti, A.R., Azzahra Wardatul Jannah, A.W., & Susilawati, I. (2021). Pentingnya Media Pembelajaran untuk Meningkatkan Minat Belajar Siswa SDN Meruya Selatan 06 Pagi. *EDISI: Jurnal Edukasi dan Sains*, 3(2), 312-325.
- 20) Mayer, R.E. (2005). Principles of Multimedia Learning. In R.E. Mayer (Ed.), *The Cambridge Handbook of Multimedia Learning* (pp. 183-206). Cambridge: Cambridge University Press.
- 21) Muklis, M. (2012). Pembelajaran Tematik. *FENOMENA*, 4(1), 63-76.
- 22) Nasa, N.A., & Rizal, M.S. (2022). Fabel Bahan Literasi Anak dalam Pembelajaran Tematik Kelas 5 SDN Mragel Lamongan. *Pendas: Jurnal Ilmiah Pendidikan Dasar*, 7(2), 477-490.
- 23) Nurfadhillah, S., Ulfah, M., Nikmah, S. Z., & Fitriyani, D. (2021). Peranan Media Pembelajaran dalam Meningkatkan Minat Siswa serta Memotivasi Belajar Siswa Kelas 3 SDN Kohod III. *BINTANG: Jurnal Pendidikan dan Sains*, 3(2), 260-271.
- 24) Nurfajariyah, A.F., & Kusumawati, E.R. (2023). Implementasi dan Tantangan Pembelajaran Tematik Terintegrasi Steam (Science, Technology, Engineering, Arts, Mathematics). *Jurnal Lentera Pendidikan Pusat Penelitian LPPM UM METRO*, 8(1), 49-63.
- 25) O'Connor, M.P. (Tanpa tahun). A Qualitative Study of Students with Behavioral Problems Participating in Service-Learning. *Journal of the American Academy of Special Professionals*.
- 26) Piaget, J. (1972). *The psychology of the child*. New York, NY: Basic Books.
- 27) Pujiono, A. (2021). Media Sosial sebagai Media Pembelajaran bagi Generasi Z. *Didaché: Journal of Christian Education*, 2(1), 1-19.
- 28) Purnami, W.H. (2022). The Language Use in TikTok Social Media as A Means of Entertainment for the Community. In N. Haristiani et al. (Eds.): *ICOLLITE 2022, ASSEHR 722*, pp. 637-642, 2022.



## Tiktok as Rhyming Media in Thematic Learning Platform: Phenomenological Study at SD Negeri 3 Duwet Tumpang Malang

- 29) Rahmana, P.N., Putri, D.A., & Damariswara, R. (2022). Pemanfaatan Aplikasi TikTok sebagai Media Edukasi di Era Generasi Z. *Akademika: Jurnal Teknologi Pendidikan*, 11(2), 401-410.
- 30) Rahmawati, Y., & Anwar, K. (2022). The Use of Tiktok Application: The Impact on Students' Vocabulary and Attitude. *PROJECT: Professional Journal of English Education*, 5(3), 610-621.
- 31) Riwanti, R., & Hidayati, A. (2019). Pengembangan Modul Pembelajaran Tematik Berbasis Pendidikan Karakter di Kelas V Sekolah Dasar. *Jurnal Basicedu*, 3(2), 572-581.
- 32) Sarnoto, A., Hidayat, R., Hakim, L., Alhan, K., Sari, W., & Ika, I. (2023). Analisis Penerapan Teknologi dalam Pembelajaran dan Dampaknya terhadap Hasil Belajar. *Journal on Education*, 6(1), 82-92.
- 33) Skinner, B. F. (1968). *The technology of teaching*. New York, NY: Appleton-Century-Crofts.
- 34) Sternberg, R. J. (2003). *Wisdom, intelligence, and creativity synthesized*. Cambridge, UK: Cambridge University Press.
- 35) Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.
- 36) Wangid, M.N., Mustadi, A., Erviana, V.Y., & Arifin, S. (2014). Kesiapan Guru SD dalam Pelaksanaan Pembelajaran Tematik-Integratif pada Kurikulum 2013 di DIY. *Jurnal Prima Edukasi*, 2(2), 175-182.
- 37) Yélamos-Guerra, M.S., García-Gámez, M., & Moreno-Ortiz, A.J. (2022). The use of TikTok in higher education as a motivating source for students. *Porta Linguarum*, 38(1), 83-98.
- 38) Zulkifli, N.N., Letchumanan, M., Kamarudin, S., Halim, N.D.A., & Hashim, S. (2022). A Review: The Effectiveness of Using TikTok in Teaching and Learning. *Proceedings of the 30th International Conference on Computers in Education*. Asia-Pacific Society for Computers in Education, 292-297.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## A Comprehensive Review of FACTS Controllers in Nigeria Power Systems Network for Enhanced Performance on Variable Loads



Joshua Odion<sup>1</sup>, Chukwu F. Nelson<sup>2</sup>, Aniekan B. Inyang<sup>3</sup>, Andikan K. Ekpa<sup>4</sup>, Uduak J. Essien<sup>5</sup>

<sup>1</sup>Department of Instrumentation and Control, Total Energies Limited, Port Harcourt, Nigeria

<sup>2</sup>Department of Electrical and Electronic Engineering, Akwa Ibom State University, Ikot Akpaden, Nigeria

<sup>3,4,5</sup>Department of Electrical/Electronic, Akwa Ibom State Polytechnic, Ikot Osurua, Nigeria

**ABSTRACT:** Interest on FACTS controllers in the scientific and engineering community have increased due to their high reliability, low cost, and absence of infrastructural overhauling. In the context of global sustainability, it is required that FACTS controllers must fulfill physical, technological, and environmental requirements, through design and optimization studies. This study provides a comprehensive evaluation of the state-of-the-art technologies relevant to multi-objective optimization and performance analysis of FACTS controllers. Types, general overview, FACTS deployed in the Nigerian power systems and multi-objective location optimization and their impact were discussed. Several efficient optimization strategies from recent research works are highlighted and compared, showing that there are research gaps on the integration of advanced control algorithms and use of robust optimization methods.

**KEYWORDS:** FACTS controllers, enhanced performance, variable loads, optimization strategy, location optimization

### I. INTRODUCTION

The rising energy demand due to advancement in technology and population growth throughout the country in recent time as forecasted in (Nkan & Okpo, 2016), have resulted to expansion of power generation harnessed from several sources. Irregularity in power demands due to varying loads have significant impacts on the voltage profile, dynamic performance and stability of the grid frequency, particularly on inductive loads such as induction machines which have wide applications in commercial homes and industrial settings. These problems compromise the optimal performance of power system network. It becomes imperative to explore advance strategies to compensate the poor performance of power system equipment so as to enhance dynamic performance and system stability. Flexible alternating current transmission systems (FACTS) are power electronic devices to improve the power transfer capacity and controls in conventional AC transmission networks. Their application enhances power transfer capability, which improves the voltage stability, transient stability, voltage regulation, network reliability, and thermal limits. Prior to the advent of power electronics switches, challenges in power system were traditionally addressed by employing capacitor, reactor, and synchronous generator facilitated by mechanical switches. This posed serious issues such as slow response time and susceptibility to wear and tear in power system equipment. The conventional methods are unreliable for enhancing the controllability and stability of the transmission lines. Introduction of power electronic switches, such as Thyristors suitable for high-voltage applications, leads to the development of power electronic-based FACTS controllers. In power system network, effective coordination between the generation and electric power demand is imperative, due to the escalating demand for electrical energy. To meet this growing demand, optimizing the operation of all components at their maximum capacity becomes essential (Rao, Amarnath, and Rao, 2014; Abunike, Umoh, Nkan, & Okoro, 2021; Okpo, Okoro, Awah, & Akuru, 2020; Okoro, Abunike, Akuru, Awah, Okpo, Nkan, Udenze, Innocent, & Mbunwe, 2022; Okpo, Okoro, Akuru, & Awah, 2019). Extensive review on various categories of electrical power system including active, reactive and apparent power and their impacts on power system network was discussed in (Liu, Heydt, & Edris, 2002; Omorogiuwa & Okpo, 2015; Williams, Okpo, & Nkan, 2023; Edifon, Nkan, & Ben, 2016). To ensure stability in power system network, the capacitive and inductive reactive power must be in equilibrium. This is achieved through compensation techniques (Farahmand, Rashidinejad, Gharaveici, & Shojaee, 2006; Nelson & Odion, 2023; Innocent, Nkan, Okpo, & Okoro, 2021; Hu, Xiang, Zhang, Liu, Wang, & Hong, 2019). Studies in (Prajapati & Gandhi, 2018; Zhang, Hu, Xu, & Yan, 2015; Innocent, Nkan, Okpo, & Okoro, 2021; Ezeonye, Okpo, Nkan, & Okoro, 2020),

## A Comprehensive Review of FACTS Controllers in Nigeria Power Systems Network for Enhanced Performance on Variable Loads

categorizes various FACTS devices according to types of connections and their compensation techniques, grouping them into series and shunt compensators.

### A. Series Compensation

Series compensator devices are used to improve the available transfer capability (ATC) in high voltage and extra high voltage transmission networks. The integration of series compensator decreases the phase angle between voltage and current and significantly improves the system stability. Shown in Fig. 1 is the diagram of series compensated transmission line.

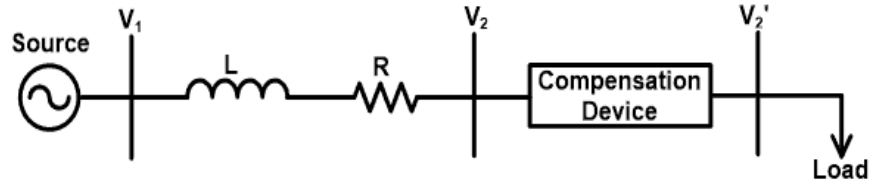


Fig 1. Series compensator (Farahmand *et al*, 2006)

### B. Shunt Compensation

Shunt compensation techniques are deployed in overloaded transmission networks to boost or bulk the voltage as required. The reactive power demand is established by the line capacitance and high demand of reactive power will amount to significant drop in voltage. This necessitate the incorporation of capacitor banks at the receiving end of the transmission lines to boost the voltage. However, under light loads condition, the reactive power increases leading to imbalance in sending end and receiving end voltage. This can be controlled by introducing a shunt reactor. The shunt compensated power system network is represented in Fig. 2.

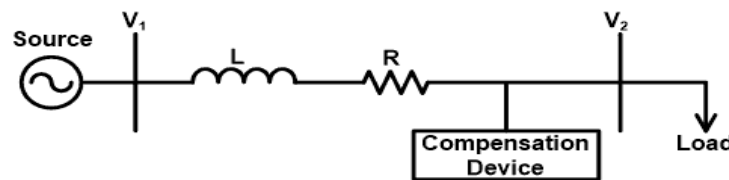


Fig. 2. Shunt compensator diagram (Zhang *et al*, 2015)

FACTS controllers are basically classified according to connections as depicted in Fig. 3.

- i. Series connected controller
- ii. Shunt connected controller
- iii. Combined series-series controller
- iv. Combined shunt-series controller

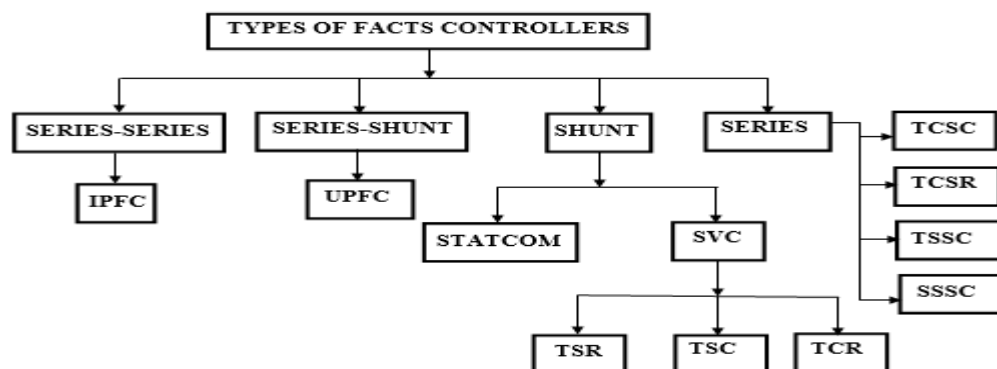


Fig. 3. Types of FACTS devices

- i. Series connected controller

This consist of capacitors or reactors used to control variable reactive power in the transmission network. It induces voltage in series with the line voltage and the capacitor bank are usually introduced at the receiving end to compensate for voltage drop while reactors are introduced when there is less demand for reactive power (Sinha, Karan, & Singh; Awah, Okoro, Nkan, & Okpo, 2022; Ezeonye, Nkan, Okpo, & Okoro, 2022). The diagram of series compensated transmission network is represented in Fig. 4.

# A Comprehensive Review of FACTS Controllers in Nigeria Power Systems Network for Enhanced Performance on Variable Loads

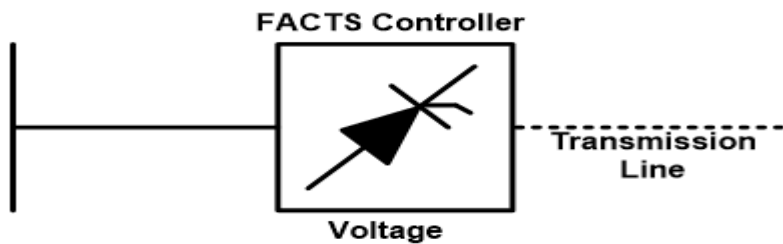


Fig. 4. Series Connected FACTS controller (Xiao et al 2000)

The various types of series connected controllers includes: Thyristor Controlled Series Capacitor (TCSC), Thyristor Controlled Series Reactor (TCSR), Thyristor Switched Series Capacitor (TSSC) and Static Synchronous Series Compensator (SSSC). The diagrams of the basic types of series FACTS controllers are presented in Table 1.

Table 1. Types of Series FACTS Controllers

Series Connected FACTS Controllers	Symbols
Thyristor Controlled Series Capacitor (TCSC)	
Thyristor Controlled Series Reactor (TCSR)	
Static Synchronous Series Compensator (SSSC)	

## ii. Shunt connected controller

This controller shares similar characteristics with the series connected controller. It consists of capacitors and inductors use for reactive power control in the power system network. When the transmission line is inductive, it operates on a lagging power factor to ensure system stability (Xiao, Song, & Sun; Oduleye, Nkan, & Okpo, 2023; Edifon, Nkan, & Macaulay, 2016). The diagram of static connected FACTS is shown in Fig. 5.

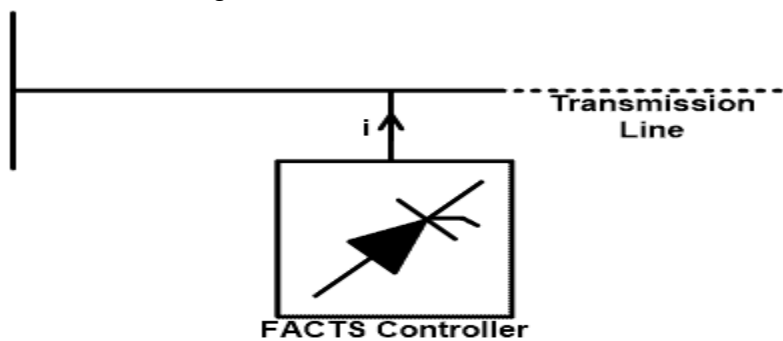


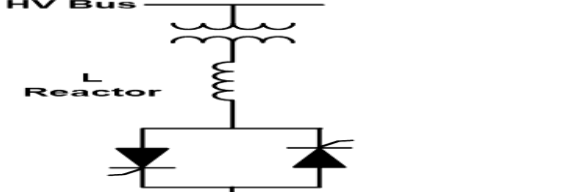
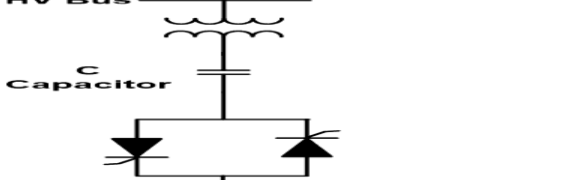
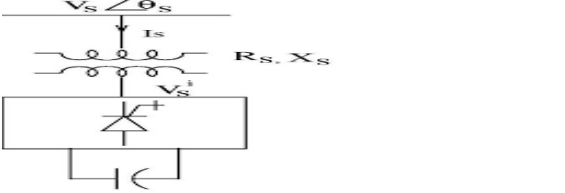
Fig. 5. Static connected FACTS

The various types of shunt FACTS controllers respectively deployed in the power system network includes: Static Var Compensator (SVC), Thyristor Control Reactor (TCR), Thyristor Switched Capacitor (TSC), Thyristor Switched Reactor (TSR), Static Synchronous Compensator (STATCOM). Shown in Table 2 is the various types of shunt connected FACTS controllers.

Table 2. Types of Shunt connected FACTS Controllers

Shunt connected FACTS Controllers	Symbols
Static Var Compensator	

# A Comprehensive Review of FACTS Controllers in Nigeria Power Systems Network for Enhanced Performance on Variable Loads

Thyristor Controlled Reactor	
Thyristor Switched Capacitor	
Static Synchronous Compensator	

### iii. Series-series controller

This controller finds application in multi lane transmission lines. A combination of series controllers in a coordinated manner provides independent series reactive compensation for each line. Reactive power also can be transferred through power link or connected through unified controller interlinked with the DC terminals of the converters. This enable real power transfer within the transmission network. Shown in Fig. 6 is the diagram of combined series-series FACTS controller (Yao, Cartwright, Schmitt, & Zhang, 2005; Okpo & Nkan, 2016).

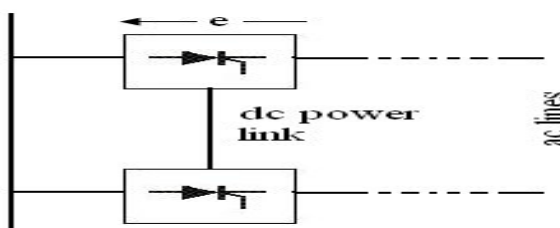


Fig. 6. Series-Series Compensator (Edifon *et al*, 2016)

A typical example of this FACTS controller is Interline Power Flow Controller (IPFC) represented in Fig. 7.

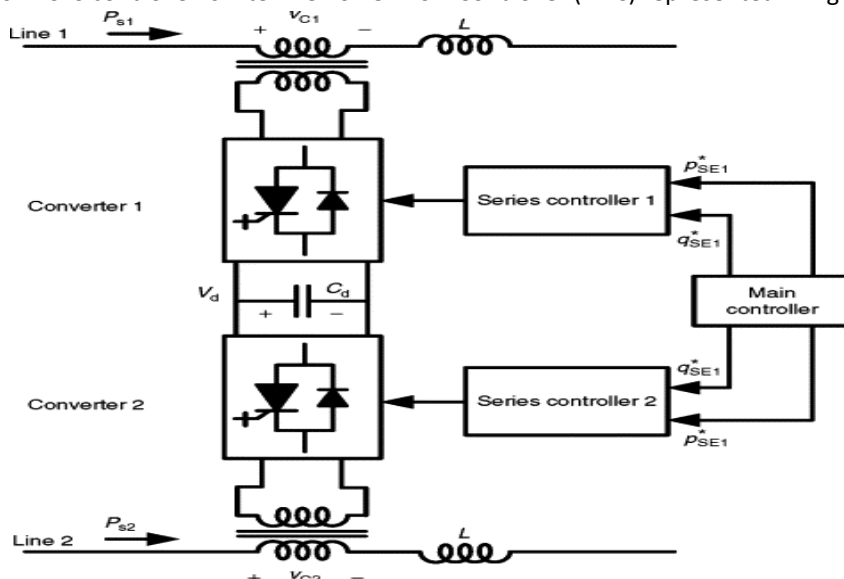


Fig. 7. Interline Power Flow Compensator (Okpo & Nkan, 2016)

## A Comprehensive Review of FACTS Controllers in Nigeria Power Systems Network for Enhanced Performance on Variable Loads

### iv. Shunt-series controller

This consist of shunt and series controllers operating in a coordinated manner. It is used for current and voltage control. Figure 8 represents a combined shunt-series FACTS controller.

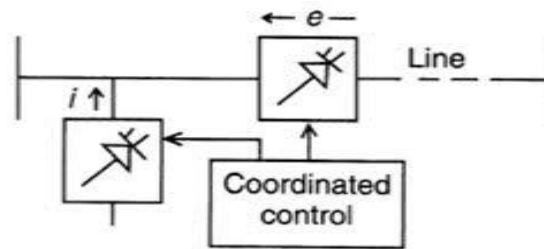


Fig. 8. Combined shunt-series FACTS (Edifon *et al*, 2016)

Example of this FACTS controller is the Unified Power Flow Controller. It controls the real and reactive power of the transmission line and function only on balance 3-phase systems. It is represented in Fig. 9.

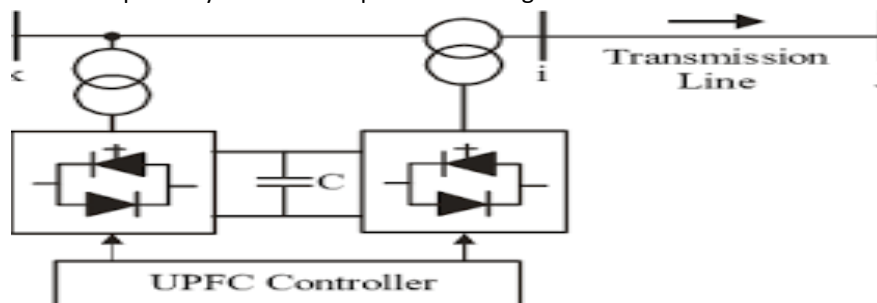


Fig. 9. UPFC FACTS (Zhang & Yokoyama, 2007)

## II. OVERVIEW OF FACTS CONTROLLERS

The complexity of power system network requires a large scale control models so as to ensure optimal power flow within the power system network. Power system stabilizers integrated with excitation control system for synchronous generators, provides solution to this challenge by enhancing power system stability and reliability. Flexible alternating current transmission system (FACTS) significantly improve the dynamic performance and stability of the power system network. The investigation on performance of power system network when Fractional Order Fish Migration Optimization (FOFMO) algorithm utilizing fractional calculus (FC) theory, was deployed for dynamic regulation of the non-linear controller, showed significant improvement in control accuracy and the dynamic characteristics of a controlled power system (Fathollahi & Andresen, 2023). Due to increase in energy demand, modern power system is designed to accommodate distributed generators (DGs) and flexible alternating current transmission system (FACTS) controllers to improve the voltage profile and provides compensation effects for active and reactive power losses. The comprehensive review on various FACTS controllers deployed in power system network to improve the power quality and the Significant impacts on the grid studied in (Singh, Payasi, & Shukla, 2017; Kavitha, 2023; Singh, Verma, Mishra, Maheshwari, Srivastava, & Baranwal, 2012), deployed advanced techniques such as Hybrid techniques and multitask objectives for optimal placement of distributed generators (DGs) and FACTS controllers to enhance the performance of the power system network. Technology advancement have resulted to the innovation of environmental friendly transport system known as the electric vehicle (EVs). This necessitate studies on the impact EVs have on the power system network and optimal placement of electric vehicles (EVs) charging stations at strategic locations to enhance stability of the radial distribution system (RDS), due to their increase usage in order to enhance their safe operation. The revolutionary meta heuristics optimization provides solution to the challenges encountered during strategic placement of DSTATCOM and DGs using the Bald eagle search algorithm (BESA). The proposed system was validated using the two network bus system (34-bus system and 118- bus system), with the outcome showing a notable improvement in the overall system performance. This make BESA a good alternative for loss reduction in radial distribution system (Yuvarah, Devabalaji, Thanikanti, Aljafari, & Nwulu, 2023). Faults in power system network leads to severe contingencies necessitating proper evaluation of the fault magnitude so as to ensure the system reliability and safe operation within prescribed limit. The steady state contingency analysis of single (N-1) contingencies of IEEE 39-bus system using Newton Raphson method demonstrated in PSS/E software, presents a promising solution to most of these severe contingencies (Rehman, Farooq, Ahmad, Khan, Haq, Ayaz, & Saad, 2023; Nakiganda, Catherine, & Spyros, 2023). The present study is therefore significant as it will carry out an extensive review on various FACTS controllers

## **A Comprehensive Review of FACTS Controllers in Nigeria Power Systems Network for Enhanced Performance on Variable Loads**

deployed in power system networks and explore their significant impacts towards improving the power system parameters such as voltage profile, power quality, reduction of active power losses, dynamic performance and power system stability. Also this study will explore the FACTS devices already deployed in Nigerian power system network.

FACTS controller may be defined as an intelligent electronic device that is optimally positioned or placed within power system networks which dynamically adjust the system voltage profile, impedance and phase angle for enhancement of grid stability and power quality. There are various types of FACTS controllers used in power system networks. The study in (Singh, Verma, Mishra, Maheshwari, Srivastava, & Baranwal, 2012), classified them under two major headings namely Thyristor controlled based FACTS and voltage source inverter FACTS controllers. Examples of the former includes TSC, TCR, FC-TCR, SVC, TCSC, TC-PAR etc. While the later includes SSSC, STATCOM, UPFC, GUPFC, IPFC, GIPFC, HPFC etc. Congestion in Power system network and poor penetration of renewable sources remain a significant focal point to power system engineers. However, the combination of FACTS controllers with transmission network expansion planning (TNEP) can remedy solution to these problems. Advance strategy to control Irregularity in power flow is a factor to consider when FACTS controllers are deployed. The study in (Wu, Tanneau, & Henthenryck; Labeled, Zellagui, Benidir, Sekhane, & Tebbakh, 2023) proposed mixed-integer linear programming (MILP) known as the extended formulation and particle swarm optimization method to address the problem of congestion in power system network and to mitigate active power losses and improvement of the voltage profile in a standard IEEE 33 bus radial distribution network. The first and second generation of FACTS controllers deployed in the power system network presents some drawbacks that includes: Increased cost, bulky size and reliability issues leading to poor dynamic performance of the electric grid and reduction in power quality. The first generation includes: static Var compensator (SVC), Thyristor controlled series compensator (TCSC), Thyristor controlled phase shifting transformer (TCPST), and the second generation FACTS controllers includes: SSSC, STATCOM, UPFC and IPFC. Modern FACTS controllers address these challenges. Distributed FACTS controllers such as the enhance power flow controller (EPFC) studied in (Dhaked & Lalwani, 2017; Rao & Rao, 2015; Madhuranthaka & Manohar, 2016) depict some high qualities which addresses the gaps observed in previous generations of FACTS controllers. The study conducted in a particular loaded transmission line in the Ethiopian power system network, showed significant improvement in dynamic performance and stability of the power system when FACTS controllers such as SVC, TCSC, and UPFC were respectively deployed into network to reduce the real power losses, improve the voltage profile and transient stability. The real power losses reduced to 9.54%, 37.24%, and 37.47% respectively (Adama, 2021; Kumar, Kumer, Srirambabu, & Nagulmeera, 2014). Comparative assessment of the cost incurred when the conventional method utilizing multi-machine system and modern methods utilizing FACTS controllers specifically, static VAr Compensator (SVC), Thyristor Controlled Series Capacitor(TCSC), Thyristor Controlled Voltage Regulator(TCVR), and Thyristor Controlled Phase Shifting Transformer (TCPST) for active and reactive power control was discussed in (Alabduljabbar & Milanovic, 2010; Sahu, Jhapse, & Sahu, 2015; Raval & Dwivedi, 2013). The study outcome after calculating the net present value revealed that FACTS controllers do not only have less cost in power generation but also improve the power transfer in power system network. The fuzzy c-means clustering technique together with initially estimated cluster identification criterion was used for optimal location of the voltage control area (VCAs) and placement of the SVC controller in (Garrido, Tellez, & Ortiz, 2023). The proposed technique was tested on 14-node and 30-node scheme to determine its proficiency. In order to facilitate cost saving, the linear voltage stability index (LVSI) was utilized for the arrangement of the compensators. The study outcome showed great improvement in the voltage profile when SVC was optimally placed. The study in (Mirsaeidi, Devkota, Wang, Tzeleipsis, Abbas, Alshahir, & He, 2023; Beikbabaei & Mehrizi-sani, 2023; Sanchez-Mora, Villa-Acevedo, & Lopez-Lezama, 2023; Abderrahmane, M'hamdi, Mahammedi, Moussa, & Elbar, 2023) compared the major attributes and drawbacks of the traditional techniques used in enhancing the power system quality: optimal reactive power dispatch (ORPD), and the MOTH flame and grasshopper optimization algorithm (GOA). The outcome showed that UPFC and GUPFC have a better performance due to their high sensitivity and voltage regulation. Comprehensive study guiding the selection of ideal FACTS controllers, based on specific need in the power system network using PSO, Genetic algorithm (GA), Brainstorming Optimization Algorithm (BSOA), Gravitational Search Algorithm (GSA), Moth Flame Algorithm (MFA), Imperialistic Competitive Algorithm (ICA), and Adaptive Cuckoo Search Algorithm (ACSA), was conducted in (Gaur & Mathew, 2023; Bhole & Nigam, 2015; Ghaffarzadeh, Marefatjou, & Soltain, 2012; Bharathi & Rajan, 2011). The study conducted in (Gupta & Mallik, 2022; Divya, Prakash, & Bhaskar, 2018; Cakir & Radman, 2013), used the contingency ranking together with the degree centrality methods, leveraging novel FACTS controllers into the power system network, residue factor method to optimally placed the FACTS controller in the power system. Voltage stability critically index method was used to optimally place STATCOM, SSSC and UPFC. The study in Shahgholian & Faiz, 2010; Bhande & Chandrakar, 2013; Hemallath; Fughar & Nwohu, 2014) explored extensively, STATCOM controllers, including plant, modelling, operation aspects, control fundamentals, and performance evaluation. The study also cover optimal method of placing STATCOM in the power system network. Three models

## **A Comprehensive Review of FACTS Controllers in Nigeria Power Systems Network for Enhanced Performance on Variable Loads**

of the STATCOM device were also presented. This facilitate a comprehensive understanding on functionalities of STATCOM FACTS controllers and effective method of placement. Energy crisis is a significant challenge faced by power system engineers resulting to the rising demand in energy consumption from the distribution sector. FACTS controllers including SVC, SSSC, UPFC, and IPFC ameliorate these issues. The unified power flow controllers (UPFC) emerges as a more viable solution due to its versatility in real and reactive power control and voltage regulation, offering an effective means to mitigate the energy crisis and improved overall system performance. The proposed system was validated in MATLAB-Simulink (Khan, Narasimhegowda, Mohan, & Manjunatha, 2014). A comprehensive review carried out in (Dixon, Moran, Rodriguez, & Domke, 2005), delves into the reactive power control, operational principles, design characteristics and practical applications of VAR compensators implemented using Thyristors, and self-commutated converters. Studies in (Ameh & Onyedikachi, 2018; Mohammed & Abdul-Rahim, 2004; Nguyen, Le, Phan, & Nguyen, 2023; Olana, 2021), carried out an intensive research on the root cause of voltage instability and voltage drop emanating from the active and reactive power demand within the power system transmission network using Coot bird behavior-based optimization algorithm (COOTBA) and PSAT in MATLAB environment. The study in (Tolba, Houssein, Ali, & Hashim, 2023; Fawzy, Abd-Raboh, & Eladi, 2023; Agrawal, Bharadwaj, & Kothari, 2016; Rehman, Koondhar, Ali, Jamali, & El-Sehiemy, 2023), deployed novel methods to improve the system performance. This is the modified capuchin search algorithm (mCapSA), bilevel multi-objective musical chairs optimization algorithm, and meta-heuristic method to mitigate transmission losses and enhance overall efficiency. In order to mitigate severe contingencies in power system network, the study in (Iranmanesh & Rashid-Nejab, 2013), deployed real genetic algorithm (RGA) optimization with evaluation of RGA fitness function which was conducted and verified in the IEEE 5 bus test system.

### **III. FACTS CONTROLLERS DEPLOYED IN NIGERIAN POWER SYSTEMS**

FACTS deployed in Nigerian power system network plays a crucial role in enhancing grid stability and control. They provide real-time adjustment to voltage and reactive power, helping to mitigate voltage instability and power oscillations. The ant colony optimization algorithm technique presents tactical approach towards optimal placement of STATCOM device in the Nigerian 330 kV network. It has the capacity to decode the STATCOM parameters using some mathematical models for optimal location and placement of the STATCOM device (Fughar & Nwohu, 2014). Three FACTS controllers namely TCSC, UPFC and IPFC were respectively deployed in NEPLAN, using the continuation power flow (Natala, Nkan, Okoro, & Obi, 2023), improve proposed applicable technique. The outcome showed that UPFC outperformed TCSC and IPFC. The MATLAB code extracted was used to determine the available transfer capability with and without FACTS. Novel methods to alleviate stress in the power system network due to overloading condition caused by the rising population and advancement in technology was carried out in (Oleka, Ndubisi, & Ijamaru, 2016; Nkan, Okpo, & Okoro, 2020; Ayodele, Ogunjuyigbe, & Oladele, 2016) using voltage stability sensitivity factor (VSSF) in PSAT environment and the step-by-step approach to enhance performance of the Nigerian 330kV electric power grid. The application of FACTS devices for the enhancement of transient and steady state stability in the Nigerian 48-bus power system network was discussed in (Nkan, Okoro, Obi, Awah, & Akuru, 2019; Nkan, Okoro, Awah, & Akuru, 2019; Adebisi, Adejumobi, Ogunbowale, & Ade-Ikuesan, 2018) using continuation power flow. SVC, STATCOM, and SSSC were respectively deployed to determine the response of the system when three phase fault was introduced. Voltage stability is a prerequisite for enhancement of power quality. Studies in (Folorunso, Osuji, & Ighodaló, 2014; Ugwuanyi, Uma, & Ekwue, 2021) investigated this problem using modal sensitive analysis to identify the fault-sensitive locations and respective generators involved. The study conducted in (Nkan, Okpo, & Inyang, 2023; Ambafi, Nwohu, Ohize, & Tola, 2012; Bakare, Aliyu, Haruna, & Abu, 2012; Sanni, 2014), focused on the Nigerian 48-bus power system utilizing PSAT software in MATLAB to examine the response of the generator parameters when a three phase fault was applied on Bus 33 and the TCSC optimally placed on line 21-28 using continuation power flow, small population-based particle swarm optimization (SPPSO) for optimal tuning of Unified Power Flow Controllers (UPFC), and python programming using the application programming interface (API) to enhance the voltage profile, power flow along lines, and the damping of the power system oscillations. The investigation on the dynamic control capabilities of UPFC in enhancing system security, by optimizing its placement using the differential evolution (DE) technique was conducted in (Mustapha, Musa, Bakare, Bukar, Modu, Gwoma, Benisheikh, & Buji, 2017). This was applied to the IEEE14 bus power system using MATPOWER. The outcome showed robustness of the UPFC in minimizing real power losses and improving the voltage profiles under various steady state conditions. The conventional methods of addressing power system issues like reactive power imbalance and voltage instability on heavily loaded transmission lines presents significant challenges. Alternative approach to address such issues is by deploying FACTS devices to provide compensation to power oscillations. The investigation carried out in Nigerian 330kV transmission system using MATLAB, showed enhancement in the voltage magnitudes (Adeniji & Mbamaluikem, 2017; Oluwagbade, Wura, Adejumobi, & Mustapha, 2015; Nkan, Okpo, & Okpura, 2023; Essien, Odion, &



## A Comprehensive Review of FACTS Controllers in Nigeria Power Systems Network for Enhanced Performance on Variable Loads

Chukwu, 2023; Omoigui, Lawal, & Alao, 2017). Extensive review carried out in (Adepoju & Tijani, 2014; Amaize, Anthony, Claudius, & Abel, 2017; Ajabuego & Olubiwe, 2019), explored the accompanied benefits in deploying various FACTS controllers into the Nigerian 330kV transmission network. Emphasis are on the present challenges faced in the Nigerian power system network such as voltage instability, erratic power supply and security of supply which could be addressed by integration of various FACTS controllers into the power system network. The study in (Nkan, Okoro, Awah, & Akuru, 2019; Nkan, Okpo, Akuru, & Okoro, 2020) also carried out an investigation using static synchronous series compensator (SSSC) and Thyristor Controlled Series Compensator (TCSC), to enhance steady-state stability in the Nigerian 48-Bus power system network using the voltage stability sensitivity factor (VSSF) in all the buses after performing continuation power flow (CPF). A comparative study carried out in [97,98,99] assessed the performance of FACTS devices namely STATCOM and SSSC to address the challenge of voltage instability and power loss in the Nigerian 330 kV electric power grid using Newton Raphson power iterative algorithm. Effective mitigation measures to issues of voltage collapse phenomenon was explored in [100,101], using the fault tree method and heuristic approach to identify the weak buses in the Nigerian-26 bus system. The study in [102,103,104], deployed IPFC, STATCOM, HVDCVSC, and UPFC into the Nigerian 330 kV system to improve the voltage profile at the weak buses using GA, flexible alternating current transmission system power flow (FACTSPF), and small population-based particle swarm optimization (SPPSO) to adjust the bus voltage, transmission line reactance and the phase angle between two buses. The simulation conducted on the Nigerian grid system in the PSAT environment showed appreciable improvement in voltage profile, power flow, and damping of power oscillations with the installation.

### IV. MULTI-OBJECTIVE LOCATION OPTIMIZATION OF FACTS AND THEIR IMPACTS

The various methods use for optimal placement of FACTS in the reviewed literature and their significant impacts in the power system parameters is presented in the Table 3 and the summary in Table 4. The pie chart of Fig. 10 depicts the percentage application of the various optimization techniques employed in the placement of FACTS controllers in Nigeria.

**Table 3. Comparison of different optimization methods of FACTS controllers**

Ref	Optimization Method	Voltage Profile	Power Quality	Dynamic Stability	Voltage Stability	Power Transfer capability	Transient stability	Validation Method
[67]	CPF	No	No	No	No	Yes	No	Simulation
[10]	Dynamic Response	No	No	Yes	No	No	No	Simulation
[72]	VSSF and CPF	No	No	Yes	No	No	No	Simulation
[21]	Least square method	No	Yes	No	No	No	No	Analysis
[54]	Meta-Heuristic	Yes	No	No	No	Yes	No	Simulation
[70]	Step-by-step technique	No	No	Yes	No	No	Yes	Simulation
[73]	Newton Raphson	Yes	NO	No	No	Yes	No	Simulation
[77]	GA	No	No	Yes	No	No	No	Simulation
[75]	Modal analysis	No	NO	Yes	No	No	No	Simulation
[98]	SPPSO	Yes	No	Yes	No	Yes	No	Simulation
[80]	Differential Evolution	No	No	No	No	Yes	No	Simulation
[94]	SPEA	No	No	Yes	No	No	No	Simulation
[26]	BESA	Yes	No	Yes	No	Yes	No	Simulation
[24]	Fuzzy based approach	No	No	Yes	Yes	No	No	Simulation

## A Comprehensive Review of FACTS Controllers in Nigeria Power Systems Network for Enhanced Performance on Variable Loads

[28]	GNN	No	Yes	No	No	Yes	No	Simulation
[59]	COOTBA	No	No	No	Yes	Yes	No	Simulation
[43]	MFO and GOA	No	No	Yes	Yes	Yes	No	Simulation
[22]	FOFMO	No	No	Yes	Yes	No	Yes	Simulation
[45]	VSI	No	No	Yes	Yes	Yes	Yes	Simulation
[61]	mCapSA	Yes	No	No	No	Yes	No	Simulation
[62]	MCOA	No	Yes	No	Yes	No	No	Simulation
[65]	RGA	Yes	No	No	Yes	No	yes	Simulation
[50]	Residue Factor	No	No	Yes	Yes	Yes	No	Simulation
[62]	Musical chairs algorithm	No	Yes		Yes	Yes	No	Simulation

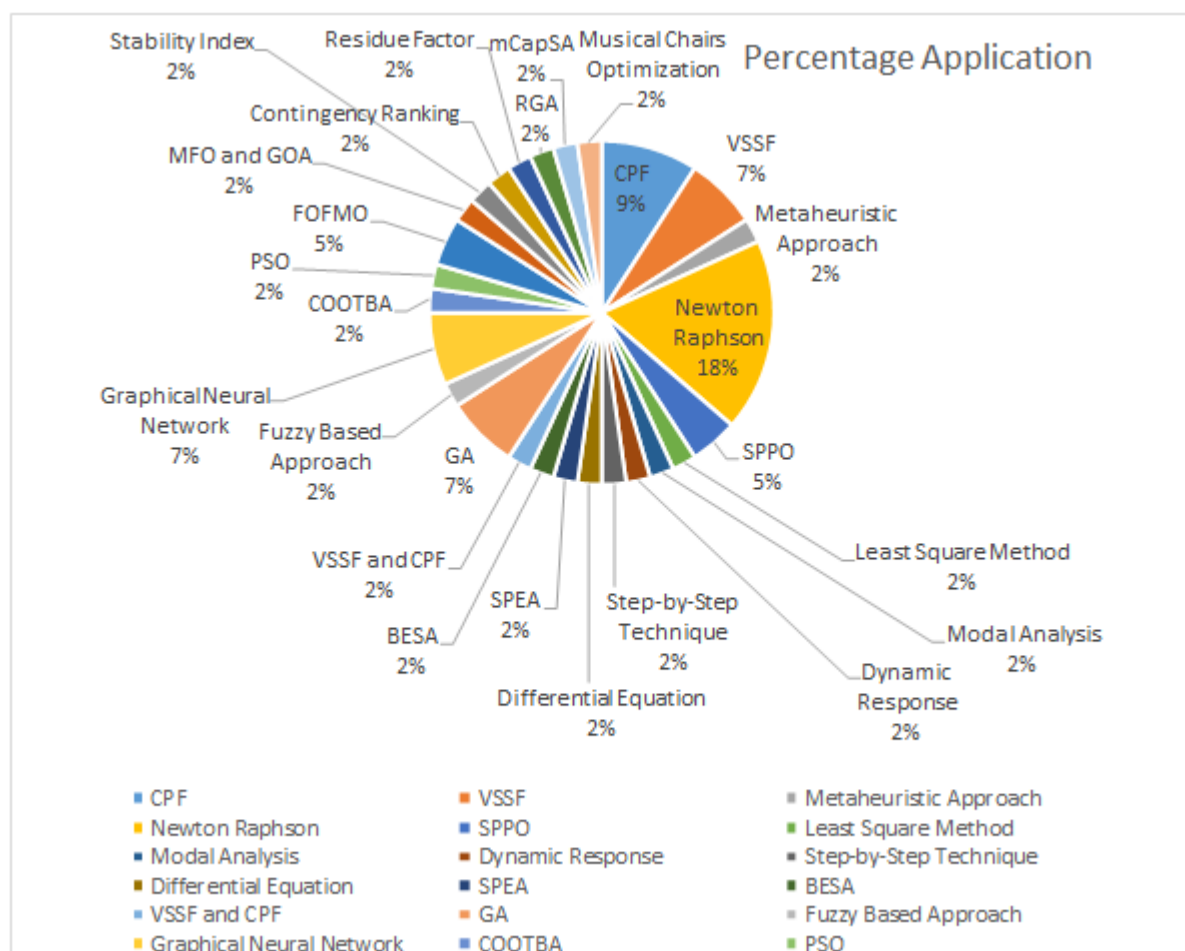


Fig. 10: Different optimization method used for placement of FACTS devices

Table 4. Summary of optimization methods and percentage application

Optimization Method	Percentage Application
Continuation power flow (CPF)	9
Dynamic Response	2
Voltage stability sensitivity factor and CPF	2
Least square method	2
Meta-Heuristic	2
Step-by-step technique	2

## A Comprehensive Review of FACTS Controllers in Nigeria Power Systems Network for Enhanced Performance on Variable Loads

Newton Raphson	18
Genetic Algorithm (GA)	7
Modal analysis	2
Small population particle swarm optimization (SPPSO)	5
Differential Evolution	2
Strength pareto evolutionary algorithm (SPEA)	2
Bald eagle search algorithm (BESA)	2
Fuzzy based approach	2
Graph neural network (GNN)	7
Coot bird behavior-based optimization algorithm (COOTBA)	2
MOTH flame optimization (MFO) and the grasshopper optimization algorithm (GOA)	2
Fractional Order Fish Migration Optimization (FOFMO)	5
Voltage stability index (VSI)	2
Modified capuchin search algorithm (mCapSA)	2
Musical chairs optimization (MCO)	2
Real genetic algorithm (RGA)	2
Residue Factor	2

### V. CONCLUSIONS

This work is a detailed overview of FACTS optimization methods employed in Nigerian power system in particular, including existing performance analysis strategies for reducing real and reactive power losses and improving the system steady state and dynamic stability. The results of several multi-objective optimization methods, including genetic algorithms, particle swarm optimization method etc, applied to the installation of FACTS, are explored and contrasted.

### REFERENCES

- 1) Abderrahmane, A., M'hamdi, B., Mahammed, A., Moussa, M. A., & Elbar, M. (2023). FACTS Devices Optimal Placement and Parameter Setting to Improve Power Network System Performance . *Semiconductor Optoelectronics* , 42(2), 368-386.
- 2) Aborisade, D. O., Adebayo, I. G., & Oyesina, K. A. (2014). A Comparison of the Voltage Enhancement and Loss Reduction Capabilities of STATCOM and SSSC FACTS Controllers . *American Journal of Engineering Research (AJER)*, 3(1), 96-105.
- 3) Abunike, C. E., Umoh, G. D., Okpo, E. E., & Okoro, O. I. (2020). A Comparative Approach for the Analysis of Switched Reluctance Motors with Modified Rotor Pole Geometry. *Nigerian Journal of Engineering*, 27(3), 2705-3954.
- 4) Abunike, E. C., Umoh, G. D., Nkan, I. E., & Okoro, O. I. (2021). Investigating the Magnetic Characteristics of 12/8 Switched Reluctance Motor for Enhanced Starting Torque. *Nigerian Journal of Technological Development*, 18(1).
- 5) Adama, O. (2021). Investigation of the Dynamic Stability and Performance of Koka-Dire Dawa [Eastern Region] HVAC Line with SVC, TCSC and UPFC. Haramaya: Haramaya University.
- 6) Adebisi, O. I., Adejumbi, I. A., Ogunbowale, P. E., & Ade-Ikuesan, O. O. (2018). Performance Improvement of Power System Networks Using Flexible Alternating Transmission Systems Devices: The Nigerian 330kV Electricity Grid As a Case Study . *LAUTECH Journal of Engineering and Technology*, 12(2), 46-55.
- 7) Adeniji, O. A., & Mbamaluikem, P. O. (2017). Voltage Stability Enhancement and Efficiency Improvement of Nigerian Transmission System Using Unifield Power Flow Controller. *American Journal of Engineering Research*, 6(1), 37-43.
- 8) Adepoju, G. A., & Tijani, M. A. (2014). A Survey of FACTS Controller Applications to Nigerian Transmission System. *International Academy of Science, Engineering and Technology*, 3(2).
- 9) Adepoju, G. A., Komolafe, O. A., & Aborisade, D. O. (2011). Power Flow Analysis of the Nigerian Transmission System Incorporating FACTS Controllers . *International Journal of Applied Science and Technology*, 1(5).
- 10) Agrawal, R., Bharadwaj, S. K., & Kothari, D. P. (2016). Simulation Tool for FACTS Controllers-"A Review". *International Journal of Development Research*, 6(4), 7409-7416.
- 11) Ajabuego, O. G., & Olubiwe, M. (2019). Comparative Analysis of Different FACTS Devices on Expanded Port Harcourt Network. *Intrnational Journal of Engineering Research and Technology (IJERT)*, 8(8), 290-295.

## **A Comprehensive Review of FACTS Controllers in Nigeria Power Systems Network for Enhanced Performance on Variable Loads**

- 12) Alabduljabbar, A. A., & Milanovic, J. V. (2010). Assessment of Techno-Economic Contribution of FACTS Devices to Power System Operation . *Electric Power Systems Research*, 80, 1247-1255.
- 13) Amaize, P., Anthony, A., Claudius, A., & Abel, A. (2017). A Review of the Applications of FACTS Devices on Nigerian 330kV Transmission System. *Journal of Engineering and Applied Sciences* , 12(20), 5182-5185.
- 14) Ambafi, J. G., Nwohu, M. N., Ohize, H. O., & Tola, O. J. (2012). Performance Evaluation of PSS and STATCOM on Oscillation Damping of a North-Central Power Network of Nigeria Grid System. *International Journal of Engineering and Technology* , 2(2), 209-219.
- 15) Ameh, B. V., & Onyedikachi, N. S. (2018). Review, Comparison and Similarities of Static Var Compensator (SVC) and Thyristor Control Series Series Capacitor (TCSC) With Other (FACTS) Devices . *Iconic Research and Engineering Journals*, 2(3).
- 16) Awah, C. C., Okoro, O. I., Nkan, I. E. & Okpo, E. E. (2022). Impact of structural dimensions and poles on the torque performance of dual-stator permanent magnet machines. *Nigerian Journal of Technological Development*, 19(1), 68-79.
- 17) Ayodele, T. R., Ogunjuyigbe, A. S., & Oladele, O. O. (2016). Improving the Transient Stability of Nigerian 330kV Transmission Network using Static Var Compensation Part 1: The Base Study. *Nigerian Journal of Technology (NIJOTECH)*, 35(1), 155-166.
- 18) Bakare, G. A., Aliyu, U. O., Haruna, Y. S., & Abu, U. A. (2012). Transient Enhancement of Nigerian Grid System Using Optimally Tuned Based on Small Population Particle Swarm Optimization. *Asian Journal of Natural and Applied Sciences* , 1(3), 79-89.
- 19) Bakare, G. A., Aliyu, U. O., Haruna, Y. S., & ABU, U. A. (2012). Transient Enhancement of Nigerian Grid System Using Optimally Tuned UPFC Based on Small Population Particle Swarm Optimization. 1(3).
- 20) Beikbabaei, M., & Mehrizi-Sani, A. (2023). Series FACTS Devices for Increasing Resiliency in Severe Weather Conditions. *energies*, 16(16).
- 21) Bhande, S. A., & Chandrakar, V. K. (2023). Enhancement of Power System Security by the Intelligent Control of a Static Synchronous Series Compensator . *Engineering, Technology and Applied Science Research* , 13(5), 11953-11958.
- 22) Bharathi, R., & Rajan, C. C. (2011). An Advanced Fact Controller for Power Flow Management in Transmission System Using IPFC. *International Conference on Process Automation Control and Computing* , (pp. 1-6). Coimbatore, India.
- 23) Bhole, S. S., & Nigam, P. (2015). Improvement of Voltage Stability in Power System by Using SVC and STATCOM. *International Journal of Advanced Research in Electrical Electronics and Instrumentation Engineering* , 4(2).
- 24) Cakir, G., & Radman, G. (2013). Placement and Performance Analysis of FACTS -CONTROLLERS (SVC and STATCOM for Damping Oscillation. *3rd International Conference on Electric Power and Energy Conversion Systems* , (pp. 1-5). Istanbul, Turkey.
- 25) Dhaked, D. K., & Lalwani, M. (2017). A Comprehensive Review on a D-FACTS Controller: Enhanced Power Flow Controller (EPFC). *International Journal of Advanced in Engineering and Technology*, 10(1), 84-92.
- 26) Divya, R., Prakash, S., & Bhaskar, C. (2018). Minimizing Power Losses and Power Quality Improvement Using FACTS Controllers Using DPFC. *International Journal of Pure and Applied Mathematics* , 118(18), 291-299.
- 27) Dixon, J., Moran, L., Rodriguez, J., & Domke, R. (2005). Reactive Power Compensation Technology, State-of-the-Art Review. *Proceedings of the IEEE* , 93(12), 2144-2164.
- 28) Edifon, A. I., Nkan, I. E., & Ben, I. A. (2016). Estimation and ranking of the photovoltaic energy potential for local government areas in Akwa Ibom State, Nigeria. *Science Journal of Energy Engineering*, 4(6), 68-77.
- 29) Edifon, A. I., Nkan, I. E., & Macaulay, E. U. (2016). Comparative analysis of the performance of different photovoltaic (PV) technologies based on PVsyst thermal model. *Science Journal of Energy Engineering*, 4(6), 62-67.
- 30) Essien, U. J., Odion, J., & Chukwu, N. F. (2023). Performance Evaluation of Optimally Placed SVC for Dynamic Stability of the Power System. *International Journal of Multi-Disciplinary Research and Analysis*, 6(11), 5120-5129.
- 31) Ezeonye, C. S., Okpo, E. E., Nkan, I. E., & Okoro, O. I. (2020). Effects of Saliency and Core Losses on the Dynamic Behaviour of Permanent Magnet Synchronous Motor. *Bayero Journal of Engineering and Technology (BJET)*, 15(3), 124-133.
- 32) Farahmand, H., Rashidinejad, M., Gharaveici, A. A., & Shojaee, M. (2006). An Application of Hybrid Heuristic Approach for ATC Enhancement. *Large Engineering Systems Conference on Power Engineering*. Halifax, NS, Canada.
- 33) Fathollahi, A., & Andresen, B. (2023). Multi-Machine Power System Transient Stability Enhancement Utilizing a Fractional Order-Based Nonlinear Stabilizer . *MDPI*, 7(11), 808.
- 34) Fawzy, S., Abd-Raboh, E., & Eladi, A. (2023). Optimal Allocation of Multi-Type FACTS Devices for Mitigating Wind Power Spillage with Enhancing Voltage Stability and Social Welfare. *Scientific Report*, 13.

## A Comprehensive Review of FACTS Controllers in Nigeria Power Systems Network for Enhanced Performance on Variable Loads

- 35) Folorunso, O., Osuji, C. C., & Ighodalo, O. S. (2014). Enhancement of Power System Voltage Stability with the Aid of Reactive/Capacitive Power Switching Mechanism (A Case Study of Owerri Transmission Company of Nigeria). *Journal of Advancement in Engineering and Technology*, 2(1), 2348-2931.
- 36) Fughar, A., & Nwohu, M. N. (2014). Optimal Location of STATCOM in Nigerian 330kv Network using Ant Colony Optimization Meta-Heuristic. *Double Blind Peer Reviewed International Research Journal*, 14(3), 2249-4596.
- 37) Garrido, C., Tellez, A. A., & Ortiz, L. (2023). Linear Voltage Stability Indicator (LVSI) for Optimal Placement of SVC Devices to Improve the Voltage Stability Margin in Transmission Systems. *Electronics*, 1(12), 2-26.
- 38) Gaur, D., & Mathew, L. (2023). Optimal Placement of FACTS devices Using Optimization Technique: A Review. 3rd International Conference on Communication Systems. San Francisco.
- 39) Ghaffarzadeh, N., Marefatjou, H., & Soltani, I. (2012). Investigation and Comparison of the Effects of FACTS Devices, Capacitors and Line Reactance Variation on Voltage Stability Improvement and Loadability Enhancement in Two Area Power System. *International Journal of Applied Power Engineering (IJAPE)*, 1(3), 145-158.
- 40) Gupta, S. K., & Mallik, S. K. (2022). Enhancement in Voltage Stability Using FACTS Devices Under Contingency Conditions. *Journal of Operation and Automation in Power Engineering*.
- 41) Hemalatha, r. (n.d.). Flexible Alternating Current Transmission System. vijayamangalam.
- 42) Hu, S., Xiang, Y., Zhang, X., Liu, J., Wang, R., & Hong, B. (2019). Reactive Power Operability of Distributed Energy Resources for Voltage Stability of Distribution Networks. *Power System Clean Energy*, 7(4), 851-861. Retrieved from <http://doi.org/10.1007/s40565-018-0484-3>
- 43) Innocent, U. O., Nkan, I. E., Okpo, E. E., & Okoro, O. I. (2021). Dynamic Response Evaluation of a Separately Excited DC Motor. *Nigeria Journal of Engineering*, 28(2).
- 44) Innocent, U. O., Nkan, I. E., Okpo, E. E., & Okoro, O. I. (2021). Predicting the Stability Behaviour of Three-Horse Power Induction Motor Using Eigenvalue Method. *Bayero Journal of Engineering and Technology (BJET)*, 16(2), 66-81.
- 45) Iranmanesh, H., & Rashid-Nejab, M. (2013). Using UPFC and IPFC Devices Located by a Hybrid Meta-Heuristic Approach to Congestion Relief. *Energy and Power Engineering*, 5, 474-480.
- 46) Kavitha, K. (2023). Fuzzy based optimal placement of tscs-svc to enhance system security. *International Journal of Management, Technology and Engineering*, 9(5).
- 47) Khan, A., Narasimhegowda, T. R., Mohan, K. R., & Manjunatha, B. (2014). Power Quality Enhancement By Using UPFC. *International Journal of Engineering Research and Technology (IJERT)*, 3(6).
- 48) Kumar, K. C., Kumer, S. M., SriramBAbu, V., & Nagulmeera, S. (2014). A Comparative Analysis of UPFC as a Power Flow Controller with Application. *IOSR Journal of Electrical and Electronics Engineering (IOSR-JEEE)*, 9(4), 28-36.
- 49) Labeled, M. A., Zellagui, M., Benidir, M., Sekhane, H., & Tebbakh, N. (2023). Optimal Hybrid Photovoltaic Distributed Generation and Distributed Static Synchronous Compensators Planning to Minimize Active Power losses Using Adaptive Acceleration Coefficients Particle Swarm Optimization Algorithms. *Electrical Engineering and Electromechanics* (6), 1-15.
- 50) Liu, C. C., Heydt, G. T., & Edris, A. A. (2002). Impacts of FACTS controllers on transfer capability of power grids," in *Proceedings of the Power Engineering Society Transmission and Distribution Conference. Proceedings of the Power Engineering Society Transmission and Distribution Conference.*, New York, NY, United States.
- 51) Madhuranthaka, T., & Manohar, G. T. (2016). A Review on Power System Voltage Stability and Optimization Techniques. *International Journal of Engineering Research and Application*, 6(11), 6-14.
- 52) Mirsaedi, S., Devkota, S., Wang, X., Tzelepis, D., Abbas, G., Alshahir, A., & He, J. (2023). A Review on Optimization Objectives for Power System Operation Improvement Using FACTS Devices. *energies*, 16(1).
- 53) Mohammed, A. A.-M., & Abdel-Rahim. (2004). Optimal power flow with FACTS devices, Roorkee, India.
- 54) Mustapha, M., Musa, B., Bakare, G., Bukar, A., Modu, B., Gwoma, Z., . . . Buji, A. (2017). Dynamic Analysis of Power Loss Minimization and Voltage Profile Enhancement Using UPFC Devices with Differential Evolution Algorithm. *European Journal of Advances in Engineering and Technology*, 4(1), 36-43.
- 55) Nakiganda, A. M., Catherine, C., & Spyros, C. (2023). Topology-Aware Neural Networks for Fast Contingency Analysis of Power Systems. *arXiv*.
- 56) Natala, H., Nkan, I. E., Okoro, O. I., & Obi, P. I. (2023). Investigation of the Transfer Capability of the Nigerian 330kV, 58-Bus Power System Network Using FACTS Devices. *Journal of Electrical Engineering*, 22(1), 53-62.
- 57) Nelson, F. C. & Odion, J. (2023). Core loss reduction in induction motor using finite element analysis. *Journal of Multidisciplinary Engineering Science and Research (JMESR)*, 2(9), 242-247, 2023.

## A Comprehensive Review of FACTS Controllers in Nigeria Power Systems Network for Enhanced Performance on Variable Loads

- 58) Nguyen, A. T., Le, C. K., Phan, M. T., & Nguyen, T. T. (2023). Coot Bird Behavior-Based Optimization Algorithm For Optimal Placement Of Thyristor Controlled Series Compensator Devices In Transmission Power Networks. *Power engineering and electrical engineering*, 21(3).
- 59) Nkan, I. E., & Okpo, E. E. (2016). Electric power forecasting by the year 2020 using the least square method. *International Journal of Research and Advancement in Engineering Science*, 6(1).
- 60) Nkan, I. E., Okoro, O. I., Awah, C. C., & Akuru, U. B. (2019). Investigating the Dynamic Stability of the Nigerian 48-Bus Systems for Improved System Performance using FACTS. *Proceedings of the 27th Domestic use of Energy Conference*.
- 61) Nkan, I. E., Okoro, O. I., Awah, C. C., & Akuru, U. B. (2019). Investigating the Steady State Stability of the Nigerian 48-Bus Systems using FACTS Devices. *Nigerian Journal of Technology (NIJOTECH)*, 38(3), 732-743.
- 62) Nkan, I. E., Okoro, O. I., Obi, P. I., Awah, C. C., & Akuru, U. B. (2019). Application of FACTS Devices in a Multi-Machine Power System for Transient Stability Enhancement: A Case Study of the Nigerian 330kV 48-Bus System . *IEEE AFRICON*, (pp. 1-9). Accra, Ghana.
- 63) Nkan, I. E., Okpo, E. E., & Inyang, A. B. (2023). Enhancement of Power System Transient Stability with TCSC: A Case Study of The Nigerian 330kV, 48-Bus Network. *International Journal of Multidisciplinary Research and Analysis*, 6(10), 4828-4841.
- 64) Nkan, I. E., Okpo, E. E., & Okoro, O. I. (2020). Multi-Type FACTS Controllers for Power System Compensation: A Case Study of the Nigerian 48-Bus, 330kV System. *Nigerian Journal of Technological Development*, 63-69.
- 65) Nkan, I. E., Okpo, E. E., & Okpura, N. I. (2023). Optimum Location of Shunt FACTS Devices for Enhancement of Power System Loadability Using Continuation Power Flow. *International Multilingual Journal of Science and Technology (IMJST)*, 8(9).
- 66) Nkan, I. E., Okpo, E. E., Akuru, U. B., & Okoro, O. I. (2020). Contingency Analysis for Improved Power System Stability of the Nigerian 330Kv, 48-Bus System using Series FACTS Controllers. *AIUE Congress 2020: International Conference on Use of Energy*.
- 67) Oduleye, A. E., Nkan, I. E. & Okpo, E. E. (2023). High impedance fault detection and location in the Nigerian 330 kV transmission network using adaptive neuro-fuzzy inference system. *International Journal of Multidisciplinary Research and Analysis*, 6(11), 5390-5398.
- 68) Okoro, O. I., Abunike, C. E., Akuru, U. B., Awah, C. C., Okpo, E. E., Nkan, I. E., Udenze, P. I., Innocent, U. O., & Mburwe, M. J. (2022). A Review on the State-of-the-Art Optimization Strategies and Future Trends of Wound-Field Flux Switching Motors. *IEEE PES/IAS PowerAfrica*, (pp. 1-5). Kigali, Rwanda.
- 69) Okpo, E. E., & Nkan, I. E. (2016). Construtional Features and Performance Analysis of 3-Phase Linear Induction Motor. *International Journal of Scientific Innovations and Sustainable Development* , 6(1).
- 70) Okpo, E. E., Nkan, I. E., Okoro, O. I., & Akuru, U. B. (2021). Winding Reconfiguration of 5.5 kW Three-Phase Induction Motor for Improved Performance. *IEEE PES/IAS PowerAfrica*, (pp. 1-4). Nairobi, Kenya.
- 71) Okpo, E. E., Ogbonnaya, I. O., Chukwuemeka, C. A., & Udochukwu, B. A. (2020). Investigating the Dynamic Behaviour of a Six Phase Induction Motor under Unbalanced Faults. *IEEE PES/IAS Power Africa*, (pp. 1-5). Nairobi, Kenya.
- 72) Okpo, E. E., Ogbonnaya, O. I., Udochukwu, B. A., & Chukwuemeka, C. A. (2019). Performance Evaluation of 5.5kW Six-Phase Asynchronous Motor. *IEEE PES/IAS Power Africa*, (pp. 639-644). Abuja, Nigeria.
- 73) Olabisi, O. P. (2010). Optimal Power Flow Solution to Voltage Collapse in a Deregulated Electricity Market. Lagos.
- 74) Olana, A. (2021). Investigation of The Dynamic Stability and Performance of Koka—Dire Dawa [Eastern region] HVAC Line With SVC, TCSC, And UPFC. Haramaya.
- 75) Oleka, E. U., Ndubisi, S. N., & Ijamaru, G. K. (2016). Electric Power Transmission Enhancement: A Case of Nigerian Electric Power Grid . *American Journal of Electrical and Electronic Engineering* , 4(1), 33-39.
- 76) Oluwagbade, Z. V., Wara, S. T., Adejumbi, I. A., & Mustapha, A. O. (2015). Effects of Unifield Power Flow Controller on Power System Performance: A Case Study of Maryland 132/33/11 kV Transmission Station. *International Journal of Engineering Technologies and Advanced Engineering*, 5(6).
- 77) Omoigui, M., Lawal, O. A., & Alao, R. A. (2017). Improving dthe Nigerian 330kV Power System Steady State Voltage Stability Using Static Var Compenstaion and Genetic Algorithm Optimization . *CARD International Journal of Engineering and Emerging Scientific Discovery*, 2(2).
- 78) Omorogiuwa, E., & Okpo, E. E. (2015). PV-Diesel Hybrid Power System for a Small Village in Nigeria. *International Journal of Scientific Research Engineering Technology* , 1(4).

## A Comprehensive Review of FACTS Controllers in Nigeria Power Systems Network for Enhanced Performance on Variable Loads

- 79) Omorogiuwa, E., & Onohaebi, S. (2015). Optimal Location of IPFC in Nigeria 330kV Integrated Power Network Using GA Technique. *Electrical and Electronic Systems*, 4(1).
- 80) Prajapati, S. M., & Gandhi, P. R. (2018). Impacts of FACTS Devices for ATC Enhancement in Deregulated Market. *International Conference on Power Energy, Environment and Intelligent Control (PEEIC)*. Greater Noida, India.
- 81) Rao, N. S., Amarnath, J., & Rao, V. P. (2014). Comparison of Performance of Multitype FACTS devices on available transfer capability in a deregulated power system. *International Conference on Smart Electric Grid (ISEG)*, (pp. 1-6). Guntur, India.
- 82) Rao, S. R., & Rao, S. V. (2015). A generalized approach for determination of optimal location and performance analysis of FACTS devices. *Electrical Power and Energy Systems*, 73, 711-724.
- 83) Raval, M., & Dwivedi, V. V. (2013). Commencing the FACTS in Variable Energy Sources Network to Optimize Existing Transmission System with Stability. *International Journal of Emerging Trends in Electrical and Electronics (IJETEE)*, 2(1).
- 84) Rehman, A. U., Farooq, A., Ahmad, I., Khan, S., Haq, I., Ayaz, A., & Saad, M. (2023). Steady State Contingency Analysis of IEEE-39 Bus System Using PSS/E. *International Journal of Advanced Natural Science and Engineering Researches*, 7(7), 78-85.
- 85) Rehman, A., Koondhar, M. A., Ali, Z., Jamali, M., & El-Sehiemy, R. A. (2023). Critical Issues of Optimal Reactive Power Compensation Based on an HVAC Transmission System for an Offshore Wind Farm. *Sustainability*, 15(19).
- 86) Sahu, A. K., Jhapse, R., & Sahu, A. K. (2015). Available Transfer Capability Enhancement By Using UPFC. *International Journal of Applied Science Engineering and Management*, 1(2), 15-22.
- 87) Sanchez-Mora, M. M., Villa-Acevedo, W. M., & Lopez-Lezama, J. M. (2023). Multi-Area and Multi-Period Optimal Reactive Power Dispatch in Electric Power System. *energies*, 16(17).
- 88) Sanni, S. O. (2014). Assessment of Transient Stability Enhancement Capability of Unified Power Flow Controller in a Multi-Machine Power System. Zaria: Ahmadu Bello University.
- 89) Shahgholian, G., & Faiz, J. (2010). Static Synchronous Compensator for Improving Performance of Power System: a Review. *International Review of Electrical Engineering (I.R.E.E)*, 5(5).
- 90) Singh, B., Payasi, R. P., & Shukla, V. (2017). A taxonomical review on impact assessment of optimal placed DGs and FACTS controllers in power systems. *ScienceDirect*, 3, 94-108.
- 91) Singh, B., Verma, K. S., Mishra, P., Maheshwari, R., Srivastava, U., & Baranwal, A. (2012). Introduction to FACTS Controllers: A Technological Literature Survey. *International Journal of Automation and Power Engineering*, 1(9).
- 92) Sinha, N., Karan, S., & Singh, S. K. (2015). Modified DE Based ATC Enhancement Using FACTS Devices. *International Conference on Computational Intelligence and Networks*. Odisha, India.
- 93) Tochukwu, O. O. (2012). Improved Energy Efficiency Using FACTS-Device Technique: A Case Study of Ogui-Enugu Power Distribution Network. Ogui-Enugu: Afribary.
- 94) Tolba, M. A., Houssein, E. H., Ali, M. H., & Hashim, F. A. (2023). A New Robust Modified Capuchin Search Algorithm for the Optimum Amalgamation of DSTATCOM in Power Distribution Network. *Neural Computing and Applications*.
- 95) Ugwuanyi, N. S., Uma, U. U., & Ekwue, A. O. (2021). Fundamental Study of Oscillations in the Nigerian Power System. *Nigerian Journal of Technology (NIJOTECH)*, 40(5), 913-926.
- 96) Williams, E. A., Okpo, E. E., & Nkan, I. E. (2023). Performance evaluation of induction motor behaviour on conventional and PV system power sources. *International Journal of Multidisciplinary Research and Analysis*, 6(12), 5500-5511.
- 97) Wu, K., Tanneau, M., & Hentenryck, P. V. (2007). Strong-Mixed-Integer Formulations for Transmission Expansion Planning with FACTS Devices. *IEEE transaction on Power Systems*, 22(3), 1171-1180.
- 98) Xiao, Y., Song, Y. H., & Sun, Y. Z. (2000). Application of Stochastic Programming for Available Transfer Capability Enhancement using FACTS Devices. *Power Engineering Society Summer Meeting (Cat.No.00CH37134)*. Seattle, WA, USA.
- 99) Yao, L., Cartwright, P., Schmitt, L., & Zhang, X. P. (2005). Congestion Management of Transmission System Using FACTS. *IEEE/PES Transmission and Distribution Conference and Exposition. Asia and Pacific, Dalian*.
- 100) Yuvaraj, T., Devabalaji, K. R., Thanikanti, S. B., Aljafari, B., & Nwulu, N. (2023). Minimizing the electric vehicle charging stations impact in the distribution networks by simultaneous allocation of DG and DSTATCOM with considering uncertainty in load. *Energy Reports*, 10, 1796-1817.
- 101) Zhang, J., & Yokoyama, A. (2007). Application of interline Power Flow Controller to ATC Enhancement by Optimal Power Flow Control. *IEEE Lausanne Power Tech*, (pp. 1226-1231). Lausanne, Switzerland.
- 102) Zhang, P., Hu, W., Xu, W., & Yan, F. (2015). Co-ordinated control of multi-FACTS based on Improved teaching and Learning algorithm to improve ATC. *IEEE PES Asia-Pacific Power and Energy Engineering Conference (APPECO)*, Brisbane, QLD, Australia.

## Towards the Unification of Inheritance Law in Indonesia: Challenges and Opportunities in the Context of Religious and Cultural Diversity



Rosmanila<sup>1</sup>, Wiwit Pratiwi<sup>2</sup>, Sherly Nelsa Fitri<sup>3</sup>

<sup>1,2,3</sup> Fakultas Hukum, Universitas Prof. Dr. Hazairin., S.H., Bengkulu, Indonesia

**ABSTRACT:** This research examines inheritance law in Indonesia which is very pluralistic and not uniform, consisting of civil inheritance law regulated in the Burgerlijk Wetboek (WB), customary inheritance law regulated in their respective customary inheritance laws based on the existing kinship system (patrilineal, matrilineal, and parental), and Islamic inheritance law regulated in Islamic law. In heading towards the unification of inheritance law in Indonesia, there are challenges and opportunities that must be faced due to the diversity of religions and cultures that exist in Indonesia. This research uses normative research methods. The subject matter will be studied juridically normative and juridically philosophical with a systemic and comparative juridical approach. The nature of this research is descriptive, namely describing the overall object that is explored and collected systematically. The approaches used in this research are statute approach and conceptual approach. In this research, library materials in the form of secondary data are used as the main source. Secondary data includes primary legal materials, secondary legal materials and tertiary legal materials. These various data can be obtained through literature studies or online data searches. Data collection provides verification, correction, supplementation, and itemization of each other. Will be analyzed qualitatively after being collected. The results of this study, to unify inheritance law in Indonesia can be done by adjusting the elements of the applicable legal order within the framework of the legal system. In each legal system consists of 3 (three) sub-systems, namely legal substance, legal structure, and legal culture. Furthermore, to create opportunities for the unification of inheritance law in Indonesia, the steps that can be taken are studies and research related to the inheritance law system that applies in Indonesia; dialogue and discussion between stakeholders; submitting proposals and discussions at the legislative level to make rules for the unification of inheritance law in Indonesia; conducting socialization and education to the public about the importance of unification of inheritance law; and after the unification of inheritance law is passed, implementation and evaluation of its implementation are carried out.

**KEYWORDS:** Culture; Inheritance Law; Religion; Unification

### I. INTRODUCTION

One of the roots of the diversity of Indonesian inheritance law is inseparable from the influence of history, namely the Dutch colonial period for 350 years. During the Dutch colonial period, the constitutional system of the Dutch East Indies was called the Indian National Constitution (*Indische Staatsregeling, IS*). The application of Articles 131 and 163 of the *IS* is one of the factors that gave birth to legal pluralism in the civil sphere, especially inheritance law. The Dutch regulated the classification of residents of the Dutch East Indies in Article 163 of the *IS*. At that time Indonesia or the Dutch East Indies had not yet become a sovereign state and was still a Dutch colony. Therefore, the Dutch East Indies at that time did not recognize the term citizen.

There are three groups of residents in Article 131 *IS*. The first group is the white group, or European society and people who are equated with Europeans. The second group is the Chinese and other foreign easterners, and the third group is the Bumiputra group or the original natives of the archipelago. The division of population groups is also followed by the enactment of the rule of law in accordance with the group.<sup>1</sup>

The law that applies to each of these groups is regulated in Article 131 of the *Indische Staatsregeling* which was established by *Staatsblad* 1919 No. 286 and Dutch East Indies *Staatsblad* 1919 No. 621. This can be described as follows. For

<sup>1</sup> Supriyadi, "Pilihan Hukum Waris Dalam Masyarakat Majemuk (Studi Banding Hukum Islam Dan Hukum Perdata)," *Al-Adalah* 12, no. 1 (2015): 553.



## Towards the Unification of Inheritance Law in Indonesia: Challenges and Opportunities in the Context of Religious and Cultural Diversity

European Groups, Civil Law (*Burgerlijk Wetboek*) and Commercial Law (*Wetboek van Koophandel*) apply in accordance with the principle of concordance. For the Foreign Eastern Group, their respective Customary Law applies, based on Article 75 of the *Regeering Reglement*, *Staatsblad* 1854 No. 129 in the Netherlands jo. *Staatsblad* of the Dutch East Indies Year 1855 No. 2:<sup>2</sup>

1. For those who submit themselves (*Toepasselijk Verklaring*), *Staatsblad* 1917 No. 12 applies to them, which means European Law in accordance with *Staatsblad* 1926 No. 30.
2. In 1855, with *Staatsblad* 1855 No. 79, a partial codification of European Law (*Burgerlijk Wetboek* and *Wetboek van Koophandel*), which included family law and *ab-intestato* inheritance.

Furthermore, the Foreign Eastern group is further subdivided into the following:

1. The Chinese Foreign Eastern Classes under *Staatsblad* 1917 No. 129, which took effect on May 1, 1919 and *Staatsblad* 1924 No. 557, which took effect on May 1, 1925, as well as *Staatsblad* 1925 No. 29 which took effect on September 1, 1925, shall apply to them:<sup>3</sup>
  - a. The *Burgerlijk Wetboek* and the *Wetboek van Koophandel*, except for certain articles of the Second and Third Parts of Book I of Title IV relating to ceremonies to be performed before marriage and to means of preventing marriage.
  - b. Civil registration itself which is regulated by *Staatsblad* 1917 No. 130 and *Staatsblad* 1919 No. 81.
  - c. Special provisions on adoption and sharing (child adoption) which are regulated by *Staatsblad* 1917 No. 129 and *Staatsblad* 1919 No. 81.
2. The non-Chinese foreign eastern groups (in Java and Madura), based on *Staatsblad* 1855 No. 79, are subject to the codification of Civil Law, except regarding Family Law and Law of Inheritance *ab-intestato* (inheritance without a will). In addition, their customary law established by *Staatsblad* 1924 No. 556, was enacted and came into force on March 1, 1925. In terms of property, (*vermogensrecht*) only applies to non-Chinese foreigners.<sup>4</sup>

According to Article 131 IS paragraph (2) sub b, the applicable law for the Bumi Putera (Indigenous Indonesian) Group is legislation, religion, folk institutions, customs of the population, or *Godsdiestige Wetten, Volkinstelling en Grebruiken*, or Customary Law. Therefore, the applicable law for the Bumi Putera (Indigenous Indonesian) Group is their written Customary Law or voluntary submission to Western Civil Law (*Burgerlijk Wetboek*) based on *Staatsblad* 1917 No. 12 jo. *Staatsblad* No. 300 of 1926. There are several possibilities for submission:<sup>5</sup>

1. Submission to all European Civil Law (applicable to non-Chinese foreigners and Bumi Putera).
2. Partial submission to European Civil Law (applicable to the Bumi Putera group).
3. Submission to a certain legal act (applicable to the Bumi Putera group).
4. Silent submission or presumption (applicable primarily to the Bumi Putera group).
5. Article 1601, 1602, and 1603 BW (*Staatsblad* Year 1879 No. 256) concerning labor agreements.
6. About gambling (debts due to gambling) and betting Article 1788 jo. Article 1791 BW based on *Staatsblad* Year 1907 No. 306.
7. Several articles of *Wetboek van Koophandel* Book II most of the law of the sea based on *Staatsblad* Year 1933 No. 49 jo. *Staatsblad* 1939 No. 214 jo. *Staatsblad* 1938 No. 2.
8. Regulations applicable to all classes such as the Copyright Act (Authors) *Auteurswet Staatsblad* 1912, the General Regulation on Cooperatives *Staatsblad* 1933 No. 108, and the ordinance on transportation in the air (*luchtver Voor Ordonantie Staatsblad* 1938 No. 98 jo. *Staatsblad* 1939 No. 100).

In addition, some special regulations apply to certain groups:<sup>6</sup>

1. Marriage regulations for Indonesian Christians and Catholics, known as the *Huwelijks Ordonantie Christen Indonesiers or HOCl*. Based on *Staatsblad* 1933 No. 74 jo. *Staatsblad* 1936 No. 247 and 607, later amended and supplemented by *Staatsblad* 1938 No. 264 and No. 370 jo. *Staatsblad* 1938 No. 288.
2. Article 2 Paragraph 2 of Law No. 1 of 1974 concerning Marriage applies to Hinduism and Buddhism.
3. The Marriage Ordinance (*Huwelijks Ordonantie*), *Staatsblad* 1929 No. 348, *Staatsblad* 1932 No. 482, and *Staatsblad* 1933 No. 48 applies to native Indonesians who are Muslims. However, this law only applied to Java and Madura in 1946. Law No. 32 of 1954 was then implemented throughout Indonesia. Marriage Law No. 1 of 1974 was enacted in 1974. The Compilation of Islamic Law was then established through Presidential Instruction of the Republic of Indonesia Number 15 of 1991 in

---

<sup>2</sup> Mohd. Idris Ramulyo, *Beberapa Masalah Pelaksanaan Hukum Kewarisan Perdata Barat (Burgerlijk Wetboek)* (Jakarta: Sinar Grafika, 1993).

<sup>3</sup> H. Suparman Usman, *Ikhtisar Hukum Waris Menurut KUH Perdata (BW)* (Serang: Darul Ulum Press, 1990).

<sup>4</sup> Mohd. Idris Ramulyo, *Op.Cit.*, p. 17.

<sup>5</sup> H. Suparman Usman, *Op.Cit.*, p. 8.

<sup>6</sup> *Ibid.*, p. 9.

## Towards the Unification of Inheritance Law in Indonesia: Challenges and Opportunities in the Context of Religious and Cultural Diversity

accordance with the Decree of the Minister of Religious Affairs of the Republic of Indonesia Number 154 of 1991 (see Article 5 paragraph (2)).

4. Every Indonesian citizen is subject to Law Number 1 of 1974 concerning Marriage.
5. Mixed Marriage Regulation (*Regeling op de Gemengde Huwelijken*) also abbreviated as *GHR* which was re-established by the King of the Netherlands on December 29, 1896 (*Staatsblad* 1898 No. 158 amended and supplemented by *Staatsblad* 1901 No. 348 jo. *Staatsblad* 1902 No. 311 jo. *Staatsblad* 1907 No. 205 jo. *Staatsblad* 1918 No. 30 JIS *Staatsblad* 1931 No. 108 and 423).

Until now, there are various legal systems that apply in Indonesia regarding other inheritance laws, namely as follows:<sup>7</sup>

1. The Civil Inheritance Law System is regulated in the *Burgerlijk Wetboek (BW)* based on the provisions of Article 131 *IS* jo. *Staatsblad* 1917 Number 12 jo. *Staatsblad* 1924 Number 557 concerning Submission to European Law:<sup>8</sup>
  - a. Europeans and those considered to be the equivalent of Europeans;
  - b. Chinese from the Middle East (*Staatsblad* 1917 No. 129); and
  - c. Other foreigners and Indonesians who follow European law.

The Law of Inheritance *BW* does not apply to Indonesians of foreign eastern descent other than Chinese, except for Chapter 13, which deals with wills (*Staatsblad* 1924: 556). According to Article 4 of the *Staatsblad*, people of such descent can only make a will in the form of a general will except in the cases mentioned in Articles 946, 947, and 948.

2. Customary Inheritance Law System. This system varies due to the various ethnic forms within customary law. There are matrilineal, patrilineal, and bilateral or parental systems.<sup>9</sup>
3. The Islamic inheritance law system also consists of various teachings, such as the teachings of *ahlus sunnah wal jama'ah*, the teachings of Shia, and the teachings of Hazairin Indonesia. The most dominant teaching adopted in Indonesia is the teaching of *ahlus sunnah wal jama'ah* (Syafi'i, Hanafi, Hambali and Maliki schools of thought). However, among the four madhhabs, the most dominant is the Syafi'i madhhab. At the same time, Hazairin's teachings began to be influential since 1950 in Indonesia. This is an *ijtihad* to elaborate the law of inheritance in the Qur'an bilaterally.<sup>10</sup>

The laws of inheritance that even apply until now (both customary inheritance law, Islamic inheritance law and Western inheritance law, are positive laws that are determined or enforced by the court. According to the former Chief Justice of the Supreme Court, Bagir Manan, the various inheritance laws even without codification, without unification, does not mean that there will be no national law. Legal diversity is not something that needs to be avoided, as long as it is not intended to give privilege or otherwise to demean a group. Legal diversity can actually be useful in building unity and harmonization of relations between groups because each feels valued and given a reasonable and reasonable place in the common life system, besides that it is also in order to accommodate the landscape of Indonesian society which is very pluralistic sociologically.<sup>11</sup>

Since the Dutch East Indies, inheritance law has evolved and changed, as shown by the decisions of the Padang, Batavia and other landrads in the application of Minangkabau customary inheritance law, which allows wives and children to inherit the estate of their husbands or fathers, or the decision of the Supreme Court of the Republic of Indonesia that establishes widows in the customary law community of Tanah Batak as heirs. In Bali, there have also been Supreme Court decisions that have attempted to reduce the strictness of inheritance laws for children who marry out. Even the various Supreme Court decisions on the relationship of children within the family in Minangkabau and other issues show a change in judges' opinions on the application of customary law. In the same way as the changes caused by religious beliefs, more and more people who are Muslims are applying the law of inheritance (*kewarisan*) according to Islam.<sup>12</sup>

---

<sup>7</sup> Surini Ahlan Syarif, *Intisari Hukum Waris Menurut Burgerlijk Wetboek* (Jakarta: Ghalia Indonesia, 2003).

<sup>8</sup> Ali Afandi, *Hukum Waris, Hukum, Keluarga, Hukum Pembuktian* (Jakarta: PT. Rineka Cipta, 2000).

<sup>9</sup> Ramulyo, *Beberapa Masalah Pelaksanaan Hukum Kewarisan Perdata Barat (Burgerlijk Wetboek)*, *Op.Cit.*, p. 4.

<sup>10</sup> H.M. Idris Ramulyo, *Perbandingan Hukum Kewarisan Islam Dengan Kewarisan Kitab Undang-Undang Perdata, Edisi Revisi* (Jakarta: Sinar Grafika, 2004).

<sup>11</sup> Bagir Manan's paper, Towards National Inheritance Law, delivered at the Symposium on Towards a National Certificate of Inheritance for Indonesian Citizens, organized on May 6, 2009 by BPHN in collaboration with the Notariat-UNPAD Alumni Family Association in Jakarta.

<sup>12</sup> According to Daniel S. Lev, an American scholar who wrote the book *Islamic Courts in Indonesia*, the results of his research on Religious Courts in Indonesia, that religious courts in Java and Madura even though they lost their power over inheritance cases in 1937, but in reality they still continue to resolve inheritance cases in very impressive ways. This is evident from the fact that more Muslims file inheritance cases in the Religious Courts than in the District Courts. (Mrs. Habibah Daud conducted research in DKI Jakarta in 1976, and the result was that out of 1081 people only 47 people filed inheritance cases with the District Court (4.35%), and 1034 people (96.65%) filed inheritance cases with the Religious Court), Vide Muhammad Daud Ali, 1984, *The Position of Islamic Law in the Indonesian Legal System*, Yayasan Risalah, Jakarta, pp. 24-25

## Towards the Unification of Inheritance Law in Indonesia: Challenges and Opportunities in the Context of Religious and Cultural Diversity

The aforementioned legal diversity is not only caused by legal and political norms; it is also influenced by social, cultural, belief and other aspects. In addition, customary inheritance law is extremely diverse, with different inheritance laws based on kin, matrilineal, and parental<sup>13</sup>. In inheritance law, there are many aspects of inheritance, including the definition of inheritance, the object of inheritance, the inheritor and the recipient of inheritance, the method of inheritance distribution, the obligation to distribute inheritance, the relationship between inheritance and the rights of third parties, the relationship between inheritance and other rights such as grants and wills, and the principles governing the relationship between different inheritance law systems, including the link between the inheritance law system and the object of inheritance as a whole.

Inheritance law is closely related to marriage law, marriage between customary law communities or between people of different beliefs will cause problems. Likewise, how the inheritance law should be applied when a testator dies and leaves children of different religions. In the context of legal development, the matters mentioned above are an effort towards the unification of inheritance law in Indonesia. From the background mentioned above, the issues that are the focus of this research are:

1. What are the challenges faced in implementing the unification of inheritance law in Indonesia, given the diversity of religions and cultures that exist?
2. What are the opportunities in moving towards unification of inheritance law in Indonesia?

### II. RESEARCH METHOD

Based on the identification of the problem as described earlier, this research is a normative legal research, therefore this research will use normative research methods. The subject matter will be studied juridically normative and juridically philosophical with a systemic and comparative juridical approach. The nature of this research is descriptive, namely describing the overall object that is explored and collected systematically. The approaches used in this research are statute approach and conceptual approach.

In this research, library materials in the form of secondary data are used as the main source. Secondary data includes:<sup>14</sup>

- a. Primary legal materials: the binding legal basis derived from the state constitution, both written and unwritten, as well as other norms governing the lawmaking system.
- b. Secondary legal materials: materials that explain primary legal materials, such as draft laws, theses, dissertations, and other research.
- c. Tertiary legal materials, which are materials that help interpret and explain primary and secondary legal materials, such as dictionaries and encyclopedias.

This variety of data can be obtained through desk research or online data searches. Data collection provides verification, correction, supplementation, and itemization of each other. It will be analyzed qualitatively once collected.

### III. RESULT AND DISCUSSION

#### A. *Challenges in Implementing Unification of Inheritance Law in Indonesia in the Context of Religious and Cultural Diversity*

The idea of inheritance law has been developing since the beginning of independence. Quoting Soetandyo Wignjosoebroto, the 1945 Constitution of the Republic of Indonesia incorporates the principle of the rule of law from the doctrine of *rechtsstaat*, the principle of impartiality in the administration of justice, and the principle of a state not based on power (*machtsstaat*).<sup>15</sup>

Daniel S. Lev notes in his research that since 1945 unification and modernization have always been the main motives for legal change.<sup>16</sup> Ratno Lukito argues that Indonesian leaders have faced the challenge of building a coherent legal system in a pluralistic country without eliminating the ethnic, cultural and social practices of its people.<sup>17</sup>

The ideas of uniformists on the one hand, and pluralists on the other, were a natural result of these attempts at legal unification. The first group are those who hold the idea of modernizing Indonesia, that the state must adapt itself to modern state models if development and growth are to be realized. This group regarded customary law as a symbol of backwardness.<sup>18</sup>

---

<sup>13</sup> Bagir Manan, *Op.Cit.*

<sup>14</sup> Sri Mamuji Soerjono Soekanto, *Penelitian Hukum Normatif* (Jakarta: CV. Rajawali, 1990).

<sup>15</sup> Soetyandyo Wignjosoebroto, "Hukum Nasional: Unifikasi Dicitacitakan, Pluralisme Acap Merupakan Fakta Menyulitkan," *Majalah Hukum Nasional*, no. 2 (2008): 56.

<sup>16</sup> Danile S. Lev, *Hukum Dan Politik Di Indonesia*, ed. Nirwono dan A.E. Priyono (Jakarta: LP3ES, 1990).

<sup>17</sup> Ratno Lukito, *Pergumulan Antara Hukum Islam Dan Hukum Adat Di Indonesia* (Jakarta: INIS, 1998).

## Towards the Unification of Inheritance Law in Indonesia: Challenges and Opportunities in the Context of Religious and Cultural Diversity

However, the second group, known as pluralists, argue that the law of pluralistic nature is the only law that can be applied to the diverse society in Indonesia. Therefore, pluralists argue that inheritance law agrees to assign the position of inheritance law to pluralistic law.

In connection with the unification of inheritance law, according to Soetandyo Wignjosebroto emphasized:<sup>19</sup> "The difficulty of national legal unification is due to the fact that this country, like other developing countries, is built on the interests of the organization of the nation-state life on top of socio-cultural pluralism. That is why the western experience of legal unification cannot be taken for granted. Western nation-states are built on the foundation of a culturally factual national unity, primarily the existence of a common language despite its dialectal variants. This is in contrast to developing countries, including Indonesia, which consists of units of society that culturally in the aspect of language and customs do not depict unity".

The above opinion suggests that unification is difficult to achieve, however, understanding existing laws is the way to achieve it. In terms of inheritance law, it needs to be understood that the current system of inheritance law, which consists of three systems, can be considered pluralistic.<sup>20</sup> It is pluralistic because inheritance law is not uniform; civil inheritance law is regulated in the *Burgerlijk Wetboek (WB)*, customary inheritance law is regulated in its respective customary inheritance law based on the existing kinship system (patrilineal, matrilineal, and parental), and Islamic inheritance law is regulated in Islamic law.

### 1. Civil Inheritance System

Civil inheritance law system as stipulated in the Civil Code.<sup>21</sup> In civil inheritance law, there are 3 conditions for inheritance, namely:

- a. The existence of the deceased (Heir);
- b. There are people who are still alive, as heirs of the heir (heirs);
- c. The existence of a number of assets left by the heir (inheritance).

In the division of inheritance according to civil law after the fulfillment of these three conditions, the group of living heirs is seen. In civil inheritance law is divided into four groups, namely:<sup>22</sup>

#### a. First Class Heirs

Article 852 of the Civil Code states that boys and girls have the same rights or are considered equal. Meanwhile, adopted children or children out of wedlock who are not explicitly mentioned in the court decision have a different status from legal children.

#### b. Second class heirs

The second class of heirs consists of parents, brothers and sisters, and their descendants. Articles 854, 855, 857, and 859 of the Civil Code regulate the division of this estate.

#### c. Heirs of the third group

If the testator leaves no descendants, husband or wife, parents, brothers and sisters, or their descendants, they are considered the third class of heirs. According to articles 850 and 853 BW, paragraph (1) and paragraph (3), the estate must be divided into two equal parts: one for all blood relatives in a straight line up and another for all blood relatives in the mother's line.

#### d. Heirs of the Fourth Group

Article 858 of the Civil Code stipulates that in cases where there are no brothers and sisters, the family in a straight line upwards will not exist. Half of the inheritance will be given to all relatives in the straight line up who are still alive, while the other half, except in cases mentioned in article 859 will be given to relatives in other lines. Other relatives in the lateral line limited to the sixth degree are the fourth class of heirs.

### 2. Customary Inheritance System

Customary inheritance law is closely related to kinship and marriage law, so the formation of customary inheritance law of a community is not inseparable from the kinship and marriage laws that apply there. According to Soerojo Wignjodipuro:<sup>23</sup>

"that customary inheritance law is closely related to the familial characteristics of the legal community concerned, and affects the property left behind in that community. Therefore, in discussing the issue of inheritance, kinship law and marriage law must also be discussed".

---

<sup>18</sup> *Ibid.*, p. 64

<sup>19</sup> Soetandyo Wignjosebroto, *Op.Cit.*, p. 24

<sup>20</sup> Soeroyo Wignjodipuro, *Pengantar Dan Asas-Asas Hukum Adat* (Jakarta: Gunung Agung, 1995).

<sup>21</sup> Surini Ahlan Syarif, *Log.Cit.*

<sup>22</sup> Elviana Sagala, "Hak Mewaris Menurut Ketentuan Hukum Waris Perdata," *Jurnal Ilmiah: Advokasi* 6, no. 1 (2018): 121–122.

<sup>23</sup> Soerojo Wignjodipuro, *Pengantar Dan Asas-Asas Hukum Adat* (Jakarta: Haji Masagung, 1990).

## Towards the Unification of Inheritance Law in Indonesia: Challenges and Opportunities in the Context of Religious and Cultural Diversity

The customary descent and kinship system is still strong in society, especially in rural communities. According to Hazairin:<sup>24</sup> "...customary inheritance law has its own style from the mind of a traditional society with a form of kinship whose descent system is patrilineal, matrilineal, parental or bilateral".

In terms of the nature of the family Hilman Hadikusuma mentions it as a descent system, he says that in Indonesia the descent system has been in effect since a long time ago before the entry of Hinduism, Islam and Christianity.<sup>25</sup> Different descent systems appear to have an influence on the customary law inheritance system.<sup>26</sup> This can be described as follows, namely:

- a. Patrilineal system, this is a system that draws the line of descent and only links children to their father. This occurs both in a pure patrilineal system such as in Tanah Batak and in a switched patrilineal system, where children are linked to their father or mother depending on the type of marriage of their parents, such as in Lampung and Rejang.<sup>27</sup>
- b. Matrilineal system, which is a system of descent based on the mother's line, where the position of women is more prominent than men (Minangkabau, Enggano, and Timor).<sup>28</sup>
- c. According to Hazairin, the parental or bilateral system is a system of inheritance drawn through the parental line, or a two-sided line (father-mother), where the roles of men and women are equal in inheritance.<sup>29</sup> Soerojo Wignjodipuro expressed the same opinion and then said that societies that recognize only patrilineal or matrilineal descent in everyday life are called unilateral, and societies that recognize both are called bilateral.<sup>30</sup>

The nature of customary inheritance law can be compared with the nature or principles of inheritance law applicable in Indonesia, including:<sup>31</sup>

- a. In the customary law system, inherited property is not regarded as an asset that can be valued in money, but as an asset that cannot be divided or divided based on its type and the interests of the heirs. In contrast, in the Islamic and Western legal systems, inherited property is considered an asset that can be valued in money;
- b. As stipulated in Western inheritance law and Islamic inheritance law, customary inheritance law does not recognize the principle of *legitime portie* or absolute share;
- c. Customary inheritance law does not recognize the right for heirs to demand that the inheritance be distributed at any time.

There are three customary inheritance systems found in Indonesia, namely:<sup>32</sup>

- a. According to the individual inheritance system, each heir receives or owns the inheritance according to their own share. This system is usually used in Javanese society which adheres to a bilateral social system.
- b. Collective inheritance system: this system considers the inheritance property as a unit that cannot be divided, and the heirs only have the right to use or obtain the results of the property.
- c. Majority inheritance system: in this system, the property is inherited as an undivided unit, with the right of control given only to certain children. For example, the oldest son (Bali, Lampung, Teluk Yos Sudarso) or the oldest daughter (Semendo/South Sumatra), the youngest son (Batak), or the youngest daughter or son only.

In customary inheritance law, several principles are recognized, namely:<sup>33</sup>

- a. The general principle that states, "If inheritance cannot be carried out based on the applicable provisions, then this inheritance is carried out upwards or sideways. This means that the heirs are first of all sons or daughters and their descendants. If there are no children or descendants by descent, then the inheritance falls on the father, grandmother and so on up. If this also does not exist who inherit is the brothers of the deceased property and their descendants, namely blood relatives according to the line sideways, with the understanding that the closest family excludes the family far".
- b. The principle of replacement of place (*Plaats Vervulling*) which states that if a child is the heir of his father, and the child dies, the place of the child is replaced by the children of the deceased (grandchildren of the deceased) And the inheritance of this grandchild is the same as that which will be obtained by his father as part of the inheritance he received. There is also the institution of child adoption, where the rights and position can also be like their own children".

---

<sup>24</sup> Hazairin, *Bab-Bab Tentang Hukum Adat* (Jakarta: Pradnya Paramita, 1975).

<sup>25</sup> Hilman Adikusuma, *Hukum Waris Indonesia, Perundang-Undangan Hukum Adat, Hindu, Dan Islam* (Bandung: Cipta Aditya Bakti, 1994).

<sup>26</sup> Soerojo Wignjodipoero, *Op.Cit.*, p. 109

<sup>27</sup> Mohd. Idris Ramulyo, *Op.Cit.*, p. 4

<sup>28</sup> Ali Afandi, *Log. Cit*

<sup>29</sup> Hazairin, *Hukum Kewarisan Bilateral Menurut AL-Qurán Dan Hadist, Cet. Kelima* (Jakarta: Tintamas, 1983).

<sup>30</sup> Soerojo Wignjodipoero, 1995, *Op.Cit.*, p. 110

<sup>31</sup> Adelina Nasution, "Pluralisme Hukum Waris Di Indonesia," *L-Qadhâ* 5, no. 1 (2018): 25.

<sup>32</sup> Tolib Setiady, *Intisari Hukum Adat Indonesia (Dalam Kajian Kepustakaan)* (Bandung: Alfabeta, 2008).

<sup>33</sup> Adelina Nasution, *Op.Cit.*, p. 26.

## Towards the Unification of Inheritance Law in Indonesia: Challenges and Opportunities in the Context of Religious and Cultural Diversity

In customary law, in general, religious differences are not a problem because they are not a barrier to inheritance. When customary law is implemented, there is no legal certainty because each custom is different, so there will be many different laws. And if customary law is applied in the distribution of inheritance, there are two things that make injustice and harm one party, namely: First, patrilineal societies (fatherhood) such as the Batak tribe in general who give much more inheritance to the male party. Second, matrilineal (maternal) societies such as the Minang tribe in general who give much more inheritance to the women.

### 3. Islamic Inheritance System

Islamic inheritance law is basically sourced from several verses of the Qur'an and the Hadith of the Messenger which consists of the sayings, actions, and things determined by the Messenger.<sup>34</sup> Some verses of the Qur'an that directly regulate the division of inheritance are as follows:

a. Surat An-Nisaa verse: 7

*"For men there is a right to a share of the estate of their fathers and their relatives, and for women there is a right to a share of the estate of their fathers and their relatives, either a little or a lot according to a predetermined share".*

b. Surah An-Nisaa verse: 11

*"Allah has prescribed for you the division of inheritance for your children. That is, the share of a son is equal to the share of two daughters, and if the children are all girls more than two then their share is two-thirds of the property left behind, if the daughter is alone then she gets half the property. And for two mothers and fathers, for each of them a sixth of the property left behind, if the deceased has children, if the deceased has no children and he is inherited by his mother and father alone then his mother gets a third, if the deceased has several brothers then his mother gets a sixth. (These divisions shall be made) after the fulfillment of any will he may have made or (and) after the payment of his debts (concerning) your parents and your children, you do not know which of them is more likely to benefit you. This is the decree of Allah. Verily, Allah is All-knowing and All-wise".*

c. Surah An-Nisaa verse: 12

*"And for you (husbands) one-half of the property left by the wives, if they have no children. If your wives have children, then you get a quarter of the property they leave behind after fulfilling the will they make or (and) after paying their debts. If you have no children, the wives get a quarter of the property you leave behind. If you have children, then the wives get an eighth of what you leave after fulfilling the will you make or (and) after paying your debts. If a man or woman dies, leaving no children, but has a brother or sister, then each of the brothers or sisters shall receive one-sixth of the estate. But if the brothers are more than one, then they are allies in the third, after the fulfillment of the will made by him or after the payment of his debts with no harm to the heirs. Allah has established this as a true law from Allah, and Allah is All-knowing and Merciful."*

d. Surah An-Nisaa verse: 33

*"For each of the property left behind by parents and relatives, we have made heirs. And (if there are) those with whom you have sworn allegiance, then give them their share. Verily, Allah is witness to all things."*

e. Surah An-Nisaa verse: 176

*"They ask you for a fatwa (about kalalah). Say: Allah gives you a fatwa on kalalah (namely): if a man dies, and he has no children and has a sister, then for his sister is one-twelfth of the property he leaves behind, and his brother uses (all the property of the sister), if he has no children; but if the sisters are two, then for them two-thirds of the property left by the deceased. And if they (the heirs consist of) brothers and sisters, then the share of a brother is as much as the share of two women. Allah has explained this to you, so that you may not go astray, and Allah knows all things".*

The hadiths of inheritance from the Prophet are very helpful in gaining an understanding of inheritance. Here are some Hadiths that are related to the law of inheritance, namely:<sup>35</sup>

- The Prophetic Hadith of Ibn Abbas narrated by Al-Bukhari and Muslim which reads: Give *fara'idh* (the part that has been determined in the Qur'an) to the part that is entitled to receive it and the rest give it to the closest male family.
- Hadith of the Prophet SAW narrated by Imam Ahmad, At-Tirmidzi and An-Nasaa'i: Learn the Qur'an and teach it to people and learn *fara'idh* and teach it because verily you are a person who will die and knowledge will be raised, it may be that there will be two people who dispute, but they will not meet someone who will tell them (the law).
- The Hadith of the Prophet SAW narrated by Ibn Majah and Ad-Daarquthni reads as follows: Learn *fara'idh* and teach it to people because it is half knowledge, and it will be forgotten. *Fara'idh* is the first knowledge that will be uprooted from my people.

<sup>34</sup> Retnowulan Sutantio, *Wanita Dan Hukum* (Bandung: Alumni, 2000).

<sup>35</sup> Surini Ahlan Sjarif dan Nurul Elmiyah, *Pewarisan Menurut Undang-Undang* (Jakarta: Kencana, 2006).

## Towards the Unification of Inheritance Law in Indonesia: Challenges and Opportunities in the Context of Religious and Cultural Diversity

- d. The Hadith of the Prophet SAW narrated by Imam Abu Daud and Ibn Majah reads as follows: Knowledge is three, apart from that all branches are firm verses, valid sunnah and fair distribution of inheritance.
- e. The Hadith of the Prophet SAW from Jabir according to the narration of Imam Abu Daud AtTirmidzi, Ibn Majah and Imam Ahmad which means: The wife of Sa'ad Ibn Rabi' came to the Messenger of Allah SAW with two daughters of Sa'ad Ibn Rabi' who had died in battle. Their uncle took their father's estate and gave nothing to them. While both of them could not marry without property, the Prophet said: Allah will determine the law in this incident after which the verses on inheritance will be revealed.

The elements of Islamic inheritance law in the implementation of inheritance law for Muslim communities inhabiting the republic of Indonesia consist of three elements, namely: heirs, inheritance and heirs. The three elements are interrelated, and each has its own provisions.

### 1) Heirs

The heir is a person who at the time of death is Muslim, leaving an inheritance and a living heir. The term heir is specifically associated with a process of transferring rights to property from someone who has died to his family who are still alive.<sup>36</sup>

Heirs in the Qur'an Surah al-Nisa' verses 7, 11, 12, 33, and 176, consist of parents/father or mother (*al-wālidaini*), and relatives (*al-aqrabīn*). *Al-wālidain* can be expanded to grandparents if the father or mother has died. Similarly, the notion of children (*al-walad*) can be expanded to grandchildren if there are no children. Likewise, the definition of relatives (*al-aqrabīn*) is all family members who can and legitimately become heirs, namely the nasab relationship from the straight line up, down, and side lines. In addition, the marriage relationship is also the heir, wife or husband.<sup>37</sup>

### 2) Inherited Property

Inheritance or inheritance is mentioned by al-Qur'an surat al-Nisa' verse 7 with the term *taraka* or property that will be left (al-Qur'an surat al-Nisa' verse 180) transferring to those who are entitled to receive it (heirs). *Taraka* mentioned by the Qur'an surat al-Nisa' verses 11 and 12, which is then translated as the inheritance consists of objects and rights whose distribution is carried out according to the specified portion after the payment of debts and wills of the testator. The rest of the property after the fulfillment of these various obligations, that is what must be divided by the heirs as inheritance.<sup>38</sup>

In connection with the rights of the heirs, the majority of Sunni scholars stipulate three obligations that must be carried out by the heirs before dividing the testator's estate, namely the cost of managing the body of the deceased, paying off the debts of the testator, and fulfilling the testator's will.<sup>39</sup>

### 3) Heirs

Kin heirs (*nasab*) consist of :

- a) Children, the position of children as heirs, both male and female, is determined by their respective shares in the legal line of the Qur'an surat al-Nisa' verse 11, which regulates the acquisition between the rights and obligations of a boy and a girl, namely 2:1.<sup>40</sup> Regulates the acquisition of two or more daughters, which is  $\frac{2}{3}$  of the inheritance. Regulates the acquisition of a daughter, which is  $\frac{1}{2}$  of the inheritance.<sup>41</sup>
- b) Mother-father, the position of parents as heirs, both mother and father have determined their respective shares as heirs in three lines of law al-Qur'an surat al-Nisa' verse 11. First, regulates the acquisition of mother-father, each of whom gets  $\frac{1}{6}$  of the inheritance if the deceased has children. Second, only determines the acquisition of the mother only, which is  $\frac{1}{3}$  of the inheritance while the father gets an open share if the deceased has no children or brothers. Third, it determines the mother's acquisition of  $\frac{1}{6}$  of the inheritance if the deceased does not leave children but has siblings, both brothers-father, mother, and siblings.<sup>42</sup>
- c) Widowers and widows, both of which have been determined by their respective shares as heirs in the legal line of the Qur'an surat al-Nisa' verse 12. Regulates the acquisition of widowers by  $\frac{1}{2}$  of his wife's estate if the wife has no children,

<sup>36</sup> Husnain Muhammad, *Makhluf, Al-Mawāriṭh fī al-Sharī'ah Al-Islāmiyyah, Matabi' Al-Ahram Al-Tijariyyah* (Kairo, 1971).

<sup>37</sup> Hazairin, *Hukum Kewarisan Bilateral Menurut Al-Qur'an Dan Hadis* (Jakarta: Tintamas, 1990).

<sup>38</sup> Zainuddin Ali, *Pelaksanaan Hukum Waris Di Indonesia* (Jakarta: Sinar Grafika, 2008).

<sup>39</sup> *Ibid.*, p.47

<sup>40</sup> Rahmad Haniru, "Hukum Waris Di Indonesia Perspektif Hukum Waris Dan Hukum Adat," *AL-HUKAMA: The Indonesian Journal of Islamic Family Law* 4, no. 2 (2014): 460.

<sup>41</sup> H.M. Tahir Azhary, *Bunga Rampai Hukum Islam* (Jakarta: Ind-Hild-Co, 1992).

<sup>42</sup> Hazairin, *Op.Cit.*, p. 6

## Towards the Unification of Inheritance Law in Indonesia: Challenges and Opportunities in the Context of Religious and Cultural Diversity

but if the wife has children, the acquisition is  $\frac{1}{4}$  of his wife's estate. Conversely, the widow gets  $\frac{1}{4}$  of her husband's estate if the husband does not leave children, if the husband leaves children then the widow gets  $\frac{1}{8}$  of her husband's estate.<sup>43</sup>

- d) Brother, a brother either alone or with several brothers have been determined share each as heirs in the legal line al-Qur'an Surat al-Nisa' verse 12 and 176. Verse 12 regulates the acquisition. a brother or a sister, who each get  $\frac{1}{6}$  of the inheritance. Also regulates the acquisition of two or more brothers, all brothers share equally on  $\frac{1}{3}$  of the inheritance.<sup>44</sup> Verse 176 is a definition of *kalalah*. *Kalalah* is a man or woman who dies leaving no children or no descendants, but only brothers and sisters.<sup>45</sup> Also regulates the acquisition of a sister by  $\frac{1}{2}$  of the inheritance. Regulates the acquisition of one or more brothers equal to the entire inheritance. In addition, it also regulates the acquisition of two or more sisters amounting to  $\frac{2}{3}$  of the inheritance, then regulates the balance of rights and obligations of acquisition between brothers and sisters, namely 2:1.<sup>46</sup>
- e) Surrogate Heirs, a child or more than one, both male and female who replaces the position of his parents as heirs, the heir is determined in the legal line of the Qur'an surat al-Nisa' verse 33. The line of law, regulates the replacement heirs for the estate of the mother-father, for the estate of the immediate family. However, the share of each successor heir refers to the provisions of Surah al-Nisa' verses 11, 12, and 176.<sup>47</sup>

As a religious law that is primarily based on the revelation of God delivered by the Prophet Muhammad SAW, Islamic inheritance law contains various principles that in some cases also apply in the law of inheritance derived from human reason. These principles are:<sup>48</sup>

- a. *Ijbari* Principle: In Islamic law, the transfer of property from a deceased person to a living person takes place automatically without the efforts or wishes of the deceased. This method of transfer is known as *Ijbari*.
- b. Bilateral Principle: In terms of inheritance, the right of inheritance is given to each individual from both sides of the bloodline, namely from the male and female bloodlines.
- c. Individual Principle: Islamic law teaches the principle of individual ownership, which means that property can be divided for each person to own. All inherited property can be divided into a certain amount that can be divided, and each heir is entitled to receive their respective shares, without being bound by other heirs.
- d. The Principle of Balanced Justice refers to the balance between rights and obligations and what is obtained based on need and utility. In other words, it can be said that gender does not affect inheritance rights. However, in societies that adhere to the patrilineal lineage system, where heirs are only of the fatherly line or male descent, this principle of balance does not exist.
- e. Islamic Inheritance Law stipulates that death is the only reason for the transfer of property. In other words, a person's property cannot be transferred if he is still alive.

Based on the explanation above, inheritance law in Indonesia still adheres to three systems, namely civil inheritance law, inheritance law based on custom and inheritance law according to Islam. The current regulation of inheritance law in Indonesia is based on a system of diversity, related to the different religions and cultures that exist in this country. This creates significant challenges in achieving equality and justice in the distribution of inheritance.

Indonesia is a country with high religious diversity. Inheritance law is governed by each religion, such as Islam, Christianity, Hinduism, Buddhism, and other religions practiced by the Indonesian people. Each religion has its own provisions regarding inheritance, including who is entitled to receive inheritance, the proportion of distribution, and the implementation mechanism. This religious diversity is a challenge in creating consistency and uniformity in the regulation of inheritance law throughout Indonesia. In addition, cultural diversity also affects the regulation of inheritance law in Indonesia. Each ethnic group and region has different customs in terms of inheritance. These customs involve traditions, norms and cultural values that affect the distribution of inheritance. These differences can cause injustice and conflict between family members who come from different cultures.

In this context of religious and cultural diversity, there are challenges that need to be overcome in the effort to unify inheritance law in Indonesia. One of the main challenges is achieving consensus among diverse stakeholders, including legal experts, religious leaders, customary communities and the general public. The process of unifying inheritance law must consider

---

<sup>43</sup> *Ibid.*, p.7

<sup>44</sup> Sajuti Thalib, *Hukum Kewarisan Islam Di Indonesia* (Jakarta: Bina Aksara, 1981).

<sup>45</sup> Hazairin, *Op.Cit.*, p. 8

<sup>46</sup> Sajuti Thalib, *Op.Cit.*, p. 134

<sup>47</sup> Zainuddin Ali, *Op.Cit.*, p.50

<sup>48</sup> Amir Syarifuddin, *Hukum Kewarisan Islam* (Jakarta: Kencana, 2004).



## **Towards the Unification of Inheritance Law in Indonesia: Challenges and Opportunities in the Context of Religious and Cultural Diversity**

the needs and interests of all parties, while maintaining Indonesia's diversity and religious freedom. However, amidst these challenges, there are also opportunities to create a fairer and more harmonious inheritance law system in Indonesia. Unification of inheritance law can simplify the process of inheritance administration, reduce bureaucracy, and avoid conflicts that often arise in the division of inheritance. In addition, by applying the principles of justice and equality in the unification of inheritance law, Indonesia can strengthen public trust in the justice system and improve social stability in the country.

### **B. Opportunities Toward the Unification of Inheritance Law in Indonesia**

Indonesians are welcome to choose which inheritance law to use. As long as there is an agreement, people can choose customary inheritance law, Islamic inheritance law or civil inheritance law. But the problem becomes complex if there is no agreement between the disputing parties. If so, then the problem can become endlessly long and protracted. In such a situation, it is of course inevitable that there will be a conflict of interest from each party. The problem is widening which then leads to a conflict over the use of inheritance law, namely whether Islamic inheritance law will be used, or customary inheritance law, or civil inheritance law.<sup>49</sup>

The complexity that stems from such legal conflicts is time to find a way out. There are two possible ways to resolve the problem of conflicts in inheritance law, namely: (1) keep the inheritance law in diversity and when a legal conflict arises, it is then submitted to the court; or (2) unify it by making a new law in the field of inheritance that is national in nature.

In order to realize national unity, one of them can only be achieved through legal unification. The idea of maintaining legal plurality is certainly not in line with the ideals of legal equality. On a more fundamental level, there is no constitutional basis for making different laws applicable to different groups of people. If we look deeper, the Indonesian Constitution does not recognize population groups.

The argument to keep inheritance law in Indonesia in a state of diversity has more negative consequences, because allowing this situation to continue is clearly contrary to the ideals of the nation which wishes to have a national law (which is unified and codified) which is the nation's own product. By ignoring this, it also means preserving the legal conflict between the three systems of inheritance law that has occurred since the Dutch colonial period and which continues to this day.<sup>50</sup>

Efforts towards the unification of nationally applicable inheritance law should be started immediately, in addition to avoiding family conflicts, providing legal certainty, as well as updating things that are considered unfair in the existing inheritance law system.

The pattern of drafting the future national inheritance law can use the view of Sociological Jurisprudence from Roscoe Pound. According to Pound, a good (written) law is a law that is in accordance with the laws that live in society.<sup>51</sup> This formulation shows a careful compromise between written law (from the national legislative process) as the legal needs of the legal community for legal certainty and living law as a form of appreciation for the importance of the role of society in law formation and legal orientation.<sup>52</sup> In line with Pound's view, Eugen Ehrlich emphasized the principle of the importance of balance between formal law and the living law. Balance between the interests of the state and the interests of society.<sup>53</sup>

Furthermore, to unify inheritance law in Indonesia can be done by adjusting the elements of the applicable legal order within the framework of the legal system. According to Sudikno Mertokusomo, a legal system is a collection of elements that work together to achieve certain goals.<sup>54</sup> According to Lawrence M. Friedman, every legal system consists of 3 (three) sub-systems, namely legal substance, legal structure, and legal culture.<sup>55</sup>

The substance of inheritance law refers to the rules and principles that govern the distribution of a person's property, possessions or wealth after death. The substance of inheritance law can vary from one country to another, and can also sometimes vary depending on the prevailing religion, customs, or legal system. Therefore, there must be synchronization and harmonization in determining the substance of inheritance law towards unification.

Legal structure refers to the organization and structure of law within a particular country or jurisdiction. It includes the legal framework that governs how laws are made, applied and enforced within a legal system. Legal structure can vary from custom/culture to custom/culture, as can inheritance law. It can also involve independent judicial systems, law enforcement

---

<sup>49</sup> Mohammad Yasir Fauzi, "Legislasi Hukum Kewarisan Di Indonesia," *Jurnal Pengembangan Masyarakat Islam* 9, no. 2 (2016): 71.

<sup>50</sup> Busthanul Arifin, *Pelembagaan Hukum Islam Di Indonesia Akar Sejarah, Hambatan Dan Prospeknya* (Jakarta: Gema Insani Pres, 1996).

<sup>51</sup> Lili Rasjidi, *Dasar-Dasar Filsafat Hukum* (Bandung: Alumni, 1985).

<sup>52</sup> Lili Rasjidi dan I.B. Wyasa Putra, *Hukum Sebagai Suatu Sistem* (Bandung: Rosdakarya, 1993).

<sup>53</sup> *Ibid.*, p.84

<sup>54</sup> Sudikno Mertokusomo, *Mengenal Hukum* (Yogyakarta: Liberty, 1991).

<sup>55</sup> Lawrence M. Friedman, *Hukum Amerika: Sebuah Pengantar, Terjemahan Dari American Law An Introduction, 2nd Edition*, ed. Wisnu Basuki (Jakarta: Tatanusa, 2001).

## **Towards the Unification of Inheritance Law in Indonesia: Challenges and Opportunities in the Context of Religious and Cultural Diversity**

bodies, legislatures and executive governments that have roles and responsibilities in law making, implementation and enforcement. It is important to remember that legal structure can vary between customary, Islamic and Western inheritance law and the legal systems are different. Each inheritance law system has its own legal system that is based on history, culture and prevailing legal values.

Meanwhile, legal culture, also known as legal culture, refers to the values, norms, beliefs and practices relating to law in a particular society or group. This includes the perspective, attitude, and behavior towards the law adopted by individuals in that society. Legal culture affects the way people understand, obey and interact with the law. Here are some factors that influence legal culture:

1. **History and Cultural Heritage:** A society's history and cultural heritage have a significant influence on its legal culture. Past experiences, existing legal systems, and long-standing legal traditions can shape people's perceptions and legal values.
2. **Religion and Belief:** Religion and belief also play an important role in shaping legal culture. The value systems and ethics advocated by religions can influence people's views and behaviors towards the law. For example, some religions have rules and regulations that their followers follow, which can influence the legal culture in that society.
3. **Social Values and Personality:** The social values upheld by a society also have an impact on the legal culture. For example, if a society has a high concern for justice, equality or a sense of social responsibility, then their legal culture is likely to reflect these values.
4. **Economic and Social Factors:** The economic and social context of a society also affects legal culture. Economic inequality, social conflict, and certain social problems can reflect attitudes and views towards the law. In addition, these factors can also affect the level of compliance with the law and people's interaction with the justice system.
5. **The prevailing legal system:** The legal system that exists within a country or jurisdiction plays an important role in shaping the legal culture. A particular legal system, such as a common law system or continental legal system, can provide guidelines, rules and procedures that influence the way people interact with the law. Legal culture is not a fixed or universal entity, but varies across societies. Each society has its own legal culture that is influenced by a number of factors. Understanding the legal culture in a society is important to understand how the law operates, is accepted, and is carried out in it, as well as in efforts to unify inheritance law, it is necessary to understand each culture of the existing inheritance law system, namely customary inheritance law, Islamic inheritance law and civil inheritance law.

Furthermore, to create opportunities for the unification of inheritance law in Indonesia, the following steps can be taken:

1. An in-depth study and research should be conducted regarding the inheritance law systems applicable in Indonesia, namely the Civil inheritance law system, customary inheritance law, and Islamic inheritance law. This research can involve legal experts, academics, and legal practitioners to analyze the differences and similarities between the three legal systems.
2. Open dialog and discussion between stakeholders, such as legal experts, religious leaders, indigenous people, and the government. This discussion aims to find an understanding and solution that can be accepted by all parties regarding the unification of inheritance law.
3. Submitting proposals and discussions at the legislative level to adopt laws governing the unification of inheritance law in Indonesia. This process involves discussion and decision-making by members of parliament to determine the form and content of the law.
4. Socialize and educate the public on the importance of unification of inheritance law and the benefits of legal certainty in inheritance. This can be done through public campaigns, seminars, workshops and mass media.
5. After the unification of inheritance law is passed, implementation and evaluation of its implementation should be carried out. This evaluation aims to ensure that the unification of inheritance law can be implemented properly and provide justice and legal certainty for all parties involved.

However, it should be remembered that the chances of unification of inheritance law in Indonesia are still very small due to the different views, beliefs and values in society. Therefore, efforts to create unification of inheritance law need to be done carefully and involve all parties involved to reach a broader understanding.

### **IV. CONCLUSIONS**

Inheritance law in Indonesia is very pluralistic because inheritance law is not uniform, consisting of civil inheritance law regulated in the Burgerlijk Wetboek (WB), customary inheritance law regulated in their respective customary inheritance laws based on existing kinship systems (patrilineal, matrilineal, and parental), and Islamic inheritance law regulated in Islamic law. There are challenges that need to be overcome in the effort to unify inheritance law in Indonesia. One of the main challenges is achieving consensus among diverse stakeholders, including legal experts, religious leaders, customary communities and the

## Towards the Unification of Inheritance Law in Indonesia: Challenges and Opportunities in the Context of Religious and Cultural Diversity

general public. The process of unifying inheritance law must consider the needs and interests of all parties, while maintaining Indonesia's diversity and religious freedom. However, amidst these challenges, there are also opportunities to create a more just and harmonious inheritance law system in Indonesia.

To unify inheritance law in Indonesia can be done by adjusting the elements of the prevailing legal order within the framework of the legal system. A legal system is a collection of elements that work together to achieve certain goals. In every legal system consists of 3 (three) sub-systems, namely legal substance, legal structure, and legal culture. Furthermore, to create opportunities for the unification of inheritance law in Indonesia, the following steps can be taken: Conduct in-depth studies and research related to the prevailing inheritance law system in Indonesia; Open dialogue and discussion between stakeholders, such as legal experts, religious leaders, indigenous peoples, and the government; Submit proposals and discussions at the legislative level to adopt laws governing the unification of inheritance law in Indonesia; Conduct socialization and education to the public about the importance of unification of inheritance law; And after the law on unification of inheritance law is passed, implement and evaluate its implementation.

### REFERENCES

- 1) Adelina Nasution. "Pluralisme Hukum Waris Di Indonesia." *L-Qadhâ* 5, no. 1 (2018): 25.
- 2) Adikusuma, Hilman. *Hukum Waris Indonesia, Perundang-Undangan Hukum Adat, Hindu, Dan Islam*. Bandung: Cipta Aditya Bakti, 1994.
- 3) Afandi, Ali. *Hukum Waris, Hukum, Keluarga, Hukum Pembuktian*. Jakarta: PT. Rineka Cipta, 2000.
- 4) Ali, Zainuddin. *Pelaksanaan Hukum Waris Di Indonesia*. Jakarta: Sinar Grafika, 2008.
- 5) Arifin, Busthanul. *Pelebagaan Hukum Islam Di Indonesia Akar Sejarah, Hambatan Dan Prospeknya*. Jakarta: Gema Insani Pres, 1996.
- 6) Azhary, H.M. Tahir. *Bunga Rampai Hukum Islam*. Jakarta: Ind-Hild-Co, 1992.
- 7) Fauzi, Mohammad Yasir. "Legislasi Hukum Kewarisan Di Indonesia." *Jurnal Pengembangan Masyarakat Islam* 9, no. 2 (2016): 71.
- 8) Friedman, Lawrence M. *Hukum Amerika: Sebuah Pengantar, Terjemahan Dari American Law An Introduction, 2nd Edition*. Edited by Wisnu Basuki. Jakarta: Tatanusa, 2001.
- 9) Haniru, Rahmad. "Hukum Waris Di Indonesia Perspektif Hukum Waris Dan Hukum Adat." *AL-HUKAMA: The Indonesian Journal of Islamic Family Law* 4, no. 2 (2014): 460.
- 10) Hazairin. *Bab-Bab Tentang Hukum Adat*. Jakarta: Pradnya Paramita, 1975.
- 11) ———. *Hukum Kewarisan Bilateral Menurut Al-Qur'an Dan Hadis*. Jakarta: Tintamas, 1990.
- 12) ———. *Hukum Kewarisan Bilateral Menurut AL-Qur'an Dan Hadist, Cet. Kelima*. Jakarta: Tintamas, 1983.
- 13) Lev, Danile S. *Hukum Dan Politik Di Indonesia*. Edited by Nirwono dan A.E. Priyono. Jakarta: LP3ES, 1990.
- 14) Lili Rasjidi dan I.B. Wyasa Putra. *Hukum Sebagai Suatu Sistem*. Bandung: Rosdakarya, 1993.
- 15) Mertokusumo, Sudikno. *Mengenal Hukum*. Yogyakarta: Liberty, 1991.
- 16) Muhammad, Husnain. *Makhluf, Al-Mawāriṭhīal-Sharī'ah Al-Islāmiyyah, Matabi' Al-Ahram Al-Tijariyyah*. Kairo, 1971.
- 17) Ramulyo, H.M. Idris. *Perbandingan Hukum Kewarisan Islam Dengan Kewarisan Kitab Undang-Undang Perdata, Edisi Revisi*. Jakarta: Sinar Grafika, 2004.
- 18) Ramulyo, Mohd. Idris. *Beberapa Masalah Pelaksanaan Hukum Kewarisan Perdata Barat (Burgerlijk Wetboek)*. Jakarta: Sinar Grafika, 1993.
- 19) Rasjidi, Lili. *Dasar-Dasar Filsafat Hukum*. Bandung: Alumni, 1985.
- 20) Ratno Lukito. *Pergumulan Antara Hukum Islam Dan Hukum Adat Di Indonesia*. Jakarta: INIS, 1998.
- 21) Sagala, Elviana. "Hak Mewaris Menurut Ketentuan Hukum Waris Perdata." *Jurnal Ilmiah: Advokasi* 6, no. 1 (2018): 121–22.
- 22) Setiady, Tolib. *Intisari Hukum Adat Indonesia (Dalam Kajian Kepustakaan)*. Bandung: Alfabeta, 2008.
- 23) Soerjono Soekanto, Sri Mamuji. *Penelitian Hukum Normatif*. Jakarta: CV. Rajawali, 1990.
- 24) Soerojo Wignyodipoero. *Pengantar Dan Asas-Asas Hukum Adat*. Jakarta: Haji Masagung, 1990.
- 25) Supriyadi. "Pilihan Hukum Waris Dalam Masyarakat Majemuk (Studi Banding Hukum Islam Dan Hukum Perdata)." *Al-Adalah* 12, no. 1 (2015): 553.
- 26) Surini Ahlan Sjarif dan Nurul Elmiyah. *Pewarisan Menurut Undang-Undang*. Jakarta: Kencana, 2006.
- 27) Sutantio, Retnowulan. *Wanita Dan Hukum*. Bandung: Alumni, 2000.
- 28) Syarif, Surini Ahlan. *Intisari Hukum Waris Menurut Burgerlijk Wetboek*. Jakarta: Ghalia Indonesia, 2003.

## Towards the Unification of Inheritance Law in Indonesia: Challenges and Opportunities in the Context of Religious and Cultural Diversity

- 29) Syarifuddin, Amir. Hukum Kewarisan Islam. Jakarta: Kencana, 2004.
- 30) Thalib, Sajuti. Hukum Kewarisan Islam Di Indonesia. Jakarta: Bina Aksara, 1981.
- 31) Usman, H. Suparman. Ikhtisar Hukum Waris Menurut KUH Perdata (BW). Serang: Darul Ulum Press, 1990.
- 32) Wignjosoebroto, Soetyandyo. "Hukum Nasional: Unifikasi Dicitakan, Pluralisme Acap Merupakan Fakta Menyulitkan." Majalah Hukum Nasional, no. 2 (2008): 56.
- 33) Wignodipoero, Soeroyo. Pengantar Dan Asas-Asas Hukum Adat. Jakarta: Gunung Agung, 1995.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Competence of Islamic Religious Education Teachers in the Era of Globalization: Multi Case Studies at State Senior High School in Palu City, Indonesia



Ulfa Wahyuni<sup>1</sup>, Sagaf S. Pettalongi<sup>2</sup>, Hamlan Andi Baso Malla<sup>3</sup>, Nurdin Nurdin<sup>4</sup>

<sup>1,2,3,4</sup> Department of Islamic Education, Postgraduate Studies, Universitas Islam Negeri Datokarama Palu, Indonesia

<sup>4</sup> Department of Education Management, Postgraduate Studies, Universitas Islam Negeri Palu, Indonesia

**ABSTRACT:** The influence of globalization has occurred in various aspects of human life, including social, cultural, economic, political, and even educational aspects. The Role and duties of Islamic religious education teachers must be performed with qualified competence. This study examines the competency of Islamic spiritual education teachers in three State Senior High Schools in Palu City. This research used a qualitative approach with a multi-cases study design. Data collection techniques were carried out through direct observation, in-depth interviews, and written material analysis. The results of this study show that the competence of Islamic religious education teachers in three State Senior High Schools in Palu City is good, especially in personality competence, social competence, leadership competence, and spiritual competence. However, there are still several Islamic religious education teachers who need to improve in using information technology in teaching. The teacher's competency has affected the formation of students' character or attitudes, both social and religious. Islamic religious teachers' competency needs to improve in pedagogic and professional job performance, which affects the teaching quality.

**KEYWORDS:** School leadership, Islamic education, teacher, professionalism

### I. INTRODUCTION

Globalization has been illustrated as a process that runs at high speed, which no one can control (Milanovic, 2003). According to Milanovic globalization is a world that is out of control. It's like a big truck rolling without control, and no one can stop the big truck called Globalisa. This is a picture of what will happen in the future, and whether we like it or not, humans have to face it. This kind of situation will affect the world of education, both from institutional aspects, curriculum, teaching materials, educators, and methods, as well as infrastructure (Waks, 2003). At the same time, the globalization will be a challenge for the world of education, especially Islamic Religious Education with a learning system that is integrated via the internet network.

Facing such conditions, the Role of Islamic religious education teachers is to develop students' morals so that they can direct and control their behavior so that there will be no deviations from religious provisions. Islamic Religious Education Teachers should have the same abilities as other teachers as one of the aspects involved in carrying out their mandate (Habibah, Asmawati, Fitriingsih, & Nurdin, 2021). This is because responsibilities are not only limited to the school environment but also to the society in which they are located, especially in facing the era of globalization, which shows the importance of education, which is the responsibility of Islamic religious education teachers and parents.

The moral education taught by religious teachers in schools is not enough to use theories; moral education must be provided during the learning process or outside of learning (Latepo, Suharto, & Nurdin, 2021). Religious education in public schools is an effort to integrate Islamic education into a school system whose curriculum is oriented towards general knowledge, as is the case in government systems in Western countries. The general education system has been implemented in Indonesia since the Dutch Colonial period. The integration of Islamic religious education into the public school system began in the early 20th century. One of the big problems facing the world of education in Indonesia since the New Order era is teacher professionalism, which still needs to be improved (Sari, 2012). Many teachers still need to be qualified and matched, so they are less able to present and provide genuinely quality education. To achieve these educational goals, the Role of teachers in the teaching and learning process is very much needed. The duties and roles of teachers in education are very important, both as educators and

## **Competence of Islamic Religious Education Teachers in the Era of Globalization: Multi Case Studies at State Senior High School in Palu City, Indonesia**

instructors. Teachers, as teaching staff, are expected to be able to master how to lead and manage the student learning process because the quality of teaching determines student success in learning.

Teachers as leaders must be able to organize ideas that need to be developed among students with a leadership system that can stimulate their interest, passion, and enthusiasm for learning through appropriate and effective teaching methods. The target of the teacher's task is not only to form brain intelligence but also to shape the child's entire personality into an adult human being capable of mastering knowledge and developing the welfare of human life.

### **II. LITERATURE REVIEW**

#### **A. Islamic Religious Education Competency**

The word competency can be interpreted as skill or ability (Hoffmann, 1999). In Arabic, competency is called *kafā'ah* and *al-aliyah*, which means having the ability and skills in one's field so that one has the authority or authority to do something within the limits of one's knowledge. This word has become a keyword in the world of education. The importance of competency in education is based on rational considerations, that the learning process is complicated and complex. Various aspects are interrelated and influence the success or failure of learning activities.

Competency is a collection of information containing knowledge, skills, and behavior that a teacher must have in achieving learning goals through training, education, and independent learning by utilizing learning resources (McClelland, 1998). Therefore, the competencies teachers must have are related to personal, scientific, technological, social, and spiritual abilities, all of which are included in the professional standards for teachers when teaching their students.

Competence is a combination of knowledge (thinking power), attitudes (heart power), and skills (physical strength) which are realized in the form of actions. In other words, competence is a combination of mastery of knowledge, skills, values, and attitudes, which are reflected in habits of thinking and acting in carrying out tasks or work.

Starting from the belief that there is a change in the status of teachers to become professionals and a high appreciation of the environment, of course, competence is an important step that needs to be improved. Intellectual competence is a variety of knowledge tools within an individual that are required in order to support various aspects of performance as a professional teacher. Meanwhile, competence, physical and individual, is closely related to behavioral devices related to the individual's ability to realize himself as an independent person to carry out self-transformation, self-identity, and self-understanding.

Competency is the main component of professional standards, in addition to the code of ethics as a regulation of professional behavior stipulated in specific procedures and supervision systems. Meanwhile, what is meant by teacher competency is a combination of personal, scientific, technological, social, and spiritual abilities that substantially form teacher competency standards, which include mastery of material, understanding of students, educational learning, personal development, and professionalism.

#### **B. Islamic Religious Teachers' Competency in the Global Age**

Globalization has a significant influence on human life in various aspects of life, including social, political, economic, cultural, etc (Mukherjee & Kriekhaus, 2012). In this case, globalization has changed everyday life, especially felt by developing countries, and at the same time, it has created new transnational systems and forces.

Globalization also has a significant influence on the implementation of education, both on goals, processes, teacher-student relationships, ethics, methods, and others. The problems humans face require an educational vision and orientation that does not solely emphasize filling the brain but also the soul, developing morals, and obedience in carrying out worship.

As time passes, challenges and obstacles in Islamic Religious Education continue to experience development and change (Abdullah, 2017). If conversations between students and teachers felt taboo a few decades ago, today it is normal. Even in the view of modern educational theory, it is a necessity. Such interactions are an indication of the success of the educational process. This era of globalization has brought the influence of science and culture in every corner of the world so that the boundaries and barriers between one country and another are no longer clear. Globalization is also a process of integration of increasingly rapid developments in science and technology, resulting in the world becoming smaller and forming a global society that is interdependent. Globalization is a historical necessity that cannot be rejected. This phenomenon has already happened and is real before our eyes. Now is no longer the time to engage in polemics about this issue; the most important thing is how a Muslim should behave and position himself against the current of Western thought that is continuously hitting Muslims.

Entering the era of globalization requires a Muslim to be wise and be able to actualize the values of Islamic teachings when interacting with the outside world. A Muslim must maintain his identity in facing various challenges and temptations. Muslims must be able to take the positive side of globalization, while the opposing side must be discarded and used as a bad example.

## **Competence of Islamic Religious Education Teachers in the Era of Globalization: Multi Case Studies at State Senior High School in Palu City, Indonesia**

This situation requires teachers to know the existing challenges, especially in the current digital era. Teachers must be able to find solutions to every challenge so that they can have a positive impact on or benefit the development of education, especially in the learning process, both in and outside the classroom. Among these challenges is that teachers must be able to adapt teaching methods to the needs of the nation's generation by utilizing information and communication technology.

Another paradigm shift, for example, in terms of learning approaches. In the era of traditional Islamic education, the teacher was the central figure in learning activities (Hardaker & Sabki, 2018). He was the main source of knowledge in the classroom and could even be said to be the only source of knowledge. However, this no longer applies in the context of modern Islamic education. The Role of teachers today has shifted, namely as a student facilitator. Learning is no longer teacher-centered but more student-centered. The development of science and technology increasingly encourages reform efforts in the use of technological results in learning, including in the selection and use of media. Teachers are required to be able to use educational institutions' tools in accordance with the times' developments and demands. The tendency to use high technology, especially communication and information technology such as computers, has led to demands from the public to get services that are faster, more transparent, and not limited by time and place. This high technology has also entered the world of education, such as in administrative services, finance, and learning processes. Through this communication and information technology, students can participate in distance learning activities. Meanwhile, the Role and function of teaching staff have also shifted to become facilitator, motivator, and dynamist. The Role of educators today is no longer as the only source of knowledge (agent of learning). This situation, in turn, requires the existence of an education management model based on communication and information technology.

### **III. METHODOLOGY**

This study was carried out within three State Senior High Schools in Palu city, Indonesia. This study uses a qualitative case study method (Nurdin, Scheepers, & Stockdale, 2022; Nurdin, Stockdale, & Scheepers, 2013) to investigate the competency of Islamic religious education teachers in global age (Amiruddin, Nurdin, & Ali, 2021). Data were collected through direct observation in the case field and in-depth interviews with teachers and the elementary school principal (Jumahir, Nurdin, Pettalongi, Fitri, & Aftori, 2023; Nurdin, 2023). Written materials were also analyzed to understand the strategy used to implement moderate Islamic values in elementary school. Data analysis consists of several procedures, which include reduction and verification techniques with various data sources (Alamsyah, Pettalongi, & Nurdin, 2023; Arif, Nurdin, & Elya, 2023). The reduced data was then analyzed, reflecting on the theoretical concepts used in this study. Finally, the results were presented based on thematic issues found in the data (Muhaimin, Nurdin, & Alhabsyi, 2023; Nurdin, Agam, & Adawiyah, 2023; Nurdin, Pettalongi, Ahsan, & Febrianti, 2023), which show the insight relating to leadership style within schools in Poso regency in Indonesia.

### **IV. RESULTS AND DISCUSSION**

#### **A. Islamic Religious Teacher's Competency in Global Age**

As said by Lester (2014), competence is the main component of professional standards, in addition to the code of ethics, which is a regulation of professional behavior that is stipulated in specific procedures and supervision systems. Meanwhile, what is meant by teacher competency is a combination of personal, scientific, technological, social, and spiritual abilities that substantially form teacher competency standards, which include mastery of material, understanding of students, educational learning, personal development, and professionalism. Based on Law Number 14 of 2005 concerning Teachers and Lecturers in Chapter IV Article 10, it is stated that there are four competencies that teachers must have, namely pedagogical competence, personality competence, professional competence, and social competence. Teachers must have these four competencies; whether asked for or not, they must do them sincerely. These four competencies do not stand alone but are interconnected and, influence each other, and mutually underlie each other. The competency of Islamic Religious Education teachers is based on Minister of Religion Regulation Number 16 of 2010 concerning the Management of Religious Education in schools, Chapter VI Article 16, that Islamic Religious Education teachers must have pedagogical, personality, social, professional, spiritual, and leadership competencies. To determine the competency of Islamic Religious Education teachers at three State Senior High Schools in Palu City, we used six competencies of Islamic Religious Education teachers as indicators to measure the quality and performance of teachers in implementing Islamic Religious Education learning in schools.

#### **B. Pedagogic Competency**

Researchers have previously stated that pedagogical competence is the teacher's ability to manage learning. To determine a teacher's pedagogical skills, researchers use indicators of pedagogical competence, including mastering learning theory and

## **Competence of Islamic Religious Education Teachers in the Era of Globalization: Multi Case Studies at State Senior High School in Palu City, Indonesia**

learning principles, understanding students, the ability to design learning, implementing educational and dialogical learning, utilizing learning technology, and helping students to be able to actualize their knowledge. The various potentials it has.

Mastery of learning theories and educational learning principles is essential for teachers to realize effective, efficient, and optimal learning (Kay & Kibble, 2016). By mastering learning theories and academic learning principles, at least teachers can understand what and how the learning process occurs in students so that teachers can take appropriate pedagogical and educational actions for implementing learning. In addition, teachers can choose and use learning approaches, strategies, methods, and techniques that are flexible, varied, innovative, and effective in implementing learning so that they can achieve optimal learning goals.

Today's students have a much different character compared to students several decades ago. Therefore, teachers must be more astute in using learning strategies, as stated by education experts regarding learning and learning theories, so that learning becomes more varied, exciting, and enjoyable, thus making students less interested in participating in learning in the classroom. Moreover, Islamic Religious Education subjects are usually avoided by students because, apart from the religious subject matter, they are considered difficult and less interesting (because they talk a lot about verses and concepts of creed), also because the methods and strategies used are not varied. and the nature of watching without any innovation and creativity to make learning more exciting and fun.

When the researcher asked about how the activities carried out by Hadijah were related to the Market Place Activity method, which had been conveyed by one of the students above. Hadijah explained that the material presented using the Market Place Activity method was material about the laws of buying and selling in Islam. Then, he connected the material to the world today, related to world markets. The following are the results of an interview with Hadijah regarding the methods she uses in delivering material about buying and selling laws related to world markets.

This method is included in the Project Base Learning category because it takes quite a long time to complete several preparations. My students were divided into several groups; they were assigned to look for information about the world market, for example, what types of goods are being sold, how they are being sold, as well as the elements in the practice of buying and selling, whether they meet the legal requirements in the view of Islamic law or not. Then, they were also advised to use the attributes of which country was the object of their assignment.

Likewise, when the researcher observed the learning carried out by an informan from a senior high school in Palu city, the researcher saw that the learning process used quite creative, varied, and effective learning methods. At that time, the material presented was about "the Koran and al-Hadith are my guides to life." In delivering this material, the informan uses the Role-playing method, or what is known as socio-drama, where students are given role cards to study and then practice in a role-play situation according to a predetermined scenario.

Apart from the Role Playing method, Rasyid also uses several innovative and fun ways, such as the "Testimony" method in material about "the spirit of studying and putting it into practice," where students are divided into several groups and then given video shows. The Bridging Analogy method is also used to convey material about tolerance. This Bridging Analogy uses the approach of linking one concept to another by looking for similarities and the Gallery Wall method.

### **C. Personal Competency**

The teacher's personality competency has a huge influence on the personal growth and development of students. This personality competency plays an important role in shaping the child's personality. Eventhought teacher must have adequate personality competencies because the personality competency will become the basis for other competencies (Oser, Renold, Oser, Achtenhagen, & Renold, 2006). Teachers are not only required to be able to interpret learning, but what is most important is how they make learning a means of forming competencies and improving the personal qualities of students.

To determine the Personality Competence of Islamic Religious Education teachers in these three state high schools, researchers used personality competency indicators, namely (1) a steady, stable personality and the teacher's Personal Competence has a huge influence on personal growth and development of students. This personality competency has a vital role and function in shaping the personality of adult children: (2) being disciplined, wise, and authoritative, (3) being a role model for students, and (4) having noble character.

### **D. Stable and Mature Personality**

To carry out their duties well, professionally, and responsibly, teachers must have a strong, stable, and mature personality. This is important because many educational problems are caused by teachers' personality factors that are less stable, less stable, and less mature. Such personality conditions often cause teachers to carry out unprofessional, dishonorable, and even indecent actions that damage the teacher's image and dignity. Regarding a steady and stable personality, the researcher found that



## **Competence of Islamic Religious Education Teachers in the Era of Globalization: Multi Case Studies at State Senior High School in Palu City, Indonesia**

Islamic Religious Education teachers from the four case studies have good personalities. This can be seen when they communicate with students and their colleagues. They are quite aware of how to behave towards each other and students.

In line with the opinion of several students at the schools said that Islamic Religious Education teachers taught them and what they thought about the teacher's personality. Regarding personality, a student said Islamic religious education teachers are the persons with very good manner. The teachers rarely gets angry, and even if they get angry, it's only reasonable and not too emotional. If we are wrong, we will definitely be advised.

As for the description of the personality competency of the Islamic Religious Education teachers at the four senior high schools are stable and mature. We found that Islamic Religious Education teachers have quite stable and mature personalities. We found the facts from holding several dialogues regarding their attitude towards students who are challenging to manage or who like to be disobedient. An informan said:

I don't want to be rude or yell at these stubborn students because high school students are teenagers, not the same as elementary or middle school students, so the teacher should not embarrass them in front of their friends.

The strict test for teachers in terms of personality, as stated by E. Mulyasa, is stimuli that often provoke their emotions. Emotional stability is essential, but not everyone can restrain their emotions towards stimuli that offend them. Teachers who get angry easily will make students afraid, and fear results in a lack of interest in participating in learning, as well as low concentration, because fear creates anxiety about being scolded, and this distorts students' attention.

### **E. Discipline and Authoritative**

In education, disciplining students must start with a disciplined, wise, and authoritative teacher. Teachers cannot expect much from forming disciplined students if the teacher lacks discipline, wisdom, and authority. Teachers who have a disciplined attitude will usually come and leave on time. He will teach with full responsibility, comply with the regulations in force at school, be a role model and role model for his students, and be very enthusiastic in carrying out his duties.

In this study we define discipline as teachers comply with various rules and regulations consistently, with professional awareness, because they are tasked with disciplining students at school, especially in learning. Therefore, in instilling discipline, teachers must start with themselves with various actions and behaviors. This is where the importance of the teacher's personal or personal competence comes in.

Overall, the disciplinary attitude of Islamic religious education teachers in the three high schools is good. However, it cannot be denied that there is still one of the Islamic Religious Education teachers who does not have a disciplinary attitude. Based on the results of the researcher's interviews with several students and teachers, including the deputy principal for curriculum at all senior high schools. We also found few Islamic religious education teachers who lack discipline because they once left the classroom when the lesson was in progress, or sometimes not attending class at all to carry out their obligations as a teacher. We found that the situation mentioned above does not only occur within the four case studies, but in general, there are still many teachers who need to implement discipline optimally.

In education, disciplining students must start with a disciplined, wise, and authoritative teacher. Teachers cannot expect much from forming disciplined students if the teacher lacks discipline, wisdom, and authority. Teachers who have a disciplined attitude will usually come and leave on time. He will teach with full responsibility, comply with the regulations in force at school, be a role model and role model for his students, and be very enthusiastic in carrying out his duties. To create a discipline teacher, the teachers must comply with various rules and regulations consistently, with professional awareness, because they are tasked with disciplining students at school, especially in learning. Therefore, in instilling discipline, teachers must start with themselves with various actions and behaviors. This is where the teacher's personal or personal competence is important.

With regard to authority, teachers must have advantages in realizing spiritual, emotional, moral, social, and intellectual values in their personal, as well as having benefits in understanding science, technology, and art. Another form of maintaining authority is conformity between words and actions. Sometimes, teachers teach students about discipline, honesty, cleanliness, and so on, but sometimes, without realizing it, the teacher violates what he has said in front of the students. This will make students not respect the teacher.

### **V. CONCLUSIONS**

Overall, the competency of Islamic Religious Education teachers in three public high schools in Palu City is good in terms of personality competence, social competence, leadership competence, and spiritual competence. However, there are still several Islamic Religious Education teachers who are weak in specific academic competencies in the aspects of mastery of learning technology, understanding of learning theories or educational foundations, and professional competencies.

## Competence of Islamic Religious Education Teachers in the Era of Globalization: Multi Case Studies at State Senior High School in Palu City, Indonesia

The maximum competence of Islamic Religious Education teachers has implications for the ability of Islamic Religious Education teachers to organize all the potential that exists in schools in realizing Islamic culture. Formation of an attitude of tolerance and respect for differences, as well as the establishment of effective communication between fellow school members and between school members and parents of students, as well as the surrounding community, the performance of PAI teachers who have a sincere and patient attitude in carrying out guidance to students, and (4) formation of good student personalities. PAI teacher competencies that are inadequate are pedagogic competence and professional competence which have implications for the quality of learning in the classroom.

### REFERENCES

- 1) Abdullah, Amin. (2017). SLAMIC STUDIES IN HIGHER EDUCATION IN INDONESIA : Challenges, Impact and Prospects for the World Community. *Al-Jāmi'ah: Journal of Islamic Studies*, 55(2), 391-426.
- 2) Alamsyah, Moh Ayuub, Pettalongi, Sagaf S, & Nurdin, Nurdin. (2023). *Peran Teknologi Pendidikan Dalam Meningkatkan Minat Belajar Siswa Di Era Society 5.0*. Paper presented at the Prosiding Kajian Islam dan Integrasi Ilmu di Era Society (KIIIES) 5.0, Palu.
- 3) Amiruddin, Amiruddin, Nurdin, Nurdin, & Ali, Moh. (2021). Islamic Education Teacher Communication Strategy in Increasing Students' Learning Interest. *International Journal of Contemporary Islamic Education*, 3(1), 41-61.
- 4) Arif, Arifuddin M, Nurdin, Nurdin, & Elya, Elya. (2023). Character Education Management at Islamic Grassroot Education: The Integration of Local Social and Wisdom Values. *Al-Tanzim: Jurnal Manajemen Pendidikan Islam*, 7(2), 435-450.
- 5) Habibah, Alfu, Asmawati, Nur, Fitriningsih, Fitriningsih, & Nurdin, Nurdin. (2021). The Effect of Instagram in Learning English Vocabulary. *Datokarama English Education Journal*, 2(1), 22-34.
- 6) Hardaker, Glenn, & Sabki, Aishah Ahmad. (2018). The Rise of the Islamic Institution *Pedagogy in Islamic Education* (pp. 3-16): Emerald Publishing Limited.
- 7) Hoffmann, Terrence. (1999). The meanings of competency. *Journal of European Industrial Training*, 23(6), 275-286. doi:10.1108/03090599910284650
- 8) Jumahir, Jumahir, Nurdin, Nurdin, Pettalongi, Adawiyah, Fitri, Anindya, & Aftori, Rohmatika. (2023). Religious Culture Implementation in State Islamic Senior High School in Indonesia. *Research and Analysis Journal*, 6(2), 19-26.
- 9) Kay, Denise, & Kibble, Jonathan. (2016). Learning theories 101: application to everyday teaching and scholarship. *Advances in Physiology Education*, 40(1), 17-25. doi:10.1152/advan.00132.2015
- 10) Latepo, Ibrahim, Suharto, Suharto, & Nurdin, Nurdin. (2021). Understanding Muslim Preaching Students' Use of Social Media. *International Journal of International Relations, Media and Mass Communication Studies*, 7(1), 52-66.
- 11) Lester, Stan. (2014). Professional standards, competence and capability. *Higher Education, Skills and Work-based Learning*, 4(1), 31-43. doi:10.1108/HESWBL-04-2013-0005
- 12) McClelland, David C. (1998). Identifying Competencies with Behavioral-Event Interviews. *Psychological Science*, 9(5), 331-339. doi:10.1111/1467-9280.00065
- 13) Milanovic, Branko. (2003). The Two Faces of Globalization: Against Globalization as We Know It. *World Development*, 31(4), 667-683. doi:https://doi.org/10.1016/S0305-750X(03)00002-0
- 14) Muhaimin, Alif, Nurdin, Nurdin, & Alhabsyi, Firdiansyah. (2023). *Ilmu Pengetahuan dan Teknologi Menurut Pandangan Islam*. Paper presented at the Kajian Islam dan Integrasi Ilmu di Era Society (KIIIES) 5.0, Palu.
- 15) Mukherjee, Nisha, & Kriekhaus, Jonathan. (2012). Globalization and human well-being. *International Political Science Review*, 33(2), 150-170. doi:10.1177/0192512111402592
- 16) Nurdin, Nurdin. (2023). *Tantangan Guru Dimasa Industri 4.0: Pengetahuan dan Ketrampilan Baru*. Paper presented at the Kajian Islam dan Integrasi Ilmu di Era Society (KIIIES) 5.0, Palu.
- 17) Nurdin, Nurdin, Agam, Muhammad, & Adawiyah, Adawiyah. (2023). *Geographic Information System Continuance Adoption and Use to Determine Bidikmisi Scholarship Recipients Distribution*. Paper presented at the Proceedings of the 2022 International Conference on Computer, Control, Informatics and Its Applications, Virtual Event, Indonesia. <https://doi.org/10.1145/3575882.3575953>
- 18) Nurdin, Nurdin, Pettalongi, Sagaf S, Ahsan, Muhammad Nur, & Febrianti, Vindy. (2023). Factors affecting students' continuance intention to use teaching performance assessment application from technology continuance theory. *International Journal of Electrical and Computer Engineering (IJECE)*, 13(5), 5342-5353.

## Competence of Islamic Religious Education Teachers in the Era of Globalization: Multi Case Studies at State Senior High School in Palu City, Indonesia

- 19) Nurdin, Nurdin, Scheepers, Helana, & Stockdale, Rosemary. (2022). A social system for sustainable local e-government. *Journal of Systems and Information Technology*, 24(1), 1-31. doi:10.1108/JSIT-10-2019-0214
- 20) Nurdin, Nurdin, Stockdale, Rosemary, & Scheepers, Helana. (2013). *The Use of Social Media to Gather Qualitative Data: A Case of Government E-Procurement Implementation and Use*. Paper presented at the 24th Australasian Conference on Information Systems (ACIS)
- 21) Oser, Fritz, Renold, Ursula, Oser, Fritz K., Achtenhagen, Frank, & Renold, Ursula. (2006). Competence Oriented Teacher Training: Old Research Demands and New Pathways *Modeling Teacher Competencies: Identifying and Measuring Standards* (pp. 23-47): Brill.
- 22) Sari, Eunice Ratna. (2012). Online learning community: a case study of teacher professional development in Indonesia. *Intercultural Education*, 23(1), 63-72. doi:10.1080/14675986.2012.664755
- 23) Waks, Leonard J. (2003). How Globalization Can Cause Fundamental Curriculum Change: An American Perspective. *Journal of Educational Change*, 4(4), 383-418. doi:10.1023/B:JEDU.0000006068.61419.90



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## The Impact of Cooperative Learning Method on Learning Motivation and Academic Achievement of Elementary School Students



Uyu Muawanah

Universitas Islam Negeri Sultan Maulana Hasanuddin Banten, Indonesia

**ABSTRACT:** This study aims to investigate the impact of Cooperative Learning Method on learning motivation and academic achievement among elementary school students in Indonesia. Employing a quantitative research design, Likert scale-based questionnaires were distributed directly to students to measure learning motivation, while academic achievement was assessed through examination scores. The study found significant positive relationships between the Cooperative Learning Method and both learning motivation and academic achievement. Moreover, learning motivation emerged as a crucial mediator, partially explaining the observed positive influence on academic achievement. The theoretical contribution lies in enhancing our understanding of the intricate dynamics between instructional methods, motivation, and academic outcomes. From a practical standpoint, the study suggests that educators and policymakers should prioritize the implementation of Cooperative Learning Methods and focus on cultivating and sustaining students' motivation to learn. However, it is crucial to acknowledge the study's limitations, including its regional focus and reliance on self-reported measures. Future research could expand the scope and incorporate diverse contexts, employing mixed-methods approaches for a more comprehensive exploration of these relationships.

**KEYWORDS:** Cooperative Learning Method, Learning Motivation, Academic Achievement, Elementary School Students

### INTRODUCTION

Education is a dynamic field that continuously seeks innovative approaches to enhance the learning experience and academic outcomes of students (Higgins et al., 2019). In recent years, there has been a growing interest in exploring alternative teaching methods that go beyond traditional approaches (Roy & Uekusa, 2020). One such method that has gained attention is Cooperative Learning, a pedagogical strategy emphasizing collaborative efforts among students to achieve shared learning goals (Altun, 2015). Elementary education serves as the foundation for a child's academic journey, shaping their attitudes towards learning and influencing their overall academic performance (Wang & Degol, 2016). In this context, the application of Cooperative Learning in elementary schools becomes a pivotal area of investigation (Mehta & Kulshrestha, 2014). Cooperative Learning involves students working together in small groups, fostering an environment where they actively engage with the learning material and each other (Collazos et al., 2014).

Motivation plays a crucial role in the learning process, influencing students' willingness to participate, persevere through challenges, and ultimately excel academically (Trevino & DeFreitas, 2014). The Cooperative Learning method, with its emphasis on teamwork, interaction, and shared responsibility, has the potential to positively impact students' motivation levels (Silva et al., 2021). Understanding the relationship between the implementation of Cooperative Learning methods and the motivation levels and academic achievements of elementary school students is vital for educators, curriculum developers, and policymakers. This research seeks to explore and analyze the influence of Cooperative Learning on learning motivation and academic performance within the specific context of elementary education.

By investigating the potential benefits and challenges associated with Cooperative Learning, this study aims to contribute valuable insights to educational practitioners and stakeholders. The findings may inform future pedagogical practices, curriculum development, and educational policies aimed at creating a more effective and engaging learning environment for elementary school students. Ultimately, the research endeavors to enhance our understanding of the dynamics between teaching methods, student motivation, and academic success in the context of elementary education.

# The Impact of Cooperative Learning Method on Learning Motivation and Academic Achievement of Elementary School Students

## LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

### *Cooperative Learning Method and Learning Motivation*

According to Baloche & Brody (2017), The Cooperative Learning Method, an instructional approach that emphasizes collaborative efforts among students in small groups, has garnered attention for its potential impact on learning motivation. In this method, students actively engage with the learning material, work together to solve problems, and collectively pursue predetermined learning objectives (Callaghan, 2016). Each group member assumes responsibility for the overall success of the learning on of Cooperative process, fostering an environment of positive interaction and mutual assistance (Laal & Laal, 2012). Alsawaier (2018) assert that the implementation of Learning introduces social dynamics that positively influence students' motivation to learn. By providing opportunities for shared ownership of the learning experience and assigning responsibilities within the group, students feel a sense of significance in achieving collective goals. Moreover, the social recognition received for group achievements serves as a reinforcing factor for extrinsic motivation (Richter et al., 2015). The satisfaction derived from the group's overall success contributes to a positive and motivating atmosphere surrounding the learning process. As such, Cooperative Learning demonstrates the potential to not only enhance academic outcomes but also to cultivate and sustain intrinsic and extrinsic motivation among elementary school students (Fernandez-Rio et al., 2017). Thus, the hypothesis is the following:

H1: Cooperative Learning Method impacts on Learning Motivation

### *Cooperative Learning Method and Academic Achievement*

The Cooperative Learning Method, emphasizing collaborative efforts in small groups, is intricately connected to academic achievement (Liebech-Lien, 2020). Through active participation, students deepen their understanding of subjects, leading to improved performance (Sølviik & Glenna, 2021). The method cultivates a supportive environment where shared responsibility fosters a sense of collective accountability, motivating students to invest in their studies. Positive social dynamics enhance confidence, communication skills, and academic self-efficacy (Korfiatis & Petrou, 2021). Additionally, Cooperative Learning stimulates critical thinking and problem-solving skills through collaborative discussions, positively correlating with academic achievement (Warsah et al., 2021). Educators exploring effective teaching methodologies recognize the potential of Cooperative Learning in significantly enhancing students' academic success in elementary education. Therefore, the hypothesis is the following:

H2: Cooperative Learning Method impacts on Academic Achievement

### *Learning Motivation and Academic Achievement*

Sáenz et al. (2020) defines that motivation serves as a driving force that influences students' willingness to engage in learning activities, persist through challenges, and ultimately achieve academic success. High levels of learning motivation are often associated with increased effort, focus, and persistence in academic tasks (Agger & Koenka, 2020). Students who are intrinsically motivated, deriving satisfaction and fulfillment from the learning process itself, tend to exhibit a deeper and more sustained engagement with their studies (Oudeyer et al., 2016). On the other hand, extrinsic motivation, driven by external rewards or recognition, can also positively impact academic achievement by encouraging students to meet specific goals or standards (Ryan & Deci, 2020). The connection between motivation and academic achievement is reciprocal. Aslam & Khan (2020) assess that academic success can reinforce and enhance motivation, creating a positive feedback loop. When students experience success, they are more likely to develop a sense of competence and confidence, leading to increased motivation to tackle new challenges. Educators play a pivotal role in nurturing and sustaining students' motivation. Creating a supportive and stimulating learning environment, incorporating relevant and interesting instructional methods, and providing constructive feedback are strategies that can positively influence motivation and, consequently, academic achievement. Then, the hypothesis is the following:

H3: Learning Motivation impacts on Academic Achievement

### *Learning Motivation as mediator*

Learning motivation can play a crucial role as a mediator in the relationship between various factors and academic achievement. As a mediator, it acts as an intermediary variable that helps explain the process or mechanism through which certain factors impact academic outcomes. For instance, consider the relationship between teaching methods and academic achievement. The choice of instructional approaches, such as Cooperative Learning, can influence students' motivation to engage with the learning material (Herrmann, 2013). When students find the learning environment stimulating, collaborative, and relevant, it tends to enhance their intrinsic motivation, contributing positively to academic achievement. In this scenario, learning motivation serves as a mediator, elucidating how the teaching method indirectly influences academic success through its impact on student motivation. Similarly, factors like parental involvement, peer relationships, and self-efficacy can also be linked to academic achievement through the mediating role of learning motivation. When students perceive support from parents, experience positive interactions with peers, or develop a belief in their ability to succeed (self-efficacy), it can boost their motivation to learn, subsequently influencing academic outcomes. Thus, the hypothesis is the following:

# The Impact of Cooperative Learning Method on Learning Motivation and Academic Achievement of Elementary School Students

H4: Learning Motivation mediates the relationship between Cooperative Learning Method and Academic Achievement

## METHODS

This study adopts a quantitative research design, focusing on the influence of implementing the Cooperative Learning Method on the learning motivation and academic achievement of elementary school students. The research involves the distribution of Likert scale-based questionnaires directly to the student respondents, eliminating the need for distinct control and treatment groups. The research subjects consist of students from a randomly selected sample of 5th classes in Tanara Sub Distric, Serang Regency, Banten, Indonesia amount 150 respondents. The independent variable is the implementation of the Cooperative Learning Method, while the dependent variables include students' learning motivation and academic performance, measured through Likert scale questionnaires and academic test scores, respectively. Data will be collected through a meticulously designed questionnaire addressing various aspects of student motivation. Simultaneously, academic performance data will be gathered from students' test scores or examination results. The questionnaire aims to measure students' perceptions and experiences related to learning motivation using a Likert scale. Following the distribution of the questionnaires, the Cooperative Learning Method will be applied in selected sessions. Data on academic performance will be collected from students' test scores or examination results. The subsequent data analysis will employ descriptive statistical techniques and regression analysis to evaluate the relationships between variables. The anticipated results of this study aim to reveal a positive influence of implementing the Cooperative Learning Method on both learning motivation and academic achievement among elementary school students. These findings could have valuable implications for the development of more effective teaching strategies to enhance elementary education outcomes.

## FINDINGS AND DISCUSSION

### Validity and Reliability

The data presented provides an analysis of three constructs: Cooperative Learning Method (CLM), Learning Motivation (LM), and Academic Achievement (ACAD). For the Cooperative Learning Method, the outer loading values indicate the strength of each item's relationship with the construct. Notably, Positive Interdependence (CLM1) has a high outer loading of 0.949, suggesting a strong association with the overall construct. The reliability of the scale is supported by a Cronbach's Alpha of 0.962, indicating good internal consistency. Additionally, the Composite Reliability (CR) is high at 0.971, emphasizing the reliability of the scale. The Average Variance Extracted (AVE) is 0.869, signifying that a substantial proportion of the variance in the observed variables is attributed to the latent construct. Moving on to the Learning Motivation construct, Intrinsic Interest (LM1) stands out with an outer loading of 0.843, reflecting a robust connection to the overall construct. The scale's reliability is affirmed by a Cronbach's Alpha of 0.957, signifying internal consistency. The CR is notably high at 0.967, reinforcing the reliability of the scale. The AVE of 0.855 indicates that a significant proportion of the variance is captured by the latent construct. For the Academic Achievement construct, Subject Mastery (ACAD1) demonstrates a strong outer loading of 0.938, indicating a solid association with the overall construct. The Cronbach's Alpha of 0.914 suggests good internal consistency for the scale. The CR is high at 0.937, attesting to the reliability of the scale. The AVE of 0.750 suggests that a substantial proportion of the observed variables' variance is accounted for by the latent construct. In summary, the analysis highlights the robustness and reliability of the scales used to measure Cooperative Learning Method, Learning Motivation, and Academic Achievement. The high outer loading values, along with favorable internal consistency and reliability indices, indicate that the constructs are effectively captured by the selected items (see Table 1).

**Table 1. Confirmatory Factor Analysis**

Construct	Items	Outer Loading	Cronbach's Alpha	rho_A	CR	AVE
Cooperative Learning Method	CLM1= Positive Interdependence	0.949	0.962	0.963	0.971	0.869
	CLM2= Individual Accountability	0.931				
	CLM3= Face-to-Face Interaction	0.963				
	CLM4= Social Skills Development	0.876				
	CLM5=Group Processing:	0.940				
Learning Motivation	LM1= Intrinsic Interest	0.843	0.957	0.96	0.967	0.855
	LM2= Goal Orientation	0.966				
	LM3= Persistence and Effort	0.944				

# The Impact of Cooperative Learning Method on Learning Motivation and Academic Achievement of Elementary School Students

Academic Achievement	LM4= Positive Self-Perception	0.905				
	LM5= Engagement in Learning Activities	0.959				
	ACAD1= Subject Mastery	0.938	0.914	0.915	0.937	0.750
	ACAD2= High Grades and Assessments	0.817				
	ACAD3= Class Participation	0.929				
	ACAD4= Completion of Assignments and Tasks	0.722				
	ACAD5= Continuous Improvement:	0.906				

## Hypothesis Result

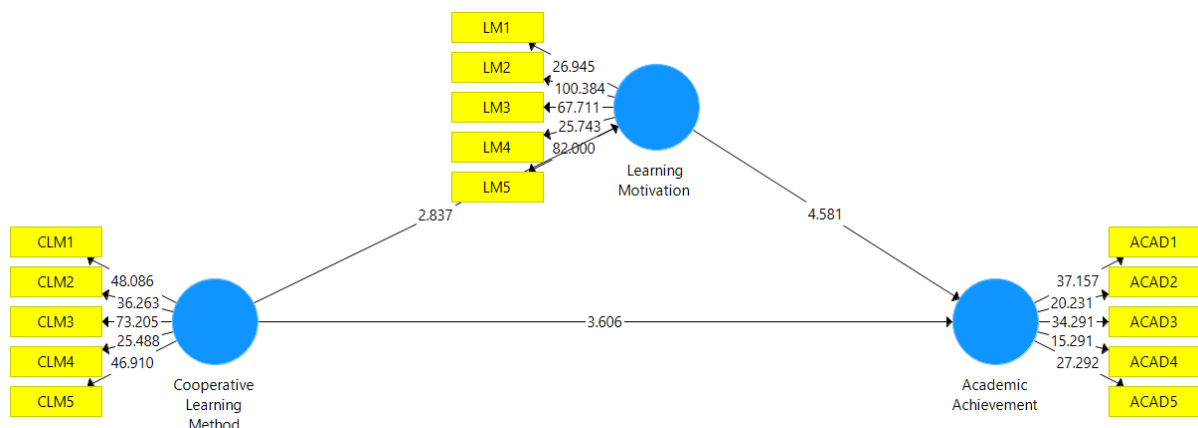
The analysis of the hypotheses provides valuable insights into the relationships between Cooperative Learning Method (CLM), Learning Motivation (LM), and Academic Achievement (ACAD). Hypothesis 1 (H1), which posits a direct relationship between CLM and LM, is supported by a T statistic of 2.837 and a p-value of 0.005. This suggests that there is a statistically significant positive relationship between Cooperative Learning Method and Learning Motivation. Consequently, H1 is accepted. Moving to Hypothesis 2 (H2), which suggests a direct link between CLM and ACAD, the T statistic of 3.606 and a p-value of 0.000 indicate a statistically significant positive relationship between Cooperative Learning Method and Academic Achievement. Thus, H2 is accepted, underscoring the impact of Cooperative Learning Method on Academic Achievement.

Hypothesis 3 (H3) explores the direct association between Learning Motivation (LM) and Academic Achievement (ACAD). The T statistic of 4.581 and a p-value of 0.000 demonstrate a statistically significant positive relationship between Learning Motivation and Academic Achievement. Therefore, H3 is accepted, highlighting the crucial role of Learning Motivation in influencing Academic Achievement. Lastly, Hypothesis 4 (H4) investigates the sequential relationship involving CLM, LM, and ACAD. The T statistic of 2.304 and a p-value of 0.022 suggest a statistically significant positive relationship. Consequently, H4 is accepted, indicating that the combined influence of Cooperative Learning Method and Learning Motivation has a positive impact on Academic Achievement. In summary, the analysis provides robust evidence supporting the hypotheses. The accepted hypotheses underscore the importance of Cooperative Learning Method and Learning Motivation in predicting and influencing Academic Achievement. These findings contribute to a deeper understanding of the interplay between these constructs in the educational context (see Table 2 and Figure 1).

**Table 2. Hypothesis Result**

Hypothesis	Construct	Original Sample	STDEV	T Statistics	P Values	Result
H1	CLM -> LM	0.299	0.105	2.837	0.005	Accepted
H2	CLM -> ACAD	0.369	0.102	3.606	0.000	Accepted
H3	LM -> ACAD	0.343	0.075	4.581	0.000	Accepted
H4	CLM-> LM -> ACAD	0.103	0.045	2.304	0.022	Accepted

\*) CLM=Cooperative Learning Method; LM=Learning Motivation ; ACAD=Academic Achievement



**Figure 1. Bootstrapping Result**

The research findings unequivocally support the acceptance of all hypotheses (H1, H2, H3, and H4), shedding light on critical aspects of the educational landscape. Firstly, H1 establishes that the implementation of the Cooperative Learning Method

## The Impact of Cooperative Learning Method on Learning Motivation and Academic Achievement of Elementary School Students

significantly influences learning motivation. This implies that incorporating cooperative learning strategies in educational practices can effectively enhance students' enthusiasm and engagement with the learning process. Secondly, H2 underscores the substantial impact of the Cooperative Learning Method on academic achievement. The positive correlation identified in this study emphasizes the method's potential not only to foster collaborative learning but also to contribute significantly to overall academic success among elementary school students. Furthermore, H3 illuminates the influential role of learning motivation in shaping academic achievement. This finding emphasizes the need for educators and policymakers to prioritize initiatives that cultivate and sustain high levels of student motivation, recognizing its direct link to academic performance. Most notably, H4 introduces an intriguing dimension by establishing that learning motivation serves as a mediator in the relationship between the Cooperative Learning Method and academic achievement. This suggests that the positive effects of cooperative learning on academic success are, in part, channeled through its impact on students' motivation to learn. These research insights carry profound managerial implications for elementary education in Indonesia. Firstly, educators should actively integrate and prioritize Cooperative Learning Methods in their pedagogical approaches. This not only aligns with the broader global shift towards collaborative learning but also addresses the specific needs of the Indonesian educational context. Moreover, acknowledging the pivotal role of learning motivation, schools and policymakers must implement targeted strategies to enhance and sustain students' motivation. This could involve professional development programs for teachers, focusing on creating engaging learning environments, acknowledging individual learning styles, and incorporating varied teaching methodologies. Understanding the mediating role of learning motivation provides a strategic lever for educational managers. It suggests that interventions targeting increased motivation may amplify the positive effects of Cooperative Learning Methods on academic achievement. Therefore, educational leaders in Indonesia can tailor professional development initiatives and resource allocations to fortify these interconnected elements, ultimately fostering a more vibrant and effective elementary education system.

### CONCLUSION

This study has provided valuable insights into the relationships between Cooperative Learning Method, learning motivation, and academic achievement among elementary school students in Indonesia. The acceptance of hypotheses (H1, H2, H3, and H4) underscores the significance of collaborative learning approaches and the role of motivation in influencing academic outcomes. The Cooperative Learning Method has been found to positively impact both learning motivation and academic achievement, with learning motivation identified as a crucial mediator in this relationship. The findings have theoretical implications by contributing to the understanding of how instructional methods, motivation, and academic achievement interconnect in the context of elementary education. The study reinforces the importance of considering motivational factors in educational theories, emphasizing that effective pedagogical strategies should not only enhance collaboration but also cultivate and sustain students' motivation to learn. Practically, the results suggest that educators and policymakers should prioritize the incorporation of Cooperative Learning Methods, implement motivational strategies, and recognize the interconnectedness of these elements for a holistic educational approach.

#### *Limitations and Recommendations for Future Research*

Despite the meaningful contributions, this study has limitations. The research scope focused on a specific geographic region or school setting, potentially limiting the generalizability of findings. Additionally, the study primarily relied on self-reported measures for learning motivation, introducing the possibility of response bias. Furthermore, external factors such as socio-economic background and individual differences were not extensively explored, representing potential variables that could influence the outcomes. To address these limitations, future research endeavors could adopt a broader scope, encompassing diverse demographic and socio-economic contexts. Employing mixed-methods approaches could provide a more comprehensive understanding of the intricate dynamics between Cooperative Learning, motivation, and academic achievement. Additionally, longitudinal studies may offer insights into the sustainability of the observed effects over time. Lastly, investigating potential moderators and contextual factors influencing these relationships could enhance the depth of knowledge in this field.

### REFERENCES

- 1) Agger, C. A., & Koenka, A. C. (2020). Does attending a deeper learning school promote student motivation, engagement, perseverance, and achievement? *Psychology in the Schools*, 57(4), 627–645.
- 2) Alsawaier, R. S. (2018). The effect of gamification on motivation and engagement. *The International Journal of Information and Learning Technology*, 35(1), 56–79.
- 3) Altun, S. (2015). The effect of cooperative learning on students' achievement and views on the science and technology course. *International Electronic Journal of Elementary Education*, 7(3), 451–468.



## The Impact of Cooperative Learning Method on Learning Motivation and Academic Achievement of Elementary School Students

- 4) Aslam, R., & Khan, N. (2020). Constructive feedback and Students' academic achievement: a theoretical framework. *New Horizons*, 14(2), 175–198.
- 5) Baloche, L., & Brody, C. M. (2017). Cooperative learning: Exploring challenges, crafting innovations. In *Journal of education for teaching* (Vol. 43, Issue 3, pp. 274–283). Taylor & Francis.
- 6) Callaghan, N. (2016). Investigating the role of Minecraft in educational learning environments. *Educational Media International*, 53(4), 244–260.
- 7) Collazos, C. A., Padilla-Zea, N., Pozzi, F., Guerrero, L. A., & Gutierrez, F. L. (2014). Design guidelines to foster cooperation in digital environments. *Technology, Pedagogy and Education*, 23(3), 375–396.
- 8) Fernandez-Rio, J., Sanz, N., Fernandez-Cando, J., & Santos, L. (2017). Impact of a sustained Cooperative Learning intervention on student motivation. *Physical Education and Sport Pedagogy*, 22(1), 89–105.
- 9) Herrmann, K. J. (2013). The impact of cooperative learning on student engagement: Results from an intervention. *Active Learning in Higher Education*, 14(3), 175–187.
- 10) Higgins, D., Refai, D., & Keita, D. (2019). Focus point: The need for alternative insight into the entrepreneurial education paradigm. *Journal of Small Business & Entrepreneurship*, 31(3), 225–242.
- 11) Korfiatis, K., & Petrou, S. (2021). Participation and why it matters: children's perspectives and expressions of ownership, motivation, collective efficacy and self-efficacy and locus of control. *Environmental Education Research*, 27(12), 1700–1722.
- 12) Laal, M., & Laal, M. (2012). Collaborative learning: what is it? *Procedia-Social and Behavioral Sciences*, 31, 491–495.
- 13) Liebech-Lien, B. (2020). The bumpy road to implementing cooperative learning: Towards sustained practice through collaborative action. *Cogent Education*, 7(1), 1780056.
- 14) Mehta, S., & Kulshrestha, A. K. (2014). Implementation of cooperative learning in science: A developmental-cum-experimental study. *Education Research International*, 2014.
- 15) Oudeyer, P.-Y., Gottlieb, J., & Lopes, M. (2016). Intrinsic motivation, curiosity, and learning: Theory and applications in educational technologies. *Progress in Brain Research*, 229, 257–284.
- 16) Richter, G., Raban, D. R., & Rafaeli, S. (2015a). *Studying gamification: The effect of rewards and incentives on motivation*. Springer.
- 17) Roy, R., & Uekusa, S. (2020). Collaborative autoethnography: "Self-reflection" as a timely alternative research approach during the global pandemic. *Qualitative Research Journal*, 20(4), 383–392.
- 18) Ryan, R. M., & Deci, E. L. (2020). Intrinsic and extrinsic motivation from a self-determination theory perspective: Definitions, theory, practices, and future directions. *Contemporary Educational Psychology*, 61, 101860. <https://doi.org/https://doi.org/10.1016/j.cedpsych.2020.101860>
- 19) Sáenz, V. B., García-Louis, C., De Las Mercédez, C., & Rodriguez, S. L. (2020). Mujeres supporting: How female family members influence the educational success of Latino males in postsecondary education. *Journal of Hispanic Higher Education*, 19(2), 169–194.
- 20) Silva, R., Farias, C., & Mesquita, I. (2021). Cooperative learning contribution to student social learning and active role in the class. *Sustainability*, 13(15), 8644.
- 21) Sølvik, R. M., & Glenna, A. E. H. (2021). Teachers' potential to promote students' deeper learning in whole-class teaching: An observation study in Norwegian classrooms. *Journal of Educational Change*, 1–27.
- 22) Trevino, N. N., & DeFreitas, S. C. (2014). The relationship between intrinsic motivation and academic achievement for first generation Latino college students. *Social Psychology of Education*, 17, 293–306.
- 23) Wang, M.-T., & Degol, J. L. (2016). School climate: A review of the construct, measurement, and impact on student outcomes. *Educational Psychology Review*, 28(2), 315–352.
- 24) Warsah, I., Morganna, R., Uyun, M., Afandi, M., & Hamengkubuwono, H. (2021). The impact of collaborative learning on learners' critical thinking skills. *International Journal of Instruction*, 14(2), 443–460.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Effectiveness of Circulo Massage on Fatigue Recovery and Sleep Quality of Field Workers



Wildan Wirawan Pinandita<sup>1</sup>, BM. Wara Kushartanti<sup>2</sup>, Enggista Hendriko Delano<sup>3</sup>, Inas Gita Amalia<sup>4</sup>, Sabda Hussain As Shafi<sup>5</sup>, Wahyu Aji Nugroho<sup>6</sup>, Anggun Saraswati<sup>7</sup>, Rulianta Dwi Mundita<sup>8</sup>

<sup>1,2,3,4,5,6,7,8</sup> Department of Sports Science, Faculty of Sports and Health Sciences, Yogyakarta State University.

**ABSTRACT:** The aim of the research was to determine the effectiveness of Circulo Massage for fatigue recovery and improving sleep quality. This study is quasi-experimental research with a one-group pretest-posttest design. The research included 30 field workers complaining of fatigue symptoms and decreased sleep quality. The treatment lasted 90 minutes and was administered once. Measurements were taken before and 24 hours after the treatment using the modified Fatigue Assessment Scale (FAS) to assess the fatigue scale, and the modified Pittsburgh Sleep Quality Index (PSQI) to measure the sleep quality index. Data analysis involved the paired t-test and Wilcoxon test. The results indicated that Circulo Massage effectively reduced the fatigue scale (p-value: 0.000) and significantly increased the sleep quality index of field workers (p-value: 0.000). In conclusion, Circulo Massage was found to be effective in reducing the fatigue scale and improving the sleep quality index. This research suggests that Circulo Massage can be beneficial for field workers experiencing fatigue and decreased sleep quality.

**KEYWORDS:** Circulo Massage, Fatigue, Sleep Quality

### I. INTRODUCTION

Labor is defined as development and economic actors, both individually and in groups. It plays a crucial role in regional and national economic activities, aiming to enhance productivity and community welfare (Soleh, 2017). Another perspective on labor was presented by Adam (2017), stating that labor is the primary factor that can drive and influence an economy's competitiveness. Labor is categorized into two types: office labor and field labor. Office workers spend their working hours in the office, while field workers operate outside the office or company to fulfill the requirements of their profession. The key difference between office and field workers lies in their working hours. Office workers generally have more flexible working hours, while field workers often depend on achievement targets set by the company and may work beyond specified working hours.

The Employment Law Number 13 of 2003 governs working hours during the week. For a six-day working week, the recommended working time is seven hours per day and 40 hours per week. In the case of a five-day working week, the recommended working time is eight hours per day and 40 hours per week. A minimum rest period of at least half an hour is required after four hours of work, and a weekly rest of one day for a six-day working week, and two days for a five-day working week should be provided (Verawati, 2017).

Tarwaka (2015) stated that excessive working hours can accelerate the onset of fatigue, leading to decreased accuracy and thoroughness of work. Work fatigue is the primary factor contributing to work accidents, with approximately 50% of work accidents being attributed to it (Soleh, 2017). According to the International Labor Organization (ILO), nearly 2 million workers die each year due to work accidents caused by fatigue. Factors influencing work fatigue can stem from inadequate work environment conditions to psychosocial issues (Wurarah et al., 2020). Field workers, who have demanding targets necessitating high energy and mobility, are particularly susceptible to fatigue. In addition to the risk of fatigue, irregular rest hours can result in poor sleep quality for field workers.

Sleep quality refers to the state an individual experiences upon waking, leading to a feeling of freshness and fitness. It encompasses quantitative aspects such as sleep duration and latency, as well as subjective elements like deep sleep and rest (Rachman, 2018). Field workers frequently report disrupted sleep patterns due to work fatigue, resulting in decreased sleep

## Effectiveness of Circulo Massage on Fatigue Recovery and Sleep Quality of Field Workers

quality. To alleviate fatigue and enhance sleep quality, workers often address their physical condition by resting, using traditional herbal remedies, and seeking massage therapy (Chompoonpan et al., 2022).

Massage is an art involving gentle touches on the body through the manipulation of hands using various techniques, including friction, shaking, tapping, and vibration (Anggait, 2022). This method of massage treatment yields physiological effects on the body, such as reducing the pulse rate, relaxing muscles, and enhancing blood and lymph flow (Delano & et al., 2022). Additionally, it increases endorphin and serotonin hormones, which can help reduce cortisol and depression, while also improving dopamine levels to alleviate anxiety (Khasanah & Sulistyawati, 2020). Massage offers extensive benefits for body fitness and care, primarily through the principle of relaxing the body's muscles. It has evolved into various types of massage therapy, such as acupressure, reflexology, sports massage, and Swedish massage (Anggriawan & Kushartanti, 2019). Based on interview results, field workers often resort to body massage as one of the effective methods to alleviate fatigue and improve sleep quality. There are several massage purposes to choose from, including massage for fatigue and therapeutic massage. Fatigue massage aims to alleviate exhaustion (Nugroho, W. A., & et al., 2023), while therapeutic massage is used to enhance the body's physiological and anatomical functions. Circulo Massage, as an alternative, is designed to relieve fatigue and tiredness (Arovah & Prastowo, 2015). This type of massage is intended to improve peripheral blood circulation, aiding in the removal and processing of metabolic waste, and is beneficial for relaxing muscles and nerves (Purnomo, 2013). Manipulation techniques in Circulo Massage encompass rubbing (effleurage), friction, tapotement (hitting), walking (rubbing across the muscles), and vibration (Purnomo, 2013). Circulo Massage has the physiological effect of improving blood and lymph circulation. The manipulations administered during Circulo Massage stimulate the release of endorphin hormones, thyroxine hormones, and adrenaline hormones (Sumarjo & et al., 2021: 1100). Endorphin hormones function to create a sense of comfort and alleviate pain (Delano & et al., 2023) (Saraswati, & et al., 2023) (Wijaya, F & et al., 2023). The implementation of Circulo Massage can reduce fatigue levels and enhance the sleep quality of field workers. Given the aforementioned background, researchers seek to assess the effectiveness of Circulo Massage in facilitating fatigue recovery and improving sleep quality among field workers.

## II. METHODS

This research constitutes a quasi-experimental study utilizing a Pretest-Posttest Design, involving a pretest before treatment and a posttest after treatment, thereby enabling the comparison of data before and after treatment (Sugiyono, 2007). The subjects of this research were patients at the Health and Sports Center therapy clinic, Faculty of Sports and Health Sciences, Yogyakarta State University. The patients encompassed various types of field workers, including construction workers, offline marketing workers, online motorcycle taxi drivers, as well as farmers and fishermen who reported experiencing fatigue and sleep disturbances and sought fatigue recovery services. The research employed a random sampling technique over a period of 3 months, and the number of subjects for Circulo Massage was determined using a Sample Size Calculator application, resulting in 30 participants. Prior to the research, respondents completed and signed an Informed Consent form to indicate their agreement to participate as research subjects. The instrument used for data collection in this study was a questionnaire. The questionnaire technique was utilized to assess the level of fatigue and sleep quality among the respondents. The first questionnaire (Pre-test) was completed prior to the Circulo Massage manipulation, while the second questionnaire (Post-test) was filled out 24 hours after the Circulo Massage treatment. The data instrument in this study utilized the Fatigue Measurement Scale, adapted from the Fatigue Assessment Scale, for measuring fatigue. The Fatigue Measurement Scale is a subjective instrument for assessing chronic fatigue, developed based on commonly used fatigue questionnaires in research. It has been reported to have high reliability for measuring fatigue among workers (Michielseon, Vreis, Van Heck, 2003), with a reliability value of 0.812, signifying a high level of reliability. Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI) scale developed by Curcio et al. (2012) and adapted to the Indonesian version. The treatment administered was Circulo Massage, lasting 90 minutes and provided only once. Circulo Massage is specifically designed to address complaints of fatigue and physical fitness issues, and it encompasses a full-body massage using lotion to ensure the patient's comfort.

## III. RESULTS

In this section, data from the normality test and t-test will be presented. the prerequisite test was used to determine the data processing method to be employed in hypothesis testing. the normality of the data was assessed using the shapiro-wilk normality test.

**Table 1. Normality Test Results for Fatigue Variables and Sleep Quality**

Variables	SIG.	Category
-----------	------	----------

## Effectiveness of Circulo Massage on Fatigue Recovery and Sleep Quality of Field Workers

Fatigue	0.107	Normal
Sleep Quality	0.017	Not Normal

The results of the normality test for fatigue data in the table above indicate a significance value of 0.107, suggesting that the data is normally distributed, and the subsequent hypothesis test analysis was conducted using the parametric Paired T-test. However, the normality test results for the quality data yielded a significance value of 0.017. Therefore, it can be inferred that the data difference is not normally distributed, and the subsequent hypothesis test analysis utilized the nonparametric Wilcoxon test.

**Table 2. Treatment T-test *Circulo Massage***

Indicators	Analysis	Significance	Results
Fatigue	<i>Paired T Test</i>	0.000	Significant
Sleep Quality	<i>Wilcoxon</i>	0.000	Significant

Based on the table above, the Paired T-test for the fatigue indicator yields a significance value of 0.000 ( $p < 0.05$ ), indicating a significant difference. In contrast, the analysis of sleep quality indicators using the Wilcoxon test yields a significance value of 0.000 ( $p < 0.05$ ), also demonstrating a significant difference.

### IV. DISCUSSION

Work fatigue represents a decrease in the body's capacity and endurance. It encompasses a complex physiological response, comprising both physiological and psychological fatigue, but predominantly associated with physical decline, decreased work motivation, and productivity (Zainul Hidayat, 2016). From a clinical perspective, physiological fatigue can be identified by the presence of fatigue, weakness, muscle stiffness, and pain (Arovah & Kunto Prastowo, 2015). Certain forms of fatigue within the work environment manifest as a chronic condition. This situation is not solely attributed to a single cause, such as excessive workload, but also to the accumulation of daily pressure over an extended period. Feelings of tiredness often emerge upon waking in the morning, even before the commencement of work, such as in the form of "hatred" stemming from disrupted emotions (Lestari, 2016). Sleep quality refers to the condition experienced by an individual to achieve freshness and vitality upon waking. It encompasses quantitative aspects such as sleep duration and latency, as well as subjective elements like deep sleep and rest (Rachman, 2018). For field workers, adequate sleep quality is essential to enhance health and recuperate from fatigue, ultimately leading to improved productivity (Grimaldi et al., 2021). The recovery of fatigue and improvement of sleep quality among field workers are pursued through various means, including pharmacological and non-pharmacological therapies. Pharmacological therapy entails the use of medications, whereas non-pharmacological therapy encompasses strategies such as rest or massage therapy. Massage therapy is employed due to its perceived direct impact on alleviating fatigue and enhancing sleep quality. Circulo massage is utilized as an alternative method to alleviate fatigue and tiredness. This type of massage is specifically designed to enhance peripheral blood circulation, aiding in the transportation and processing of metabolic waste, while also promoting muscle and nerve relaxation (FIK UNY Physical Therapy Clinical Team 2006: 1). The differentiating factor of circulo massage compared to other massage techniques lies in its specific massage technique. The primary technique employed in circulo massage involves friction, initiated from the distal to the proximal body (Arovah & Kunto Prastowo, 2015). This friction is executed through circular movements, with tapotement utilized to maximize the friction results and effleurage intended for calming purposes. Initially, friction is deliberately applied to induce a shock and stimulate the release of endorphins, which serve as a calming agent. Circulo massage encompasses manipulation of all body parts, from the soles of the feet to the head, taking into account muscle structure and the body's organ function (Arovah & Kunto Prastowo, 2015). The primary objective of circulo massage is to enhance blood and lymph circulation. Effective blood circulation facilitates the smooth distribution of nutrients to cells. Nutrients, serving as a source of cellular energy, are metabolized with oxygen (O<sub>2</sub>). The removal of metabolic by-products aids in alleviating feelings of fatigue, stiffness, and muscle tension in the nerves. Additionally, the distribution of nutrients and oxygen supports overall bodily fitness (Klinik Terapi Fisik FIK UNY, 2008: 1)

### V. CONCLUSIONS

This research concludes that the application of Circulo Massage is effective in reducing fatigue and improving the sleep quality of field workers. Researchers recommend applying non-pharmacological therapy in the form of Circulo massage in cases of fatigue and sleep disorders.

### REFERENCES

- 1) Adam, L. (2017). Membangun Daya Saing Tenaga Kerja Indonesia Melalui Peningkatan Produktivitas. *Jurnal Kependudukan Indonesia*, 11(2), 71. <https://doi.org/10.14203/jki.v11i2.205>
- 2) Arovah, N. I., & Kunto Prastowo. (2015). Perbandingan Efektivitas Circulo Massage Dan sport Massage Dalam Mengatasi Kelelahan Kerja karyawan Laki-Laki Gadjah Mada Medical Center. *Medikora*, 1. <https://doi.org/10.21831/medikora.v0i1.4584>
- 3) Chompooan, W., Eungpinichpong, W., Chompooan, W., & Sujimongkol, C. (2022). The Effect of Traditional Thai Massage on Quality of Sleep in Adults with Sleep Problem. *Trends in Sciences*, 19(7). <https://doi.org/10.48048/TIS.2022.3063>.
- 4) Delano, E. H., Kushartanti, W., Amajida, A., Humam, M. F., & Shafi, S.H.A. (2022). The effectiveness of massage therapy with stretching to blood pressure of elderly people with hypertension. *Jurnal Keolahragaan*, 10 (2), 196-207. doi: <https://doi.org/10.21831/jk.v10i2.47877>
- 5) Delano, Enggista Hendriko., Kushartanti, Wara., Arovah, Novita Intan., As-Shafi, Sabda Hussain. Nugroho, Wahyu Aji., Sabillah, Muhamad Ichsan., & Ndayisenga, Japhet. (2023). Comparison of the effectiveness Tepurak therapy with deep tissue massage and stretching in treating non-specific low back pain injuries. *Fizjoterapia Polska*. 2(23).
- 6) Grimaldi, D., Reid, K. J., Papalambros, N. A., Braun, R. I., Malkani, R. G., Abbott, S. M., Ong, J. C., & Zee, P. C. (2021). Autonomic dysregulation and sleep homeostasis in insomnia. *Sleep*, 44(6), 1–13. <https://doi.org/10.1093/sleep/zsaa274>
- 7) Nugroho, Wahyu Aji., Kushartanti, Wara., Delano, Enggista Hendriko., Shafi, Sabda Hussain As., Saraswati, Anggun., Amalia, Inas Gita., Khasanah, & Evi Nur. 2023. The effect of Thai massage on decreasing fatigue levels and blood pressure. *Int J Yogic Hum Mov Sports Sciences*, 8(2):119-121. DOI: <https://doi.org/10.22271/yogic.2023.v8.i2b.1444>
- 8) Purnomo, N. T. (2013). Pengaruh Circulo Massage dan swedia Massage terhadap Penurunan Kadar Asam Laktat darah pada Latihan Anaerob. *Journal Of Physical Education Sports*, 2(1), 181–185.
- 9) Zainul Hidayat. (2016). Pengaruh Stres Dan Kelelahan Kerja Terhadap Kinerja Guru Smpn 2 Sukodono. *Jurnal Penelitian Ilmu Ekonomi WIGA*, 6(1), 36–44.
- 10) Saraswati, Anggun., Arovah, Novita Intan., Delano, Enggista Hendriko., Shafi, Sabda Hussain As., Khasanah, Evi Nur., & Nugroho. Wahyu Aji. (2023). The effectiveness of manipulative therapy in reducing pain and improving range of motion in patients with shoulder injuries. *Int J Phys Educ Sports Health*. 10(4): 91-94. DOI: <https://doi.org/10.22271/kheljournal.2023.v10.i4b.3012>
- 11) Soleh, A. (2017). Masalah ketenagakerjaan dan pengangguran di indonesia. *Jurnal Ilmiah Cano Ekonomos*, 6(2), 83–92.
- 12) Tim Klinik Terapi Fisik FIK UNY. (2008). Pelatihan Circulo Massage. Makalah. Yogyakarta: Klinik Terapi Fisik Fakultas Ilmu Keolahragaan Universitas Negeri Yogyakarta.
- 13) Sugiyono (2019). Metode Penelitian Kuantitatif, Kualitatif, dan R&D. Bandung: Alfabeta.
- 14) Sumarjo & *et all*. (2021). The effect of sport and circulo massage on the improvement of work productivity of the physically disabled. *Advances in Social Science, Education and Humanities Research*, volume 278.
- 15) Tarwaka, dkk., 2004, Ergonomi untuk Kesehatan Kerja dan Produktivitas, Surakarta: UNISBA Press.
- 16) Verawati, L. (2017). Hubungan Tingkat Kelelahan Subjektif Dengan Produktivitas Pada Tenaga Kerja Bagian Pengemasan Di Cv Sumber Barokah. *The Indonesian Journal of Occupational Safety and Health*, 5(1), 51. <https://doi.org/10.20473/ijosh.v5i1.2016.51-60>.
- 17) Wijaya, F.M., Kushartanti, W., Ambardini, R.L., Delano, E.H., Manihuruk, F., & Murnianah. (2023). Effectiveness of manipulative therapy and heat therapy on pain reduction, increased range of motion and motion function in cases of low back pain. *International Journal of Physical Education, Sports and Health*.
- 18) Wurarah, M. L., Artur, P., Kawatu, T., Akili, R. H., Kesehatan, F., Universitas, M., & Ratulangi, S. (2020). *Journal of*. 1(April), 6–10.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Evaluation of Demonstration and Drill Methods for Lower and Upper Passing Skills Volleyball Learning



Panji Pangestu<sup>1</sup>, Ridho Gata Wijaya<sup>2</sup>, Andika Prabowo<sup>3</sup>

<sup>1,2</sup> Faculty of Sports and Health Sciences, Yogyakarta State University, Yogyakarta, Indonesia

<sup>3</sup> Faculty of Teacher Training and Education, Bengkulu State University, Baengkulu, Indonesia

**ABSTRACT:** This research aims to evaluate the demonstration and drill method for lower and upper passing skills in volleyball learning based on context, input, process and product. The subjects of this research are PJOK teachers, students. The sampling technique uses random sampling, with details of 11 PJOK teachers, 246 students. Data collection techniques use observation, interviews, questionnaires and documentation methods. The data analysis technique in this research is quantitative and qualitative descriptive analysis. The results of the research show that: (1) Context evaluation of the Demonstration and Drill Method for Lower and Upper Passing Skills in Volleyball Learning, the results are in the good category. The indicator for designing teaching and learning activities is 2.48 in the poor category, classroom management is 2.45 in the poor category, and assessment is 2.59 in the poor category. (2) Demonstration and drill evaluation input for bottom and top passing skills in volleyball learning results in the poor category. The learning material indicator is 2.45 in the poor category and student skills are 2.48 in the poor category. (3) The demonstration and drill evaluation process for lower and upper passing skills in volleyball learning resulted in the poor category. The learning activity indicator is 2.50 in the less category and student activities are 2.47 in the less category. (4) Product evaluation of Demonstrations and Drills on Bottom and Top Passing Skills in Volleyball Learning resulted in the poor category. The learning outcome indicator is 2.47 in the poor category.

**KEYWORDS:** Volleyball, Demonstration, Drill, Evaluation, Lower Pass, And Upper Pass

### I. INTRODUCTION

Physical education learning is directed at fostering better physical growth and psychological development. Learning activities are a communication process that must be created through exchanging messages or information from a teacher to students (Purnomo et al, 2019). Physical education is a learning process that aims to develop motor skills, knowledge and active living behavior as well as sportsmanship through physical activities (Handiyono: 2017).

Basic technique is one of the main factors that can measure a person's level of skill in playing volleyball in addition to the physical and mental condition of a player and strategy development. To be able to perform the basic movement skills of playing volleyball properly and correctly, elements of physical condition are needed such as speed, flexibility, balance, accuracy, endurance, agility, coordination and good muscle power. If in a team all the players have good basic techniques, you can be sure that the team has good team strength and quality. Physical ability is related to motor ability which influences a player's performance both in learning skill movements and in competitions (Nusufi, 2016). Thus, it can be said that good movement skills are a requirement in achieving maximum performance for players in learning basic movement skills for playing volleyball.

A volleyball player's ability to combine elements of hand-eye coordination and arm muscle strength when performing basic techniques will influence the resulting accuracy, whether good or bad. One effort to improve students' sports abilities at school is the drill and demonstration learning method. The game of volleyball emphasizes physical condition which is a prerequisite that an athlete must have in improving and developing optimal sporting performance, so that all physical conditions must be improved in accordance with the characteristics, characteristics and needs of each sport (Rudiyanto, 2012).

Factors that influence volleyball playing skills require elements of physical condition such as: strength, speed, flexibility, balance, accuracy, endurance, agility, coordination and explosive power of leg muscles. Based on this, the learning method becomes a means to improve basic movement skills in playing volleyball. In this study, researchers wanted to look at the drill method for students' basic movement skills in playing volleyball. The demonstration method is a teaching method by demonstrating items, events, rules and the sequence of carrying out activities, either directly or carrying out activities, either directly or through the use

## Evaluation of Demonstration and Drill Methods for Lower and Upper Passing Skills Volleyball Learning

of teaching media that is relevant to the subject matter or material being presented (Yuliyanti, 2016). Demonstration means giving a demo to carry out a certain activity or concept. In the demonstration method, the teaching and learning process is carried out systematically. Basic skill level is the degree of consistent success in achieving a goal effectively and efficiently. A person must have a basic skill level to carry out any sporting activity, especially volleyball. Someone who can play volleyball well is required to have the ability or skills to play volleyball, especially basic skills in playing volleyball.

The basic skill level of playing volleyball is the basis that a person must have to be able to play volleyball well. This is because the basic technique of playing volleyball is a very important factor, mastery of basic technique is one of the elements that determines whether a team wins or loses in a match in addition to the physical, mental and tactical elements. The better the basic skill level, the greater the chance of winning the match. On the other hand, if the basic skill level is not good, it will be more difficult to win the match. Thus, the researcher intends to study further with research entitled "Evaluation of the Drill Method and Demonstration Learning Method on Upper and Lower Passing Skills in Volleyball Learning".

## II. METHODOLOGY

This type of research is evaluation research which uses a mixture of quantitative and qualitative methods. Evaluation is a series of processes that determine the extent to which goals can be achieved. Evaluation provides information for making decisions. Evaluation is also a process of seeking information about an object or subject which is carried out with the aim of making decisions about that object or subject. This research uses the CIPP (Context, Input, Process and Product) model with quantitative descriptive analysis to produce data in the form of numbers. The CIPP model was chosen because this model provides a comprehensive evaluation format for each evaluation stage which consists of context, input, process and product stages. Participants in this research included 11 physical education teachers and 246 class X students at the State Vocational School in Bengkulu City. The sampling technique uses random sampling. Research instruments are tools used and selected by researchers in their data collection activities so that these activities become systematic and easier (Arikunto, 2013). The instruments used in this research were interviews, questionnaires and documentation. The data analysis technique used is a data analysis technique according to the Stake model, namely by comparing the resulting data obtained with predetermined criteria. Researchers describe conditions and activities with quantitative data descriptions. The research data in the form of questionnaires is added up to obtain a total score. Then the total score is calculated descriptively using the standard deviation of the total score position of the respondent's answers. The criteria for processing the questionnaire use the following criteria from Sudijono (2015):

Table 1. Success Criteria

No	Intervals	Criteria
1	3,26-4,00	Very good
2	2,51-3,25	Good
4	1,76-2,50	Not enough
5	1,75-1,00	Very less

## III. RESULTS AND DISCUSSION

The approach used in the evaluation research on the implementation of physical education, sports and health (PJOK) learning is the CIPP Model (Daniel Stufflebeam's) in terms of the stages of context, input, process and product, meaning obtaining accurate and objective information and comparing what has been done. achieved from the evaluation of demonstration and drill methods on the lower and upper passing skills of class The dimensions that can be used as determinants of success in evaluating the demonstration and drill methods for lower and upper passing skills in class X volleyball learning at State Vocational Schools in Bengkulu City are as follows.

### A. Descriptive Research Results

#### 1. Context Evaluation

This research consists of aspects of teaching and learning activities, classroom management, and assessment. The results of the context evaluation consist of designing teaching and learning activities, classroom management and assessment. The research results for each indicator in the context component show that the indicator for designing teaching and learning activities is 2.48 in the poor category, class management is 2.45 in the poor category, and assessment is 2.59 in the good category. Based on these results, it shows that the Contexts Evaluation of drill and demonstration learning methods for lower and upper level skills in class X at Bengkulu City State Vocational School is 2.51 in the good category.

#### 2. Input Evaluation

Input Evaluation basically has the aim of linking objectives, context, input and process with program results. This evaluation is also

## Evaluation of Demonstration and Drill Methods for Lower and Upper Passing Skills Volleyball Learning

to determine the suitability of the environment to help achieve program goals and objectives. This input evaluation is to help organize decisions, determine existing resources, what alternatives to take, what plans and strategies to achieve goals, and what work procedures to achieve them. This evaluation helps organize decisions, determine existing resources, what alternatives to take, what plans and strategies to achieve needs, what work procedures to achieve them. shows that the learning material indicator is 2.45 in the lacking category and student skills are 2.48 in the lacking category. The evaluation input for the drill and demonstration method for the lower and upper level skills of class.

### 3. Process evaluation

Process evaluation is a CIPP model that is aimed at finding out how far activities have been carried out, whether the program has been implemented according to plan or not. Process evaluation is also used to detect or predict procedural designs or implementation plans during the implementation phase, provide information for program decisions and as a record or archive of procedures that have occurred. The process evaluation aims to determine the implementation of the program in real activities in the field or learning activities when using demonstration and drill methods for lower and upper level skills in class X volleyball learning. This research focuses on learning activities and student activities. The research results for each indicator in the process component show that the learning activity indicator is 2.5 in the poor category and student activity is 2.45 in the poor category. Process evaluation of demonstration and drill methods for lower and upper passing skills in class X volleyball learning at Bengkulu City State Vocational School 2.47 in the poor category.

### 4. Product Evaluation

Product evaluation is an evaluation that aims to measure, interpret and assess program achievements. Product evaluation can be done by creating operational definitions and measuring the measurement criteria that have been achieved (objective), through collecting values from stakeholders, using quantitative or qualitative analysis. This product analysis requires a comparison between the objectives set in the design and the program results achieved. The results assessed can be in the form of test scores, percentages, observation data, data diagrams, sociometry and so on which can be traced in relation to more detailed objectives. Next, a qualitative analysis was carried out regarding why the results were like that. The results of the product evaluation product evaluation of the demonstration and drill methods on lower and upper passing skills in class class X volleyball at Bengkulu City State Vocational School was 2.47 in the poor category. Based on the results above, it can be determined that the results of the evaluation of the demonstration and drill method on lower and upper passing skills in class amounting to 2.48 is in the poor category which can be seen in table 2.

**Table 2 CIPP Evaluation Results**

No	Evaluation aspect	Skor	Criteria
1	Context	2,51	Very good
2	Input	2,46	Not enough
3	Process	2,47	Not enough
4	Product	2,47	Not enough
	CIPP Evaluation	2,48	Not enough

## B. Discussion

Program evaluation is a systematic and subjective assessment of an object, program or policy that is ongoing or has been completed, both in terms of implementation design and results, where the aim of program evaluation is to determine the relevance and achievement of objectives, efficiency, effectiveness, impact and sustainability, where an evaluation must provide reliable and useful information to be able to draw lessons for the decision-making process. Based on the results of the research, it shows that the evaluation of demonstrations and drills on lower and upper passing skills in volleyball learning at State Vocational Schools in Bengkulu City resulted in poor results.

The obstacles for students who make lower and higher learning outcomes in volleyball learning are only 3 meetings where one meeting only lasts 2 hours and insufficient volleyball where each school only has 3-5 volleyballs that are suitable for use. Of course, this makes the results of learning the bottom and top of volleyball less good. Evaluation of demonstration and drill methods for lower and upper passing skills in class.

## IV. CONCLUSION

Based on the research results and the results of the data analysis that has been carried out, the following conclusions are obtained. Context: Evaluation of the demonstration and drill methods for lower and upper passing skills in class The indicator for designing teaching and learning activities is 2.48 in the poor category, classroom management is 2.45 in the poor category, and



## Evaluation of Demonstration and Drill Methods for Lower and Upper Passing Skills Volleyball Learning

assessment is 2.59 in the good category. Input: Evaluation of demonstration and drill methods for lower and upper passing skills in class X volleyball learning at Bengkulu City State Vocational School. The learning material indicator is 2.45 in the lacking category and student skills are 2.48 in the lacking category. Process Evaluation of demonstration and drill methods for lower and upper passing skills in class X volleyball learning at Bengkulu City State Vocational School. The learning activity indicator is 2.5 in the poor category. And the student activity indicator is 2.45 in the poor category. Product Evaluation of demonstration and drill methods for lower and upper passing skills in class The learning outcome indicator is 2.47 in the poor category. Evaluation of the demonstration and drill methods for lower and upper passing skills in class.

### REFERENCES

- 1) Arikunto, S. (2013). The research procedure is a practical approach. Jakarta, Rineka Cipta.
- 2) Handiyono, Y. P. (2017). The Influence of the Problem Solving Learning Method on the Completeness of Basketball Dibble Learning Outcomes in Physical Education, Sports and Health Learning (Study on Class X Students of SMA N 1 Trenggalek). *Journal of Sport and Health Education*, 5(2), 589-594.
- 3) Nusufi, M. (2016). The relationship between motor skills and soccer playing skills at the Himadirga Unsyiah club. *Journal of Sports Pedagogy*, 2(1), 1-10.
- 4) Rudiyanto. (2012). Relationship between Body Weight, Height and Leg Length with Agility. *Journal of Sport Sciences and Fitness* 1 (2) (2012)
- 5) Sudijono, A. (2017). Introduction to educational statistics. Jakarta: Rajawali Press
- 6) Yulianti. (2016). The Influence of Demonstration Learning Methods on Students' Volleyball Playing Skills at SMP N 1 Batu Bersurat. *Primary Journal Primary School Teacher Education Study Program, Faculty of Teacher Training and Education, Riau University* | Volume 5 | Number 1 | April - September 2016 | ISSN: 2303-1514.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Conflict Resolution between Russia and Ukraine Based on an International Law Perspective



Awang Bayu Aji<sup>1</sup>, Dr. Joko Setiyono, S.H., M.Hum<sup>2</sup>

<sup>1,2</sup> Master of Laws, Faculty of Law, Diponegoro University, Indonesia

**ABSTRACT:** The conflict between Ukraine and Russia is not something new. The Russian invasion of Ukraine, which began on February 24, 2022, is one of the significant upheavals in the global order since World War II. The roots of the conflict between Ukraine and Russia can be traced back to Ukraine gaining independence in 1991 after the collapse of the Soviet Union. Since then, Ukraine has become one of Russia's most vital satellite states, influenced by Russian politicians, oligarchs, and businesses. The concentration of forces and military drills eventually led to the invasion conducted by Russia into the territory of Ukraine on February 24, 2022. This invasion then intensified, encouraging various efforts to resolve the conflict. This analysis aims to examine the resolution of the dispute between Russia and Ukraine from the perspective of International Law. The research employed a normative legal research approach. Several attempts to resolve the Ukraine-Russia conflict have been made, including through negotiations, efforts by Turkey, interventions by the United Nations Security Council, and mediations conducted by four countries, namely Turkey, Israel, China, and Indonesia. However, these efforts did not yield any results. Currently, the International Court of Justice (ICJ) is urgently trying to persuade Russia to cease its invasion of Ukraine, but Russia has declined to attend the hearings.

**KEYWORDS:** International Law, Dispute Resolution, Russia and Ukraine

### INTRODUCTION

The conflict between Ukraine and Russia is not a recent development. The Russian invasion of Ukraine, which began on February 24, 2022, is one of the significant shocks to the global order since World War II. The roots of the Ukraine-Russia conflict can be traced back to Ukraine gaining its independence in 1991 after the collapse of the Soviet Union. Since then, Ukraine has become one of Russia's most vital satellite states, influenced by Russian politicians, oligarchs, and businesses. However, due to corruption within the Ukrainian government and inefficient fulfillment of constituents' needs.

The Ukrainian crisis began in November 2013 when Ukrainian President Viktor Yanukovich canceled agreements for trade cooperation with the European Union. Instead, Yanukovich opted to accept a \$15 billion debt loan from Russia. At that time, Russia provided it as compensation because Ukraine had abandoned a trade deal with the European Union. As a result, residents in western Ukraine continued to desire closer ties with Western Europe, and nationalist groups organized demonstrations (Aji Muhammad, 2021). Subsequently, Russia attempted to establish closer relations with Ukraine because Russia had plans to form an economic pact rivaling the European Union. Ukraine is the largest country in the Eurasian group and relies on gas supplies from Russia. Therefore, since November 2013, Russian President Vladimir Putin has deployed a military force of 16,000 soldiers to the Crimean Peninsula. Russia sent its forces because the region is predominantly inhabited by ethnic Russians, comprising about 58% of the population (Manurung H, 2017).

The annexation of the Crimean Peninsula by Russia in 2014 marked the onset of open conflict between the two countries. This conflict was further intensified by the confirmation of Russia's involvement in supporting separatism in Donetsk and Luhansk. Ukraine's response, seeking to join the North Atlantic Treaty Organization (NATO), was also considered unhelpful in the conflict resolution process. Ukraine's actions were instead viewed as a new source of tension in the conflict between Russia and Ukraine (Adib Izzuddin, 2022).

The tension between Ukraine and Russia is also rooted in ethnic, linguistic, and religious differences among the domestic population in Ukraine. One of the differences leading to the conflict is the ethnic distinction of the populations in the Donetsk, Luhansk, and Crimea provinces, who identify themselves as part of Russia. Ukraine responded to these cultural differences by initiating Ukrainianization efforts, where the residents in those regions were mandated to use the Ukrainian language. This Ukrainianization effort is undertaken due to the close affinity of the communities in those regions with Russia, which significantly

## **Conflict Resolution between Russia and Ukraine Based on an International Law Perspective**

impacts the increasing influence of Russia in Ukraine. Therefore, Ukrainization efforts are carried out to prevent Russian hegemony through cultural pathways, particularly in the use of language (Stephen, 1998).

A series of events directly leading to the annexation of the Crimean Peninsula began on February 27 and 28, 2014, when pro-Russian residents seized critical buildings in the Crimean capital, Simferopol, and organized a referendum in the following days (Sebastian, 2018). According to information from CBS News, the referendum produced a surprising voter turnout, with 83% of the Crimean population participating and 97% of them choosing integration into the Russian Federation. Russia's campaign succeeded as, within three weeks, without resorting to coercion but solely through diplomatic measures, they seized all Ukrainian military bases and undermined Ukrainian morale. At present, the legal status of Crimea remains unclear. Putin's concerns about the security of the Russian minority were then rejected by the majority of governments and intergovernmental organizations. Russia's claims regarding the legality of its military intervention and the call for a referendum cannot be considered a response to securing the Russian minority or acting upon Viktor Yanukovich's invitation. In this case, not much is known about the details of Yanukovich's invitation and the presence of Russian military forces in the Crimean Peninsula (Bartos, 2020).

The referendum on the status of Crimea triggered demonstrations from other pro-Russian factions in the Eastern Ukrainian provinces of Donetsk and Luhansk, which border the Russian Federation. Both provinces have the largest percentage of Russian ethnicity, with 39% Russians in Luhansk and 38.2% in Donetsk. Moreover, these provinces have the highest population percentage, with as much as 92.7% using the Russian language (Bartos, 2020).

In 2019, Volodymyr Zelensky was elected as the President of Ukraine. During his campaign, Zelensky declared that he would end all tensions and push Ukraine towards Europe rather than Russia. Zelensky subsequently implemented a series of policies that contradicted Russia's interests. In addition to urging Ukraine to join the European economic community, Zelensky also registered Ukraine as a member of NATO to enhance Ukraine's military strength, thus preventing Russian aggression against Ukraine and withdrawing from Russian influence. Ukraine and NATO have been cooperating since 1992, and in 1997, the Ukraine-NATO Commission was established as a forum for security discussions without a formal membership agreement (Habib, 2022).

In 2021, Russia deployed troops on the border with Ukraine under the pretext of planned military exercises, denying any intention to attack Ukraine. Subsequently, Putin issued an ultimatum to NATO, demanding that they stop interfering in Ukrainian affairs, citing it as a military threat to Russia. Currently, Ukrainian President Volodymyr Zelenskyy is implementing plans to join NATO and the European Union, citing reasons of sovereignty, national interests, and the will of the people (Marc Miles, 2022).

The accumulation of troops and military exercises then led to the invasion by Russia into the territory of Ukraine on February 24, 2022. This invasion escalated and encouraged various efforts to resolve the conflict. One of them is the mediation efforts by Turkey and Israel. However, both Turkey and Israel must be cautious in mediating the conflict between Russia and Ukraine to avoid isolating themselves from the international community or the West. While no one agrees with Russia's actions against Ukraine, the two positions of Israel and Turkey, operating as negotiating powers, become more challenging to navigate and sustain. Israel faces pressure from Ukraine and the international community to join sanctions and condemn Russia for the attacks during the Babyn Yar Holocaust memorial, while Turkey is under pressure from NATO to condemn Russia's actions. However, this mediation process failed, raising questions about why the attempted mediation process was unsuccessful (Adib, 2022).

### **PROBLEM FORMULATION**

1. How Conflict Resolution between Russia and Ukraine Based on an International Law Perspective?

### **RESEARCH METHODOLOGY**

Research is a systematic process, a framework of steps conducted, planned, and systematically to obtain solutions to specific problems or respond to particular statements. Research is fundamentally an effort to search, not just an observation carried out casually on an easily accessible object. To achieve the best results, the research method used was normative juridical, consisting of regulations in the UN charter.

### **DISCUSSION**

#### **1. Conflict Resolution Efforts between Russia and Ukraine**

The resolution of the conflict between Ukraine and Russia has been attempted in various ways but has proven unsuccessful. The United Nations (UN) has advocated that diplomacy and dialogue are the best methods for resolving the conflict. Article 2, Paragraph 3 of the UN Charter states, "All Members shall settle their international disputes by peaceful means in such a manner that international peace and security, and justice, are not endangered."

## **Conflict Resolution between Russia and Ukraine Based on an International Law Perspective**

According to Huala Adolf, methods or ways of peacefully resolving international disputes include diplomatic dispute resolution and dispute resolution through international judicial institutions, arbitration, and other international organizations. These methods encompass negotiation, inquiry, good offices, mediation, conciliation, arbitration, and international courts. Additionally, other methods involve submitting the dispute to regional bodies (organizations) and arrangements and other peaceful options chosen by the parties in dispute (Huala Adolf, 2008).

Several conflict resolution efforts between Ukraine and Russia have been attempted, including negotiations, good offices, international organizations, and mediation.

### **1. Negotiation**

The effort to resolve the conflict through negotiation is currently widely open as President Volodymyr Zelensky of Ukraine, as reported by Tass, expressed readiness to do anything to settle the conflict peacefully, namely through negotiations (Mikrefin, 2022).

### **2. Good Offices**

Good offices, or good offices, is a method of dispute resolution with the assistance of a third party aiming to facilitate a meeting between conflicting parties, enabling them to come together, sit down, and negotiate with the goal of resolving the conflict. One country willing to facilitate a meeting between the two nations is Turkey. Turkey has offered itself as the venue for a meeting between the two parties on Thursday, March 10, 2022. The good offices conducted by Turkey can be seen as a follow-up to the resolution issued by the United Nations General Assembly, where a country can offer its role to become a mediator without intending to intervene in the conflict parties' affairs, as mandated in Article 33, Paragraph 1, and Article 35, Paragraph 1 of the UN Charter (Mikrefin, 2022).

### **3. International Organization**

The UN Security Council conducted a vote in an emergency session of the UN General Assembly held on March 2, 2022, to approve a Draft Resolution condemning Russia's military attack on Ukraine and calling on Russia to cease military actions and withdraw its troops from Ukraine. Out of the 193 voting members, 141 countries, including Indonesia, supported the resolution. This mechanism is carried out in accordance with the UN Charter. It appears that the UN Security Council cannot achieve maximum results in the UN General Assembly session because Russia is one of the permanent members, thus preventing all countries from creating a powerful draft resolution to stop this conflict. As a conflicting party, Russia has the right to veto in the General Assembly held in New York.

### **4. Mediation**

Mediation is a dispute resolution effort through a third party known as a mediator. It can be a country, an international organization, or a neutral individual with the capacity to reconcile the parties by providing suggestions for dispute resolution. There are four countries that the author sees as potential mediators in resolving this conflict.

1. Turkey, as we have explained in the negotiation alternative, Turkey has bilateral closeness with both countries, making the author consider Turkey suitable as a mediator in resolving the Russia-Ukraine conflict.
2. Israel, Israel is one of the few countries that have a good working relationship with both Russia and Ukraine. Israel, through its Prime Minister, has spoken three times with Ukrainian President Volodymyr Zelensky. Naftali Bennett has also engaged in a dialogue with Putin, and although the chances of mediation are not significant, Israel will continue to extend any requested assistance.
3. China, China is a country that has a very close relationship with Russia. In addition to the shared ideology between the two countries, bilateral cooperation between China and Russia has been thriving year by year. Apart from its ties with Russia, China invests in Ukraine, particularly in infrastructure, agriculture, and military technology. China has maintained a neutral position in the emergency UN voting regarding the Russia-Ukraine conflict.
4. Indonesia, Indonesia is a founding member of the Non-Aligned Movement and a leader in ASEAN that has successfully mediated several conflicts within the region. In addition to its relatively good historical ties with Moscow, both countries consider Indonesia a future economic partner. The growing Muslim population in both nations is a significant factor, as Indonesia is regarded as a leader among Muslim-majority countries due to having the largest Muslim population in a single country. Therefore, it is not implausible that Indonesia's diplomatic and strategic position could serve as a mediator to facilitate peace agreements.

## **2. Conflict Resolution from the Perspective of International Law**

Questions about "international law" as law have been present and heavily influenced by John Austin's theory, which conceptualizes law as sovereign commands. Sovereignty is something obeyed by most of society and does not comply with any other superior authority. This proposition becomes the basis for the statement that "international law" is not law. This theory has

## Conflict Resolution between Russia and Ukraine Based on an International Law Perspective

significantly influenced attitudes toward international law. Even if not outright rejected, it at least diminishes the role of international law in the reality of international politics. H.L.A. Hart then acknowledged international law as a set of legal rules, although not a legal system. This subsequently gave rise to the view that the positivist legal tradition has consequences for a voluntarist approach to international law, although not always the case (Mehrdad, 2011).

International Law is often said to be nothing more than morality. However, this view is not acceptable because there are parts that indicate specific cases conflicting with morality, such as a country's actions to fulfill its own interests. International law is often made to meet the interests of each country and common interests, not on moral considerations. In international law, Hart argues that in the process of law formation, which is in morality, the establishment, modification, or elimination cannot be done based on the deliberate will of the law authority (legislative). In international law, the establishment, modification, or elimination is done in a manner similar to a state's legislative process with its units. From this, it can be seen that formal international law does not share the same fundamental characteristics as morality (Hart, 1979).

Referring to Hart's opinion, international law cannot be used as a tool to resolve the conflict between Russia and Ukraine. This is based on Hart's view of the formal structure of international law, which lacks a legislative body, a court with definite jurisdiction, and officially organized sanctions, making it different from national law. However, these conditions share similarities with a simple primary or customary law *regime*.

The resolution of a conflict such as war through a treaty is essentially considered a legislative act by some theorists. However, in reality, the International Court cannot adjudicate a case without the consent of the disputing states.

However, Mehrdad Payandeh has a different opinion on this. Payandeh argues that Hart's views cannot be separated from the context of the time when the book "The Concept of Law" was written, namely in 1961. At that time, the conditions of international law, in Hart's understanding, were still heavily influenced by the aftermath of World War II, the failure of the League of Nations to prevent war, and the establishment of the United Nations (UN), which had not provided a bright prospect for collective security, and the Cold War had already begun. At that time, Hart had not seen the development of international law in the second half of the 20th century. Therefore, Hart only positioned international law as an additional aspect.

Payandeh further states that in the 21st century, international law has institutions that perform legislative, judicial, and executive functions, thus addressing issues of uncertainty, stagnation, and inefficiency. One of Hart's doubts about international law in terms of conflict resolution is the lack of a court to address violations of international law. In today's international law, there is the International Court of Justice (ICJ), whose jurisdiction is limited to disputes between states and requires the consent of the involved parties.

In the conflict between Ukraine and Russia, the ICJ has urged Russia to halt its invasion of Ukraine. This decision marks the first ruling issued by an international court since the war began. Kyiv is seeking immediate action to stop the fighting, which the UN human rights body reported has claimed the lives of 1,834 civilian casualties. In this case, Ukraine has requested legal intervention and argued that Russia was falsely accused of genocide in the Donetsk and Luhansk regions to justify its attack. The wording of the ICJ decision is "*The Russian Federation must immediately suspend the military operations that began on February 24, 2022, in the territory of Ukraine*" while awaiting the final decision in the case, said ICJ President Joan Donoghue. However, Russia refused to attend the hearings on March 7 and 8, 2022, stating in a written submission that the ICJ "lacks jurisdiction" because Ukraine's request falls outside the scope of the 1948 Genocide Convention, which forms the basis of the case. However, the ICJ determined that it has jurisdiction in the case. Furthermore, in international law, an absolute prohibition is using armed force, as stated in Article 2(4) of the UN Charter, recognized as customary international law and even *jus cogens*.

H.L.A. Hart rejected the idea that international law has rules of recognition. *Pacta Sunt Servanda* cannot be placed as a rule of recognition because not all international obligations arise from an agreement. Payandeh then stated that the primary function of the rules of recognition is to determine the validity of primary rules, as stated in Article 38(1) of the ICJ Statute, which mentions that generally recognized sources of international law include international agreements, customary international law, and principles of general law. Hart also argued that international law does not have a written constitution. In its development, there is currently an approach to the constitutionalization of international law as developed by Hermann Mosler. Namely, developing rules for the formation of law as the constitution of the international community.

## CONCLUSION

The conflict between Ukraine and Russia has been ongoing since 1991, when Ukraine gained independence. The Russian invasion of Ukrainian territory, which began on February 24, is a major shock to the global order since World War II. One of the roots of this invasion is the previous Russian annexation of the Crimean region and its proven support for separatist movements in Donbas, Ukraine.

## Conflict Resolution between Russia and Ukraine Based on an International Law Perspective

Several efforts have been made to resolve the conflict between Ukraine and Russia, including negotiations, good offices by Turkey, the involvement of the United Nations Security Council, and mediation by four countries, namely Turkey, Israel, China, and Indonesia. However, these efforts have not yielded positive results.

According to H.L.A. Hart's Concept of Law, there are two concepts of law: primary rules and secondary rules. In primary rules, the emphasis is on human obligations to act or refrain from acting as follows:

1. There are provisions of behavior in society and social pressure for those who deviate;
2. Perceived as an obligation by most members of society.

Secondary Rules consist of rules about rules, including:

1. Rules that determine the validity of a rule (rules of recognition);
2. How and by whom the rules can be changed (rules of change);
3. How and by whom the rules can be enforced (rules of adjudication)

Referring to Hart's opinion on international law, the case of the conflict between Russia and Ukraine cannot be resolved through an international legal approach. Hart argues that international law can not be considered as law due to the absence of sanctions. In international law, sanctions are less effective as a deterrent than they are in national law.

However, Payandeh argues that Hart's views on international law cannot be separated from the context of the time when "The Concept of Law" was written in 1961 when international law had not yet developed as it has in the 21st century. To date, the ICJ is trying to urge Russia to stop the invasion of Ukraine, but Russia refuses to attend the hearing.

## REFERENCES

### Books and Journals

- 1) Kuzio Taras, 2006, *Everyday Ukrainians and The Orange Revolution*. European Security Vol. 21(3):1-19
- 2) Bartosz Gierzak, 2020, *The Russia Ukrainian Conflict*, Accessed from: [https://www.researchgate.net/publication/349948624\\_The\\_Russo-Ukrainian\\_Conflict](https://www.researchgate.net/publication/349948624_The_Russo-Ukrainian_Conflict)
- 3) Ali Muhammad, 2021, *Aneksasi Rusia atas Krimea, Sanksi Uni Eropa, dan Penguatan Hubungan Strategis antara Rusia-Tiongkok*, Insignia Journal of International Relations, Vol. 8 No. 2
- 4) Manurung, H, 2017, *Russia Domination Policy: Implementation of Military Operation in Ukraine (2014-2015)*. Insignia Journal of International Relations 4(2)
- 5) Adib Izzuddin, Rossi Indrakorniawan, Hastian Akbar S, 2022, *Analisis Upaya Penyelesaian Konflik Rusia-Ukraina Tahun 2022*, Jurnal Pena Wimaya, Vol. 2 No. 2
- 6) Stephen Shulman, 1998, *Cultures in Competition: Ukrainian Foreign Policy 'Cultural Threat' from Abroad*, Europe-Asia Studies Vol. 50 No. 2
- 7) Sebastian Blidaru, 2018, *Zero-Sum Games and Mixed Motive Games in The Fight of The Russian Federation With The West For Ukraine*, Europolity, Vol. 12, No. 2, National University of Political Studies and Public Administration
- 8) Marc Miles Vaughn, 2022, *The History of Ukraine and Russia (The Tangled History That Led To Crisis)*, Publisher: History Demystified
- 9) Adib Izzuddin, Rossi Indrakorniawan, Hastian Akbar S, 2022, *Analisis Upaya Penyelesaian Konflik Rusia-Ukraina Tahun 2022*, Jurnal Pena Wimaya, Vol. 2 No. 2
- 10) Huala Adolf, 2008, *Hukum Penyelesaian Sengketa Internasional, Cetakan Ketiga*. Jakarta: Sinar Grafika
- 11) Syuryansyah, Rethorika Berthanila, 2022, *Upaya Penyelesaian Konflik Rusia-Ukraina*, PIR Journal Vol. 7 No. 1
- 12) Muchamad Ali Safa'at, 2016, *Konsep Hukum H.L.A Hart*, Jakarta: Konstitusi Pers
- 13) Ravindra Kumar Singh, 2016, *Hart's Concept of Law and Justice*, Accessed from: <https://www.studocu.com/en-us/document/la-sierra-university/cello/8-ravindra-public-international-law/10241807>
- 14) Jeanne L. Schoeder, 2007, *His Master Voice: H.L.A Hart and Lacanian Discourse Theory*. Law Critique
- 15) William C. Starr, 1984, *Law and Morality in HLA Hart's Legal Philosophy*, Marquette Law Review. Vol 67
- 16) Mehrdad Payandeh, 2011, *The Concept of International Law in The Jurisprudence of H.L.A Hart*, The European Journal of International Law, Vol. 21 No. 4
- 17) H.L.A Hart, 1979, *The Concept of Law, Tenth Impression*, Oxford: Oxford University Press

### News

- 1) Yegorof O, 2017, *Perang Ukraina: Apa dan Kenapa?*, RTBH. Accessed from: [https://id.rbth.com/politics/2017/02/22/apa-yang-sebenarnya-terjadi-di-ukraina\\_zyx707361](https://id.rbth.com/politics/2017/02/22/apa-yang-sebenarnya-terjadi-di-ukraina_zyx707361).
- 2) Habib Albi Ferdian, 2022, *Ap aitu NATO dan Kenapa Ukraina Ingin Bergabung?* Accessed from:

## Conflict Resolution between Russia and Ukraine Based on an International Law Perspective

<https://www.researchgate.net/deref/https%3A%2F%2Fm.kumparan.com%2Famp%2Fkumparansains%2Fapa-itu-nato-dan-kenapa-ukraina-ingin-bergabung-1xZMKer5jKB>

- 3) Mikrefin, 2022, *Zelensky Ajak Putin Berdialog Demi Akhiri Perang Rusia Ukraina*. Accessed from: <https://katadata.co.id/aryowidhywicaksono/berita/622975623ec19/zelensky-ajak-putin-berdialog-demi-akhiri-perang-rusia-ukraina>
- 4) ICJ Desak Rusia Untuk Hentikan Invasi ke Ukraina, 2022, Accessed from: <https://www.dw.com/id/icj-desak-rusia-untuk-hentikan-invasi-ke-ukraina/a-61155413>



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Some Solutions to Improve the Effectiveness of Autonomous Activities at Public Vocational Education Institutions in Hanoi



Ngo Anh Cuong<sup>1</sup>, Nguyen Duc Ngan<sup>2</sup>, Nguyen Thi Diem<sup>2</sup>, Pham Bich Van<sup>3</sup>

<sup>1</sup>University of Labour and Social Affairs

<sup>2</sup>Hanoi Department of Labor, War Invalids and Social Affairs

<sup>3</sup>North Thang Long Technical and Economic College

**ABSTRACT:** In accordance with Article 25 of the Vocational Education Law of 2014, public vocational education institutions autonomously engage in activities related to organizational and personnel management, finance and assets, training and technology, international cooperation, and quality assurance as stipulated by law. In 2021, public vocational education institutions in Hanoi were transitioned to an autonomous mechanism through a city resolution. Consequently, this research aims to assess the current level of autonomy and propose solutions to enhance the effectiveness of autonomous operations for public vocational education institutions in Hanoi.

**KEYWORDS:** Autonomy; vocational education; finance; organizational personnel; academic; autonomous management

### 1. INTRODUCTION

Implementing autonomy to improve the quality of training at public vocational education institutions (PVEIs) in general and public vocational education institutions in Hanoi City in particular is one of the most important tasks for schools to improve the quality of vocational education. Through autonomous activities, the training activities of the schools will be closer to the needs of the labor market. According to Article 25 of the Vocational Education Law 2014, PVEIs are autonomous in the activities in the fields of organization and personnel, finance and assets, training and technology, international cooperation, and quality assurance in accordance with the law. In 2021, 17 colleges and vocational schools under the management of Hanoi City were issued decisions to transfer to the autonomous mechanism. Specifically, 7 colleges have transferred to the autonomous mechanism and ensured all regular operating expenses, including: Hanoi Dong District College of Health, Hanoi College of Health, Hanoi College of Commerce and Tourism, Hanoi College of Electronics and Refrigeration, Hanoi Vocational College of Industry, Hanoi Vocational College of High Technology, Vietnam-Korea Vocational College. For vocational schools, all 10 vocational schools under the city's management have transferred to the autonomous mechanism and self-ensured all regular operating expenses. In this, North Thang Long Economic - Technical College and Hanoi Technical Informatics College have implemented financial autonomy since their establishment. The remaining 8 vocational schools (8 schools) have implemented self-assurance of all regular operating expenses since 2021.

However, the autonomous activities of the schools are still facing many difficulties. Schools need a management model towards autonomy to implement the training activities of the school in an effective way. Therefore, assessing the current state of autonomy of public schools in Hanoi City will be the basis for proposing a suitable management model towards autonomy.

### 2. THEORETICAL BASIS

#### Concept of Autonomy in Public Vocational Education Institutions

The term "autonomy" has been extensively discussed in economic and social studies. For vocational education institutions, autonomy involves the right to manage all aspects related to admissions, curriculum, assessment, recruitment, finance, and research without control or influence from any government level (Tight, 1992; Anderson and Johnson, 1998). Verhoest et al. (2004) consider autonomy in managing functions, policies, structures, finances, and legal matters, including government intervention in vocational education institutions. Jongbled (2004) and Ordorika (2003) emphasize academic, appointment, and financial aspects as reflections of institutional autonomy. According to the Vocational Education Law of 2014, PVEIs exercise autonomy in organizational and personnel management, finance and assets, training and technology, international cooperation,



## **Some Solutions to Improve the Effectiveness of Autonomous Activities at Public Vocational Education Institutions in Hanoi**

and legal quality assurance. They are responsible for explaining to relevant state authorities, learners, and society regarding their organization, management, and training quality.

Autonomy essentially involves transferring decision-making powers from the state to educational institutions. The content of autonomy may evolve over time but is consistently associated with organizational structure and personnel, academic affairs, finance, and accountability. Thus, autonomy in vocational education institutions grants decision-making authority over all aspects of institutional operations (organizational structure and personnel, academic affairs, finance, accountability), limiting state interference to achieve optimal institutional performance.

As per the Vocational Education Law of 2014, vocational education institutions include vocational training centers, vocational colleges, and higher education colleges. These institutions can be public, private, 100% foreign-invested, or joint ventures between domestic and foreign investors. They exercise autonomy in organizational and personnel management, finance and assets, training and technology, international cooperation, and legal quality assurance, with a responsibility to explain to competent state agencies, learners, and society about their organization, management, and training quality.

### **Content of autonomy of public vocational education institutions**

Anderson and Johnson (1998) proposed six criteria for evaluating the level of autonomy of vocational education institutions: academic autonomy, financial autonomy, organizational and human resources autonomy, admissions and training autonomy, scientific activity autonomy, and international relations autonomy. Puvot & Estermann (2017) again mentioned 4 criteria reflecting the level of autonomy of vocational education institutions: organizational autonomy, financial autonomy, human resources autonomy, and academic autonomy. According to the Regulations on Secondary Vocational Schools and Regulations on Colleges in 2021, the right to autonomy of vocational education institutions includes: professional autonomy, organizational and human resources autonomy, and financial and property autonomy. Therefore, the evaluation of the current state of the management model towards autonomy of public vocational education institutions can be reflected through the following criteria:

### **Functions and duties**

The functions and duties of vocational education institutions are clearly reflected in the goals, missions, strategies, and development plans of the school in the Regulations on Secondary Vocational Schools and Colleges in 2021. This is also one of the contents reflecting the level of autonomy of vocational education institutions. In addition, determining, announcing, methods, quotas for admissions, methods of organizing, managing training and forms of training in accordance with the law; choosing an organization for vocational education quality assurance (including private organizations or organizations established by the state or foreign organizations) are also criteria reflecting the level of autonomy of the functions and duties of public vocational education institutions (Vũ Thị Thanh Thủy, 2012; Puvot & Estermann, 2017; Nguyễn Trọng Tuấn, 2018).

### **Organizational Structure and Personnel**

The organizational structure and personnel capabilities of vocational education institutions are demonstrated through the right to establish organizational structures, recruit and dismiss personnel, and make decisions on personnel matters, including leadership and scientific titles (Anderson and Johnson, 1998). Leadership capabilities and vision play a crucial role in the autonomy of vocational education institutions (Nguyễn Chí Hường, 2018). Simultaneously, vocational education institutions also have the right to define terms of office and dismissal of executive leaders (Puvot & Estermann, 2017). Based on the regulations of vocational colleges and higher education institutions in 2021, vocational education institutions have the right to decide on the following matters: autonomy in organizing the organizational structure and personnel according to regulations on establishment, restructuring, dissolution of public-service units, and the number of employees; autonomy in establishing and promulgating regulations on the organization and operation of the institution, determining the functions and tasks of affiliated organizations; autonomy in issuing internal regulations on the organization of the organizational structure and personnel.

### **Finance and Assets**

The financial sources of vocational education institutions are diverse and can be formed from state funding, tuition fees, and contributions from educational sponsors (Sheelan, 1997). Therefore, autonomy in mobilizing resources for vocational education institutions is only associated with the financial contributions of students, organizations, and enterprises. For effective training activities, vocational education institutions need to be autonomous in managing revenue, expenditures, asset management, management of dedicated funds, management of debts to be repaid, and distribution of surplus funds (Trần Đức Cân, 2012). According to Anderson and Johnson (1998), vocational education institutions need to be autonomous in issues related to financial management, budget utilization, and financial sources of the institution. Nguyễn Thị Hường and Tạ Ngọc Cường (2016)

## **Some Solutions to Improve the Effectiveness of Autonomous Activities at Public Vocational Education Institutions in Hanoi**

suggest that vocational education institutions need to be autonomous in budgeting for training expenses, salary regimes for employees, setting up funds for the institution, and investing in and exploiting the use of facilities. Additionally, the ability to generate surplus is also a content reflecting the level of financial and asset autonomy of vocational education institutions (Pvuvot & Estermann, 2017).

Moreover, financial and asset autonomy of vocational education institutions is also demonstrated in the regulations of vocational colleges and higher education institutions in 2021, specifically in the institutions' autonomy to establish and organize the implementation of internal spending regulations; regulations on asset use; regulations on financial transparency, internal audits as per regulations.

### **Academic autonomy**

The right to autonomy is closely linked to the academic freedom of vocational education institutions (Nguyễn Trọng Tuấn, 2018). Academic autonomy is the degree of independence and self-responsibility of the school, of the scientist in academic research from identifying tasks, deciding on the structure, content of the training program, ensuring the quality of programs and degrees. Specifically, vocational education institutions exercise autonomy in matters related to admissions and learner management, teaching methods, assessment of learner academic results, program content, and teaching materials. They are autonomous in academic standards such as diploma standards, issues related to quality assessment and verification. Institutions exercise autonomy in deciding strategies, plans, and implementing scientific and technological activities, as well as in international relations, establishing cooperative relationships with individuals and organizations abroad within the framework of legal regulations and international standards (Anderson and Thomas, 1998).

In addition to the above, Pvuvot & Estermann (2017) added criteria to assess the level of academic autonomy of vocational education institutions, including autonomy in determining the number of applicants, selecting candidates based on criteria set by the institution, autonomy in choosing the language of instruction, and autonomy demonstrated through the capability to design training program content.

## **3. RESEARCH METHODS**

The research results were conducted based on survey data of 17 public colleges and intermediate schools that have been assigned full autonomy for all recurrent expenditures by the Hanoi People's Committee by 2021. At each school, The research team directly interviewed 10 people, including: leaders of vocational education institutions, staff working directly in positions of human resources, finance, scientific research and teachers.

The survey content addressed issues reflecting the current status of the autonomous activities of public vocational education institutions in Hanoi in the following areas: mission and functions, organizational structure and personnel, finances, assets, and academics.

After the survey, the data were synthesized, cleaned, and processed using SPSS 22.0 software.

The research team employed descriptive statistical analysis to assess the current level of autonomy of public vocational education institutions in Hanoi. The results of this study served as the basis for proposing solutions to enhance the effectiveness of autonomous activities in public vocational education institutions in Hanoi.

## **4. RESEARCH RESULTS**

### **Mission and Functions**

According to survey results, when vocational education institutions are transferred to full autonomy of regular costs, they have high autonomy when performing their functions and tasks. The criteria in this section were clearly reflected on the institutions' information portals. Among them, the criterion "determining the methods of organizing and managing training, forms of training according to legal regulations" received the highest autonomy rating, with an average assessment score of 4.23. Annually, based on actual conditions, institutions proactively set targets, scales, admission methods, and develop training fields in accordance with legal regulations. Therefore, the autonomy level for these criteria was highly rated. However, some surveyed vocational education institutions still struggled to demonstrate a clear level of autonomy in determining their mission, vision, strategy, and development plans.

## Some Solutions to Improve the Effectiveness of Autonomous Activities at Public Vocational Education Institutions in Hanoi

**Table 1: Assessment of automatic function tasks**

Criteria	Number Respondents	Percentage (%) of Average Autonomy Level					Standard Deviation	
		Very low	Low	Normal	High	Very high		
C221. Autonomy in determining the goals, mission, strategy, and development plan of the institution	170	0	0	34.7	48.8	16.5	3.82	.694
C222 Autonomy in determining and announcing the admission methods	170	0	0	8.2	64.1	27.6	4.19	.568
C223 Autonomy in determining admission targets and enrollment scale	170	0	0	22.4	45.9	31.8	4.09	.732
C224 Autonomy in determining the methods of organizing and managing training, forms of training as prescribed by law	170	0	0	15.9	45.3	38.8	4.23	.705
C225 Autonomy in constructing and determining training professions	170	0	0	27.1	48.8	24.1	3.97	.717
C226 Autonomy in choosing the organization to inspect the quality of vocational education for training quality inspection	170	0	0	8.8	68.2	22.9	4.14	.547

**Source:** Survey results of the research team

### Organizing apparatus and personnel

The organizational structure and personnel of public vocational education institutions are still under the management of state management agencies (Department of Labor, War Invalids and Social Affairs, Hanoi People's Committee...). Regarding criteria reflecting the content of organizational structure and personnel, criteria related to appointment, recruitment (including building recruitment procedures, criteria, selection standards, and tenure for school leaders), appointment of professional titles, promotion, and transfer of professional titles for employees demonstrated low autonomy with average assessment scores ranging from 2.41 to 2.74. This indicates that vocational education institutions have not achieved complete autonomy in the organization of their structure and personnel. The survey process showed that although institutions were actively constructing and proposing criteria and standards for selecting school leaders, organizational structure, deployment, and rotation of staff for management positions from deputy principals or principals, they did not have the authority to decide on these matters. The direct management agencies of public vocational education institutions were the ones with decision-making power. However, according to new regulations, schools have the autonomy to plan, appoint, and recruit staff for positions from the level of director/deputy director downward. The principal of the school will directly sign the decision to recruit staff and sign employment contracts with those who are selected. In addition, schools also have the authority to decide on the rotation of officials, teachers, and employees within the school. The criteria, standards, and recruitment procedures have been determined based on the actual needs of the school and according to the legal regulations (Decree No. 161/2018/ND-CP dated November 29, 2018, of the government, and Circular No. 03/2019/TT-BNV dated May 14, 2019, of the Ministry of Home Affairs amending and supplementing some regulations on the recruitment of civil servants, public employees, promotion of civil servants, public employees, and implementation of contracts for certain types of work in state administrative agencies, public non-business units...). The school principal is the one who signs the decision to acknowledge the recruitment results and signs the employment contract with the staff, while reporting to the higher management authorities.

Criteria reflecting welfare benefits for employees, the establishment and issuance of internal expenditure regulations, and the establishment of grassroots democratic regulations received high ratings for autonomy. The percentage of high and very high autonomy ratings for these criteria was over 80%. Among them, the criterion "decision-making on welfare benefits for employees" received the highest autonomy rating with an average assessment score of 4.21. Criteria with low and very low autonomy ratings in this survey included establishing teacher standards, training plans, staff training (87.82%); appointment of professional titles, promotion, and transfer of professional titles (94.1%); establishment, reorganization, dissolution of public institutions, and the number of workers (100%). The reasons reflecting the low autonomy level are due to financial resource constraints, so the appointment, promotion of professional titles, and the development of training plans and staff training will increase the operating costs of the school. On the other hand, schools are subject to direct management by state management agencies, so the establishment, reorganization, dissolution of schools, or the appointment, promotion of professional titles for officials, teachers... are not determined by the schools but must be approved by these agencies.

## Some Solutions to Improve the Effectiveness of Autonomous Activities at Public Vocational Education Institutions in Hanoi

**Table 2: Assessment of the level of organizational autonomy and personnel**

Criteria	Number Respondents	Percentage (%) of Average Autonomy Level					Standard Deviation	
		Very low	Low	Normal	High	Very high		
C221 Autonomy in building the process of selecting school leaders	170	2.4	45.3	34.1	12.4	5.9	2.74	.683
C222 Autonomy in building and determining the criteria and standards for selecting school leaders	170	2.4	58.2	34.1	5.3	0	2.42	.751
C223 Autonomy in determining the working term of the head of the institution	170	14.7	34.7	37.6	12.9	0	2.49	.774
C224 Autonomy in appointing, reappointing, dismissing, and disciplining leaders in the institution	170	11.8	43.5	35.9	8.8	0	2.42	.619
C225 Autonomy in arranging, assigning tasks, mobilizing, appointing, transferring employees	170	0	0	41.2	52.9	5.9	3.65	.590
C226 Autonomy in choosing to build the structure, organization, staffing plan, contractual labor, and recruitment	170	4.7	54.7	35.9	4.7	0	2.41	.554
C227 Autonomy in establishing teacher standards, training plans, training and fostering officials, teachers	170	0	35.3	52.9	11.8	0	2.76	.646
C228 Autonomy in deciding employee welfare policies (salary increase, rewards, discipline, etc.)	170	0	0	5.3	68.8	25.9	4.21	.521
C229 Autonomy in appointing professional titles, promotions, title transfers	170	0	0	52.4	41.8	5.9	2.54	.607
C2210 Autonomy in establishing, reorganizing, dissolving public career units, and the number of employees	170	42.4	57.6	0	0	0	1.58	.496
C2211. Autonomy in establishing, issuing regulations on the organization and activities of the school, specifying the functions and tasks of organizations under the school	170	0	0	11.8	70.6	17.6	4.06	.541
C2212 Autonomy in issuing democratic regulations at the grassroots level, issuing internal regulations on organizational structure and personnel	170	0	0	7.1	76.5	16.5	4.09	.477

**Source:** Survey results of the research team

### Financial Autonomy and Assets

According to the survey results, the level of financial autonomy and asset management in public vocational education institutions in Hanoi is evaluated as not being high. Specifically, the implementation of the criterion "determining tuition fees in training activities" is perceived to be low, with an average score of 2.38. The reason is that these criteria are bound by regulations related to tuition fees, regulations related to the use of assets of state management agencies such as the Ministry of Education and Training, the Department of Labor - War Invalids and Social Affairs, the Ministry of Finance. ... According to Article 9 of Decree 81/2021/ND-CP, which stipulates the tuition fee ceiling from 2022 to 2026: for public vocational education institutions that ensure regular expenditure, the maximum tuition fee is not more than 2 times the tuition fee ceiling applied to vocational education institutions that do not ensure regular expenditure. Based on the practical conditions, some institutions may determine tuition fees for certain fields of study below the regulatory ceiling set by the state. However, for specialized fields that require high training costs, institutions find themselves constrained by these regulations. If institutions determine tuition fees higher than the prescribed fees by the government, they will be in violation of the law. Conversely, if institutions set tuition fees below or equal to the prescribed ceiling, they may face difficulties in training activities as the generated revenue may not be sufficient to offset the incurred training costs.

## Some Solutions to Improve the Effectiveness of Autonomous Activities at Public Vocational Education Institutions in Hanoi

**Table 3: Assessment of the level of financial and asset autonomy**

Criteria	Number Respondents	Percentage (%) of Autonomy Level				Average Autonomy Level	Standard Deviation	
		Very low	Low	Normal	High			Very high
221. Autonomy in determining tuition fees in training activities	170	18.2	32.4	42.4	7.1	0	2.38	.689
222. Autonomy in mobilizing resources from organizations and businesses	170	0	0	14.1	51.8	34.1	4.20	.667
223. Autonomy in expanding revenue sources from research activities, consulting, technology transfer	170	56.5	43.5	0	0	0	1.44	.497
224. Autonomy in using and managing expenditures (investing in development for training activities, paying salaries and additional income, setting up funds for the school, etc.)	170	4.7	57.1	24.1	14.1	0	2.48	.793
225. Autonomy in purchasing, using assets, land for exploitation and increasing revenue	170	33.5	42.9	22.4	1.2	0	1.91	.853
226. Autonomy in building, investing in facilities, equipment for training activities	170	47.1	48.2	4.7	0	0	1.58	.583
227. Autonomy in using surplus for training activities	170	4.7	14.1	52.9	28.2	0	3.05	.783
228. Autonomy in building internal expenditure regulations	170	0	0	9.4	66.5	24.1	4.15	.562
229. Autonomy in building asset use regulations	170	0	4.7	9.4	61.8	24.1	4.05	.724
2210. Autonomy in building regulations for publicizing finances, internal audit	170	0	4.7	9.4	52.4	33.5	4.15	.774

**Source:** Survey results of the research team

### Academics

According to the survey results, the criteria "building, defining the mission, objectives, structure, and content of the training program", "determining the admission methods of the training programs", "deciding the strategy, plan and implementation of scientific research activities" and "organizing the compilation or selection of teaching materials suitable for the training objectives" were rated at high and very high levels of autonomy with a rating rate of over 85%.

Most institutions autonomously select students based on criteria that align with the practical training needs of the institution, in addition to criteria set by the Ministry of Education and Training. The average rating for autonomy in selecting students is 3.93. Depending on the industry and program codes, institutions choose different admission criteria.

The survey results also show that schools are autonomous in testing, evaluating, and assessing the quality of training activities with a high and very high autonomy rating of 72.4%. Most of the schools participating in the survey have functional departments to carry out the work of testing, evaluating the quality of training activities with clear goals and tasks. The level of autonomy of these two criteria has an average rating of 2.54 and 2.46, respectively.

The survey further reveals that public vocational education institutions in Hanoi have not achieved autonomy in selecting the language of instruction for training programs. Therefore, the criterion "choice of language of instruction" is assessed at a very low level of autonomy, with an average score of 1.98.

**Table 4: Assessment of academic autonomy level**

Criteria	Number Respondents	Percentage (%) of Autonomy Level				Average Autonomy Level	Standard Deviation	
		Very low	Low	Normal	High			Very high
C221 Autonomy in developing, determining tasks, objectives, structure, and content of training programs	170	0	0	10.0	48.8	41.2	4.31	.646
C222 Autonomy in determining the admission methods of training programs	170	0	0	12.4	58.2	29.4	4.17	.625
C223 Autonomy in determining the scale of admissions	170	0	54.1	38.2	7.6	0	2.54	.636

## Some Solutions to Improve the Effectiveness of Autonomous Activities at Public Vocational Education Institutions in Hanoi

C224 Autonomy in selecting students through criteria defined by the school	170	0	0	28.2	50.6	21.2	3.93	.701
C225 Autonomy in choosing the teaching language	170	25.3	51.2	23.5	0	0	1.98	.701
C226 Autonomy in opening training programs	170	12.4	41.8	33.5	12.4	0	2.46	.864
C227 Autonomy in deciding the strategy, plan, and implementation of research activities	170	0	0	14.1	57.6	28.2	4.14	.637
C228 Autonomy in organizing the compilation or selection of teaching materials suitable for training objectives	170	0	0	13.5	50.6	35.9	4.22	.668
C229 Autonomy in testing, evaluating, and ensuring the quality of training activities	170	0	0	27.6	51.8	20.6	3.93	.693
C2210 Autonomy in issuing degrees, certificates, managing the issuance of degrees and certificates to students	170	0	20.6	64.1	15.3	0	2.95	.598
C2211 Autonomy in developing research activities, international cooperation according to the school's development strategy and plan	170	0	0	38.2	51.2	10.6	3.72	.644

*Source: Survey results of the research team*

### 5. CONCLUSION AND RECOMMENDATIONS

Revitalizing the autonomy mechanism of public vocational education institutions in Hanoi is a natural imperative, guided by clear state direction and ensuring stringent quality control. The research results indicate that institutions autonomously fulfill their functions and duties. However, autonomy in organizational structure and personnel, finance and assets, as well as academic autonomy, is not yet high. To enhance the effectiveness of autonomy, public vocational education institutions in Hanoi should implement the following solutions:

The improvement of the legal system and the mechanisms, as well as the management policies of the Government and the People's Committee of Hanoi, is highly essential for vocational education institutions to effectively carry out autonomous activities. This includes the specific delegation of authority to the school council and the school principal, as well as the reduction of managerial functions and operations by state management agencies in relation to vocational education institutions. Public vocational education institutions need to build and develop strategic plans in the following areas: admissions, curriculum development, and teaching plans. Specifically, these institutions should autonomously conduct admissions after transparently implementing publicly announced criteria. Admissions can be conducted in multiple phases throughout the year to meet the demands and orders for labor training from businesses and organizations.

The quality assurance areas of the school are determined on the basis of the criteria and standards for quality assurance of vocational education according to Circular No. 15/2017/TT-BLĐTBXH dated June 8, 2017 of the Minister of Labor - Invalids and Social Affairs Regulations on criteria and standards for quality assurance of vocational education. The focus of the school's quality management areas are: Quality Management of Teaching and Learning Activities, Quality Management of Training Programs and Curriculum, Quality Management of the Staff, Quality Management of Facilities and Training Equipment, Quality Management of Services for Learners and Graduates.

In terms of finance and assets, public vocational education institutions need to plan according to the self-reliance mechanism for the sources of income from training activities from different levels, scientific research. When implementing self-reliance, schools will no longer be supported by regular expenditure from the state budget, therefore the mechanism for ordering and assigning tasks in training must be clearly specified. In addition, vocational education institutions need to pay attention to the remuneration, development of teaching staff and management staff.

### REFERENCES

- 1) Anderson, D. & Johnson, R., (1998), University Autonomy in Twenty Countries, Higher Education, Vol.98-3.
- 2) Berdahl, Robert. (1990), Shared Academic Governance and External Constraints.
- 3) Ministry of Labor, Invalids and Social Affairs, Circular No. 14/2021/TT-BLĐTBXH, Regulations on the Statute of Intermediate Vocational Schools, dated October 21, 2021.
- 4) Ministry of Labor, Invalids and Social Affairs, Circular No. 15/2021/TT-BLĐTBXH, Regulations on the Statute of College Institutions, dated October 21, 2021.

## Some Solutions to Improve the Effectiveness of Autonomous Activities at Public Vocational Education Institutions in Hanoi

- 5) Government (2006), Decree No. 43/2006/NĐ-CP Regulating the Autonomy Rights and Responsibilities for the Implementation of Tasks, Organizational Structure, Payroll, and Finance of Public Service Units, dated April 25, 2006.
- 6) Government (2021), Decree No. 60/2021/NĐ-CP on the Mechanism of Financial Autonomy for Public Service Units, dated June 21, 2021.
- 7) Government (2015), Decree No. 15/2015/NĐ-CP, Regulations on the Autonomy Mechanism of Public Service Units, dated February 14, 2015.
- 8) EUA (European University Association) (2017), Dimensions of University Autonomy, <http://www.university-autonomy.eu>
- 9) Freeman R.E (2010). Strategic management: A stakeholder approach, Cambridge University Press.
- 10) Konthamaki, Y. & Lytinen, A. (2004). Financial autonomy and challenges to being a regionally responsive higher education institution. *Tertiary Education and Management* 10, 319-338.
- 11) Mac Van Tien (2019), Innovation in state management, administration for vocational education institutions, Proceedings of VEC2019 – Vocational Education Conference.
- 12) Mitchell, R. K., Agle, B. R., & Wood, D. J. (1997). Toward a Theory of Stakeholder Identification and Salience: Defining the Principle of who and What Really Counts. *Academy of Management Review*, 22(4), 853-886.
- 13) Mitsopoulos, M and Pelagidis, T (2008) "Compering the Administrative and Financial Autonomy of Higher Education Institutions in 7 EU countries"
- 14) Nelson, G., Potter, E., Weidman, J. & Zullo, T. (2001), ASHE reader on finance in higher education (2nd ed.), MA: Pearson, Boston.
- 15) Nguyen Trong Tuan (2017), Autonomy Rights of Public Universities in Vietnam Today, Doctoral Dissertation, Vietnam Academy of Social Sciences.
- 16) Pruvot, E.B & Estermann, T (2017), University Autonomy in Europe III The Scorecard 2017, <http://www.eua.be/Libraries/publications/University-Autonomy-in-Europe-2017> ngày 21/7/2018.
- 17) Sheehan, J. (1997), Social Demand Versus Political Economy in Higher Education at the Turn of the Century, *Higher education in Europe*, (22), 2, p. 123-136
- 18) Vu Thi Thanh Thuy (2012), "Financial Management at Vocational Colleges in Vietnam," Doctoral Dissertation, National Economics University.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Analysis of the Effect of Self-Regulation on Burnout in Athletes at the Samarinda Futsal Club



Muhammad Noor Astama<sup>1</sup>, Djoko Pekik Irianto<sup>2</sup>, Tomoliyus<sup>3</sup>

<sup>1,2,3</sup>Sports Coaching Education Study Program, Postgraduate Program, Yogyakarta State University, Jalan Colombo No. 1, Karangmalang, Yogyakarta 55281, Indonesia

**ABSTRACT:** This research aims to analyze the relationship between *self-regulation* against burnout in athletes at the Samarinda futsal club. In this dynamic sporting era, understanding the psychological factors that influence athletes' performance in futsal is crucial. These factors include *self-regulation*.

The research used quantitative methods and survey design with a sample of athletes at the Samarinda futsal club. The results of data analysis show a positive correlation between *self-regulation* on burnout ( $r = 0.218$ ,  $p < 0.01$ ). The findings highlight the importance of managing *self-regulation* to prevent and overcome burnout.

Furthermore, regression analysis shows that *self-regulation* ( $\beta = 0.218$ ,  $p = 0.002$ ) has a significant influence on burnout. This statistical model provides moderate predictions of burnout levels, *self-regulation* as the focus of coaching and training strategies at the Samarinda futsal club. The implications of this research support the development of coaching programs that focus on managing *self-regulation* to prevent and overcome burnout.

**KEYWORDS:** Self-Regulation, Burnout, Athlete, Futsal Club, Samarinda

### I. INTRODUCTION

In the world of sports, futsal in particular attracts the attention of many people because of its high intensity and fast pace of play. In an effort to achieve competitive success, futsal athletes must face great physical, emotional, and mental stress[1]. The problem of psychological and physical well-being in athletes at the Samarinda Futsal Club has become an increasing concern in recent years. The increasing level of competition and pressure experienced by athletes in achieving satisfactory results has given rise to a number of serious problems, including burnout[2].

In this context, self-regulation is an important factor to consider. Self-regulation is a person's ability to control and regulate their emotions, behavior and thoughts in order to achieve desired goals[3]. In the case of athletes at the Samarinda Futsal Club, self-regulation is expected to influence the level of burnout experienced by the athletes. Burnout in athletes can be explained as a condition of severe physical and mental fatigue, which results in a decrease in athlete performance and difficulty in maintaining motivation and passion in training and competing.[4]. Burnout can arise due to various factors, such as excessive physical fatigue, high competitive pressure, too many demands from coaches and teams, and lack of adequate rest time[5].

Ideally, every athlete at Club Futsal Samarinda has a high level of self-regulation, which helps them manage stress, avoid fatigue, and achieve balance between the demands of sport and everyday life.[6]. By having good self-regulation, every athlete can feel emotionally fulfilled, focused on their goals, and have high motivation to achieve their best performance[7]. The reality on the ground shows that the problem of burnout among athletes at the Samarinda Futsal Club has emerged and is affecting the performance and welfare of athletes. Some athletes experience decreased motivation, chronic physical fatigue, and even serious injuries or accidents. This is very worrying and requires appropriate steps to prevent and overcome this problem.

As a solution, training and mentoring can be carried out aimed at improving athletes' self-regulation abilities at the Samarinda Futsal Club. This study could focus on introducing self-regulation techniques, such as stress management, emotion regulation, time management, and handling competitive pressure. It is hoped that through this approach, athletes can develop better self-regulation abilities and prevent burnout.



## Analysis of the Effect of Self-Regulation on Burnout in Athletes at the Samarinda Futsal Club

The aim of this research is to analyze the influence of self-regulation on the level of burnout in athletes at the Samarinda Futsal Club. By analyzing the factors that influence burnout and the role of self-regulation in preventing and overcoming burnout, it is hoped that this research can provide a better understanding of this problem.

### II. METHODOLOGY

This research will be conducted using a quantitative approach and survey research design. The population of this study includes all athletes registered in the Samarinda futsal club, and the sample will be selected purposively to achieve representativeness[8]. Data will be collected through a questionnaire specifically designed to measure self-regulation of burnout. The data collection procedure will involve distributing questionnaires to respondents through face-to-face meetings or online platforms. During this process, the research objectives will be explained to respondents to ensure good understanding, and respondent anonymity will be maintained to increase honesty and objectivity in completing the questionnaire.

Data analysis will begin with descriptive analysis, which includes calculating the mean, median and standard deviation values for the research variables[9]. Next, correlation tests, such as the Pearson test, will be used to evaluate the influence of self-regulation on burnout[10]. If there is a significant correlation, regression analysis will be carried out to determine the extent of the variable[11]. Interpretation of the results of statistical analysis will be carried out to provide an in-depth understanding of the influence of self-regulation on burnout in athletes at the Samarinda futsal club.

Respondents were divided into two genders, namely men and women. The number of male respondents was 125 people, which accounted for around 62.8% of the total population. Meanwhile, there were 74 female respondents, reaching 37.2% of the total population. Thus, it can be said that the proportion of men is more dominant than women in this sample, with an overall cumulative percentage reaching 100%.

#### Gender

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Man	125	62.8	62.8	62.8
Woman	74	37.2	37.2	100.0
Total	199	100.0	100.0	

There were 199 respondents taken to measure age. The majority of respondents were in the 13-15 year age range, covering 93 individuals or around 46.7% of the total sample. Meanwhile, the 16-18 year age group had 106 respondents, accounting for around 53.3% of the total sample. These results show that the age distribution of respondents is quite balanced in this study. Therefore, it can be concluded that the majority of participants were in the early to middle teenage age category, with the 16-18 year old age group being the most represented group in this study.

#### Age

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid 13-15	93	46.7	46.7	46.7
16-18	106	53.3	53.3	100.0
Total	199	100.0	100.0	

### III. RESULTS AND DISCUSSION

This research explores the relationship between the influence of self-regulation on the level of burnout in athletes at the Samarinda Futsal Club. The results of Pearson correlation analysis show that there is a significant positive correlation between self-regulation and burnout ( $r = 0.218$ ,  $p < 0.01$ ). This shows that the better a person's ability to control and regulate their emotions, behavior and thoughts, the lower the level of burnout. which in turn can increase athlete achievement. These findings provide important insights regarding psychological factors that can influence athlete performance and provide a basis for the development of more effective coaching and training strategies in the world of sport.

## Analysis of the Effect of Self-Regulation on Burnout in Athletes at the Samarinda Futsal Club

### Correlations

		Self-regulation	Burnout
Self-regulation	Pearson Correlation	1	.218**
	Sig. (2-tailed)		,002
	N	199	199
Burnout	Pearson Correlation	.218**	1
	Sig. (2-tailed)	,002	
	N	199	199

\*\* . Correlation is significant at the 0.01 level (2-tailed).

The statistical model presented here shows a moderate level of fit to the data, as indicated by an R Square value of 0.047 and an Adjusted R Square value of 0.043. This coefficient indicates that approximately 4.7% of the variation in the dependent variable can be explained by the predictors included in this model. The predictors considered in this analysis involve constants, as well as variables such as "self-regulation". The constant reflects the baseline value when all predictors are zero, while the other variables contribute to explaining variation in the dependent variable. "Self-regulation" relates to a person's ability to control and regulate their emotions, behavior, and thoughts.

The R Square and Adjusted R Square values indicate that these predictors collectively provide a good fit to the observed data. However, it is important to note that the predictive accuracy of these models can still be influenced by unobserved factors or other variables not included in the analysis. Further interpretation and validation of this model is necessary to ensure its robustness and applicability in understanding and predicting outcome variables.

### Model Summary

Model	R	R Square	Adjusted R Square	. Error of the Estimate
1	.218a	,047	,043	8,535

a. Predictors: (Constant), Self-regulation

Analysis of variance (ANOVA) was conducted to evaluate the relationship between the dependent variable, burnout, and self-regulation predictors. The regression model was statistically significant ( $F(1, 197) = 9.816, p < .001$ ), indicating that at least one of the predictors had a significant influence on burnout. The regression model was able to explain a large amount of variation in burnout, as indicated by the significant regression sum of squares (715,055). Self-regulation predictors, contributed to the model, with a mean square of 715,055.

The residuals, which reflect unexplained variance in burnout, have a sum of squares of 14350.001. Overall, the model including both components, regression and residual, explains the total 15065.055 in the burnout variant. In summary, the ANOVA results indicate that the influence of self-regulation significantly contributes to variation in burnout.

### ANOVAa

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	715,055	1	715,055	9,816	.002b
	Residual	14350.001	197	72,843		
	Total	15065.055	198			

a. Dependent Variable: Burnout  
b. Predictors: (Constant), Self-regulation

Regression analysis was carried out to examine the factors that influence burnout (Dependent Variable: burnout). This model includes one independent variable: self-regulation. The unstandardized coefficient for self-regulation was 0.170. The standardized coefficient (Beta) for this variable is 0.218. The fixed value (constant term) is 42,908. The t value for self-regulation is 3,133. The corresponding p value is 0.002, indicating that self-regulation has a statistically significant effect on burnout.

## Analysis of the Effect of Self-Regulation on Burnout in Athletes at the Samarinda Futsal Club

### Coefficientsa

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	42,908	4,955		8,659	,000
	Self-regulation	,170	,054	,218	3,133	,002

a. Dependent Variable: Burnout

Based on the results of the data analysis that has been presented, this research provides in-depth insight into the psychological factors that influence burnout in futsal athletes. Self-regulation, which is a person's ability to control and regulate their emotions, behavior and thoughts, has been shown to have a significant positive correlation with burnout. Athletes who have the ability to control and regulate their emotions, behavior and thoughts needed to achieve their goals apparently have lower levels of burnout. This highlights the importance of managing self-regulation as part of an athlete coaching strategy to prevent and overcome burnout.

Overall, the statistical model applied in this study provides moderate predictions of burnout levels. Regression analysis shows that self-regulation has a significant influence on burnout. Therefore, the coaching and training strategy at the Samarinda futsal club can be focused on managing self-regulation as a key step in preventing and overcoming burnout.

### IV. CONCLUSIONS

In this research, it was found that psychological factors had a significant influence on the level of burnout in futsal athletes. The results of data analysis show that self-regulation, or a person's ability to control emotions, behavior and thoughts, has a strong relationship with burnout. Athletes who are able to manage self-regulation well tend to have lower levels of burnout. These findings show the importance of managing self-regulation in coaching athletes to prevent and overcome burnout. Therefore, the coaching and training strategy at the Samarinda futsal club can be focused on developing self-regulation abilities as a key step in overcoming burnout. The statistical model applied in this research provides quite accurate predictions of burnout levels. Regression analysis shows that self-regulation has a significant influence on burnout. These results provide a strong basis for considering the use of coaching strategies that focus on developing self-regulation to prevent burnout in futsal athletes.

### V. ACKNOWLEDGMENT

The researcher would like to express his infinite gratitude to all parties who have helped in completing this research. Without his support and assistance, this research would not have been completed successfully.

First of all, the researcher would like to thank the athletes at the Samarinda Futsal Club who were willing to be respondents in this research. Their voluntary participation was a key factor that made this research possible. The researchers thank them for the time and effort they have contributed. The researcher would also like to thank the management of the Samarinda Futsal Club for giving permission to the researcher to carry out this research at their place. Good cooperation from the club is very important for the smooth running of this research. Not to forget, the researcher expressed his appreciation to the supervisor, who has provided valuable guidance and direction since the beginning of this research. Guidance and input were very helpful in directing this research so that it could achieve relevant and meaningful results.

Finally, the researcher also thanks all other parties, both individuals and institutions, who have provided support and assistance in various forms during this research. The researcher realizes that this list may not be complete, but the researcher is very grateful for the contributions of all parties who have assisted in this research. Hopefully the results of this research can provide a meaningful and useful scientific contribution to the development of the world of sports, especially in terms of the influence of self-regulation on burnout in athletes at the Samarinda Futsal Club.

### REFERENCES

- 1) MAR Alves, ADS Oliveira, MJ Paes, and JMF Stefanello, "Psychological aspects of soccer and futsal players: A systematic review," *Suma Psicologica*, vol. 29, no. 1. 2022. doi: 10.14349/sumapsi.2022.v29.n1.4.
- 2) M. Daumiller, R. Rinas, and J. Breithecker, "Elite athletes' achievement goals, burnout levels, psychosomatic

## Analysis of the Effect of Self-Regulation on Burnout in Athletes at the Samarinda Futsal Club

- stress symptoms, and coping strategies," *Int J Sport Exerc Psychol*, vol. 20, no. 2, 2022, doi: 10.1080/1612197X.2021.1877326.
- 3) M. Inzlicht, KM Werner, JL Briskin, and BW Roberts, "Integrating Models of Self-Regulation," *Annual Review of Psychology*, vol. 72. 2021. doi: 10.1146/annurev-psych-061020-105721.
  - 4) [4] LHS Fagundes, F. Noce, MR Albuquerque, AGP de Andrade, and V. Teoldo da Costa, "Can motivation and overtraining predict burnout in professional soccer athletes in different periods of the season?," *Int J Sport Exerc Psychol*, vol. 19, no. 2, 2021, doi: 10.1080/1612197X.2019.1655778.
  - 5) S. Edú-valsania, A. Laguía, and J.A. Moriano, "Burnout: A Review of Theory and Measurement," *International Journal of Environmental Research and Public Health*, vol. 19, no. 3. 2022. doi: 10.3390/ijerph19031780.
  - 6) CE Morris, FW Otte, M. Rothwell, and K. Davids, "'Embracing turbulent waters': Enhancing athlete self-regulation using the 'PoST' framework for performance preparation at the 2020 Tokyo Olympic Games," *Asian Journal of Sport and Exercise Psychology*, vol. 2, no. 1, 2022, doi: 10.1016/j.ajsep.2022.03.001.
  - 7) YA Balk and C. Englert, "Recovery self-regulation in sport: Theory, research, and practice," *International Journal of Sports Science and Coaching*. 2020. doi: 10.1177/1747954119897528.
  - 8) C. Andrade, "The Inconvenient Truth About Convenience and Purposive Samples," *Indian J Psychol Med*, vol. 43, no. 1, 2021, doi: 10.1177/0253717620977000.
  - 9) P. Mishra, CM Pandey, U. Singh, A. Gupta, C. Sahu, and A. Keshri, "Descriptive statistics and normality tests for statistical data," *Ann Card Anaesth*, vol. 22, no. 1, 2019, doi: 10.4103/aca.ACA\_157\_18.
  - 10) S. Chatterjee, "A New Coefficient of Correlation," *J Am Stat Assoc*, vol. 116, no. 536, 2021, doi: 10.1080/01621459.2020.1758115.
  - 11) N. Shrestha, "Detecting Multicollinearity in Regression Analysis," *Am J Appl Math Stat*, vol. 8, no. 2, 2020, doi: 10.12691/ajams-8-2-1.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Description of the Quality of Communication between Athletes and Coaches in the District. Kutai Kartanegara, East Kalimantan



Rahmat<sup>1</sup>, Djoko Pekik Irianto<sup>2</sup>, Faidillah Kurniawan<sup>3</sup>

<sup>1,2,3</sup>Sports Coaching Education Study Program, Postgraduate Program, Yogyakarta State University, Jalan Colombo No. 1, Karangmalang, Yogyakarta 55281, Indonesia

**ABSTRACT:** The aim of this research is to determine the quality of communication between athletes and coaches in Kutai Kartanegara district, East Kalimantan. The aim of research on the quality of communication between athletes and coaches is to evaluate and analyze athletes' perceptions regarding the quality of communication they receive from their coaches. To identify areas of communication that can be improved between athletes and coaches, as well as understand how successful communication can be understood by athletes and impact outcomes. The need for coaches to understand better communication with athletes.

The method used in this research uses quantitative descriptive. Quantitative descriptive is a research method by collecting data and processing it in a descriptive way. It can also be used to identify factors that influence conclusions about the subject under study. Quantitative descriptives can be used to collect information from populations or individual subjects. This method can also be used to analyze previous data to look for patterns or trends in the data. The number of samples in the study was 233 athletes. The instrument used in this research was a questionnaire in the form of a Google Form. With Structural Equation Modeling (SEM) technique analysis using AMOS version 24 software.

The results of this study note that the results are in the quality of coach-athlete communication. The RMSEA of this research is 0.074 with a recommended value of  $\leq 0.08$ , this shows that the research model is fit. The AGFI in this model is 0.850. Values close to the recommended level  $\geq 0.90$  indicate marginal fit of the research model. The GFI in this model is 0.892. Values close to the recommended level  $\geq 0.90$  indicate marginal fit of the research model. CMIN/DF in this study was 2.101, indicating that the research model was fit. The TLI in this study was 0.942 with the recommended value being  $\geq 0.90$ , this shows that the research model is fit. The CFI in this study is 0.953, the recommended value is  $\geq 0.90$ , this shows that the research model is fit.

**KEYWORDS:** quality, communication, athletes, coaches, east kalimantan

### I. INTRODUCTION

Athletes are unique individuals, with their own talents, and then their own behavioral patterns, their own personalities, and life backgrounds that have a particular impact on them[1]. A person who participates in physical activity through achievements in sports is, so to speak, an athlete[2]. From the description above it can be concluded that an athlete is an individual who is trained, unique, and also athletically talented, physically trained[3].

Communication is the bridge between coaches and athletes. The objectives of the training are communicated through the communication of appeals, prohibitions, commands, as well as suggestions and criticism in assessment[4]. Training cannot take place without communication components such as language, sounds, body movements, facial movements, signs or words. The coach's instructions to the athlete are impossible if the athlete does not understand the coach's language or instructions[5]. Communication is important in education. Good training is a reciprocity between coach and athlete. Usually the coach gives instructions and the athlete receives or gives advice about the exercises to be carried out. This communication model influences how a person practices this method[6].

The quality of a coach must also be able to create an atmosphere of high training enthusiasm for athletes, so that athletes are motivated to participate in training[7]. Communication between coaches and athletes in this case is very necessary to motivate athletes[4]. So that athletes are motivated in training and can optimize it, it is necessary to know the factors that can influence training motivation[8]. These factors include internal factors that originate from within the individual and external factors that

## **Description of the Quality of Communication between Athletes and Coaches in the District. Kutai Kartanegara, East Kalimantan**

originate from outside the individual. Internal factors such as attitudes towards training, interests and talents, satisfaction, etc. as well as external factors from outside the individual concerned such as communication, environment and leadership[9].

The aim of this research is to determine the quality of communication between athletes and coaches in Kutai Kartanegara Regency, East Kalimantan. In the quality of athlete-coach communication is to build strong relationships between coaches and athletes, help athletes achieve their goals, and help athletes develop their skills and competencies. Effective communication between coaches and athletes can help increase motivation, increase productivity, and help athletes achieve better results. Effective communication can also help improve communication skills, increase openness, and help athletes achieve their goals.

The importance of knowing the description of the quality of communication from the athlete's perspective, can be seen to what extent a coach interacts with his athletes, where interaction in this case is communicating well between athletes and coaches, what is more emphasized by a coach is being more communicative towards athletes in the coach's emphasis on trying find out what makes a quality athlete. From various views of athletes in the field, it can be seen that there is a close relationship between soul, body and mind, which influence and interact with each other. Coaches play a role in shaping athletes into complete humans. It is not easy to understand an athlete, because humans have basic human characteristics, namely self-awareness, autonomy and transcendence, and sociability. To better understand an athlete's character, it is necessary to emphasize to coaches that character is not an abstraction. Humans are concrete creatures. An athlete with a healthy mind always thinks positively. This positive thinking makes the body stronger and more enthusiastic in carrying out physical movements, techniques and tactics to achieve peak performance.[10]. In reality, coaches and athletes, because after all, a coach will not be able to develop athletes well if there is no interaction between the coach and the athlete, and between fellow athletes, which is based on a sense of familiarity, openness, compassion, willingness to be corrected, accepting suggestions and so on which are based on positive attitudes.

### **II. METHODOLOGY**

Descriptive quantitative research is research that draws conclusions by monitoring, observing, and describing the number of samples based on phenomena that occur during the research[11].[12] Descriptive quantitative research is research with a design to visualize research results. Meanwhile, according to[13] Descriptive quantitative research aims to find information, the goal to be achieved, how to approach it, and collect various kinds of data as a reference for making a report to the conclusion that descriptive research is carried out by looking for information related to existing symptoms to achieve the goal. The main method between descriptive research and other research is that this research is more focused on answering problems that exist while the research is in progress, or there are significant problems/events that are still arising. This research aims to describe the situation precisely and accurately, not looking for a relationship between the independent variable and the dependent variable or comparing two or more variables to look for a cause and effect relationship. [14]. The method used in this study is a descriptive quantitative study. Descriptive investigation is an investigation that investigates a condition, situation or other event and then presents the results in the form of a report. The investigation is explained using quantitative methods because it uses numbers, from data collection, data interpretation and the results. Based on the understanding in the research, we can come to the conclusion that descriptive research is carried out by looking for information related to existing symptoms, achieving clear goals, how the researcher acts to approach and collect differently various data such as material to be made into a report. In this research, the author wants to know the quality of communication between athletes and coaches who use media via Google forms in the form of questionnaires distributed via WhatsApp groups. After obtaining all the required data, grouping is carried out.

In this study, researchers used the Structural Equation Modeling (SEM) technique using AMOS version 24 software. SEM is described as an analysis that combines factor analysis approaches, structural models and path analysis. to interpret and draw conclusions from a number of collected data[15]. Researchers used SEM (Structural Equation Model) AMOS software version 24 to process and analyze research data.

### **III. RESULTS AND DISCUSSION**

In this research, the quality of athlete-coach communication. In this research, the quality of athlete-coach communication is one of the important factors in determining athlete success. This research found that athletes who have good communication qualities with their coaches tend to have better results than athletes who do not have good communication qualities. This shows that the quality of communication between athletes and coaches can play an important role in determining athlete success. In addition, this research also found that good quality communication between athletes and coaches can increase athlete motivation and self-confidence, which in turn can improve athlete results. This research uses quantitative descriptive which focuses the results on statements in the form of grouped questionnaires. The sample used in this research was 233 athletes with the instrument used in this research using a questionnaire. The research results show that communication or message recipients are divided into 3,

## Description of the Quality of Communication between Athletes and Coaches in the District. Kutai Kartanegara, East Kalimantan

namely: Personal communication is communication aimed at a single target, group communication is communication aimed at a certain group, and mass communication is communication aimed at the masses or communication that uses mass media. And the final result of communication, namely people's attitudes and behavior, is appropriate or not according to what we want. The data results describe the quality of communication between athletes and coaches in Kutai Kartanegara district, East Kalimantan, with pictures and tables based on research as follows:

### Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
valid	Man	132	56.7	56.7	56.7
	Woman	101	43.3	43.3	100.0
	Total	233	100.0	100.0	

Based on the gender data of respondents obtained in the table above, it can be described that the largest number of respondents' gender is male, namely 56.7% and female, 43.3% of the total data of 233 respondents.

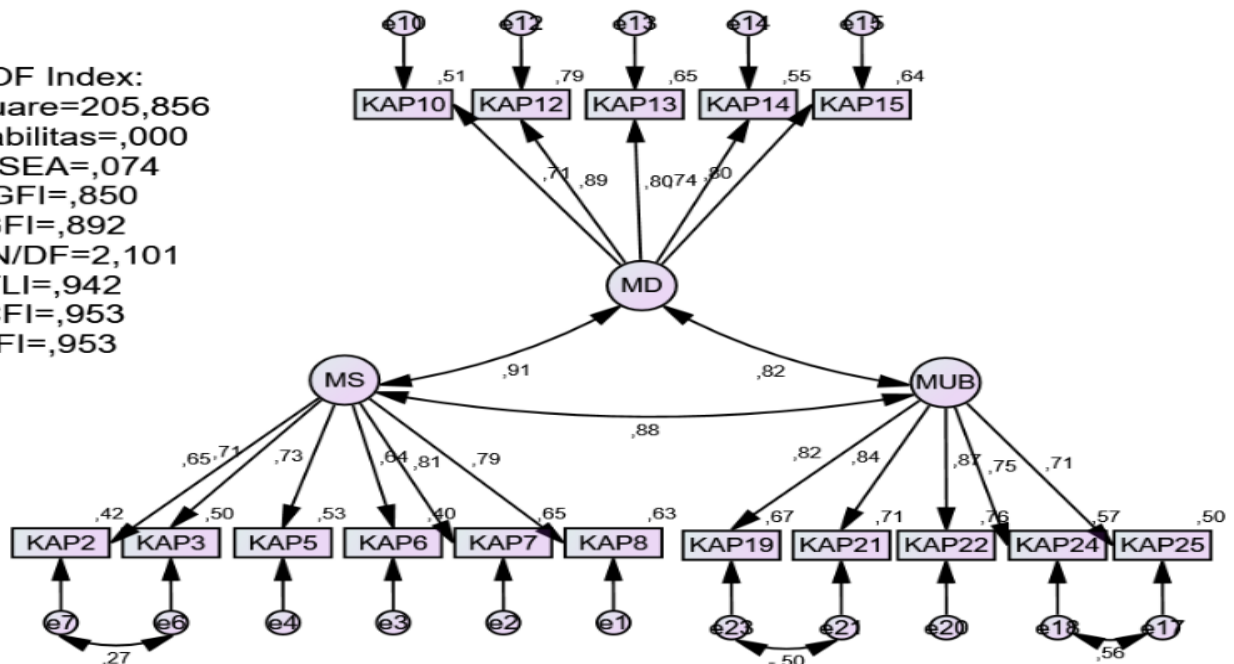
### Age

		Frequency	Percent	Valid Percent	Cumulative Percent
valid	15 – 17 Years	230	98.7	98.7	98.7
	18 – 20 Years	3	1.3	1.3	100.0
	Total	233	100.0	100.0	

Based on the respondents' age data in the table above, it can be described that the largest number of responses was 98.7% aged 15 - 17 years and 18 - 20 years old 1.3% of the total data of 233 respondents.

### AMOS SEM analysis

GOF Index:  
 chi-square=205,856  
 probabilitas=,000  
 RMSEA=,074  
 AGFI=,850  
 GFI=,892  
 CMIN/DF=2,101  
 TLI=,942  
 CFI=,953  
 IFI=,953



### Amos SEM Analysis Results

Based on the results of the data above, it can be seen that the research model is close to being a good fit model. As for the explanation of the criteria in the table above, you can see the following explanation:

1. RMSEA is an index used to compensate for chi-square values in large samples. The RMSEA value of this research is 0.074 with the recommended value of  $\leq 0.08$ , this shows that the research model is fit.
2. AGFI is the GFI adjusted by the ratio between the proposed degree of freedom and the degree of freedom of the null model. The AGFI value in this model is 0.850. Values close to the recommended level  $\geq 0.90$  indicate marginal fit of the research model.

## Description of the Quality of Communication between Athletes and Coaches in the District. Kutai Kartanegara, East Kalimantan

3. The Goodness of Fit Index (GFI) shows the level of overall model suitability which is calculated from the squared residual of the predicted model compared to the actual data. The GFI value in this model is 0.892. Values close to the recommended level  $\geq 0.90$  indicate marginal fit of the research model.
4. CMIN/DF is a parsimonious suitability index which measures the goodness of fit of the model by the number of estimated coefficients expected to achieve suitability. CMIN/DF results in this study 2.101 shows that the research model is fit.
5. TLI is a suitability index that is less influenced by sample size. The TLI value in this study was 0.942 with the recommended value, namely  $\geq 0.90$ , this indicates that the research model is fit.
6. CFI is an index that is relatively insensitive to sample size and model complexity. The CFI value in this research is with 0.953, the recommended value is  $\geq 0.90$ , this shows that the research model is fit.

Communication between athletes and coaches in Kutai Kartanegara, East Kalimantan is generally good. Coaches support and encourage their athletes, always providing guidance and feedback. Athletes are also encouraged to speak up and share ideas, and coaches are always willing to listen and make suggestions. Athletes feel comfortable communicating with their coaches, and there is a strong sense of respect and trust between both parties. This high-quality communication allows athletes to reach their full potential and achieve success in their lives. A coach and athlete is a professional tasked with helping, guiding, developing and directing talented athletes to realize maximum achievements in the shortest time. A coach is someone who has the ability to help reveal an athlete's potential into real, optimal abilities in a short time. Therefore, trainers must carry out their duties and roles according to their profession and supported by the abilities required by a trainer [16]. Open communication also allows coaches to provide useful input to help athletes achieve their goals. Coaches can also understand the situations and problems faced by athletes. With open communication, coaches can identify problems and help athletes achieve their goals more quickly. Open communication also allows athletes to express their feelings and expectations to the coach, which allows the coach to better adjust the training program [17]. Opinions between athletes and coaches depend on the context. As athletes, they will likely have different views on the strategies used in training and preparation for competitions. As coaches, they may emphasize the technical and physical skills necessary to achieve desired results. The views of athlete and coach can be complementary if they can work together and find the right balance of technique, skill and mentality necessary to succeed [18]. The opinions of athletes - coaches should be respected and taken into account. It helps to resolve the problem by following the opinion of, the coach - the athlete must have a solid understanding of the problem at hand. All parties must create and implement solutions that will provide the desired results, effective communication must be maintained so that all parties receive the correct information. Coaches must follow the necessary precautionary measures so that the problem cannot recur [19].

Athletes' satisfaction with coaches in communicating is very important for athlete success. This satisfaction depends on the coach's ability to provide information clearly and honestly so that athletes can understand it easily. Coaches must also ensure that they listen to and understand athletes' needs and provide them with the support they need. Coaches must also create interactive communication and provide opportunities for athletes to ask questions and discuss. In this way, athletes can develop self-confidence and increase their satisfaction with their coaches [20]. In addition, coaches must also build trust and strong relationships with their athletes by communicating with them openly and actively. They must also ensure that their athletes feel comfortable and that they can expect appropriate help and advice. Coaches must be willing to listen and engage in discussions with their athletes to ensure that they are getting the right information and getting the help they need [21].

Goodness of fit index	Cut of value	Research Model	Model
Chi-square	Expected to be small	205,856	Fit
Significant probability	$\geq 0.05$	0,000	Fit
RMSEA	$\leq 0.08$	0.074	Fit
AGFI	$\geq 0.90$	0.850	Fit
GFI	$\geq 0.90$	0.892	Fit
CMIN/DF	$\leq 2.0$	2,101	Fit
TLI	$\geq 0.90$	0.942	Fit
CFI	$\geq 0.90$	0.953	Fit

The quality of communication between athletes and coaches is an important aspect in the success of training and athlete achievement. Effective communication between athlete and coach will enable the coach to provide the right direction to help the athlete achieve his goals. Poor communication can hinder an athlete's development and prevent them from achieving their goals. Several factors that influence the quality of communication between athletes and coaches are openness, trust, and communication skills. Openness is the ability to openly and honestly talk about any problems an athlete is experiencing. Coaches



## **Description of the Quality of Communication between Athletes and Coaches in the District. Kutai Kartanegara, East Kalimantan**

must give athletes space to talk about their problems. Athletes should feel comfortable speaking openly and honestly with coaches. Trust is a very important factor in the quality of communication between athletes and coaches. Athletes must have trust and respect for coaches. Coaches must build strong relationships with athletes to build trust. Communication skills are the ability to speak clearly and effectively. Trainers must be able to use language that is appropriate and easy to understand. Coaches must also be able to listen carefully and provide appropriate and helpful responses. Based on the description of the quality of communication between athletes and coaches in Kutai Kartanegara district, East Kalimantan, communicating with athletes does not always have to be in formal language, because that will make athletes stiff with coaches. Active listening becomes very important when athletes are interacting. Athletes often talk to coaches about their obstacles while training and in the future. A coach must actively listen to everything an athlete says. Because with things like this, there is a reason to strengthen the communication bond between coaches and athletes.

### **IV. CONCLUSIONS**

Effective communication allows athletes and coaches to understand each other and build respectful relationships. This helps increase productivity and increases motivation. Effective communication also allows athletes and coaches to express opinions, give and receive feedback, and make decisions together. To build effective communication, athletes and coaches must ensure that they speak openly and honestly, respect different opinions, and respect and appreciate each other.

Based on the results of the data above, it can be seen that the research model is close to being a good fit model. As for the explanation of the criteria in the table above, you can see the following explanation:

- RMSEA is an index used to compensate for chi-square values in large samples. The RMSEA value of this research is 0.074 with the recommended value being  $\leq 0.08$ , this shows that the research model is fit.
- AGFI is the GFI adjusted by the ratio between the proposed degree of freedom and the degree of freedom of the null model. The AGFI value in this model is 0.850. Values close to the recommended level  $\geq 0.90$  indicate marginal fit of the research model.
- The Goodness of Fit Index (GFI) shows the level of overall model suitability which is calculated from the squared residual of the predicted model compared to the actual data. The GFI value in this model is 0.892. Values close to the recommended level  $\geq 0.90$  indicate marginal fit of the research model.
- CMIN/DF is a parsimonious suitability index which measures the goodness of fit of the model by the number of estimated coefficients expected to achieve suitability. The CMIN/DF results in this study were 2.101, indicating that the research model was fit.
- TLI is a suitability index that is less influenced by sample size. The TLI value in this study was 0.942 with the recommended value being  $\geq 0.90$ , this shows that the research model is fit.
- CFI is an index that is relatively insensitive to sample size and model complexity. The CFI value in this study is 0.953, the recommended value is  $\geq 0.90$ , this shows that the research model is fit.

The quality of communication between athletes and coaches depends on both parties creating a relationship of mutual respect and providing opportunities to share information. If athletes and coaches work together and work hard to create effective communication, the quality of communication between them will be better.

### **V. ACKNOWLEDGMENT**

The researcher would like to express his infinite gratitude to all parties who have helped complete this research. Without his support and assistance, this research would not have been completed successfully. First of all, the researcher would like to thank the athletes who were willing to be respondents in this research. Their voluntary participation was a key factor that made this research possible. The researchers are grateful for the time and effort they have contributed. The researcher also would like to thank the parties who have given permission to the researcher to carry out this research at his place. The researcher did not forget to express his appreciation to the supervisor who has provided valuable guidance and direction since the beginning of this research. Guidance and input were very helpful in directing this research so that it could achieve relevant and meaningful results. Finally, the researcher would also like to thank all other parties, both individuals and institutions, who have provided support and assistance in various forms during this research. The researcher realizes that this list may not be complete, but the researcher is very grateful for the contributions of all parties who have helped in this research.

### **REFERENCES**

- 1) NMAYPratiwi and MD Lestari, "DIFFERENCES IN THE QUALITY OF COMMUNICATION BETWEEN EARLY ADULT INDIVIDUALS WHO ARE LONG DISTANCE AND NEAR DISTANCE DATING IN DENPASAR," Udayana Psychology Journal, vol.

## Description of the Quality of Communication between Athletes and Coaches in the District. Kutai Kartanegara, East Kalimantan

- 4, no. 1, 2017, doi: 10.24843/jpu.2017.v04.i01.p14.
- 2) E.Pluhar, C. McCracken, KL Griffith, MA Christino, D. Sugimoto, and WP Meehan, "Team sport athletes may be less likely to suffer anxiety or depression than individual sport athletes," *J Sports Sci Med*, vol. 18, no. 3, 2019.
  - 3) CH Wuet al., "Relationship between mindfulness, psychological skills and mental toughness in college athletes," *Int J Environ Res Public Health*, vol. 18, no. 13, 2021, doi: 10.3390/ijerph18136802.
  - 4) Y. Kim and I. Park, "'Coaches really know whati needed and understood me well as a person': Effective communication acts in coach–athlete interactions among Korean olympic archers," *Int J Environ Res Public Health*, vol. 17, no. 9, 2020, doi: 10.3390/ijerph17093101.
  - 5) F.WOtte, K. Davids, SK Millar, and S. Klatt, "When and How to Provide Feedback and Instructions to Athletes?—How Sport Psychology and Pedagogy Insights Can Improve Coaching Interventions to Enhance Self-Regulation in Training," *Front Psychol*, vol. 11, 2020, doi: 10.3389/fpsyg.2020.01444.
  - 6) L. Davis, S. Jowett, and S.Tafvelin, "Communication strategies: The fuel for quality coach-athlete relationships and athlete satisfaction," *Front Psychol*, vol. 10, no. SEP, pp. 1–12, 2019, doi: 10.3389/fpsyg.2019.02156.
  - 7) GAMageau and RJ Vallerand, "The coach-athlete relationship: A motivational model," *Journal of Sports Sciences*, vol. 21, no. 11. 2003. doi: 10.1080/0264041031000140374.
  - 8) N. Walter, L.Nikoleizig, and D. Alfermann, "Effects of self-talk training on competitive anxiety, self-efficacy, volitional skills, and performance: an intervention study with junior sub-elite athletes," *Sports*, vol. 7, no. 6, 2019, doi: 10.3390/sports7060148.
  - 9) F.Pezzimenti, E. Durrani, S. Zheng, RE Adams, S.L. Bishop, and J.L. Taylor, "Perspectives on Employer-Initiated Terminations Among Young Adults on the Autism Spectrum," *J Autism Dev Disord*, 2023, doi: 10.1007/s10803-022 - 05884-6.
  - 10) A.Aryati, "UNDERSTANDING HUMAN BEINGS THROUGH PHILOSOPHICAL DIMENSIONS (Attempts to Understand Human Existence)," *EL-AFKAR: Journal of Islamic Thought and Hadith Interpretation*, vol. 7, no. 2, 2018, doi: 10.29300/jpkth.v7i2.1602.
  - 11) H.KMohajan, "Quantitative Research: A Successful Investigation in Natural and Social Sciences," *Journal of Economic Development, Environment and People*, vol. 9, no. 4, 2020, doi: 10.26458/jedep.v9i4.679.
  - 12) mHaviz and IM Maris, "Teaching Quantitative Research Method with Three Methods of Learning," *Al-Ta lim Journal*, vol. 25, no. 3, 2018, doi: 10.15548/jt.v25i3.394.
  - 13) I.Jayusman and OAK Shavab, "STUDENT LEARNING ACTIVITIES USING EDMODO-BASED LEARNING MANAGEMENT SYSTEM (LMS) LEARNING MEDIA IN HISTORY LEARNING," *Artifact Journal*, vol. 7, no. 1, 2020, doi: 10.25157/ja.v7i1.3180.
  - 14) Sugiyono, "Quantitative, Qualitative Research Methods and R & Quantitative, Qualitative Research Methods and R & D. Bandung: Alfabeta.," Bandung: Alfabeta., 2016.
  - 15) PTarka, "An overview of structural equation modeling: its beginnings, historical development, usefulness and controversies in the social sciences," *Qual Quant*, vol. 52, no. 1, 2018, doi: 10.1007/s11135-017-0469-8.
  - 16) NB Ishmaelet al., "The Role of Training and Development on Organizational effectiveness," *International Journal of Engineering, Business and Management*, vol. 5, no. 3, 2021, doi: 10.22161/ijebm.5.3.3.
  - 17) N.Nilamsari and MN Perdana, "Interpersonal Communication Patterns of Coaches and Players in the Tuter FC Futsal Community Training Program," *Communication Library*, vol. 2, no. 2, 2019.
  - 18) A.Purbaningrum and FY Wulandari, "The Role of Coaches in Shaping the Character of Kediri City TPC-t Athletics Athletes to Support Achievement," *Surabaya State University E-Journal*, 2021.
  - 19) ARGunawan, B. Rusyidi, and L. Meilany, "PARENT SOCIAL SUPPORT FOR PARALLEYMPIC ATHLETES BY ACHIEVING BLIND STUDENTS IN BANDUNG CITY," *Proceedings of Research and Community Service*, vol. 3, no. 3, 2015, doi: 10.24198/jppm.v3i3.13785.
  - 20) Gerald Novian and Ira Purnamasari Mochamad Noors, "The Relationship between Coach Leadership Style and Taekwondo Athletes' Achievement," *Gladi: Journal of Sports Science*, vol. 11, no. 02, 2020, doi: 10.21009/gjik.112.07.
  - 21) RMKurnia and NC Apsari, "The Role of Social Workers as Counselors for Athletes with Disabilities in Increasing Motivation to Achieve Achievement," *Proceedings of Research and Community Service*, vol. 7, no. 3, 2021, doi: 10.24198/jppm.v7i3.29610.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## A Multifaceted Exploration of Loyalty in SSB: Links between Training Environment, Coach Leadership, and Participant Satisfaction



Tri Fandes Purba<sup>1</sup>, Tomoliyus<sup>2</sup>, Faidillah Kurniawan<sup>3</sup>

<sup>1,2,3</sup>Sports Coaching Education Study Program, Postgraduate Program, Yogyakarta State University, Jalan Colombo No. 1, Karangmalang, Yogyakarta 55281, Indonesia

**ABSTRACT:** This study aims to investigate the multifaceted nature of participant loyalty in School Soccer (SSB) with a focus on the link between the training environment, coach leadership, and participant satisfaction. Through survey, interview and observation approaches, data was collected from participants at SSB Pekanbaru, Riau. The results of the correlation analysis show that there is a significant positive relationship between the training environment and trainer leadership, as well as between the training environment and participant satisfaction. These findings support the concept that a conducive training environment can increase the level of participant loyalty towards SSB. Trainer leadership was also shown to influence participant satisfaction, while participant satisfaction was significantly related to the level of participant loyalty. The regression model showed that the training environment, trainer leadership, and participant satisfaction could explain approximately 65.9% of the variation in participant loyalty. From the regression coefficient, participant satisfaction emerged as the most significant variable in influencing participant loyalty. The implication is that SSB management is advised to focus on improving the quality of the training environment and efforts to increase participant satisfaction in order to strengthen participant loyalty to the training program. This research contributes academic insight and a strong empirical basis for the development of more effective strategies and programs in increasing participant loyalty at SSB Pekanbaru, Riau.

**KEYWORDS:** Multifaceted Loyalty, Football School, Training Environment, Coach Leadership, Participant Satisfaction.

### I. INTRODUCTION

Football as a sport has a central role in shaping the character and skills of athletes [1], and the Football School (SSB) is a vital vehicle for developing participant potential [2]. Basically, SSB success is not only reflected in the team's achievements, but also in the level of participant loyalty to the club [3]. In exploring the complex dynamics of loyalty in SSB, this study approaches the phenomenon through a multifaceted lens, considering crucial factors such as the training environment and coach leadership. In this ever-growing era, interest in sports, especially football, is not only reflected in the existence of professional level competitions [4]. On the other hand, public attention to the talent development stage is realized through the existence of the Football School [5]. SSB is a vital landscape in producing future players, not only as skilled athletes, but also as individuals who are dedicated and loyal to their long journey of self-development [6]. In this context, participant loyalty becomes a compelling and multifaceted dimension, involving complex dynamics shaped by factors of the training environment, trainer leadership, and participant satisfaction [7]. This research attempts to explore this complexity, uncovering layers in SSB dynamics that are often invisible to the naked eye. The training environment, often considered the foundation for athlete development, has an impact not only on participants' technical skills, but also on their psychological well-being [8]. Meanwhile, the key leadership role of the trainer as a guide, motivator, and authoritative figure opens up space for further understanding of how these interpersonal aspects play a role in shaping participant loyalty [9]. No less important, participant satisfaction is an element that cannot be ignored, considering its pervasive influence on the relationship between SSB and its participants [10]. As a study that explores this depth and complexity, this research does not simply examine these factors separately, but rather tries to reveal the complex and often mutually influencing links between them. Therefore, a detailed understanding of how an optimal practice environment and effective coach leadership correlates with levels of participant satisfaction, forms an integral foundation for our understanding of the multifaceted nature of loyalty in the context of SSB [11]. In this context, this research enters territory that goes beyond conventional studies, with the aim of opening new insights into the way these complex factors interact and how these interactions stimulate or dampen participant loyalty [12]. Thus, it is hoped that this research will not only contribute

## A Multifaceted Exploration of Loyalty in SSB: Links between Training Environment, Coach Leadership, and Participant Satisfaction

to academic understanding of SSB management, but also bring practical implications that can lead to the development of more effective strategies and programs to increase the level of participant loyalty in SSB. The focus of this research is to investigate the relationship between the training environment, coach leadership, and participant satisfaction as core elements that shape participant loyalty in SSB. It is hoped that the study of these three aspects can provide a more comprehensive understanding of the factors underlying individual loyalty in the context of basic football. This study has high urgency because participant loyalty not only influences the sustainability of SSB, but also plays an important role in the athletic development and character of participants. With a deep understanding of the factors that can strengthen or undermine loyalty, SSBs can improve the effectiveness of training programs and training management to achieve their long-term goals. Although there is previous research examining loyalty in a sports context, this study makes a significant contribution by broadening the scope of factors influencing participant loyalty in SSB. The novelty of this research lies in its multifaceted approach that combines aspects of the training environment, coach leadership, and participant satisfaction in one conceptual framework. The central question of this research involves the extent to which the training environment provided by SSB, trainer leadership, and participant satisfaction contribute to the level of participant loyalty. Therefore, this research aims to fill knowledge gaps and answer crucial problems in an effort to understand and increase participant loyalty at SSB.

### II. METODOLOGY

#### Participation

This research was conducted at SSB Pekanbaru, Riau, where SSB is a representation of the respondent population. The data presented describes the respondent profile based on several key parameters. Table 1 displays respondent data consisting of three main variables: gender, age and education. In terms of gender, 154 respondents (74.8%) were men, while 52 respondents (25.2%) were women. In terms of age, there are two main ranges, namely 13-15 years and 16-18 years. Of the total 206 respondents, 102 respondents (49.5%) were in the 13-15 year age group, while 104 respondents (50.5%) were 16-18 years old. In terms of education, the majority of respondents had studied Senior High School, including 123 people (59.7%), while 83 respondents (40.3%) came from Junior High School. This analysis provides a comprehensive picture of the composition of respondents, including differences in gender, age distribution and their education level. With this data, we can see diversity in the respondent population, which can provide a basis for further research. This information provides valuable insight into understanding the demographic characteristics of the groups involved in the research or survey.

**Table 1: Respondent Data Table**

	Frequency	Percent	Valid Percent	Cumulative Percent
<b>Gender</b>				
Man	154	74.8	74.8	74.8
Woman	52	25.2	25.2	100.0
Total	206	100.0	100.0	
<b>Age</b>				
13-15 Years	102	49.5	49.5	49.5
16-18 Years	104	50.5	50.5	100.0
Total	206	100.0	100.0	
<b>Education</b>				
Junior High School	83	40.3	40.3	40.3
Senior High School	123	59.7	59.7	100.0
Total	206	100.0	100.0	

#### Statistics Analysis

This research uses survey methods to explore the multifaceted loyalty of participants at Football Schools[13]. The survey method was chosen because it provides a systematic and measurable framework for exploring participants' perceptions regarding social dynamics, coach leadership, and family support in the SSB environment. The survey design was developed with careful consideration, arranging structured and semi-structured questions to obtain in-depth quantitative data. The sample was randomly selected from various SSBs, taking into account variations in social dynamics, coach leadership, and family support, with the inclusion criteria being active participants having at least one season of experience at an SSB. Researchers will use SPSS statistical software to analyze the data that has been collected. In this analysis First, Pearson Correlation is used to evaluate the

## A Multifaceted Exploration of Loyalty in SSB: Links between Training Environment, Coach Leadership, and Participant Satisfaction

extent to which there is a linear relationship between the main variables, namely Training Environment, Coach Leadership, and Participant Satisfaction. Significant correlation can provide an indication of the relationship between these variables [14]. Next, a Regression Analysis was conducted to understand the extent to which variability in Participant Loyalty could be explained by variability in Practice Environment, Coach Leadership, and Participant Satisfaction [15]. Regression models are used to identify the relative contribution of each variable to participant loyalty, providing an idea of how much influence each factor has. Then, ANOVA analysis is used to test the significance of the regression model [16]. This test helps in determining whether the overall regression model is significant in explaining variability in Participant Loyalty. In other words, does the combination of these factors together play an important role in influencing participant loyalty to the training program? Through this analysis, it is hoped that deeper insight can be found regarding the factors that most influence participant loyalty, so that it can provide a basis for improving and developing more effective and satisfying training programs.

### III. RESULTS AND DISCUSSION

#### RESULTS

**Table 2: Correlation Between Training Environment Variables, Coach Leadership, Participant Satisfaction, and Loyalty in SSB**

		Practice Environment	Coach Leadership	Participant Satisfaction	Loyalty
Practice Environment	Pearson Correlation	1	,524**	,494**	,531**
	Sig. (2-tailed)		,000	,000	,000
	N	206	206	206	206
Coach Leadership	Pearson Correlation	,524**	1	,595**	,565**
	Sig. (2-tailed)	,000		,000	,000
	N	206	206	206	206
Participant Satisfaction	Pearson Correlation	,494**	,595**	1	,793**
	Sig. (2-tailed)	,000	,000		,000
	N	206	206	206	206
Loyalty	Pearson Correlation	,531**	,565**	,793**	1
	Sig. (2-tailed)	,000	,000	,000	
	N	206	206	206	206

\*\* . Correlation is significant at the 0.01 level (2-tailed).

The results of the Pearson correlation analysis showed that there was a significant positive correlation ( $p < .01$ ) between the Training Environment and Coach Leadership, with a correlation coefficient of .524. This indicates that the quality of the training environment at SSB is positively related to the level of trainer leadership. Other findings revealed a positive correlation between Training Environment and Participant Satisfaction, with a correlation coefficient of .494 ( $p < .01$ ). This illustrates that SSB participants tend to feel satisfaction when the training environment is considered conducive. Furthermore, the results of the analysis show a significant correlation ( $p < .01$ ) between the Training Environment and Loyalty, with a correlation coefficient of .531. This indicates that the level of participant loyalty at SSB is positively correlated with the quality of the training environment provided. In the context of Coach Leadership, findings show a strong positive correlation ( $p < .01$ ) between Coach Leadership and Participant Satisfaction, with a correlation coefficient of .595. This confirms that the presence of effective trainer leadership contributes to the level of participant satisfaction in SSB. Furthermore, the results of the analysis also show a significant positive correlation ( $p < .01$ ) between Coach Leadership and Loyalty, with a correlation coefficient of .565. That is, participants led by effective coaches were more likely to show high levels of loyalty to SSB. The results of the correlation analysis also highlighted a very strong positive relationship ( $p < .01$ ) between Participant Satisfaction and Loyalty, with a Pearson correlation coefficient reaching .793. This indicates that participants who are satisfied with the training experience at SSB have a very high tendency to remain loyal to the program. Thus, these findings provide in-depth insight into the factors that play a role in shaping participant loyalty in SSB, involving the complexity of interactions between the Training Environment, Coach Leadership, and Participant Satisfaction. The implication is that SSB management can use this information to design more targeted strategies to improve participant experience and strengthen their loyalty to the training program.

## A Multifaceted Exploration of Loyalty in SSB: Links between Training Environment, Coach Leadership, and Participant Satisfaction

**Table 3: Summary of Regression Models for Training Environment Variables, Coach Leadership, and Participant Satisfaction as Predictors of Loyalty in SSB**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.812a	.659	.654	3.04820

a. Predictors: (Constant), Participant Satisfaction, Training Environment, Trainer Leadership

The results of the statistical model analysis show that the model used has a good level of fit with observational data. This model explains approximately 65.9% of the variation in participants' loyalty to School Football (SSB). This is reflected in the R Square value of 0.659, which indicates the extent to which variability in loyalty can be explained by variability in the Training Environment, Coach Leadership, and Participant Satisfaction. Furthermore, Adjusted R Square, which takes into account the number of predictors in the model, also shows good results at 0.654. This provides an indication that the model maintains a high level of fit without sacrificing the level of accuracy obtained by adding predictor variables. Additionally, the Standard Error of the Estimate of 3.04820 provides an estimate of the average deviation between the model predicted value and the actual observed value. The lower this value, the better the model can provide accurate estimates. Thus, the results of this statistical model analysis show that the Training Environment, Coach Leadership, and Participant Satisfaction have a significant relationship with participant Loyalty in SSB. This model makes a significant contribution in explaining the complexity of factors influencing participant loyalty and provides an empirical basis for a deeper understanding of these dynamics in the context of Football Schools.

**Table 4: Analysis of Variance (ANOVA) for Regression Model of Participant Loyalty in SSB**

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3634.840	3	1211.613	130,400	,000b
	Residual	1876,888	202	9,292		
	Total	5511.728	205			

a. Dependent Variable: Loyalty

b. Predictors: (Constant), Participant Satisfaction, Training Environment, Trainer Leadership

ANOVA results showed that the model significantly explained the variation in participants' Loyalty ( $F = 130.400$ ,  $p < .001$ ). Thus, it can be concluded that at least one of the predictor variables (Training Environment, Coach Leadership, or Participant Satisfaction) has a significant influence on participant Loyalty in SSB. Further explanation can be found in the details, where the Sum of Squares for Regression is 3634,840 and for Residual is 1876,888. This value reflects how much variation the model explains and how much variation the model cannot explain. This model as a whole achieved a significant F value, indicating that the predictor variables together contributed significantly to participant Loyalty. Thus, the results of the ANOVA analysis support previous findings that factors such as Training Environment, Coach Leadership, and Participant Satisfaction play a significant role in shaping participant Loyalty in SSB. By implication, these results provide a strong empirical basis for recommendations and strategy development within the Football School environment to increase the level of participant loyalty.

**Table 5: Regression Coefficients for Practice Environment Variables, Coach Leadership, and Participant Satisfaction as Predictors of Loyalty in SSB**

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1	(Constant)	1,585	2,424	,654	,514
	Practice Environment	,230	,073	,158	,002
	Coach Leadership	,071	,044	,088	,107
	Participant Satisfaction	,674	,054	,663	,000

a. Dependent Variable: Loyalty

The results of the analysis show that the Training Environment variable has an unstandardized coefficient of 0.230 ( $p = 0.002$ ), with a standardized coefficient of 0.158. This shows that a one unit change in the Training Environment correlates with a 0.230 unit increase in participant Loyalty, and this contribution is positive, although with a relatively low effect. Meanwhile, the Coach Leadership variable has an unstandardized coefficient of 0.071 ( $p = 0.107$ ), with a standardized coefficient of 0.088. Although it did not reach the required level of significance ( $p > 0.05$ ), the presence of a positive coefficient indicates that Coach Leadership

## **A Multifaceted Exploration of Loyalty in SSB: Links between Training Environment, Coach Leadership, and Participant Satisfaction**

makes a positive contribution to participant Loyalty, although the effect is limited. The Participant Satisfaction variable, with an unstandardized coefficient of 0.674 ( $p < 0.001$ ) and a standardized coefficient of 0.663, shows the most significant contribution in this research. These results confirm that a one unit increase in Participant Satisfaction is associated with a 0.674 unit increase in Participant Loyalty, with a very positive and significant contribution. In all, these findings imply that, in the context of SSB, the Training Environment and Participant Satisfaction may have a stronger role in shaping participant Loyalty than Coach Leadership. The implication is that SSB management can focus on improving the quality of the Training Environment and make maximum efforts to increase Participant Satisfaction in order to strengthen participant loyalty to the training program.

### **IV. DISCUSSION**

The results of this research reveal a number of significant findings related to the factors that influence participant loyalty at the Football School (SSB). Correlation analysis shows that there is a significant positive relationship between the quality of the Training Environment and the level of Coach Leadership, as well as between the Training Environment and Participant Satisfaction. In addition, the findings also illustrate a positive correlation between the Training Environment and the level of Participant Loyalty, indicating that the quality of a conducive training environment can increase participant loyalty towards SSB. Furthermore, the results of the analysis highlight the important role of Trainer Leadership in shaping Participant Satisfaction, with a strong positive correlation between the two factors. It was also found that participants led by effective coaches were more likely to show high levels of loyalty to SSB. This finding is strengthened by the very strong correlation between Participant Satisfaction and Participant Loyalty, confirming that participant satisfaction is a key element in forming and maintaining loyalty to the training program. The regression model suggested that the combination of the factors Training Environment, Coach Leadership, and Participant Satisfaction could explain approximately 65.9% of the variation in participant loyalty at SSB. From the regression coefficient, Participant Satisfaction was identified as the most significant variable in influencing participant loyalty, followed by Training Environment. Therefore, the implication is that SSB management should focus efforts on improving the quality of the Training Environment and pay maximum attention to increasing the level of participant satisfaction in order to strengthen participant loyalty to the training program.

### **V. CONCLUSIONS**

This research describes in detail the multifaceted nature of participant loyalty in School Soccer (SSB) by recognizing the significant link between the practice environment, coach leadership, and participant satisfaction. The conclusion of this research confirms that the Training Environment, Coach Leadership, and Participant Satisfaction have an integral role in forming participant loyalty at the Football School (SSB). The findings show a positive relationship between the quality of the Training Environment and Trainer Leadership, Participant Satisfaction, and Participant Loyalty. In particular, a conducive training environment can increase the level of participant loyalty towards SSB. Furthermore, the vital role of Coach Leadership was revealed in shaping Participant Satisfaction, and participants who were guided by effective coaches tended to show high levels of loyalty. The regression model showed that approximately 65.9% of the variation in participant loyalty could be explained by a combination of Training Environment, Trainer Leadership, and Participant Satisfaction factors. From the regression coefficients, Participant Satisfaction emerged as the most significant variable in influencing participant loyalty, followed by Training Environment. Therefore, the recommendation for SSB management is to focus on improving the quality of the Training Environment and make maximum efforts to increase participant satisfaction in order to strengthen participant loyalty to the training program. In the context of strategy and program development at SSB, a deep understanding of the complex interactions between Training Environment, Coach Leadership, and Participant Satisfaction is key. By detailing the contribution of each factor to participant loyalty, SSB management can take more targeted steps to create a supportive environment, strengthen trainer leadership, and improve the participant experience. The implication is that this research not only contributes to academic understanding of SSB management, but also provides a strong empirical basis for the development of strategies and programs that are more effective in increasing the level of participant loyalty in SSB.

### **VI. ACKNOWLEDGMENT**

The researcher would like to express sincere thanks to all parties who have contributed to making this research a success. First of all, the researcher would like to thank the research participants, namely the Football School (SSB) based in Pekanbaru, Riau, who have voluntarily participated in surveys, interviews and observations. Without their support and cooperation, this research would not have been possible. We would like to express our deepest thanks to the SSB management in Pekanbaru who have given permission and full support during the research process. The cooperation and positive response from all SSBs that ended

## A Multifaceted Exploration of Loyalty in SSB: Links between Training Environment, Coach Leadership, and Participant Satisfaction

in Pekanbaru was very significant for the smoothness and success of this research. All the support, collaboration and contributions provided by all parties are a strong foundation in formulating the findings and conclusions in this research. Hopefully the results of this research can make a positive contribution to the development of strategies and programs at Football Schools, as well as provide new insights in understanding the dynamics of participant loyalty.

### REFERENCES

- 1) J. Vaughan, C. J. Mallett, P. Potrac, C. Woods, M. O'Sullivan, and K. Davids, "Social and Cultural Constraints on Football Player Development in Stockholm: Influencing Skill, Learning, and Wellbeing," *Front. Sport. Act. Living*, vol. 4, no. May, pp. 1–18, 2022, doi: 10.3389/fspor.2022.832111.
- 2) P. F. Johansen and K. Green, "'It's alpha omega for succeeding and thriving': parents, children and sporting cultivation in Norway," *Sport. Educ. Soc.*, vol. 24, no. 4, pp. 427–440, 2019, doi: 10.1080/13573322.2017.1401991.
- 3) S. Kim, A. Morgan, and G. Assaker, "Examining the relationship between sport spectator motivation, involvement, and loyalty: a structural model in the context of Australian Rules football," *Sport Soc.*, vol. 24, no. 6, pp. 1006–1032, 2021, doi: 10.1080/17430437.2020.1720658.
- 4) C. Nolasco, "Player migration in Portuguese football: a game of exits and entrances," *Soccer Soc.*, vol. 20, no. 6, pp. 795–809, 2019, doi: 10.1080/14660970.2017.1419470.
- 5) C. T. Bjørndal and S. Gjesdal, "The role of sport school programmes in athlete development in Norwegian handball and football," *Eur. J. Sport Soc.*, vol. 0, no. 0, pp. 1–23, 2020, doi: 10.1080/16138171.2020.1792131.
- 6) G. Breivik, "What would a deep ecological sport look like? The example of Arne Naess," *J. Philos. Sport*, vol. 46, no. 1, pp. 63–81, 2019, doi: 10.1080/00948705.2019.1566003.
- 7) W. Chiu, R. T. Yin Hui, D. Won, and J. sup Bae, "Leader-member exchange and turnover intention among collegiate student-athletes: the mediating role of psychological empowerment and the moderating role of psychological contract breach in competitive team sport environments," *Eur. Sport Manag. Q.*, vol. 22, no. 4, pp. 609–635, 2022, doi: 10.1080/16184742.2020.1820548.
- 8) E. E. Madsen *et al.*, "Resilience as a protective factor for well-being and emotional stability in elite-level football players during the first wave of the COVID-19 pandemic," *Sci. Med. Footb.*, vol. 5, no. sup1, pp. 62–69, 2021, doi: 10.1080/24733938.2021.1959047.
- 9) M. Wang and D. Ho, "Making sense of teacher leadership in early childhood education in China," *Int. J. Leadersh. Educ.*, vol. 23, no. 3, pp. 300–314, 2020, doi: 10.1080/13603124.2018.1529821.
- 10) H. Collison and D. Marchesseault, "Finding the missing voices of Sport for Development and Peace (SDP): using a 'Participatory Social Interaction Research' methodology and anthropological perspectives within African developing countries," *Sport Soc.*, vol. 21, no. 2, pp. 226–242, 2018, doi: 10.1080/17430437.2016.1179732.
- 11) J. Tanskanen, L. Mäkelä, and R. Viitala, "Linking Managerial Coaching and Leader–Member Exchange on Work Engagement and Performance," *J. Happiness Stud.*, vol. 20, no. 4, pp. 1217–1240, 2019, doi: 10.1007/s10902-018-9996-9.
- 12) R. Musavengane, "Using the systemic-resilience thinking approach to enhance participatory collaborative management of natural resources in tribal communities: Toward inclusive land reform-led outdoor tourism," *J. Outdoor Recreat. Tour.*, vol. 25, no. August 2018, pp. 45–56, 2019, doi: 10.1016/j.jort.2018.12.002.
- 13) S. Kim, "The Process Model of Corporate Social Responsibility (CSR) Communication: CSR Communication and its Relationship with Consumers' CSR Knowledge, Trust, and Corporate Reputation Perception," *J. Bus. Ethics*, vol. 154, no. 4, pp. 1143–1159, 2019, doi: 10.1007/s10551-017-3433-6.
- 14) Y. Liu, Y. Mu, K. Chen, Y. Li, and J. Guo, "Daily Activity Feature Selection in Smart Homes Based on Pearson Correlation Coefficient," *Neural Process. Lett.*, vol. 51, no. 2, pp. 1771–1787, 2020, doi: 10.1007/s11063-019-10185-8.
- 15) Y. Yuan, M. Wang, Y. Zhu, X. Huang, and X. Xiong, "Urbanization's effects on the urban-rural income gap in China: A meta-regression analysis," *Land use policy*, vol. 99, no. August, p. 104995, 2020, doi: 10.1016/j.landusepol.2020.104995.
- 16) F. D. Guillén-Gámez and M. <sup>aj</sup> Mayorga-Fernández, "Quantitative-comparative research on digital competence in students, graduates and professors of faculty education: an analysis with ANOVA," *Educ. Inf. Technol.*, vol. 25, no. 5, pp. 4157–4174, 2020, doi: 10.1007/s10639-020-10160-0.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.



# The Influence of Employee Selection, Job Placement, Work Experience, Job Training, and Reward on Employee Work Productivity in the Trade Office West Nusa Tenggara Province



Isnawati<sup>1</sup>, St. Maryam<sup>2</sup>

<sup>1,2</sup>Faculty of Economics and Business, University of Mataram, West Nusa Tenggara Province, Indonesia

**ABSTRACT:** This research aims to determine the influence of employee selection, job placement, work experience, job training, and reward in increasing employee work productivity at the Trade Office of West Nusa Tenggara Province. This type of research is quantitative with multiple linear regression analysis methods, t-test, f-test, coefficient of determination test, and applying saturated sample methods, namely taking all 57 employees of the Trade Office of West Nusa Tenggara Province as samples. The data obtained came from interviews, questionnaires, books, and journals. This research found that the variables of employee selection, job placement, work experience, and job training were positively and significantly correlated with increasing work productivity. However, the reward variable did not significantly increase work productivity. Simultaneously, all variables have an impact on increasing work productivity. Meanwhile, testing the coefficient of determination shows that all independent variables can explain the work productivity variable by as much as 47%.

**KEYWORDS:** Selection, Placement, Experience, Training, Reward, Productivity

## I. INTRODUCTION

Workforce is one of the main components that cannot be ignored if you want to improve the capabilities of an organization or agency. The workforce in agencies is usually called employees. It is a valuable asset for an agency that must be developed to continue progressing and surviving in business development (Fransisca, 2016). An agency's success can not only be seen from adequate facilities but must also be supported by its employees' quality, abilities, and skills.

Productivity is an essential component that must be present if you want to operate an organization or agency. According to Stevenson in (Candra & Ojak, 2021), productivity is the ratio of resource use to the final result. The meaning of getting results is the condition of a person who works dynamically, where the quality of a person's work can change if influenced by things that can support his productivity. Meanwhile, according to Hasibuan in (Candra & Ojak, 2021), improvements in production techniques, work systems, materials, time, energy, and workforce skills can cause productivity to increase. So, if the employees have low productivity, the agency will have difficulty developing and competing. Therefore, agencies must have qualified, competent, and competitive employees to build and increase agency growth (Yulastri, 2018).

Work productivity is a condition where employees can create goods or services optimally in a short time (Yulastri, 2018). Different levels of employee work productivity are still a problem that needs to be analyzed in depth because by studying it, you can find out how to use employees in developing an agency. So, to increase employee work productivity, agencies need to consider several factors, such as employee selection, job placement, work experience, job training, and reward.

Selection is an activity carried out by an agency to search for and determine prospective employees who meet the criteria so that they have the right to be accepted to work at the agency (Kartawan et al., 2018). The success of the selection process can be seen in the employees who are born as having a high level of work productivity. Research conducted by (Denok, 2018; Siska & Jacky, 2018; Sudirman et al., 2023) found that selection positively and significantly correlates to increasing work productivity. However, based on research (Atmajati, 2017; Fatimah, 2019; Rinaldi & Alifah, 2022), selection did not significantly impact increasing work productivity.

Job placement is an activity carried out to place employees in positions based on the qualifications required by the agency (Atmajati, 2017). This job placement can increase work productivity because if employees are placed in positions that suit their capacity, their performance level will be more effective and efficient, and vice versa. This research aligns with the opinion

## **The Influence of Employee Selection, Job Placement, Work Experience, Job Training, and Reward on Employee Work Productivity in the Trade Office West Nusa Tenggara Province**

(Atmajati, 2017; Sudirman et al., 2023; Wisdalia, 2018) that job placement positively and significantly correlates to increasing work productivity. Meanwhile, opinions from (Hasbi, 2022; Pungky et al., 2017) found that job placement did not significantly impact increasing work productivity.

Work experience is a type of work that a person has been involved in to provide the opportunity to do a better job in the future (Imran, 2017). With work experience, it is hoped that employees can solve various problems and increase their work productivity. Research from (Ardika, 2014; Imran, 2017; Yulastri, 2018) found that work experience positively and significantly correlates to increasing work productivity. However, research from (Permana & Mansur, n.d.; H. Rizki, 2011) found that work experience did not significantly impact increasing work productivity.

Job training is an activity provided by agencies to foster knowledge, skills, and positive attitudes in their employees so that they can provide benefits to the agency's sustainability (Prabu & Daslan, 2017). Job training can increase work productivity because employees can hone their abilities by holding job training, making it easier to do their work. Research results from (Fransisca, 2016; Hasbi, 2022; Prabu & Daslan, 2017) found that job training positively and significantly correlates to increasing work productivity. However, research from (Pungky et al., 2017; M. Rizki, n.d.) found that job training did not significantly impact increasing work productivity.

Rewards are awards from agencies to employees to make employees more active in working (Ansory & Indrasari, 2018). These rewards can motivate employees to increase their work productivity further. Research results from (Ita et al., 2016; Lestari et al., 2021) found that reward positively and significantly correlates to increasing work productivity. However, this research is contradicted by (Feby et al., n.d.; Kurniawan et al., 2016; Pawastri et al., 2018), who found that rewards did not significantly impact increasing work productivity.

The Trade Office of West Nusa Tenggara Province is a government agency whose task is to assist provincial government affairs in trade and market management. Employees at the Trade Office of West Nusa Tenggara Province must have high work productivity to increase the quality of their service to the community and agencies. However, the results of interviews with the Head of the Licensing and Business Order Division stated that not all employees at the Trade Office of West Nusa Tenggara Province are skilled at work. They have different levels of ability to complete their work. Some employees complete their work quickly, precisely, and easily understand their tasks, while others are slow in completing their work.

After a selection process, the Trade Office of West Nusa Tenggara Province immediately places new employees in positions that match their educational background, skills, and abilities. Researchers found that all employees have work experience over different periods, so employees try to provide maximum quality work. However, in certain types of work, such as going into the field, employees experience some difficulties and, therefore, need guidance and direction from the agency.

In addition, based on the results of interviews with General Functional Performance Analysis Employees, it was stated that the Trade Office of West Nusa Tenggara Province rarely held internal training because it was constrained by cost. In fact, by having internal training, agencies can clearly understand what abilities and skills their employees need. She also said that the Trade Office of West Nusa Tenggara Province never gave rewards to employees who excelled, such as providing bonuses, even though giving rewards is essential to increase employee motivation and work enthusiasm.

Of the phenomena and differences found in the gap research, this research aims to determine the influence of employee selection, job placement, work experience, job training, and rewards on employee work productivity at the Trade Office of West Nusa Tenggara Province.

## **II. LITERATUR REVIEW**

### **A. Productivity**

Productivity is the ratio between employees' final results in their work and the sacrifices made, such as time, energy, and thoughts. According to J. Ravianto in (Sofyan, 2013), if an employee can produce more products than other employees simultaneously, that employee is considered productive. According to Husein in (Yulastri, 2018), productivity has two essential aspects: effectiveness and efficiency. The effectiveness aspect refers to optimal income or work income, and the efficiency aspect refers to how the work is carried out.

If an agency wants to achieve its goals, it must use its employees best. Because without employees, the agency will not be able to run smoothly. Employee work productivity indicates an agency's success and can be used as a benchmark for achieving its goals (Sofyan, 2013). Therefore, agencies must produce employees who have high productivity because then all assigned tasks can be carried out effectively and efficiently.

There are many activities agencies can carry out to increase employee work productivity, such as providing job training, creating a safe and comfortable environment, giving rewards to employees, etc. Meanwhile, according to Gomes in (Candra &

## **The Influence of Employee Selection, Job Placement, Work Experience, Job Training, and Reward on Employee Work Productivity in the Trade Office West Nusa Tenggara Province**

Ojak, 2021), skills, knowledge, ability, attitude, and behavior are components of increasing work productivity. According to (Sofyan, 2013), the elements that can increase work productivity are ability, wages, environmental conditions, motivation, level of education, attitude, work agreement, and technology implementation.

### **B. Employee Selection**

Selection is a series of recruitment processes to select prospective employees based on the agency's requirements. According to (Kadek & John, 2019), selection is an activity related to deciding which prospective employees are suitable for a predetermined job. This selection aims to assess the suitability of prospective employees who will carry out their duties for the agency's progress. It can be evaluated in terms of work experience, knowledge, level of education, and training attended.

In the selection process, interviewers must provide prospective employees with fair, equal, and consistent treatment (Rizeki & Soni, 2007). Apart from that, implementing employee selection must also be done objectively, honestly, carefully, and without discrimination. It aims to ensure that prospective accepted employees meet the required job requirements and make it easier to provide guidance, regulation, and development of employees (Suwarto & Muslya Siti, 2015).

According to Casteller in (Rizeki & Soni, 2007) explains that several factors cannot be ignored in employee selection activities, namely:

- 1) Collect and examine information about prospective employees to make decisions.
- 2) Provide assessments to prospective employees to determine their suitability.
- 3) Provide information to prospective employees about the agency so they can decide to work there.

It is essential to pay attention to these factors so that agencies are selective in selecting employees because this selection process is the first step in choosing productive employees.

H1 = There is relationship between employee selection (X1) with work productivity (Y)

### **C. Job Placement**

After going through the selection stage, the next step in the recruitment process is to place employees who have passed the selection in the positions required based on their qualifications, such as work experience, skills, knowledge, abilities, and the training or coaching they have attended (Nurul et al., 2019). When employees are placed in suitable positions based on their qualifications, this can make it easier for them to complete the work assigned to them and increase their productivity.

According to Safrizal in (Sudirman et al., 2023), several essential things must be considered in placing employees: academic achievement, physical and mental health, experience, age, and marital status because these things will significantly influence employee performance. Therefore, agencies should not be careless in placing employees in a position because it could have fatal consequences if they are not selective.

H2 = There is relationship between job placement (X2) with work productivity (Y)

### **D. Work Experience**

Work experience is a valuable indicator of a person's level of expertise in a particular field of work. Work experience is usually assessed by the period a person needs to pursue a lot of work (Ardika, 2014). This work experience is required for everyone and agencies that want to recruit new employees. Because employees with a lot of work experience are more agile and skilled in carrying out the work assigned to them, their productivity level is also high. That is also beneficial for the agency because employees who have work experience can complete their tasks on time. According to (Tiyan, 2017), work experience has several essential indicators, namely:

- 1) Years of service  
A person's experience can be determined by how long the person has worked.
- 2) Level of insight and skills  
The longer someone is in the world of work, the more their insight and skills in a field of work will increase.
- 3) Level of proficiency with work and equipment  
A person's level of proficiency in a job or in using equipment can be seen from the length of time that person has been involved in a particular field of work.
- 4) Field of work

Someone who has worked in more than one field will perform better.

H3 = There is relationship between work experience (X3) with work productivity (Y)

# The Influence of Employee Selection, Job Placement, Work Experience, Job Training, and Reward on Employee Work Productivity in the Trade Office West Nusa Tenggara Province

## E. Job Training

To improve the quality of the workforce, an agency must hold job training to increase the knowledge and develop the skills of its employees. Job training contributes to the progress and success of a company or agency (Kadek & John, 2019). Training is an activity that improves the quality of employee work quickly by improving mastery of skills and work implementation techniques (Melmambessy, 2011).

Job training aims to provide all employees with equal understanding to help accelerate the agency's growth, encourage the achievement of the agency's goals, and increase work commitment (Kadek & John, 2019). According to Moses in (Kadek & John, 2019), several stages need to be carried out when an agency wants to hold job training, namely:

- 1) Find out what abilities and skills employees need.
- 2) Determine the training goals and objectives to be achieved.
- 3) Determine benchmarks for success and training methods that will be used.
- 4) Conduct trials to implement and evaluate to correct errors that occur during training.

H4 = There is relationship between job training (X4) with work productivity (Y)

## F. Rewards

Employees are the primary key to the sustainability of the agency. Because employees enormously influence agency growth, if the agency wants to increase employees who are more productive at work, it can reward employees who complete their jobs well. Rewards are recognition agencies give to employees who have achievements in carrying out their work (Pawastri et al., 2018).

The reward can be given if employees perform work that exceeds the targets set by the agency and can complete their tasks well. By providing these rewards, employees have high motivation and want to be superior in carrying out their duties, which is expected to increase work productivity (Lestari et al., 2021). Other employees will also be motivated, so they will flock to complete their tasks as best as possible. According to Nawawi in (Winda et al., 2018), several factors can be used as benchmarks in implementing a reward system, namely:

- 1) Rewarding employees can be done by looking at the difficulty level of the work.
- 2) Every agency has competitors. Therefore, agencies can reward employees so they don't move to another agency.
- 3) Employees' contributions to improving the agency's progress can be used as reference material for giving rewards.
- 4) Administration, which contains aspects of agency budget planning, can also be used as a benchmark in determining reward-giving policies.

Agencies can provide rewards in various forms, such as bonuses, certificates, salary increases, holidays, job promotions, welfare benefits, and many more.

H5 = There is relationship between reward (X5) with work productivity (Y)

H6 = There is a simultaneous relationship between employee selection (X1), job placement (X2), work experience (X3), job training (X4), and reward (X5) with work productivity (Y)

## G. Thinking Framework

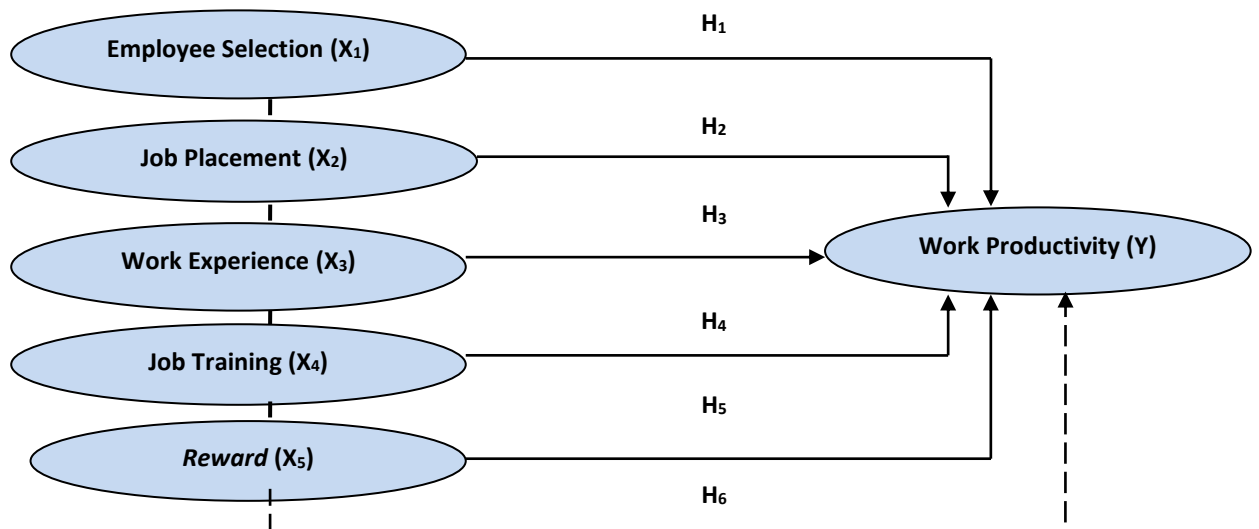


Figure 1. Thinking Framework

# The Influence of Employee Selection, Job Placement, Work Experience, Job Training, and Reward on Employee Work Productivity in the Trade Office West Nusa Tenggara Province

## III. RESEARCH METHODS

Quantitative research is a research design applied to this research, which is obtained through numbers and then analyzed into statistical data (Sugiyono, 2013). The population in this study was 57 employees, so all employees of the Trade Office of West Nusa Tenggara Province were sampled using a saturated sample because the population was relatively small (less than 100) (Sugiyono, 2013). Meanwhile, the data sources used are primary sources, such as conducting interviews and giving written questionnaires to employees, and secondary sources used as information reinforcement, such as taken from books and journals related to research. The analytical methods applied are multiple linear regression tests, t tests, f tests, and coefficient of determination tests with the help of the SPSS 22 program.

## IV. RESEARCH RESULT AND DISCUSSION

### A. Research Results

#### Multiple Linear Regression Test

Apart from estimating the value of the dependent variable if the value of the independent variable increases or decreases, this analysis also attempts to assess the relationship (positive or negative) between the independent variable and the dependent variable (Wibowo et al., n.d.).

**Table 1. Multiple linear regression test results**

Coefficients<sup>a</sup>

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1 (Constant)	3.612	3.323		1.087	.282
Employee Selection	.292	.095	.354	3.067	.003
Job Placement	.222	.109	.221	2.045	.046
Work Experience	.193	.087	.238	2.211	.032
Job Training	.267	.122	.228	2.185	.034
Reward	.001	.045	.002	.015	.988

a. Dependent Variable: Work Productivity

Source: SPSS Data Processing Results (2023)

The results of the multiple linear regression test can be seen with the following equation:

$$Y = 3,612 + 0,292 X1 + 0,222 X2 + 0,193 X3 + 0,267 X4 + 0,001 X5 + e$$

The meaning of this equation is:

- 1) The constant number 3,612 has the meaning that if the employee selection (X1), job placement (X2), work experience (X3), job training (X4), and reward (X5) variables have a value of 0, then work productivity will still have a value of 3,612.
- 2) If the variables of employee selection (0,292), job placement (0,222), work experience (0,193), job training (0,267), and reward (0,001) increase, then the productivity variables will also increase by the coefficient of each variable and all the independent variables have a positive relationship with the work productivity.

### Hypothesis Test

#### Partial test (t-test)

The t-test attempts to ascertain whether the independent variable has a single (partial) influence on the dependent variable on the regression coefficient used in the research (Wibowo et al., n.d.). The decision regarding the t-test is based on the calculated t count > t table or the significance number < 0,05, which means a partial relationship between the independent and dependent variables and vice versa.

In this research, to find out the influence of the independent variable partially on the dependent variable, it can be seen from Table 1 where the calculated t count for the variable employee selection, job placement, work experience, and job training are sequentially (3,067, 2,045, 2,211, 2,185) > t table 2,028 and the significance level sequentially are (0,003, 0,046, 0,032, 0,034) < 0,05. In this way, accepting Ha and rejecting H0 means these variables positively and significantly correlated with increasing work productivity. But the reward variable has a t count of 0,015 < t table 2,028 and a significance level of 0,988 > 0,05, so accepting H0 and rejecting Ha means that reward does not significantly influence increasing work productivity.

# The Influence of Employee Selection, Job Placement, Work Experience, Job Training, and Reward on Employee Work Productivity in the Trade Office West Nusa Tenggara Province

## Simultaneous test (f test)

The F-test is carried out to ascertain whether the independent variable can influence the dependent variable simultaneously. The decision regarding the f test is based on whether the calculated f count > f table or the significance number < 0,05 means that the variable simultaneously influences the dependent variable.

**Table 2. F test results**

**ANOVA<sup>a</sup>**

Model	Sum of Squares	Df	Mean Square	F	Sig.
1 Regression	125.116	5	25.023	11.115	.000 <sup>b</sup>
Residual	114.814	51	2.251		
Total	239.930	56			

a. Dependent Variable: Work Productivity

b. Predictors: (Constant), Reward, Job Placement, Job Training, Work Experience, Employee Selection

**Source:** SPSS Data Processing Results (2023)

Simultaneous data processing obtained a calculated f count of 11,115 > f table 2,47 and the significance number of 0,000 < 0,05, meaning that the variables were employee selection (X1), job placement (X2), work experience (X3), job training (X4), and reward (X5) has a simultaneous effect on increasing work productivity (Y).

## Analysis of the Coefficient of Determination

The coefficient of determination aims to determine the extent of participation of the independent variable (X) in the rise and fall of the dependent variable (Y) in the regression equation (Wibowo et al., n.d.).

**Table 3. Coefficient of determination test results**

**Model Summary**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.722 <sup>a</sup>	.521	.475	1.50042

a. Predictors: (Constant), Reward, Job Placement, Job Training, Work Experience, Employee Selection

**Source:** SPSS Data Processing Results (2023)

From processing the determination coefficient, the magnitude of the influence of the independent variable on the dependent variable can be seen from the Adjusted R Square, which is 0,475, which means that the variable of employee selection, job placement, work experience, job training, and reward are only able to explain the work productivity variable by 47%. In comparison, variables not considered in this analysis were influenced by 53%.

## B. Discussion

### The influence of employee selection on work productivity

From the partial test, it is stated that employee selection is positively and significantly correlated to increasing work productivity of the Trade Office West Nusa Tenggara Province employees as evidenced by the calculated t count 3,067 > t table 2,028 and the significance number 0,003 < 0,05, thus causing H1 to be accepted and H0 to be rejected.

This selection is essential because, through this section, the agency can find out the qualifications and shortcomings of prospective employees from several questions or written tests so that later, the agency will have a clear picture of which prospective employees are suitable to be accepted or rejected.

This research explains that employee selection has a good correlation with work productivity. Through the selection process, such as the interview stage, written test, and medical test, the agencies can see the background of prospective employees, such as education, work experience, health level, and what training and coaching they have attended, because all of this will influence the quality of the employee's work. Therefore, implementing a selection system is the first step in screening productive employees.

The finding of this research is strengthened by a study from (Denok, 2018; Siska & Jacky, 2018; Sudirman et al., 2023), which found that selection has a positive and significant correlation to increasing work productivity.

# **The Influence of Employee Selection, Job Placement, Work Experience, Job Training, and Reward on Employee Work Productivity in the Trade Office West Nusa Tenggara Province**

## **The influence of job placement on work productivity**

From the partial test, it is stated that job placement is positively and significantly correlated to increasing work productivity of the Trade Office West Nusa Tenggara Province employees as evidenced by the calculated t count 2,045 > t table 2,028 and the significance number 0,046 < 0,05, thus causing H2 to be accepted and H0 to be rejected.

This research explains that job placement has a good correlation with work productivity. Because if employees are placed in positions that match their skills, abilities, experience, knowledge, and training they have attended. It will make it easier for employees to complete their work on time and increase productivity. Based on the results of distributing questionnaires, most employees at the Trade Office West Nusa Tenggara Province were placed based on their qualifications so that they could carry out their work effectively and efficiently.

The finding of this research is strengthened by research from (Atmajati, 2017; Nurul et al., 2019; Sudirman et al., 2023; Wisdalia, 2018), which found that job placement has a positive and significant correlation to increasing work productivity.

## **The influence of work experience on work productivity**

From the partial test, it is stated that work experience is positively and significantly correlated to increasing work productivity of the Trade Office West Nusa Tenggara Province employees as evidenced by the calculated t count 2,211 > t table 2,028 and the significance number 0,032 < 0,05, thus causing H3 to be accepted and H0 to be rejected.

This research explains that work experience has a good correlation with work productivity. Because if employees have a lot of work experience, they will be more skilled and agile when working, so their work will feel more accessible, and their performance results will also be better. Based on the results of distributing questionnaires and interviews, all employees at the Trade Office West Nusa Tenggara Province have work experience over different periods, so they have good quality work, are agile in completing their work, can work together with a team or superiors and can reduce the level of errors in their work.

The findings of this research are strengthened by research from (Ardika, 2014; Imran, 2017; Octavianus et al., 2018; Yulastri, 2018), which found that work experience has a positive and significant correlation with increasing work productivity.

## **The influence of job training on work productivity**

From the partial test, it is stated that job training is positively and significantly correlated to increasing work productivity of the Trade Office West Nusa Tenggara Province employees as evidenced by the calculated t count 2,185 > t table 2,028 and the significance number 0,034 < 0,05, thus causing H4 to be accepted and H0 to be rejected.

The Trade Office West Nusa Tenggara Province rarely holds internal employee training because costs constrain it. However, the employees often participate in training provided by external parties in collaboration with the Trade Office West Nusa Tenggara Province. It aims solely to hone employee's abilities and skills regarding job procedures. The findings from this research explain that job training is closely related to work productivity because the more training activities employees participate in, the more honed their skills and abilities regarding work mechanisms will be, giving rise to good work productivity.

The finding of this research is strengthened by research from (Fransisca, 2016; Hasbi, 2022; Octavianus et al., 2018; Prabu & Daslan, 2017), which found that job training has a positive and significant correlation to increasing work productivity.

## **The influence of rewards on work productivity**

From the partial test, it is stated that rewards do not have a significant influence on the work productivity of the Trade Office West Nusa Tenggara Province employees, as evidenced by the calculated t count 0,015 < t table 2,028 and the significance number 0,988 > 0,05, thus causing H5 to be rejected and H0 to be accepted.

The Trade Office West Nusa Tenggara Province never rewards employees who excel in the form of bonuses, allowances, or incentives because government agencies are prohibited from doing this. However, the rewards often given are social rewards such as praise and recognition for success at work. However, employees feel this is normal, so their motivation is stagnant at work, and they cannot increase productivity.

The findings of this research are strengthened by research from (Feby et al., n.d.; Kurniawan et al., 2016; Pawastri et al., 2018), which found that reward did not correlate significantly with increasing work productivity.

## **V. CONCLUSIONS**

This research found that employee selection, job placement, work experience, and job training have a positive and significant effect on increasing the work productivity of the Trade Office West Nusa Tenggara Province employees. In contrast, the reward variable does not significantly increase the work productivity of the Trade Office West Nusa Tenggara Province employees. As for the Adjusted R Square value of all independent variables is 0,475, meaning employee selection, job placement, work experience,

## The Influence of Employee Selection, Job Placement, Work Experience, Job Training, and Reward on Employee Work Productivity in the Trade Office West Nusa Tenggara Province

job training, and reward can only influence work productivity by 47%. In comparison, variables not considered in this analysis are controlled 53%.

It is hoped that the results of this research can provide considerations for the Trade Office West Nusa Tenggara Province to conduct internal training so that it has clear targets regarding what abilities and skills are needed by its employees so that the output from the training can be more structured in helping to increase employee work productivity. Apart from that, the head of the Trade Office West Nusa Tenggara Province must also pay more attention to the reward system, which they feel is capable of increasing the work productivity of their employees. The researcher also suggests that further research uses other independent variables that might increase work productivity. That is because the independent variables used in this research have influenced work productivity by 47%.

### REFERENCES

- 1) Ansory, A. F., & Indrasari, M. (2018). *Manajemen Sumber Daya Manusia*. Indomedia Pustaka.
- 2) Ardika, S. (2014). Pengaruh Upah dan Pengalaman Kerja terhadap Produktivitas Karyawan Kerajinan Ukiran Kabupaten Subang. *Ekonomi Trikonomika*, 13, 91–100.
- 3) Atmajati, A. R. (2017). *Pengaruh Rekrutmen, Seleksi, dan Penempatan Tenaga Kerja Terhadap Produktivitas Kerja Karyawan Pada PT. Bank Papua Jayapura*. 5(September), 1–7.
- 4) Candra, W., & Ojak, M. (2021). *Produktivitas Kerja* (H. Rahmat (ed.)). KENCANA.
- 5) Denok, S. (2018). Pengaruh Rekrutmen, Seleksi dan Pelatihan Terhadap Produktivitas Kerja Karyawan. *KREATIF : Pemasaran, Sumberdaya Manusia Dan Keuangan*, 6(1), 14–31.
- 6) Fatimah. (2019). *Analisis Rekrutmen, Seleksi dan Penempatan Terhadap Produktivitas Kerja Karyawan PT. Wirasena Cipta Reswara*. Universitas Pembangunan Panca Budi Medan.
- 7) Feby, M. K., Tarmizi, G., & Tuwisna. (n.d.). Pengaruh Reward, Beban Kerja dan Pengalaman Kerja Terhadap Produktivitas Kerja Pegawai di Dinas Pendidikan dan Kebudayaan Kabupaten Aceh Besar. *Jurnal Ilmiah Manajemen Muhammadiyah Aceh (JIMMA)*, 9(1), 1–10.
- 8) Fransisca, R. (2016). Pengaruh Pelatihan Kerja dan Motivasi Kerja Terhadap Kinerja Karyawan pada PT Trias Sentosa, Krian Sidoarjo. *Agora*, 4, 259–264.
- 9) Hasbi, M. (2022). *Pengaruh Pelatihan Kerja, Penempatan Posisi Kerja Dan Etika Kerja Islam Terhadap Produktivitas Kerja Pegawai (Studi Pada Dinas Penanaman Modal Dan Pelayanan Terpadu Satu Pintu Provinsi Kalimantan Timur)* Rizki Sintia Putri. 2(1), 1–17.
- 10) Imran, U. (2017). Faktor-Faktor yang Mempengaruhi Produktivitas Tenaga Kerja Industri Kecil Kota Palopo. *Journal of Islamic Education Management*, 2(2).
- 11) Ita, S., Trias, S., & Abadi, S. (2016). Pengaruh Reward, Punishment dan Motivasi Kerja Terhadap Produktivitas Kerja Karyawan pada PTPN XII (Persero) Kebun Jatirone Kalibaru Banyuwangi. *Jurnal Manajemen Dan Bisnis Indonesia*, 2(1), 91–105.
- 12) Kadek, S. N., & John, F. (2019). *Manajemen Sumber Daya Manusia*. Nilacakra.
- 13) Kartawan, Lina, M., & Agus, S. (2018). *Manajemen Sumber Daya Insani*. LPPM Universitas Siliwangi.
- 14) Kurniawan, H., W, M. M., & Fathoni, A. (2016). Pengaruh Reward, Punishment, Beban Kerja dan Pelatihan Terhadap Produktivitas Kerja Karyawan (Studi Kasus pada Karyawan PT Andalan Arthalestari Semarang). *Journal of Management*, 2(2).
- 15) Lestari, A. R., Firdaus, M. A., & Rinda, R. T. (2021). Pengaruh Penghargaan dan Insentif Terhadap Produktivitas Kerja Karyawan. *Ilmu Manajemen*, 4(1), 28–33.
- 16) Melmambessy, M. (2011). Pengaruh Pendidikan dan Pelatihan Penjenjangan Terhadap Prestasi Kerja Pegawai pada Dinas Koperasi dan UKM Kota Jayapura. *Analisis Manajemen*, 5(2), 63–76.
- 17) Nurul, S. A., Darwin, L., Efendy, & Julyanthry. (2019). Pengaruh Rekrutmen dan Penempatan Terhadap Kinerja Pegawai pada Kantor Pelayanan Perbendaharaan Negara (KPPN) Pematangsiantar. *Manajemen*, 5, 77–88.
- 18) Octavianus, W. R., Manajemen, J., Sam, U., & Manado, R. (2018). Pengaruh Pengalaman Kerja Dan Pelatihan Kerja Terhadap Kinerja Karyawan Pt. Telkom Indonesia Cabang Manado the Influence of Work Experience and Job Training on Employee Performance of PT. Telkom Indonesia Manado Branch. *EMBA*, 6(3), 1758–1767.
- 19) Pawastri, N., Kustiah, E., Ekonomi, F., Islam, U., & Surakarta, B. (2018). *Pengaruh Pelatihan, Reward, dan Kepuasan Kerja terhadap Produktivitas Kerja Karyawan pada PT Kusumahadi Santosa Karanganyar*. 7(1), 73–81.
- 20) Permana, A. D., & Mansur, M. (n.d.). Pengaruh Pendidikan, Umur dan Pengalaman Kerja Terhadap Produktivitas



## The Influence of Employee Selection, Job Placement, Work Experience, Job Training, and Reward on Employee Work Productivity in the Trade Office West Nusa Tenggara Province

Karyawan pada PT. Anela KM 79 Kabupaten Lamongan. *E - Jurnal Riset Manajemen*, 108–122.

- 21) Prabu, D., & Daslan, S. (2017). Pengaruh Pendidikan dan Pelatihan Terhadap Produktivitas Kerja pada Kantor Cabang Dinas Pendidikan Kecamatan Kualuh Hulu Labuhan Batu Utara. *Jurnal Ecobisma*, 4(2), 64–76.
- 22) Pungky, S., Lisbeth, M., & Rita, N. T. (2017). Pengaruh Pelatihan Kerja dan Penempatan Kerja Terhadap Produktivitas Kerja Dinas Budaya Daerah Sulawesi Utara. *EMBA*, 5, 371–379.
- 23) Rinaldi, & Alifah, W. R. (2022). Pengaruh Rekrutmen, Seleksi dan Kemampuan Kerja Terhadap Produktivitas Kerja Karyawan PT. ASDP Indonesia Ferry Cabang Bakauheni. *Ekonomi Manajemen Dan Akuntansi*, 2, 35–52.
- 24) Rizeki, H., & Soni, A. N. (2007). Analisis Seleksi dan Penempatan Kerja Sosial di Pusat Kesejahteraan Sosial ( PUSKESOS ) Kota Badung. *Share: Social Work Journal*, 0042, 208–218. <https://doi.org/10.24198/share.v8i2.18396>
- 25) Rizki, H. (2011). *Pengaruh pengalaman kerja dan tingkat upah terhadap produktivitas pekerja di UD. Farley's Kota Mojokerto*. 1–17.
- 26) Rizki, M. (n.d.). *Pengaruh Pelatihan dan Pengembangan Karyawan Terhadap Produktivitas Karyawan (Studi pada PT. Medion Jaya Farma Mojokerto)*.
- 27) Siska, T. N. D., & Jacky, S. . S. (2018). Pengaruh Rekrutmen, Seleksi dan Penempatan Kerja Terhadap Produktivitas Kerja di PT. HM. Sampoerna. TBK. *EMBA*, 6, 4053–4062.
- 28) Sofyan, T. (2013). *Manajemen Sumber Daya Manusia* (M. Ahmad & N. A. Moh (eds.)). STAIN Jember Press.
- 29) Sudirman, A, B., & A, H. A. (2023). Pengaruh Seleksi dan Penempatan Karyawan dalam Meningkatkan Produktivitas Tenaga Kerja pada PT. Maju Cipta Perkasa Makassar. *Ekonomi, Manajemen, Bisnis Dan Akuntansi*, 2, 373–382.
- 30) Sugiyono. (2013). *Metode Penelitian Kuantitatif Kualitatif dan R&D*. ALFABETA.
- 31) Suwanto, & Muslya Siti. (2015). Pengaruh Seleksi dan Penempatan Pegawai Terhadap Produktivitas Kerja Pegawai di BMT Familier Kota Gajah Lampung Tengah. *DERIVATIF*, 9(1), 86–106.
- 32) Tiyon, U. H. (2017). *Pengaruh Pengalaman dan Pelatihan Kerja Terhadap Produktivitas Kerja Karyawan dalam Perspektif Ekonomi Islam (Studi pada Kain Perca Limbah Jaya Desa Sukamulya Kecamatan Banyumas Kabupaten Pringsewu)*. Universitas Islam Negeri Raden Intan Lampung.
- 33) Wibowo, D., Mulyono, S., Kusuma, J. W., Arofah, I., Ningsi, B. A., Saputra, E., & Purwasih, R. (n.d.). *Ekonometrika Dasar Teori dan Praktik Berbasis SPSS*.
- 34) Winda, S. A., Herman, S., & Susenohadi, P. (2018). Pengaruh Reward dan Punishment Terhadap Kinerja Karyawan. *Organisasi Dan Manajemen*, 1(1), 31–46.
- 35) Wisdalia, M. S. (2018). Pengaruh Rekrutmen dan Penempatan Kerja Terhadap Produktivitas Kerja Karyawan pada PT. Sindang Brothers Kota Lubuklinggau. *Economic, Business and Accounting (COSTING)*, 1, 241–253.
- 36) Yulastri, F. D. (2018). *Analisa Faktor-Faktor yang Mempengaruhi Produktivitas Tenaga Kerja (Studi Kasus di PT. Gresindo Minang Platation)*. SEKOLAH TINGGI TEKNOLOGI INDUSTRI (STTIND) PADANG.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Student Perceptions on the Implementation of Practical Subjects Learning Models Post Pandemi Covid- 19



Melly Arfiani<sup>1</sup>, Fatkurahman Arjuna<sup>2</sup>

<sup>1,2</sup>Department of Sport Science, Yogyakarta State University, Yogyakarta Indonesia

**ABSTRACT:** This research is based on the outbreak of the Covid 19 pandemic, where for its prevention, it applies the rules of keeping a distance from each other or face-to-face lectures are not possible and must be carried out online or using (Zoom). In addition, this situation makes the lecturer laborious to know which students can practice the movements that are indicators of learning in practical courses. This quantitative research used a descriptive approach. It aimed to determine the perceptions of Sports and Health Education Study Program students of FKIP Universitas Jambi on the application of learning models in practical courses during the Covid-19 pandemic. The research benefits include: 1) for the lecturers, it can be a consideration to use learning models during the Covid-19 pandemic, 2) How the students need to train themselves to practice indicators of movement skills that must be mastered in these practical courses. It was because in practice, carrying out practical activities was impossible. In collecting the data, this research used a questionnaire with a Likert scale and validity and reliability tests. Afterward, the data collected were analyzed descriptively by calculating percentages. The results showed that students' perceptions of implementing learning models and practice during the Covid-19 pandemic, 64.2% stated 'agree' 31.3% 'strongly agree', and the remaining 4.5% were 'unsure'. It concluded the students 'agree' with the application of the learning model using Zoom application in practical courses during the Covid-19 pandemic.

**KEYWORDS:** perception, learning models, practical courses, covid- 19 pandemic

### I. INTRODUCTION

After the discovery of the SARS-CoV-2 (Covid-19) virus resulted in a change in the pattern of whole activities in humans, including applied learning models at all education levels to prevent the spread of Covid-19. The SARS-CoV-2 or Covid-19 virus, which was initially found in cases in Wuhan City in central China at the end of 2019 and has now spread to all countries in the world and was declared a Covid-19 virus pandemic (Wenham et al., 2020), the Covid-19 virus was first detected in Indonesia at the beginning of March 2020. In Indonesia, the number of positive exposed cases of Covid-19 increased to 11,557, so a total of 869,600, 711,205 were cured, and 25,246 died. Meanwhile, the number of specimens studied today was 70,736, while 64,332 were observed. In Jambi, there were 3,858 positive Covid-19 cases, 2,862 recovered, and 64 people died.

After the emergence of the Covid-19 pandemic in various countries and to prevent further spread, the education system began to make changes in the teaching and learning process (Aisyah et al., 2020). The circular letter no.4 of 2020 from the Minister of Education and Culture suggested all activities in institutions of education must maintain distance, and all material delivery should be delivered online, (Mufid et al., 2020). Every educational institution is required to provide the latest innovations to form an effective and efficient learning process (Musriani & Mustamin, 2014). Based on the Minister's instructions, education experts concocted teaching and learning methods that were suitable for use during a pandemic, Universitas Jambi, as an educational institution in this case, has implemented the Minister of Education circular letter from the lectures at the initial of 2020/2021 until the lecturer at the end of 2020/2021 by making rules and lecture model programs using "e-learning, namely i-LMS UNJA, or media other based on video conferencing (Webex/Google Zoom/Cisco Team/U Meet Me Met/Microsoft) or Google Classroom, social media, (WhatsApp, Telegram) or email, or other models that are integrated and documented in Unja's Learning Management System (LMS) (Circular Letter Number 1/UN21/EP/2021).

Based on the above, the lecturers for Sports and Health Education Study Program of FKIP Universitas Jambi implemented a learning model using Zoom application for practical and theoretical courses. Courses that demand the achievement of indicators with theory are more flexible in explaining subject matter using the Zoom application. However, for courses that require the achievement of indicators in motor skills, it will be difficult to develop the subject matter because it must be accompanied by

## Student Perceptions on the Implementation of Practical Subjects Learning Models Post Pandemi Covid- 19

exemplifying movements or motor skills that must be mastered by students. Thus, students must also practice and repeat these movements to achieve motor skills in the course.

Assessment for the mastery of motor skills is also laborious to know because it does not allow practical tests. However, the teacher still makes efforts by asking students to describe the movement techniques that must be carried out to achieve the course indicators but does not guarantee that students who can tell are also able to carry out the movements that must be mastered based on indicators of course achievement. If viewed from the level of attendance of students participating in lectures during the 2020/2021 pandemic with the lecture method using the Zoom application in courses that require mastery of movement skills to achieve the indicators is very high.

Based on the search results of the research, many students got good grades and felt satisfied. However, after tracing, many students did not match the grades obtained with the skills they had for the course, the discrepancy referred to in this case was that students were unable to practice the skills that are indicators of learning in these courses, but the grades are good. Based on the above, the problem formulation in this research is: How are the perceptions of Sports and Health Education Study Program students of FKIP Universitas Jambi on the application of learning methods using Zoom application in practical courses during the Covid-19 pandemic?

The learning model has four characteristics that other learning methods do not have. According to (Damschroder et al., 2009), the four special characteristics are 1) the theoretical rationale that is logically arranged by educators, 2) the learning objectives to achieve, 3) the teaching steps needed to make the learning model run well, 4) the expected learning environment to achieve learning objectives. The learning model is a learning plan used to design the learning process. The content contained in the learning model is a teaching strategy used to achieve learning objectives (Freeman et al., 2014). The learning model applied during the teaching and learning process should be adapted to the desired learning objectives because the learning model used greatly influences the level of achievement of these learning, (Erduran et al., 2015; Murga-Menoyo, 2015; Stockwell et al., 2015). The achievement of cognitive learning indicators using the online method with Zoom application is precise, but the achievement of psychomotor indicators, of course, is very difficult for teachers and students (Alexiou & Schippers, 2018; Young et al., 2014).

The Sports and Health Education is one of the study programs of FKIP Universitas Jambi, which has several theoretical and practical courses. There are 21 practical courses or 63 credits (Semester Credit Units) spread registered in semesters one to five (Curriculum Sports and Health Education Study Program 2021). It means that there are 21 courses or 63 credits in which the achievement of indicators requires cognitive and psychomotor aspects in the sense that students must be able to explain (know) and carry out (practice) properly and correctly what are the indicators that must be achieved from learning outcomes in these practical courses.

The achievement of cognitive indicators in both practical and non-practical courses with learning models carried out during the Covid-19 pandemic will not make lecturers experience difficulties in conducting teaching methods. However, in achieving indicators of movement skills, they will feel them in applying models. The achievement of practical learning indicators in movement skills must be carried out repeatedly (Harbourne & Stergiou, 2009; Moulton et al., 2006). Without training, movement skills cannot be carried out properly, and finding out the learning outcomes about the skills that must be mastered will be very difficult because it does not allow conducting skills tests (practice) on these students, (Criss, 2013). For this reason, in practical courses that should be required cognitively and psychometrically (motor skills) in the end only requires cognitive ones. As a result, many students get good grades but are not confident to practice their movement skills.

The learning model used by lecturers in carrying out the teaching and learning process has a paramount role in achieving learning indicators, (Doménech-Betoret et al., 2017; Pekrun et al., 2017). To achieve indicators of cognitive learning (knowledge), teachers should apply different learning models to achieve motor learning indicators (movement skills). Online learning models with Zoom application also make teachers laborious to know whether students have mastered and been able to practice the movement skills as indicators in the course. It is because the practice tests are not allowed to do face to face for assessments. Meanwhile, the learning outcomes obtained by students are generally very good (grades A, A-, B+, B, and B-). When viewed from the grade, the student should be able to practice the movement skills as indicators in the course.

## METHODS

This research was quantitative research with a descriptive approach. This research aimed to determine the perceptions of sports and health education study program students of fkip universitas jambi on the application of learning models in practical courses during the covid-19 pandemic. The research was conducted at sports and health education study program of fkip universitas jambi, from june to august 2021. The research population was all the fifth-semester students from 4 (four) classes, a, b, c, and d, of the sports and health education study program of fkip universitas jambi. These students had contracted and passed various

## **Student Perceptions on the Implementation of Practical Subjects Learning Models Post Pandemi Covid- 19**

subjects in practical courses during the covid-19 pandemic. The research sample was all fifth and fourth-semester students that consisted of 134 students. In addition, the instrument used to collect data on student perceptions of sports and health education study program of fkip universitas jambi on the application of practical course learning methods during the covid-19 pandemic was a questionnaire with a likert scale.

### **RESULTS**

#### **1. The Data Description of Sports and Health Education Study Program Students' Perception of the Application of Learning Models during the Covid-19 Pandemic**

Based on the results of the analysis, the average perception of Covid-19 students was 59.82 out of 134 students, the median value was 60, the highest perception score based on the sample was 60, the standard deviation was 5.715 which showed the sample score was quite far from the average, the value indicating the difference between the highest and lowest total perception scores was 28 (range=28). The lowest overall score was 46, the highest overall score was 74, and the total score was 8016 out of 134 samples. The distribution of the data above also showed the distribution of the frequency of research results at intervals of 39-50 was six students (4.5%), at intervals of 51-62 was 86 students (64.2%), at intervals 63-75 was 42 students (31.3%) while in class intervals 15 -26 and 27 - 38 there were no students in it.

#### **2. The Data Description of the Participation of Sports and Health Education Study Program Students in Lectures**

Based on the results of data analysis, the average student participation in attending lectures was 11.81 out of 134 students, the median value of the sample was 12, and the student participation score that appeared the most was 12, the standard deviation was 1.638 which showed the sample score used close enough to the mean, the value indicating the difference between the highest and lowest total student enrollment scores was 15 and 5 (range=10), and the total score was 1582 out of 134 samples. The distribution of the data above is also in the distribution of the frequency distribution of research results 4 – 6 as one student (0.7%), at intervals 7 – 9 as many as five students (3.7%), at intervals 10 – 12 as many as 88 students (65.7%), in the interval 13-15 there were 40 (29.9%) while in 1-3, there were no students in it.

#### **3. The Data Description of Sports and Health Education Study Program Students' Attention on Lecturing**

Based on the results of data analysis, the average student attention to learning material in the application of practical learning models during the Covid-19 pandemic was 15.83 out of 134 students, the median value of the sample was 16, the student participation score appeared the most was 16, the standard deviation was 2.19 which showed that the sample score was quite close to the average, the value indicating the difference between the highest and lowest total student participation scores was 20 and 10 (range = 10), and the total score was 2121 out of 134 samples. The distribution of the data above was in the distribution of the frequency of research results in class intervals 10-12 with ten students (7.5%), in intervals 13-16 with 74 (55.2%), in 17-20 with 50 (37.3%) while in class intervals 4-6 and in class intervals 7-9 there were no students in it.

#### **4. The Data Description of Sports and Health Education Study Program Students on the Values Obtained**

Based on the results of data analysis, the average student perception of the value obtained in the application of practical learning models during the Covid 19 pandemic was 8.15 out of 134 students, the median value was 8, the student participation score appeared the most was 8, Standard deviation was 1.34 which showed that the sample score was quite close to the average, the value indicating the difference between the highest and lowest total student enrollment scores was 10 and 4 (range=6), and the total score was 1092 out of 134 samples. The distribution of the data above was also in the frequency distribution. The research results obtained values in class 3-4 interval range of 1 student (0.7%), in the 5-6 interval of 17 students (12.7%), in intervals 7-8 was 62 students (46.3%), in 9-10 was 54 students (40.3%) in class intervals 1-2 there were no students in it.

#### **5. The Data Description of Sports and Health Education Study Program Students on Skills Mastery in the Courses They Have Followed**

Based on the results of data analysis on student perceptions of the application of learning models in practical courses during the Covid 19 pandemic, the mastery of skills in the indicators of the subjects studied was an average of 24.04 out of 134 students, the median value of the sample was 25, the participation score of the most appeared was 25, the standard deviation was 3.6 which showed that the sample score was quite far from the average, the highest value indicating the difference between the total score of students' perceptions of skills mastery was 30, and the lowest was 15, (range=15) and the total score was 3221 out of 134 samples. The distribution of the data above was also in the distribution of the frequency distribution of the research results, which was in the 11-15 class range of 2 students (1.5%), 22 students (16.4%) in 16-20 intervals, 21-25 intervals as many as 64 students (47.8%), 26 – 30 intervals was 46 (34.3%), while in interval class 6 – 10, there were no students in it.

### DISCUSSION

#### 1. Perceptions of Sports and Health Education Study Program Students on the Application of Practical Courses Learning Models During the Covid-19 Pandemic

Based on the results of the research and calculations, the student's perceptions of the application of the practical courses learning model during the Covid-19 pandemic were 64.2% or 86 out of 134 students stated 'agree' with the application of the learning model using Zoom. Meanwhile, those who chose "strongly agree" were 31.3% or 42 students, and the remaining 4.5% were 'unsure' about implementing the practical learning model using Zoom application during the Covid-19 pandemic.

The research results above were based on discussions with students of the Sports and Health Education Study Program of FKIP Universitas Jambi, who have attended practical lectures and have passed practical courses. They said it was easier and more practical to attend lectures, but the problem was when using Zoom application because sometimes the signal was not good. This obstacle was generally felt by students who lived outside the city because, during the Covid-19 pandemic, almost all students were back to their villages. (Al-Rahmi et al., 2021), The results of a survey conducted among university students to evaluate the challenges they face in studying online during the COVID-19 pandemic, including signal constraints and the impact on out-of-town students. (Samaka et al., 2022), revealed that the problem of unstable internet connection or poor signal is the main obstacle for students who live outside the city. One of the factors found is the quality of the internet connection, which can be an obstacle for students studying from remote locations, (Jalilifar et al., 2021).

#### 2. Perceptions of Sports and Health Education Study Program Students on the Application of Practical Courses Learning Models during the Covid-19 Pandemic from Participation in Lectures

Based on the results of research on the application of the learning model using Zoom application in practical courses during the Covid-19 pandemic, 88 out of 134 students, or 65.7% stated "agree", 40 students, or 29.9% "strongly agree", remaining five students or 3.7% were "unsure" and only one or 0.7% of students had a perception that they disagreed with the application of the practical learning model using Zoom application during the Covid-19 pandemic.

The research results above were supported by the discussions with students of the Sports and Health Education Study Program of FKIP Universitas Jambi, who attended lectures in practical courses. They said it was easier to attend lectures because wherever they were, they could participate. Some even were while driving cars, riding motorbikes, in the garden, in shops or stalls, can join or participate. It was observed when many students were driving vehicles among the palm trees while shopping at the stalls around their homes when lecturing. (Naji et al., 2020), Through online lectures, students have greater access to courses. They do not need to face transportation constraints or travel costs to get to campus, thus helping to increase student participation and attendance. (Wasilik et al., 2020), Students can save on transportation and accommodation costs that are usually required for physical presence on campus. Thus, they have the opportunity to allocate those resources to other things that support the learning process, such as acquiring textbooks or additional learning resources. (Nguyen et al., 2020), The flexibility of online courses allows students to participate in other activities while attending lectures, such as shopping at stalls around the house. This can help maximize time and efficiency, and reduce the monotony of attending lectures continuously.

#### 3. Perceptions of Sports and Health Education Study Program Students on the Application of Practical Courses Learning Models during the Covid-19 Pandemic from Student Attention to Learning Materials.

Based on the results of research on student perceptions of the application of practical learning models seen from students' attention to lecture material, there were 10 out of 134 students, or 7.5% said they were unsure, 74 students, or 55.2%, said "agree", and 50 students or 37.3% who answered "strongly agree" with the implementation of the learning model using Zoom application in practical courses during the Covid-19 pandemic.

The results of the research above show that more than half, or 55% students pay attention to lecture material when attending lectures using the Zoom application. The results of this research were under the observations of lecturers who taught during the teaching and learning process using Zoom application where many students did not turn on their laptop or cellphone cameras while attending lectures because they did not want to be seen when they were doing other things that cause their attention not to be focused on the material lectures. However, some students attended lectures that had laptops or cellphone cameras on, but when monitored by lecturers those who did other things, such as watching television (TV), moving their bodies to show they were listening to music, and some were playing with his sister. Research by (Parker, 2021), explained that Zoom fatigue can reduce the focus and productivity of online meeting participants, due to visual distractions such as students not turning on the camera and doing other activities during lectures. (A. Ahmed & A. Bogdanovych, 2020), The study showed that when participants did not turn on the camera during online lectures, they tended to have lower engagement levels and found it more difficult to maintain focus on the lecture material. (Straumsheim, 2021), suggests that students who do not turn on their cameras during online lectures may affect their social interaction and engagement in the teaching and learning process.

## **Student Perceptions on the Implementation of Practical Subjects Learning Models Post Pandemi Covid- 19**

### **4. Perceptions of Sports and Health Education Students on the Application of Practical Courses Learning Models during the Covid-19 Pandemic from the Grades Obtained**

Based on the results of research on student perceptions of the application of practical learning models from the grades obtained by students after attending lectures, there were 1 out of 134 or 0.7% of students said "disagree", 17 or 12.7% of students said "unsure", 62 or 46.3% of students said "agree" and 54 or 40.3% of students said "strongly agree" with the application of the learning model using Zoom.

The research results indicated that the scores obtained by students were under their abilities where students stated "agree" with the scores they got and the second, most stated "strongly agree". Based on monitoring results with students, when asked about the grades they got, they said they had been based on their hopes. There were also no students who protested or asked the truth about the lecturer's way gave them grades. (Aristovnik et al., 2020), the results showed a negative impact of the COVID-19 pandemic on students' grades and academic performance. 94% responden dalam penelitian (Adnan & Anwar, 2020), mengatakan kesulitan dalam menyelesaikan tugas dan penelitian akademis mereka pada masa pandemi covid-19. (Dwivedi et al., 2020), The results revealed that the grades obtained by students during the COVID-19 pandemic were consistently below their abilities.

### **5. Perceptions of Sports and Health Education Study Program Students on the Application of Practical Courses Learning Models during the Covid-19 pandemic from Skills Mastery of Followed Course Indicators**

Based on the results of research on student perceptions of the application of practical learning models from skill mastery of followed course indicators that have been attended, there were 2 out of 134 or 1.5% of students who said they did not agree, 22 or 16.4% of students said doubtful, and 64 or 47.8% of students said "agree", while 46 or 34.3% of students stated, "strongly agree".

The results of the research above showed that students master the skills from the indicators of the courses they have followed. It can be seen from the number of students who said "agree" with the application of the practical learning model using the Zoom application was 64 out of 134, or 47.8%, and 46, or 34.3% of students stated, "strongly agree". It cannot be proven true because the test results to be converted to final grades were only taken from the written exam results or only looking at the cognitive aspects.

Based on the search results, students who passed the practical course (swimming), were asked whether their swimming scores were good, the student said good, then continued with the question whether they could swim the person in question gave an unconvincing answer because he only said little, so did other practical courses. (Buccola & Caviglione, 2021), Learning during the covid-19 pandemic is conducted online, which has limited accessibility and interaction between teachers and students. This can hinder optimal learning and reduce pure results. (Wang et al., 2020), The absence of direct teacher supervision in online learning can make students less likely to focus and be tempted by distractions around them. This can reduce the effectiveness of learning and affect the results obtained. (Maican et al., 2021), Online learning during the covid-19 pandemic requires electronic devices and a stable internet connection. Not all students have equal access to adequate devices and connections, hindering their ability to obtain genuine learning outcomes. (Doridot & Delhom, 2021), Online learning during the covid-19 pandemic also requires rapid adaptation from teachers and students. Many teachers are not used to teaching online and need to learn to use online learning platforms effectively. This can affect the quality of material delivery and learning outcomes.

### **6. Research benefits**

The difficulties of modifying practical courses for the post-pandemic environment. This piece also emphasizes how crucial it is to comprehend how students view these changes. The students' perspectives, opinions, and experiences are presented in this study, and they offer important insights into how they cope with these changes and react to the post-pandemic learning paradigm that has been introduced. This article may introduce different learning models that are applied in practical courses, like modern technology or virtual simulations. This method allows students to obtain real-world experience in various educational settings. This essay examines these problems to understand better and construct post-COVID-19 pandemic realistic learning models that are applicable in a shifting educational environment.

## **CONCLUSIONS**

Based on the results of the research and discussion, the perceptions of Sports and Health Education Study Program students of FKIP Universitas Jambi on the application of practical learning models during the Covid-19 pandemic, most students agreed with the application of the learning model using Zoom application, it was from 64.2% of students said "agree", 31,3% o students said "strongly agree", the remaining or 4.5% of students said "unsure". Student perceptions of the application of the learning model

## Student Perceptions on the Implementation of Practical Subjects Learning Models Post Pandemi Covid- 19

were from participation in learning, where 65.7% said "agree", 29.9% said "strongly agree", the remaining 3.7% said "unsure", and only 0.7% said, "disagree". Student perceptions were seen from students' attention to lecture material, where 55.2% said "agree", and 37.3% said "strongly agreed, the remaining 7.5% said they were "unsure". Student perceptions were from the grades obtained, 46.3% said "agree" and 40.3% said "strongly agree", while 12.7% said "unsure", and the remaining 0.7% said "disagree". Student perceptions were from the mastery of the skills from indicators of courses that had been followed where 47.8% said "agree" and 34.3% said "strongly agree", 16.4% said "unsure" and the remaining 1.5% said, "disagreed".

### REFERENCES

- 1) A. Ahmed, & A. Bogdanovych. (2020). Investigating the Impact of Camera Usage in Virtual Classroom on Students' Engagement and Cognitive Load. *IEEE Global Communications Conference (GLOBECOM Workshops)*, 21(1), 1–9. <https://doi.org/10.1109/GLOCOMW.2020.9343597>
- 2) Adnan, M., & Anwar, K. (2020). Online Learning amid the COVID-19 Pandemic: Students' Perspectives. *Journal of Pedagogical Societies and Education*, 21(1), 1–9.
- 3) Aisyah, D. N., Mayadewi, C. A., Diva, H., Kozlakidis, Z., Siswanto, & Adisasmito, W. (2020). A spatial-temporal description of the SARSCoV-2 infections in Indonesia during the first six months of outbreak. *PLoS ONE*, 15(12 December), 1–14. <https://doi.org/10.1371/journal.pone.0243703>
- 4) Al-Rahmi, A., Zeki, A. M., & Aldraiweesh, A. (2021). Challenges of Online Learning During the COVID-19 Pandemic: A Survey of University Students. *International Journal of Information and Education Technology*, 14(1), 1–13.
- 5) Alexiou, A., & Schippers, M. C. (2018). Digital game elements, user experience and learning: A conceptual framework. *Education and Information Technologies*, 23(6), 2545–2567. <https://doi.org/10.1007/s10639-018-9730-6>
- 6) Aristovnik, A., Keržič, D., Ravšelj, D., Tomaževič, N., & Umek, L. (2020). ticle Impacts of the COVID-19 Pandemic on Life of Higher Education Students: *Sustainability (Switzerland)*, 12(20), 1–34.
- 7) Buccola, V. B., & Caviglione, L. (2021). COVID-19 Pervasive Impact on Education: Challenges and Solutions for Distance Learning. *International Journal of Information and Learning Technology*, 14(1), 1–13.
- 8) Criss, M. J. (2013). School-based Telerehabilitation In Occupational Therapy: Using Telerehabilitation Technologies to Promote Improvements in Student Performance. *International Journal of Telerehabilitation*, 5(1), 39–46. <https://doi.org/10.5195/ijt.2013.6115>
- 9) Damschroder, L. J., Aron, D. C., Keith, R. E., Kirsh, S. R., Alexander, J. A., & Lowery, J. C. (2009). Fostering implementation of health services research findings into practice: A consolidated framework for advancing implementation science. *Implementation Science*, 4(1), 1–15. <https://doi.org/10.1186/1748-5908-4-50>
- 10) Doménech-Betoret, F., Abellán-Roselló, L., & Gómez-Artiga, A. (2017). Self-efficacy, satisfaction, and academic achievement: The mediator role of students' expectancy-value beliefs. *Frontiers in Psychology*, 8(JUL), 1–12. <https://doi.org/10.3389/fpsyg.2017.01193>
- 11) Doridot, F., & Delhom, I. (2021). Online Learning during the COVID-19 Pandemic: Lessons for the Future. *In Frontiers of Education*, 14(1), 1–13.
- 12) Dwivedi, Y. K., Hughes, L., Coombs, C., Constantiou, I., Duan, Y., Edwards, J. S., & Upadhyay, N. (2020). Impact of COVID-19 pandemic on information management research and practice: Transforming education, work and life. *File:///C:/Users/VERA/Downloads/ASKEP\_AGREGAT\_ANAK\_and\_REMAJA\_PRINT.Docx*, 21(1), 1–9.
- 13) Erduran, S., Ozdem, Y., & Park, J. Y. (2015). Research trends on argumentation in science education: a journal content analysis from 1998–2014. *International Journal of STEM Education*, 2(1), 1–12. <https://doi.org/10.1186/s40594-015-0020-1>
- 14) Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences of the United States of America*, 111(23), 8410–8415. <https://doi.org/10.1073/pnas.1319030111>
- 15) Harbourne, R. T., & Stergiou, N. (2009). Movement variability and the use of nonlinear tools: Principles to guide physical therapist practice. *Physical Therapy*, 89(3), 267–282. <https://doi.org/10.2522/ptj.20080130>
- 16) Jalilifar, A., Moghaddam, M. A., & Zarei, A. A. (2021). Factors Influencing Student Satisfaction and Performance in Online Learning Environments: A Structural Equation Modeling Approach. *Education and Information Technologies*, 14(1), 1–13.
- 17) Maican, M. I., Cocorada, E., Cornea, C. P., & Zamfir, A. M. (2021). From Traditional Teaching Methods to Online Learning Platforms: A Relevant Challenge Posed by the COVID-19 Pandemic. *International Journal of Information and Communication Technologies in Education*, 14(1), 1–13.

## Student Perceptions on the Implementation of Practical Subjects Learning Models Post Pandemi Covid- 19

- 18) Moulton, C.-A. E., Dubrowski, A., MacRae, H., Graham, B., Grober, E., & Reznick, R. (2006). Teaching Surgical Skills: What Kind of Practice Makes Perfect?: A Randomized, Controlled Trial. *Annals of Surgery*, 244(3).
- 19) Mufid, M. R., Basofi, A., Mawaddah, S., Khotimah, K., & Fuad, N. (2020). Risk diagnosis and mitigation system of covid-19 using expert system and web scraping. *IES 2020 - International Electronics Symposium: The Role of Autonomous and Intelligent Systems for Human Life and Comfort*, 577–583. <https://doi.org/10.1109/IES50839.2020.9231619>
- 20) Murga-Menoyo, M. A. (2015). Las Capacidades , Actitudes Y Valores Meta. *Foro de Educaciòn*, 13, 55–83. <https://doi.org/http://dx.doi.org/10.14516/fde.2015.013.019.004>
- 21) Musriani, A., & Mustamin, M. (2014). Improving the Learning Result of the Integer Number Operation Using Card Model. *Journal of Education and Learning (EduLearn)*, 8(1), 23–28. <https://doi.org/10.11591/edulearn.v8i1.202>
- 22) Naji, S., Abdulwahed, M., & Tawfik, A. (2020). Distance education during COVID-19: A case study of online teaching in a Saudi university. *International Journal of Educational Technology in Higher Education*, 21(1), 1–9. <https://doi.org/10.1186/s41239-020-00235-2>
- 23) Nguyen, T., Pham, L., & Nguyen, D. (2020). Barriers to online learning in higher education: A literature review. *The Journal of Continuing Higher Education*, 21(1), 1–9. <https://doi.org/10.1080/07377363.2020.1735147>
- 24) Parker, L. (2021). Zoom Fatigue: The Reason Zoom Meetings Drain Your Energy. *The Guardian*.
- 25) Pekrun, R., Lichtenfeld, S., Marsh, H. W., Murayama, K., & Goetz, T. (2017). Achievement Emotions and Academic Performance: Longitudinal Models of Reciprocal Effects. *Child Development*, 88(5), 1653–1670. <https://doi.org/10.1111/cdev.12704>
- 26) Samaka, S., Helmy, Y., & Khalil, S. (2022). The Impact of COVID-19 on Higher Education: Students' Perspectives on Remote Learning. *European Journal of Education Studies*, 33(1), 1–12.
- 27) Stockwell, B. R., Stockwell, M. S., Cennamo, M., & Jiang, E. (2015). Blended Learning Improves Science Education. *Cell*, 162(5), 933–936. <https://doi.org/10.1016/j.cell.2015.08.009>
- 28) Straumsheim, C. (2021). Zoom Fatigue or Future: Is It Time to Return to Campus? *Inside Higher Ed Yang*, 14(1), 1–13.
- 29) Wang, C., Chen, X., & Ackerman, R. (2020). Challenges and Opportunities for Online Learning during the COVID-19 Pandemic. *SAGE Open*, 21(1), 1–9. <https://doi.org/https://doi.org/10.1177/2158244020948481>
- 30) Wasilik, K., Wicaksana, I. G. A., & Iskandar, A. (2020). COVID-19 as an enabler of open education: A case study of online learning in response to a pandemic. *Association for Computing Machinery*, 21(1), 1–9. <https://doi.org/10.1145/3410344.3410365>
- 31) Wenham, C., Smith, J., & Morgan, R. (2020). COVID-19: the gendered impacts of the outbreak. *The Lancet*, 395(10227), 846–848. [https://doi.org/10.1016/S0140-6736\(20\)30526-2](https://doi.org/10.1016/S0140-6736(20)30526-2)
- 32) Young, J. Q., Van Merriënboer, J., Durning, S., & Ten Cate, O. (2014). Cognitive Load Theory: Implications for medical education: AMEE Guide No. 86. *Medical Teacher*, 36(5), 371–384. <https://doi.org/10.3109/0142159X.2014.889290>



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.



## Prediction Using SVM and DT



Dr T K Ganga<sup>1</sup>, Dr S Selvakani<sup>2</sup>, Mrs K Vasumathi<sup>3</sup>

<sup>1</sup>Associate Professor Muthurangam Government Arts College (A), Vellore

<sup>1,2</sup> Assistant Professor, Department of Computer Science, Government Arts and Science College, Arakkonam.

**ABSTRACT:** Diabetes is recognized as a severe and persistent illness that leads to an elevation in blood sugar levels. Untreated and undetected diabetes can give rise to numerous complications. The laborious process of identification typically involves a patient visiting a diagnostic centre and consulting with a doctor. However, the advancement of machine learning approaches has addressed this critical issue. The objective of this study is to develop a model capable of predicting the likelihood of diabetes in patients with the utmost accuracy.

To achieve this goal, three machine learning classification algorithms—Decision Tree, SVM, and Naive Bayes—are employed in this experiment to identify diabetes at an early stage. The experiments are conducted on the Pima Indians Diabetes Database (PIDD), sourced from the UCI machine learning repository. The performance of each algorithm is assessed using various metrics such as Precision, Accuracy, F-Measure, and Recall. Accuracy is gauged based on both correctly and incorrectly classified instances. The results indicate that Naive Bayes outperforms the other algorithms, achieving the highest accuracy of 76.30%. These findings are corroborated through a meticulous examination of Receiver Operating Characteristic (ROC) curves.

**KEYWORDS:** Decision Tree Algorithm, Machine Learning, Prediction, Diabetes, Pima Indians Diabetes Database

### I. INTRODUCTION

Classification methodologies are widely employed within the medical domain to categorize data into distinct classes based on predefined criteria, particularly within the context of an individualized classifier. Diabetes, a malady characterized by the compromised ability of the body to produce the hormone insulin, results in an aberration of carbohydrate metabolism and an elevation in blood glucose levels. Individuals afflicted with diabetes typically experience heightened blood sugar levels, manifesting as increased thirst, augmented hunger, and frequent urination. Failure to address diabetes can lead to a multitude of complications, among which are severe conditions such as diabetic ketoacidosis and nonketotic hyperosmolar coma [1].

Diabetes is regarded as a significant and critical health concern characterized by an inability to regulate sugar levels. This condition is influenced by various factors, including height, weight, genetic predisposition, and insulin; however, sugar concentration is deemed the primary contributing factor. Early detection stands as the sole recourse to avert ensuing complications [2].

Numerous researchers are engaged in empirical investigations aimed at disease diagnosis, employing diverse classification algorithms rooted in machine learning methodologies such as J48, SVM, Naive Bayes, Decision Tree, and Decision Table. Empirical evidence substantiates the superior efficacy of machine-learning algorithms in disease diagnosis [1], [2], [6]. The amalgamation of Data Mining [5], [2], and Machine learning algorithms derives strength from their adeptness in handling extensive datasets, amalgamating information from diverse sources, and assimilating background knowledge into the study [8].

This research specifically delves into the realm of gestational diabetes among pregnant women. Within this investigation, the Naive Bayes, SVM, and Decision Tree machine learning classification algorithms are employed and scrutinized using the PIDD dataset to ascertain the predictive capability for diabetes in patients. The experimental performance of these three algorithms is meticulously compared across various metrics, resulting in commendable accuracy [7].

### II. RELATED WORK

Sajida et al. expound upon the efficacy of Adaboost and Bagging ensemble machine learning methodologies [18], utilizing the J48 decision tree as the foundational framework for classifying Diabetes Mellitus and distinguishing patients as either diabetic or non-

## Prediction Using SVM and DT

diabetic based on diabetes risk factors [20]. The experimental outcomes substantiate that the Adaboost machine learning ensemble technique outperforms both bagging and the J48 decision tree.

In a parallel vein, Orabi et al. [16] devised a system dedicated to diabetes prediction, with a primary focus on forecasting diabetes occurrences in individuals at specific ages. This innovative system, grounded in machine learning principles and driven by decision tree algorithms, demonstrates satisfactory results. The efficacy of the designed system in predicting diabetes incidents at precise ages is notably enhanced, achieving heightened accuracy through the utilization of Decision tree[12], [7].

Pradhan et al. [17], in their research endeavor, harnessed Genetic Programming (GP) for the training and testing of a database aimed at predicting diabetes. Utilizing a Diabetes dataset sourced from the UCI repository, the results obtained through Genetic Programming [5], [12] showcased optimal accuracy in comparison to other implemented techniques. The expeditious generation of classifiers also contributes to a notable improvement in accuracy, rendering this approach particularly useful for diabetes prediction at a reduced cost.

Rashid et al. [19] conceived a predictive model with dual sub-modules to forecast diabetes as a chronic disease. The initial module employs Artificial Neural Network (ANN), while the second module incorporates Fasting Blood Sugar (FBS). The discernment of diabetes symptoms in patient health is facilitated through the use of Decision Tree (DT)[10].

Nongyao et al. [12] executed an algorithm to assess the risk of diabetes mellitus, employing four distinguished machine learning classification methods: Decision Tree, Artificial Neural Networks, Logistic Regression, and Naive Bayes. To fortify the model's robustness, Bagging and Boosting techniques are implemented. Experimental results underscore that the Random Forest algorithm yields optimal outcomes among all the algorithms applied.

### III. DATA SET

The Pima Indian Diabetes Database stands as a renowned dataset widely employed in the intersection of machine learning and healthcare research. It serves as a valuable repository of information for the exploration and prediction of diabetes mellitus within the Pima Indian population, an indigenous community situated in Arizona, United States. This dataset has played a pivotal role in the development and assessment of various predictive models and algorithms geared towards identifying individuals at susceptibility to diabetes.

Originally curated by the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) during the 1980s, the Pima Indian Diabetes Database encompasses several variables. These include clinical, demographic, and diagnostic measurements obtained from 768 female Pima Indian individuals aged 21 and above. The variables encapsulate diverse parameters such as the number of pregnancies, glucose concentration, blood pressure, skinfold thickness, insulin levels, body mass index (BMI), and the diabetes pedigree function, among others. The dataset also incorporates a binary target variable signifying the presence or absence of diabetes within a five-year timeframe subsequent to the recorded measurements.

A salient advantage of the Pima Indian Diabetes Database lies in its real-world relevance. The dataset authentically mirrors the attributes of a specific population, offering nuanced insights into the prevalence and risk factors associated with diabetes within the Pima Indian community. This real-world applicability renders it an invaluable resource for the formulation and evaluation of predictive models in the realm of diabetes diagnosis and prevention.

Number of Instances: 768

Number of Attributes: 8 plus class

For Each Attribute: (all numeric-valued)

1. Number of times pregnant
2. Plasma glucose concentration a 2 hours in an oral glucose tolerance test
3. Diastolic blood pressure (mm Hg)
4. Triceps skin fold thickness (mm)
5. 2-Hour serum insulin (mu U/ml)
6. Body mass index (weight in kg/(height in m)<sup>2</sup>)
7. Diabetes pedigree function
8. Age (years)
9. Class variable (0 or 1)

## Prediction Using SVM and DT

Table I. Diabetes Prediction

Preg	Gluc o	BP	ST	Insu	BMI	Diabet	Ped Func	Age	Outcom e
0	6	148	72	35	0	33.6	0.627	50	1
1	1	85	66	29	0	26.6	0.351	31	0
2	8	183	64	0	0	23.3	0.672	32	1
3	1	89	66	23	94	28.1	0.167	21	0
4	0	137	40	35	168	43.1	2.288	33	1

**Data Pre-processing** - Among the crucial phases of data analysis, data preprocessing assumes paramount importance. Particularly, healthcare-related datasets often harbour missing values and other impurities that can compromise data efficacy. To enhance the quality and effectiveness derived from the mining process, meticulous data preprocessing is imperative. For the effective application of Machine Learning Techniques to the dataset, this procedural step becomes indispensable, ensuring accurate results and the success of predictive endeavors. In the context of the Pima Indian diabetes dataset, a twofold preprocessing approach is deemed necessary.

**Missing Values Removal** - The elimination of instances featuring zero (0) as their attribute value constitutes the initial step. The presence of zero as an attribute value is deemed implausible and, therefore, warrants elimination. This process extends beyond mere elimination, transforming the dataset into a more relevant and condensed feature subset through feature subset selection. Such an undertaking serves to reduce the dimensionality of the data, thereby facilitating expedited computational processes.

**Splitting of Data** - Following the cleansing of the data, it undergoes normalization to facilitate the training and testing of the model. The data is segregated into training and testing sets, allowing for the algorithm to be trained on the former while keeping the latter set aside for subsequent testing. The training process engenders the creation of a model based on logical algorithms and the values of features within the training dataset. The overarching objective of normalization is to standardize all attributes to a uniform scale.

**Apply Machine Learning** - With the prepared dataset, the application of Machine Learning Techniques ensues. Various classification and ensemble techniques are employed to predict diabetes within the Pima Indian dataset. The primary aim is to scrutinize the performance of these techniques, determine their accuracy, and discern the salient features pivotal in the prediction process.

## IV. METHODOLOGY USED

### A. Support Vector Machine

The Support Vector Machine (SVM) stands as an established paradigm within the realm of supervised machine learning models, specifically utilized for classification purposes. When presented with a two-class training sample, the primary objective of a support vector machine is to ascertain the optimal highest-margin separating hyperplane between the two classes [16]. To enhance generalization, it is imperative that the hyperplane is not in close proximity to data points belonging to the alternative class. The selection of the hyperplane necessitates its strategic placement at a considerable distance from data points in both categories. Those data points residing in close proximity to the margin of the classifier are identified as support vectors [12].

Recognized as a preeminent supervised machine learning algorithm, SVM is a favoured classification technique. Operating by creating a hyperplane to segregate two classes, SVM extends its utility to high-dimensional spaces by establishing a set of hyperplanes. This hyperplane can be applied for both classification and regression purposes, effectively discerning instances within specific classes and even classifying entities lacking direct support in the data. The separation is meticulously executed through a hyperplane, ensuring the demarcation to the closest training point of any class.

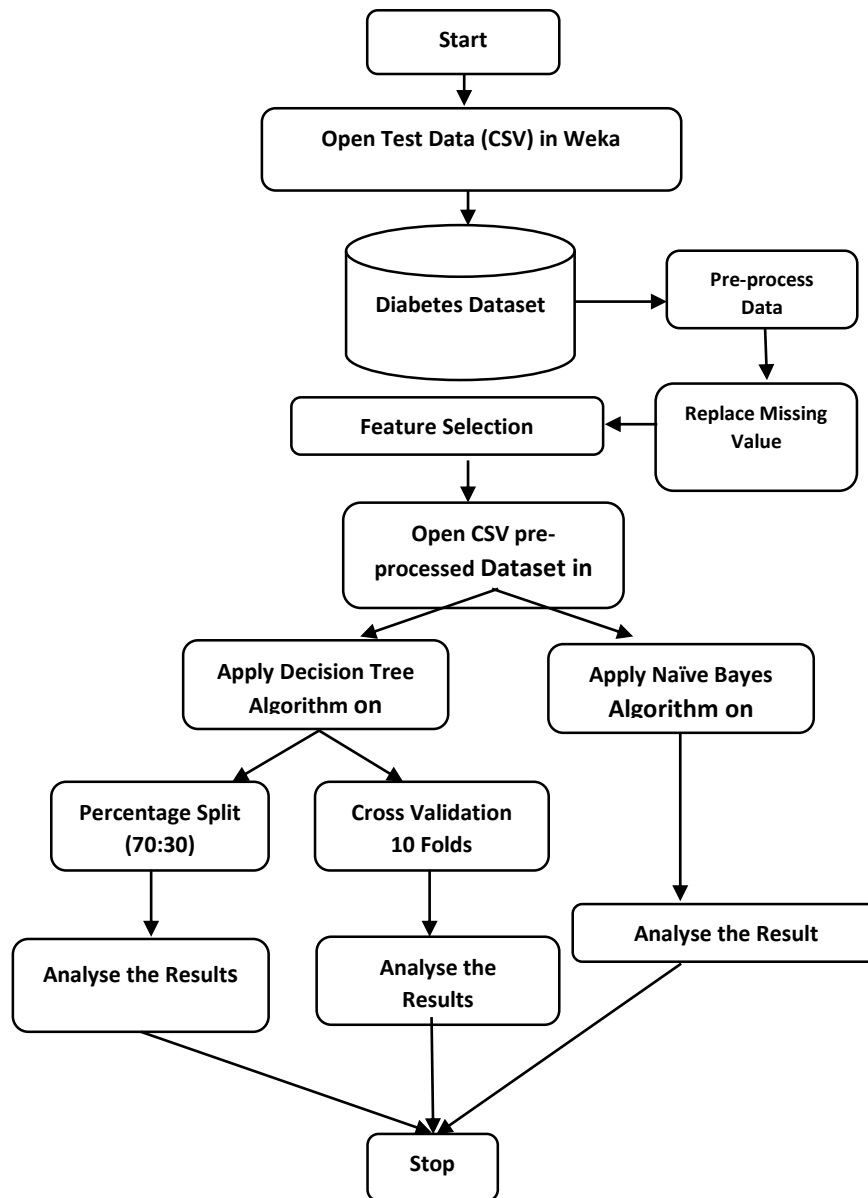


Figure 1. Prediction Flow Model

**B. Naïve Bayes Classifier**

Naive Bayes represents a classification methodology predicated on the premise that all features are mutually independent and unrelated. This paradigm asserts that the state or condition of a specific feature within a class holds no influence over the state of another feature. Leveraging conditional probability as its foundational principle, Naive Bayes is esteemed as a potent algorithm employed for classification endeavours. Notably, its efficacy is pronounced when dealing with datasets fraught with imbalanced distributions and instances of missing values.

**C. Decision Tree Classifier**

The Decision Tree stands as a supervised machine learning algorithm strategically applied to address classification challenges. Within the ambit of this research, the primary aim is to predict the target class by formulating decision rules derived from antecedent data. Decision Trees employ nodes and internodes to facilitate prediction and classification. The root nodes, equipped to handle instances with diverse features, can bifurcate into two or more branches, with the ultimate classification manifested in the leaf nodes. At each stage of decision-making, the Decision Tree selects nodes by evaluating the highest information gain among all the attributes [11].

**D. Model Evaluation Error Metrics**

The selection of an appropriate evaluation matrix for classification models is crucial in the construction of a robust model. In this study, the primary criterion for gauging the performance of each model is the accuracy of test predictions. However, it is imperative to note that other metrics, including the confusion matrix and Kappa, will also be taken into account. Table 3: shows the Confusion matrix

## Prediction Using SVM and DT

Table II. The Confusion Matrix.

	Ref:0	Ref:1
Pred: 0	True Negative	False Negative
Pred:1	False Positive	True Positive

The confusion matrix is delineated into four distinct sectors, each encapsulating distinct classification outcomes. True positive denotes the count of accurately predicted diabetes cases as diabetes. Conversely, false positive represents the tally of healthy cases inaccurately identified as diabetes. True negative signifies the instances where healthy cases are correctly identified as such. Finally, false negative characterizes the count of diabetes cases erroneously predicted as healthy.

- Accuracy: This is used to determine the amount of a particular class that is correctly predicted over the total number of sample. It can be calculated as  $\frac{TP+TN}{TP+TN+FP+FN}$
- Sensitivity: The ratio of the number of correctly predicted diabetes cases over the total number of the diabetes cases. It can be calculated as  $\frac{TP}{TP+FN}$
- Specificity: The ratio of the number of correctly predicted healthy cases over the total number of healthy cases. It can be calculated as  $\frac{TN}{FP+TN}$
- Positive predictive value: The ratio of the number of correctly predicted diabetes cases over the total number of cases predicted as diabetes. It can be calculated as  $\frac{TP}{TP+FP}$
- Negative predictive value: The ratio of the number of correctly predicted as healthy cases over the total number of the cases predicted as healthy. It can be calculated as  $\frac{TN}{TN+FN}$
- Prevalence: The total ratio of the number of diabetes cases.  $\frac{FN+TP}{TP+TN+FP+FN}$
- Detection Rate: The ratio of the number of correctly predicted as diabetes over the total number of cases.  $\frac{TP}{TP+TN+FP+FN}$
- Detection Prevalence: The ratio of the number of predicted as diabetes over the total number of cases.  $\frac{FP+TP}{TP+TN+FP+FN}$
- Balanced Accuracy: The average of the proportion corrects of each class individually.  $\left(\frac{TP}{TP+FN} + \frac{TN}{FP+FN}\right)/2$ .

## V. ALGORITHM

1. Employ recursive binary splitting to cultivate an expansive tree on the training dataset. Elect one of the inputs, denoted as  $X_j$  (where  $j \in 1, \dots, p$ ), along with a designated cut-point  $s$ . This selection partitions the input space into two distinct half-spaces, namely  $\{X : X_j < s\}$  and  $\{X : X_j > s\}$ . Iteratively execute the splitting process for each delineated region until a predetermined stopping criterion is met.
2. Implement cost complexity pruning on the enlarged tree to derive a series of optimal subtrees, contingent upon the parameter  $\alpha$ .
3. Utilize K-fold cross-validation to ascertain the optimal value for  $\alpha$ . This involves segmenting the training observations into K folds. For each  $k = 1, \dots, K$ :
  - (a) Replicate Steps 1 and 2 on all folds except the kth fold of the training data.
  - (b) Assess the error on the data within the omitted kth fold, while considering  $\alpha$  as a variable. The results are averaged for each value of  $\alpha$ , and the selection of  $\alpha$  is made to minimize the average error.
4. Conclude the process by returning the subtree derived from Step 2 that aligns with the chosen value of  $\alpha$ .

## VI. EXPERIMENTS AND RESULTS

### A. Checking Correlation

Upon the meticulous completion of data cleansing and pre-processing procedures, the dataset attains a state of preparedness suitable for both training and testing phases. Employing a dual strategy, we conducted K-fold cross-validation and employed an 85% train/test splitting methodology to assess the efficacy of various machine learning models.

## Prediction Using SVM and DT

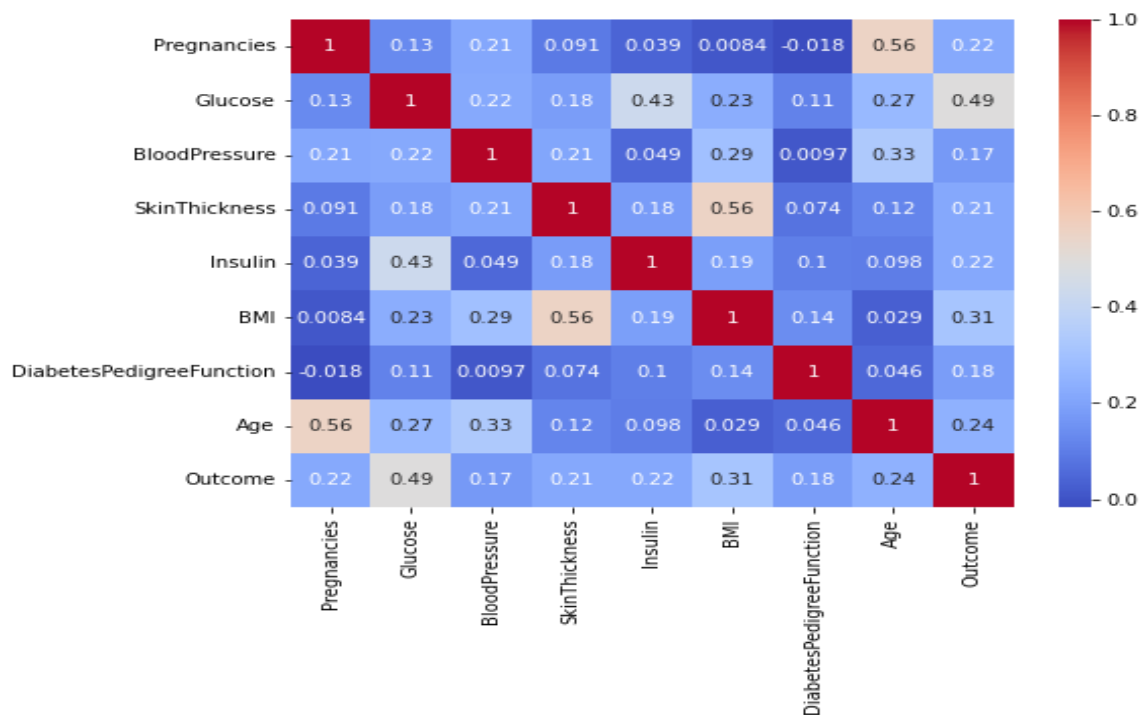


Figure 2. Correlation between Features

In the train/split paradigm, the dataset is bifurcated in a randomized fashion into training and testing subsets. Contrarily, in the K-fold cross-validation paradigm, the data is partitioned into K folds, with one fold exclusively allocated for validation/testing purposes, while the remaining K-1 folds are dedicated to training. This iterative process persists until each of the K folds has served as a distinct test set. The evaluation of performance is orchestrated through the derivation of the average from the compilation of all recorded scores pertaining to the Kth test.

### B. Sample Code

```

from sklearn.tree import DecisionTreeClassifier # Import Decision Tree Classifier
from sklearn.model_selection import train_test_split # Import train_test_split function
x_train, x_test, y_train, y_test = train_test_split(x, y, test_size=0.2, random_state=1)
# Create Decision Tree classifier object
model = DecisionTreeClassifier()
# Train Decision Tree Classifier
model = model.fit(x_train,y_train)
#Predict the response for test dataset
y_pred = model.predict(x_test)
#Evaluation using Accuracy score
from sklearn import metrics #Import scikit-learn metrics module for accuracy calculation
print("Accuracy:",metrics.accuracy_score(y_test, y_pred)*100)
Accuracy: 67.53246753246754
#Evaluation using Confusion matrix
from sklearn.metrics import confusion_matrix
confusion_matrix(y_test,y_pred)
array([[76, 23],
       [27, 28]])
print("Accuracy:",((82+27)/154))
Accuracy: 0.7077922077922078
#Evaluation using Classification report
from sklearn.metrics import classification_report
print(classification_report(y_test,y_pred))

```

## Prediction Using SVM and DT

Table III. Classification Report

	Precision	Recall	f1-score	Support
0	0.74	0.77	0.75	99
1	0.55	0.51	0.53	55
<b>Accuracy</b>			0.68	154
<b>macro avg</b>	0.64	0.64	0.64	154
<b>weighted avg</b>	0.67	0.68	0.67	154
	<b>Pred 0</b>	<b>Pred 1</b>		
<b>Act 0</b>	332	39		
<b>Act 1</b>	84	121		

```
#Import modules for Visualizing Decision trees
from sklearn.tree import export_graphviz
from sklearn.externals.six import StringIO
from IPython.display import Image
import pydotplus
features=x.columns
features
Index(['Pregnancies', 'Glucose', 'BloodPressure', 'SkinThickness', 'Insulin',
      'BMI', 'DiabetesPedigreeFunction', 'Age'],
      dtype='object')
dot_data = StringIO()
export_graphviz(model,out_file=dot_data,filled=True,rounded=True,special_characters=True,feature_names
features,class_names=['0','1'])
graph = pydotplus.graph_from_dot_data(dot_data.getvalue())
graph.write_png('diabetes_set.png')
Image(graph.create_png())
```

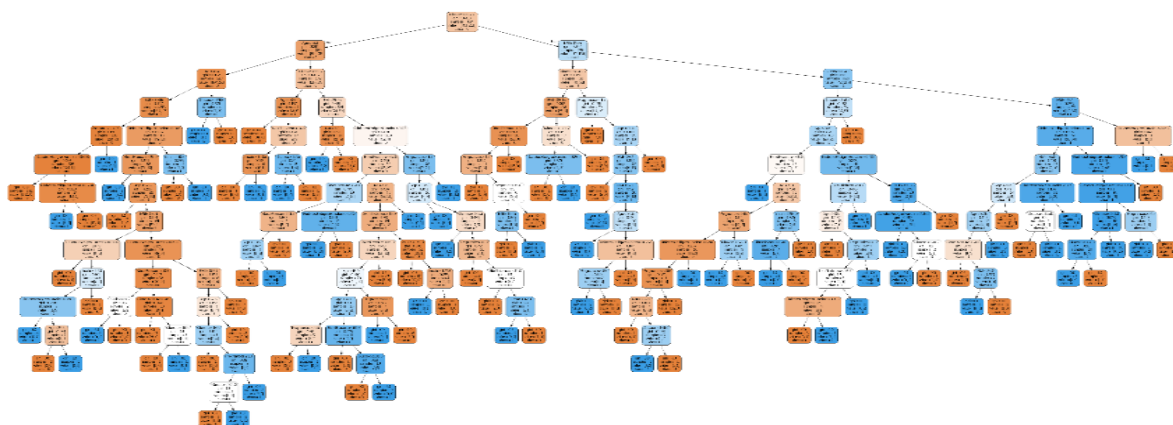


Figure 3. Decision Tree Classification for Max Depth

```
# Create Decision Tree classifier object
model = DecisionTreeClassifier(criterion="entropy", max_depth=3)

# Train Decision Tree Classifier
model = model.fit(x_train,y_train)

#Predict the response for test dataset
y_pred = model.predict(x_test)

# Model Accuracy
print("Accuracy:",metrics.accuracy_score(y_test, y_pred)*100)
```

## Prediction Using SVM and DT

Accuracy: 79.87012987012987

The classification rate increased to 79.87%, which is better accuracy than the previous model.

#Better Decision Tree Visualisation

```
from sklearn.externals.six import StringIO
```

```
from IPython.display import Image
```

```
from sklearn.tree import export_graphviz
```

```
import pydotplus
```

```
dot_data = StringIO()
```

```
export_graphviz(model,out_file=dot_data,filled=True, rounded=True,special_characters=True,
```

```
feature_names = features,class_names=['0','1'])
```

```
graph = pydotplus.graph_from_dot_data(dot_data.getvalue())
```

```
graph.write_png('diabetes_set.png')
```

```
Image(graph.create_png())
```

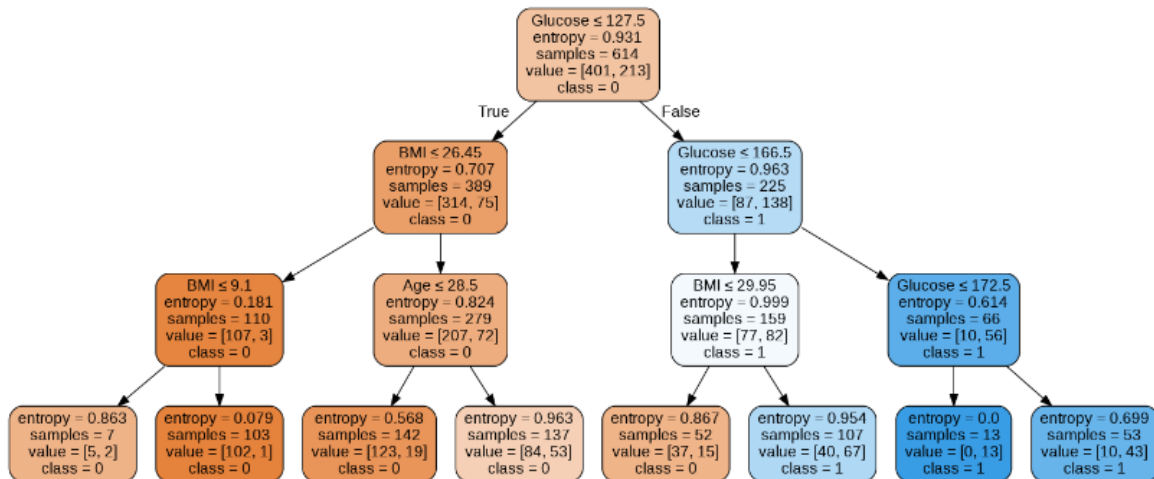


Figure 4. Decision Tree Classification for Max Depth 3

### C. Receiver Operating Characteristics

```
# Receiver Operating Characteristics
```

```
probs=log.predict_proba(x_train)[:,1]
```

```
fpr, tpr, threshold=metrics.roc_curve(y_train,probs )
```

```
plt.plot([0,1],[0,1],'k--')
```

```
plt.plot(fpr,tpr, label='logistic')
```

```
plt.xlabel('fpr')
```

```
plt.ylabel('tpr')
```

```
plt.show()
```

The Receiver Operating Characteristics (ROC) serves as an illustrative graphical representation, wherein sensitivity is juxtaposed against '1-specificity.' The Area Under the Curve (AUC), derived from the ROC curve, functions as a pivotal metric for assessing the efficacy of classifiers [45]. The AUC, a scalar ranging between '0' and '1,' encapsulates the discriminative power of the classifier as shown in the figure 5.



## Prediction Using SVM and DT

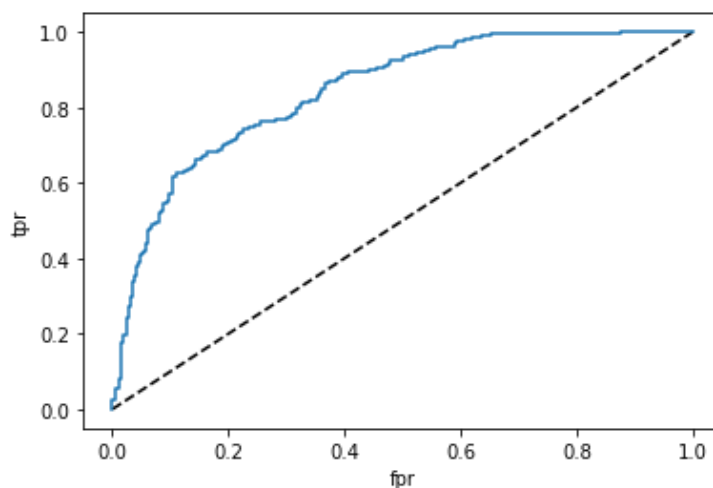


Figure 5. Roc Curve

Derived from the acquired results, we have demonstrated not only the heightened accuracy attainable through the adept management of imbalanced datasets but also the superior precision achievable via judicious feature selection. Noteworthy in our findings is the discerning efficacy of the decision tree classifier algorithm, surpassing its counterparts in performance. This discernment holds particular promise for the healthcare industry, given the discerning attributes of the model. Its cost-effectiveness and temporal efficiency make it an appealing prospect, promising not only enhanced accuracy but also practical feasibility in real-world healthcare applications.

The efficacy of the proposed models, enriched with interaction terms, surpasses that of their counterparts devoid of such interactions. This heightened efficiency is attributed to the deliberate inclusion of interactions with pivotal risk factors influencing diabetes, namely, body mass index, and a familial predisposition to diabetes. The astute integration of these interaction terms elevates the models, rendering them more discerning in their predictive capacity.

The outcomes of this research proffer a promising avenue for the development of a program tailored to the judicious screening of prospective diabetes patients in the times ahead. Nonetheless, it is imperative to acknowledge that additional facets pertaining to physical activity, lifestyle considerations (such as the waist-to-height ratio), and meticulous dietary management (embracing control over protein, fat, and sugar intake) have emerged as salient risk factors for diabetes [19].

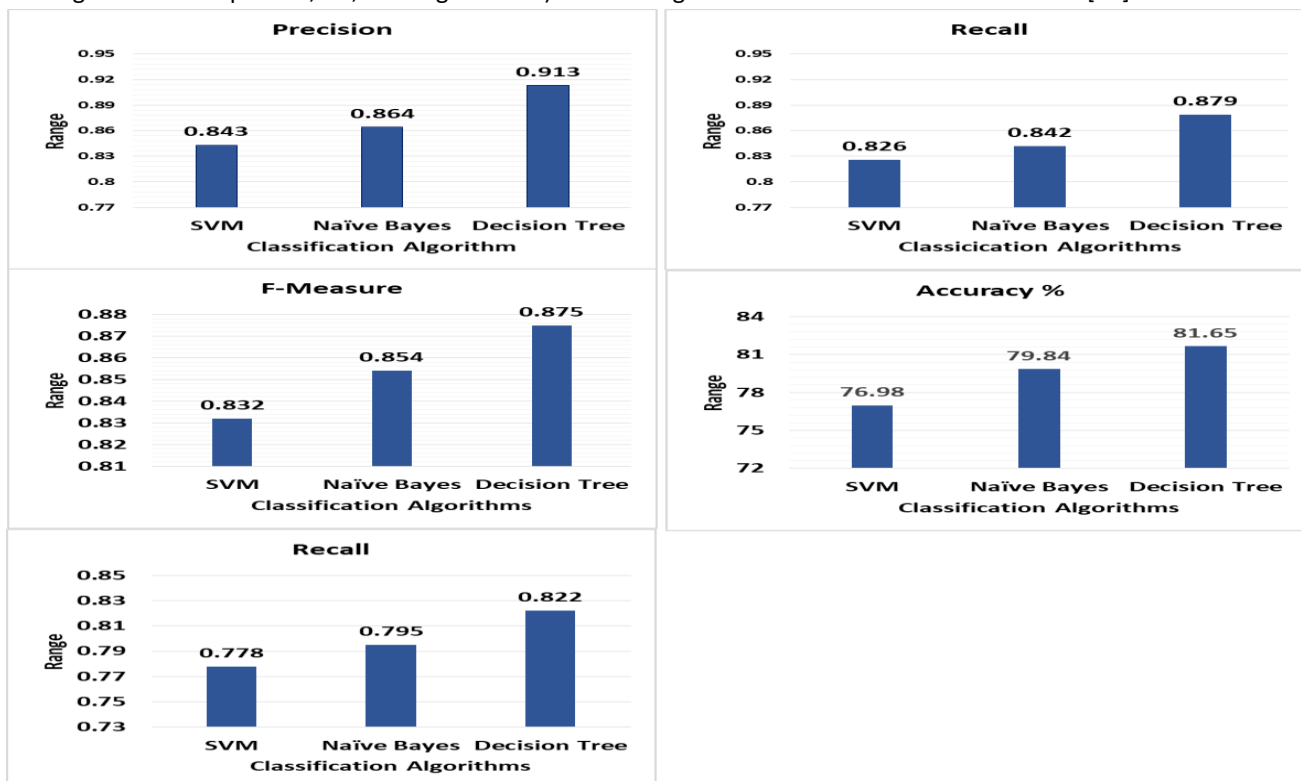


Figure 6. Error Metrics Interpretation

## Prediction Using SVM and DT

Furthermore, the nexus between certain metabolites and prediabetes/diabetes has been elucidated in extant literature [20]. Consequently, future investigations may find merit in incorporating these multifarious risk factors into the purview of consideration when crafting classification models for diabetes.

## VII. CONCLUSION

In a broader context, it is asserted that decision tree analysis stands as a predictive modelling tool with versatile applications across various domains. Employing an algorithmic approach, decision trees can be crafted to partition datasets in diverse ways contingent upon specific conditions.

Upon completion of the undertaken work, a definitive observation emerges: the augmentation of data allocated for training the model directly correlates with an improved accuracy estimate. In our specific case, optimal results are attained by bifurcating the data evenly, dedicating 50% for training the model and an equivalent 50% for testing, yielding an accuracy of 0.71.

Upon scrutinizing the developed diagnostic model, several advantages come to the fore: a rapid learning process, the formulation of rules in domains challenging for an expert to formalize, an intuitive classification model, elevated prediction accuracy comparable to alternative data analysis methods such as statistics and neural networks, and the construction of nonparametric models.

## REFERENCES

- 1) Aishwarya, R., Gayathri, P., Jaisankar, N., 2013. A Method for Classification Using Machine Learning Technique for Diabetes. *International Journal of Engineering and Technology (IJET)* 5, 2903–2908.
- 2) Aljumah, A.A., Ahamad, M.G., Siddiqui, M.K., 2013. Application of data mining: Diabetes health care in young and old patients. *Journal of King Saud University - Computer and Information Sciences* 25, 127–136.
- 3) Arora, R., Suman, 2012. Comparative Analysis of Classification Algorithms on Different Datasets using WEKA. *International Journal of Computer Applications* 54, 21–25.
- 4) Bamnote, M.P., G.R., 2014. Design of Classifier for Detection of Diabetes Mellitus Using Genetic Programming. *Advances in Intelligent Systems and Computing* 1, 763–770.
- 5) Choubey, D.K., Paul, S., Kumar, S., Kumar, S., 2017. Classification of Pima indian diabetes dataset using naive bayes with genetic algorithm as an attribute selection, in: *Communication and Computing Systems: Proceedings of the International Conference on Communication and Computing System (ICCCS 2016)*, pp. 451–455.
- 6) Dhomse Kanchan B., M.K.M., 2016. Study of Machine Learning Algorithms for Special Disease Prediction using Principal of Component Analysis, in: *2016 International Conference on Global Trends in Signal Processing, Information Computing and Communication*, IEEE. pp. 5–10.
- 7) Esposito, F., Malerba, D., Semeraro, G., Kay, J., 1997. A comparative analysis of methods for pruning decision trees. *IEEE Transactions on Pattern Analysis and Machine Intelligence* 19, 476–491.
- 8) Fatima, M., Pasha, M., 2017. Survey of Machine Learning Algorithms for Disease Diagnostic. *Journal of Intelligent Learning Systems and Applications* 09, 1–16.
- 9) Garner, S.R., 1995. Weka: The Waikato Environment for Knowledge Analysis, in: *Proceedings of the New Zealand computer science research students conference*, Citeseer. pp. 57–64.
- 10) Han, J., Rodriguez, J.C., Beheshti, M., 2008. Discovering decision tree based diabetes prediction model, in: *International Conference on Advanced Software Engineering and Its Applications*, Springer. pp. 99–109.
- 11) Kumar, D.A., Govindasamy, R., 2015. Performance and Evaluation of Classification Data Mining Techniques in Diabetes. *International Journal of Computer Science and Information Technologies*, 6, 1312–1319.
- 12) Kumar, P.S., Umatejaswi, V., 2017. Diagnosing Diabetes using Data Mining Techniques. *International Journal of Scientific and Research Publications* 7, 705–709.
- 13) Kumari, V.A., Chitra, R., 2013. Classification Of Diabetes Disease Using Support Vector Machine. *International Journal of Engineering Research and Applications (IJERA)* 1797–1801.
- 14) Nai-Arun, N., Mounghmai, R., 2015. Comparison of Classifiers for the Risk of Diabetes Prediction. *Procedia Computer Science* 69, 132–142.
- 15) Nai-Arun, N., Sittidech, P., 2014. Ensemble Learning Model for Diabetes Classification. *Advanced Materials Research* 931-932, 1427–1431.
- 16) Orabi, K.M., Kamal, Y.M., Rabah, T.M., 2016. Early Predictive System for Diabetes Mellitus Disease, in: *Industrial Conference on Data Mining*, Springer. pp. 420–427

## Prediction Using SVM and DT

- 17) Pradhan, P.M.A., Bamnote, G.R., Tribhuvan, V., Jadhav, K., Chabukswar, V., Dhobale, V., 2012. A Genetic Programming Approach for Detection of Diabetes. International Journal Of Computational Engineering Research 2, 91–94.
- 18) Sharief, A.A., Sheta, A., 2014. Developing a Mathematical Model to Detect Diabetes Using Multigene Genetic Programming. International Journal of Advanced Research in Artificial Intelligence (IJARAI) 3, 54–59.
- 19) Tarik A. Rashid, S. M.A., Abdullah, R.M., Abstract, 2016. An Intelligent Approach for Diabetes Classification, Prediction and Description. Advances in Intelligent Systems and Computing 424, 323–335.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Correlation between Macronutrient Intakes (Carbohydrate, Protein, Lipid) and Bone Mineral Density in the Elderly



Inria Astari Zahra<sup>1</sup>, Etisa Adi Murbawani<sup>2</sup>, Lusiana Batubara<sup>3</sup>

<sup>1</sup>Medical Faculty of Diponegoro University – Semarang, Indonesia

<sup>2</sup>Department of Clinical Nutrition, Medical Faculty of Diponegoro University – Semarang, Indonesia

<sup>3</sup>Department of Medical Biology and Biochemistry, Medical Faculty of Diponegoro University – Semarang, Indonesia

**ABSTRACT:** Osteoporosis is a systemic disease that occurs in bone and is characterized by reduced bone mass and simultaneous damage to bone structure. Osteoporosis commonly occurs in the elderly because of the hormonal mechanism that plays a huge role in bone density. Micronutrients such as calcium and vitamin D have long been recognized as important in maintaining bone structure. Meanwhile, the effect of macronutrient intake on bone density remains unclear. Only a few studies have analyzed the correlation between macronutrient intakes and bone mineral density (BMD) in the elderly. Moreover, the primary data regarding the correlation has not been found in Indonesia. This study analyzed the correlation between macronutrient intakes (carbohydrate, protein, and lipid) and BMD in the elderly. This research is an observational analytical study with a cross-sectional design. Thirty-eight elderly women who met the inclusion criteria underwent an interview with 3 x 24-hour food recall, SQ-FFQ, and examination of bone density using the DXA method. Bivariate analysis using Pearson and Spearman tests was then carried out. Carbohydrate intakes and BMD have a significant negative correlation ( $p=0.008$ ), while the correlations of both lipid and protein intake with BMD are insignificant ( $p>0.05$ ). There is a significant correlation between carbohydrate intake and BMD in the elderly. On the other hand, there is no significant correlation between protein and lipid intake with BMD in the elderly.

**KEYWORDS:** Osteoporosis, macronutrient intake, bone mineral density, elderly

### I. INTRODUCTION

Osteoporosis is a systemic bone disease characterized by decreased bone strength due to declining bone mass and bone damage simultaneously. Consequently, the bone becomes more fragile, thus increasing the risk of bone fracture.(1) *The World Health Organization (WHO) defined osteoporosis as a condition in which bone mineral density (BMD) has a t-score of less than -2.5.*(2)

The elderly, according to *Undang-Undang Republik Indonesia Nomor 13 Tahun 1998*, are people who have reached 60 years old and pose one of the risk factors for osteoporosis. This has become a concern since the total of elderly in Indonesia by 2012 reached 7.59%.(3) Furthermore, the Ministry of Health of the Republic of Indonesia had stated that by 2011, the cases of hip fracture in the elderly aged 60-99 years old had reached a total of 7.188.(4) According to the data from the National Health and Nutrition Examination Survey III (NHANES III), it has been reported that approximately 10 million American residents aged 50 years old and above suffer from osteoporosis while the other 33 million have low bone mass.(5)

Elderlies are more likely to suffer from osteoporosis because hormonal mechanisms significantly affect bone density.(6) Aside from age, the etiologies of osteoporosis are multifactorial. A study showed that macronutrient and micronutrient intakes were among the factors that could affect the occurrence of osteoporosis.(7)

Micronutrients such as calcium and vitamin D have long been recognized as important in maintaining bone structure. Around 100 mg of calcium daily is used for bone formation in the first 5-6 years of life and more than 400 mg in adolescence. In adulthood, calcium absorption decreases to 150 mg daily, reducing bone mass. A randomized controlled trial on 29 samples showed that calcium and vitamin D supplementations lowered the risk of bone fracture by 24%.(7,8)

Meanwhile, the effect of macronutrient intake on bone density remains unclear. A study stated that high-protein diet-induced bone damage results from excessive amino acid metabolism. The kidneys, especially in the elderly, cannot neutralize

## Correlation between Macronutrient Intakes (Carbohydrate, Protein, Lipid) and Bone Mineral Density in the Elderly

the excess acid level in the blood; therefore, the calcium from bone is excreted as a buffer.(9) Conversely, a recent study discovered a significant positive correlation between protein intake and bone density, particularly for preventing hip fractures in post-menopause women.(10) A 4-year cohort study also stated that the group with the lowest protein intake had the most vulnerable bones.(11)

A study assessing the correlation between polyunsaturated fatty acid (PUFA) and bone health in post-menopausal women stated that PUFA possessed a considerable advantage over long-chain n-3 PUFA within fish and seafood.(12) Whereas it was proven in another study on men and women aged 24-64 that low-fat consumption had no significant effect on bone health, so did low-carbohydrate consumption.(13) A distinct study also supported the theory by which the level of energy sufficiency was not considered an inhibition factor for osteoporosis.(14)

Only a few studies have analyzed the correlation between macronutrient intakes and bone mineral density (BMD) in the elderly. Moreover, the primary data regarding the correlation has not been found in Indonesia. Some of the studies also showed controversial results. Those matters encouraged this study to be done, aiming to analyze the correlation between macronutrient intakes and BMD in the elderly, particularly in the Semarang region.

## II. METHOD

This research was an analytical observational study with a cross-sectional design, in which the correlation between dependent and independent variables was measured momentarily. The targeted population was elders enrolled in the Semarang region's Elders Health Care, particularly Tegalsari, Mahoni, and Dewi Sartika. The inclusion criteria were: (1) Elderly women  $\geq 60$  years of age; (2) Able to communicate; (3) Willing to be enrolled in the study. The subjects were excluded if they: (1) Had received or are currently receiving long-term corticosteroid therapy; (2) Was a permanent recipient of calcium supplementation; and (3) Suffered from diabetes mellitus (DM). Those who met the eligibility criteria were then provided with informed consent.

Subjects were consecutively sampled, meaning the eligible subjects within the population were enrolled as study participants. Independent variables in this study were carbohydrate, protein, and lipid intakes. The dependent variable was bone mineral density (BMD), measured with DXA in  $\text{g/cm}^2$  unit and ratio scale. Carbohydrate intake refers to the percentage of carbohydrate adequate intake (carbohydrate AI) measured with 3 x 24-h food recalls and SQ-FFQ with % unit and ratio scale. This definition also applies to protein and lipid intake.

The retrieved data were processed with univariate analysis to determine the general characteristics of research subjects and bivariate analysis to examine the correlation between each macronutrient intake (carbohydrate, protein, and lipid) and bone mineral density (BMD) in the elderly. The data from both variables were numeric and less than 50 samples; therefore, the Shapiro-Wilk test was conducted to examine the normality. The data were considered normally distributed when a p-value  $>0.05$  was obtained. Pearson's test was performed on normally distributed data, while Spearman's test was performed on non-normally distributed data. Both variables were significantly associated if the obtained p-value  $< 0.05$ .

## III. RESULTS

A total of 38 subjects were recruited for the study with distribution and descriptive analysis, as shown in Table 1. Most research subjects are 60-65 years old (39.5%). The mean age of the research subjects is  $67.42 \pm 5.9$  years old.

Table 1. Subject characteristics based on age

Age (years)	N	Percentage (%)
60-65	15	39.5
66-70	14	36.9
71-75	4	10.5
76-80	4	10.5
81-85	1	2.6
<b>Total</b>	<b>38</b>	<b>100</b>
<b>Mean <math>67.42 \pm 5.9</math></b>		

Table 2 shows that most research subjects have normal BMI ( $18.5-25 \text{ kg/m}^2$ ) (55.3%). The average BMI of the subjects is  $25.21 \pm 4.6 \text{ kg/m}^2$ . According to Table 3, the BMD Lumbar variable has a mean value of  $0.89 \pm 0.1 \text{ g/cm}^2$  while the carbohydrate, protein, and lipid intake has a mean value of  $60.33 \pm 24.4 \%$ ,  $69.22 \pm 29.7 \%$ , and  $99.06 \pm 47.3 \%$  respectively.

## Correlation between Macronutrient Intakes (Carbohydrate, Protein, Lipid) and Bone Mineral Density in the Elderly

**Table 2. Subject characteristics based on Body Mass Index (BMI)**

Body Mass Index/BMI (kg/m <sup>2</sup> )	N	Percentage (%)
< 17	0	0
17 – 18.4	1	2.6
18.5 – 25	21	55.3
25.1 – 27	7	18.4
>27	9	23.6
<b>Total</b>	<b>38</b>	<b>100</b>
<b>Mean 25.21 ± 4.6</b>		

**Table 3. Descriptive analysis results from BMD Lumbar variable, carbohydrate intake, protein intake, and lipid intake**

	N	Min value	Max value	Mean± SD
BMD Lumbar (g/cm <sup>2</sup> )	38	0.63	1.25	0.89± 0.1
Carbohydrate intake (%)	38	23.94	111.83	60.33± 24.4
Protein intake (%)	38	23.52	142.84	69.22± 29.7
Lipid intake (%)	38	22.33	212.40	99.06± 47.3

**Table 4. The correlation between age, BMI, protein intake, carbohydrate intake, and lipid intake with BMD Lumbar**

	Correlation Coefficient	p-value
Age	-0.317 <sup>a</sup>	0.052
BMI	0.465 <sup>a</sup>	0.003*
Protein intake	-0.298 <sup>a</sup>	0.069
Carbohydrate intake	-0.422 <sup>b</sup>	0.008*
Lipid intake	-0.062 <sup>b</sup>	0.712

\*significant correlation applies if  $p < 0,05$

<sup>a</sup> Spearman correlation test

<sup>b</sup> Pearson correlation test

The correlation between age, BMI, and protein intake with BMD Lumbar was analyzed with the Spearman correlation test as the data were not normally distributed. In contrast, the correlation between carbohydrate and lipid intake with BMD Lumbar was analyzed with the Pearson correlation test.

It can be concluded from Table 4 that the correlation between age, protein intake, and lipid intake with BMD Lumbar is not statistically significant (p-value 0.052, 0.069, and 0.712, respectively). Nevertheless, a strong correlation between BMI and the Lumbar variable (p-value=0.003) is found. Moreover, a statistically significant negative correlation exists between carbohydrate intake and BMD Lumbar (p-value=0.008), meaning that higher carbohydrate intake leads to lower BMD value.

#### IV. DISCUSSION

Thirty-eight women with an average of 67.42±5.9 years of age were recruited for the study. Based on the results, there is no significant correlation between age and BMD. Nevertheless, the result showed that the average BMD of the subjects (0.89±0,1 g/cm<sup>2</sup>) was clinically classified as osteoporosis. The correlative coefficient between the two groups is negative, meaning that older ages tend to have lower BMD values. A study by Prihatini et al. (2010) showed that by age 55, the risk of osteoporosis among women multiplied up to five times.(15) This was also supported by the survey conducted by the Indonesia Department of Health, stating that the BMD value dropped to its lowest point at 65-75 years old.(4)

According to existing theory, one factor contributing to bone strength reduction was micro-damage/micro-crack, which increases in value along with age. The rise of osteocalcin in the elderly increases the occurrence of bone turnover. Moreover, elderlies are vulnerable to persistent secondary hyperparathyroidism due to calcium malabsorption in the intestines and diminished calcium reabsorption in the kidneys. These conditions also result in increased bone resorption and loss of bone mass. Decreased secretion of estrogen, GH, and IGF-1, along with physical inactivity, increase the vulnerability of the elderly to suffer from osteoporosis.(16)

The study indicates a significant correlation between BMI and BMD (p=0,003). The positive correlation coefficient means subjects with higher BMI will also have higher BMD values. This result was consistent with a study by Limbong et al. (2014) about the effect of body mass index on osteoporosis. It was stated that women with a BMI<18.5 were 2.99 times at greater risk than those with a BMI≥18.5.(17) Another study by Larijani et al. (2015) in Iran also provided significant evidence regarding the

## Correlation between Macronutrient Intakes (Carbohydrate, Protein, Lipid) and Bone Mineral Density in the Elderly

correlation between BMMI and BMD in women aged 10-75.(18)A theory suggests that a decrease in body mass can also indicate a decrease in bone mass. Body mass is composed of bone mass, muscle mass, and fat mass. The latter is considered a bone mass predictor due to the capability of fat tissue to stimulate bone formation (osteogenesis) by producing estrogen. Therefore, more fat tissue will enhance osteogenesis, subsequently lowering osteoporosis risk.(19)

This study also found that carbohydrate intake and BMD values are significantly correlated. The negative correlation coefficient means lower carbohydrate intake signifies a higher BMD value. This result aligned with Bazzano's study (2016) on women with low-carbohydrate diet intervention for 12 months, increasing BMD maintenance.(20) Another study by Bielohuby et al. (2015) indicated that a low-carbohydrate diet would stimulate the pituitary gland to secrete growth hormone (GH). Higher GH levels will promote osteoblast function, resulting in favorable bone remodeling.(21)A theory suggests that bone quality will decline alongside an increase in glucose levels. This is due to glucose's capability to accumulate fat tissue in the bone marrow and hamper osteoblast function. In its metabolism pathway, glucose molecules are phosphorylated, resulting in glucose-6-phosphate (G6P) molecules, which are later metabolized by the liver as fatty acid, glycogen, and ATP. Glycogen is a readily mobilized storage form of glucose in a limited amount, with only 100 g in the liver and 500 g in the muscle. Excessive carbohydrate consumption will be converted and reserved as fat tissue. Fat tissue possesses pro-inflammation cytokines such as interleukin-6 (IL-6) and tumor necrosis factor-alpha (TNF- $\alpha$ ), which induce osteoclast function and increase bone resorption.(22)The study result, however, was not in line with the initial hypothesis, which predicted a positive correlation between carbohydrate intake and BMD. This was because a study by Coleman et al. (2004) posed as the basis of the hypothesis, compared two groups of intervened subjects, one with a low-carbohydrate and high-protein diet and the other with a high-carbohydrate and low-fat diet. In contrast, this study solely analyzed the correlation between each macronutrient intake and BMD. The SQ-FFQ data showed that the average frequency of carbohydrate consumption among research subjects was 3.48 times a day, yet it covered only 60.33 % of the recommended daily intake. This result indicated that the research subjects did not yet fulfill the recommended daily intake, even if they consumed carbohydrates more than three times daily. Furthermore, subjects with 1.53 times daily carbohydrate consumption had a notable BMD value of 1.18 g/cm<sup>2</sup>. On the other hand, subjects with 6.07 times daily carbohydrate consumption had a lower BMD value, which was 0.809 g/cm<sup>2</sup>.Another finding in this study was the absence of a correlation between protein intake and BMD ( $p>0.005$ ). This was concordant with a study by Marjan et al. (2013) on elderly women aged 57-88 years old, which showed no significant correlation between protein adequacy and osteoporosis.(14) A study on adult women by Fauziah et al. (2015), in which the correlation between protein and bone density was insignificant, also supported this finding.(23) However, this result did not satisfy the initial hypothesis, which predicted the positive correlation between protein intake and BMD. This was because a study by Hanan et al. (2000), which posed as the basis of the hypothesis, was a 4-year cohort study with a total of 616 subjects. There was a striking difference in terms of duration and number of subjects.(11)A theory suggests that low protein intake will subsequently decrease the calcium absorption in the intestine and increase calcium resorption of the bone.(16) Another study stated that a high protein diet-induced bone damage results from excessive amino acid metabolism. The kidneys, especially in the elderly, cannot neutralize the excess acid level in the blood; therefore, the calcium from bone is excreted as a buffer.(9) The effect of protein intake on BMD was highly influenced by calcium level. However, this study did not consider the calcium level, so the mechanism could not be explained thoroughly.The last finding in this study was the insignificant correlation between lipid intake and BMD ( $p>0.005$ ). This result corresponded with another study by Brinkworth et al. (2016) on obese men and women aged 24-64, which provided evidence that low-fat and low-carb diets are not significantly correlated with bone health.(13) The average lipid adequacy intake among the subjects was 99.06  $\pm$  47.344 %. A theory suggests that high lipid intake will result in bone marrow adipose (BMA) expansion, a form of fat tissue in the bone. Fat tissue possesses pro-inflammation cytokines such as interleukin-6 (IL-6) and tumor necrosis factor-alpha (TNF- $\alpha$ ), which induce osteoclast function and increase bone resorption. Moreover, the adipocytes in fat tissue are lipotoxic to osteoblasts.(22)This finding also dissatisfied the initial hypothesis, which predicted a positive correlation between lipid intake and BMD. This was because a study by Longo et al. (2016) posed the basis of the hypothesis specified on the correlation between the intake of polyunsaturated fatty acid (PUFA) and bone health in post-menopausal women. In contrast, this study employed lipid intake in general.(12) Moreover, the level of pro-inflammation cytokines was ignored in this study; therefore, the lipotoxic effect of high lipid intake on bone could not be examined clearly.

## V. CONCLUSIONS

Based on this study, it can be concluded that there was a significant correlation ( $p=0.008$ ) between carbohydrate intake and BMD in the elderly. The correlation coefficient was negative, meaning lower carbohydrate intake signified a higher BMD value. It was also found that there was no significant correlation ( $p>0.005$ ) between protein and lipid intake with BMD in the elderly. For future research, the micronutrient intakes must also be measured to acquire more thorough data on the correlation between

## Correlation between Macronutrient Intakes (Carbohydrate, Protein, Lipid) and Bone Mineral Density in the Elderly

nutrient intake and BMD in the elderly. Furthermore, the recall bias can be minimized by providing daily meal notes before the interview.

### REFERENCES

- 1) NIH Consensus Statement. Osteoporosis Prevention, Diagnosis, and Therapy. Natl Institutes Heal. 2000;17(1):1–45.
- 2) World Health Organization. Scientific Group on The Assessment of Osteoporosis at Primary Health Care Level. WHO. 2004;May(May 2004):5–7.
- 3) Kementerian Kesehatan RI. Situasi dan Analisis Lanjut Usia. 2014. p. 8.
- 4) Kementerian Kesehatan RI. Data dan Kondisi Penyakit Osteoporosis di Indonesia. 2015. p. 2.
- 5) Wright NC, Looker AC, Saag KG, Curtis JR, Delzell ES, Randall S, et al. The recent prevalence of osteoporosis and low bone mass in the United States based on bone mineral density at the femoral neck or lumbar spine. *J Bone Miner Res.* 2014;29(11):2520–6.
- 6) Demontiero O, Vidal C, Duque G. Aging and bone loss: New insights for the clinician. *Ther Adv Musculoskelet Dis.* 2012;4(2):61–76.
- 7) Stránský M, Ryšavá L. Nutrition as Prevention and Treatment of Osteoporosis. *Physiol Res.* 2009;58:7–11.
- 8) Scholz-Ahrens KE, Schrezenmeir J. Nutrition and osteoporosis prevention. *Ernahrungs Umschau.* 2004;51(1).
- 9) Kerstetter JE. Dietary protein and bone : a new approach to an old question 1, 2. *Am J Clin Nutr.* 2009;145:1–2.
- 10) Surdykowski AK, Kenny AM, Insogna KL, Kerstetter JE. Optimizing bone health in older adults: The importance of dietary protein. *Aging health.* 2010;6(3):345–57.
- 11) Hannan MT, Tucker KL, Dawson-Hughes B, Cupples L a, Felson DT, Kiel DP. Effect of dietary protein on bone loss in elderly men and women: the Framingham Osteoporosis Study. *J Bone Miner Res.* 2000;15(12):2504–12.
- 12) Longo AB, Ward WE. PUFAs, Bone Mineral Density, and Fragility Fracture: Findings from Human Studies. *Adv Nutr An Int Rev J.* 2016;7(2):299–312.
- 13) Brinkworth GD, Wycherley TP, Noakes M, Buckley JD, Clifton PM. Long-term effects of a very low-carbohydrate weight-loss diet and an isocaloric low-fat diet on bone health in obese adults. *Nutrition.* Elsevier Inc.; 2016;32(9):1033–6.
- 14) Marjan AQ, Marliyati SA. Hubungan Antara Pola Konsumsi Pangan dan Aktivitas Fisik dengan Kejadian Osteoporosis pada Lansia di Panti Werdha Bogor. *Gizi Dan Pangan.* 2013;8(2):123–8.
- 15) Prihatini S, Mahirawati VK, Jahari AB, Sudiman H. Faktor Determinan Risiko Osteoporosis di Tiga Provinsi di Indonesia. *Media Litbang Kesehat.* 2010;XX(2):91–9.
- 16) Setyawati B, Julianti ED, Adha D. Faktor yang berhubungan dengan densitas mineral tulang... (Setyawati B, dkk). 2013;5(2):149–56.
- 17) Limbong EA, Syahrul F. Rasio Resiko Osteoporosis Menurut Indeks Massa Tubuh, Paritas, dan Konsumsi Kafein. *Fak Kesehat Masy Unair.* 2014;194–204.
- 18) Larijani B, Moayyeri A, Keshtkar AA, Hossein-nezhad A, Soltani A, Bahrami A, et al. Peak Bone Mass of Iranian Population : The Iranian Multicenter Osteoporosis Study. 2006;9(3).
- 19) Fatmah. Osteoporosis dan Faktor Risikonya pada Lansia Etnis Jawa. *Media Med Indosiana.* 2008;43(2):57–67.
- 20) Hu T, Zao L, Bazzano L. Effects of a 12-month Low-Carbohydrate Diet vs. a Low-Fat Diet on Bone Mineral Density: A Randomized Controlled Trial. *Faseb J.* 2016;30:1.
- 21) Bielohuby M, Sawitzky M, Stoehr BJM, Stock P, Menhofer D, Ebensing S, et al. Growth Hormone ( GH ) Resistance in Rats. 2015;152(May 2011):1948–60.
- 22) Tian L, Yu X. Fat, Sugar, and Bone Health: A Complex Relationship. 2017;
- 23) Fauziah LN, Fitrianti DY. Hubungan asupan protein, fosfor , dan kalsium dengan kepadatan tulang wanita dewasa awal. 2015;



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.



## Project Based Learning, Discovery Learning and Sports Models on Critical Thinking Ability Children Age 5-6 Years: Study Literature



Widya Sri Murti<sup>1</sup>, Nelva Rolina<sup>2</sup>, FransFile Manihuruk<sup>3</sup>, Maria Della Strada Dea Meylinda<sup>4</sup>

<sup>1,2</sup>Early Childhood Education Study Program, Faculty of Education and Psychology, Yogyakarta State University, Road Colombo No. 1, Karangmalang, Yogyakarta 55281, Indonesia.

<sup>3</sup>Sport Science Study Program, Yogyakarta State University. Road Colombo No. 1, Karangmalang, Yogyakarta 55281, Indonesia.

<sup>4</sup>Physical Education Study Program, Yogyakarta State University. Road Colombo No. 1, Karangmalang, Yogyakarta 55281, Indonesia

**ABSTRACT:** The project-based learning (PBL) model is a learning approach that emphasizes working on certain projects or tasks as a way to understand and apply knowledge. Discovery Learning is a learning approach that emphasizes student exploration and experimentation to build their own understanding. Sports in children aged 5-6 years not only provide physical benefits, but also contribute to the development of various cognitive skills, including critical thinking abilities. This type of research uses literature study. The database in this study with article criteria comes from Sinta. In this study, 3 articles were used as references for researchers to carry out reviews. Characteristics of the 3 articles, 1). Publications from the last 9 years, 2). The articles reviewed are related to the focus of this research. Then the procedure for searching for articles needed in this research is based on Google web: 1). Google scholar and 2). Google Chrome. The analysis of this research focuses on project based learning, discovery learning and sports models on the critical thinking abilities of children aged 5-6 years, project based learning, discovery learning. It was concluded that the project based learning, discovery learning and sports models affected the critical thinking abilities of children aged 5-6 years.

**KEYWORDS:** Project Based Learning Model, Discovery Learning, Sports, Critical Thinking, Children Aged 5-6 Years

### I. INTRODUCTION

The Indonesian government has regulated Early Childhood Education through Law no. 20 of 2003 concerning the National Education System. Article 1 paragraph 14 in the law defines Early Childhood Education as a coaching effort aimed at children from birth to 6 years of age (Nopriyanti, 2012) . This effort is carried out by providing educational stimuli to help children's physical and mental growth and development, so that children are mentally ready to enter kindergarten as part of preschool education. Kindergarten is one of the initial stages of education which is part of an educational pathway that provides opportunities from early childhood to basic education (Rupnidah & Eliza, 2022)

Early childhood education also has a role in helping children build early childhood knowledge (Maslich, 2016) . Through early childhood education, you can learn through direct experience, exploration and interaction with the early childhood environment (Salsabilafitri & Izzati, 2022) . Early childhood education provides comprehensive development for children, including physical, social, emotional intelligence, self-confidence, curiosity, goals, self-control, communication and cooperation, cognitive development and ethics. Early childhood education not only forms the basis for effective basic education, but also provides a solid foundation for life in the future (Musyarofah, 2017) .

In today's digital era, it is very important for children to have critical thinking skills. 21st century competencies have become the main emphasis in increasing the capacity of human resources in Indonesia as it enters the 21st century. Four elements of competency that must be instilled in 21st century children, including *critical thinking*, *creative thinking*, *communication skills* and *collaboration*, are able to help children compete in this era (Mustafa & Dwiyogo, 2020) . *Critical thinking* is thinking that is always curious and seeks details about a problem with the right assumptions and understanding (Rahardhian, 2022) .

Thinking abilities must be honed as early as possible so that children's problem-solving abilities can be honed through a series of simple experimental activities at school (Agnafia, 2019) . Apart from that, critical thinking also involves "thinking about our

## Project Based Learning, Discovery Learning and Sports Models on Critical Thinking Ability Children Age 5-6 Years: Study Literature

thoughts" by reflecting, analyzing, reasoning, planning, and evaluating (Anggraini et al., 2020) . Critical thinking consists of various high-level abilities that require demonstration of the capacity to identify problems with reasoning, assumptions, conclusions, and the ability to draw conclusions (Kusumah, 2019) .

Good critical thinking patterns will also encourage children to become problem solvers. Critical thinking is a mental process that people use to solve problems, make decisions, and learn new concepts (Nuryanti et al., 2018) . The goal of critical thinking is to evaluate information in a way that helps us make informed decisions. Critical thinking involves better understanding a problem through gathering, evaluating, and selecting information, and also by considering various possible solutions (Lally & Valentine-French, 2018).

The Minister of Education and Culture has emphasized the importance of the PISA assessment results in improving the quality of education in Indonesia, which will be the government's focus in the next five years. The government recognizes competency as the key to improving education to face the challenges of the 21st century (Sudarsana, 2016) . However, the results of the PISA study show that students' critical thinking abilities in Indonesia are still low (Lestari & Annizar, 2020) . Although it is hoped that improving the quality of education will increase PISA scores (Pratiwi, 2019) , the 2018 PISA data above indicates that Indonesia has low performance but high equity.

By exercising, humans will become healthy and strong, both physically and spiritually, and can have a positive impact on individuals such as increased responsibility, honesty in playing, cooperation, attention to others, leadership, respect for coaches, referees and coaches, loyalty, tolerance, discipline which ultimately can be expected to result in brilliant achievements to become champions. Sport has become a necessity in everyday human life, because with sport humans get pleasure and inner satisfaction, apart from that, regular and appropriate exercise can make people healthy and strong, both physically and spiritually and the motto is "mens sana en corpore sano" which means in a healthy body there is a strong soul is proof that since ancient times humans have realized how important a healthy body and soul are. (Irwanto & Romas, 2019).

Exercise in mind refers to a focused mental approach when participating in physical activity. This thinking pattern can influence the performance of children aged 5-6 years or individuals involved in sports activities (Masykuri, 2020). Responding to challenges or obstacles in a rational and productive way and creating intrinsic motivation (inner motivation) to achieve goals. Exercise in thinking patterns can help young children to optimize their performance in a more conscious and focused way (Irianto, 2019) .

## II. RESEARCH MATERIALS AND METHODS

This research uses a *literature review method*. Literature review is a process of finding out and studying research results that have been published by researchers relating to previous scientific work regarding the reasons why researchers decided to choose certain themes or titles that collect from several previous studies (Primawanti & Ali, 2022) . The data collection technique in this research uses web-based internet by focusing on articles that are relevant to this research. The data used is a type of secondary data, meaning that researchers do not go directly into the field.

Please note that the procedure for searching for articles relevant to this research uses the Synta database with the help of the *Google Chrome engine* and *Google Scholar* . The article search system uses keywords originating from the title of this research. As many as 15 articles were found during the article search process, but of the 15 articles found, only 3 articles were used as references by researchers for conducting reviews. This is because 12 articles were not included in this study. The researcher also emphasized that all data used for this research was sourced from the national or SINTA *data base* with provisions for the last 6 years so that its existence is still relevant today.

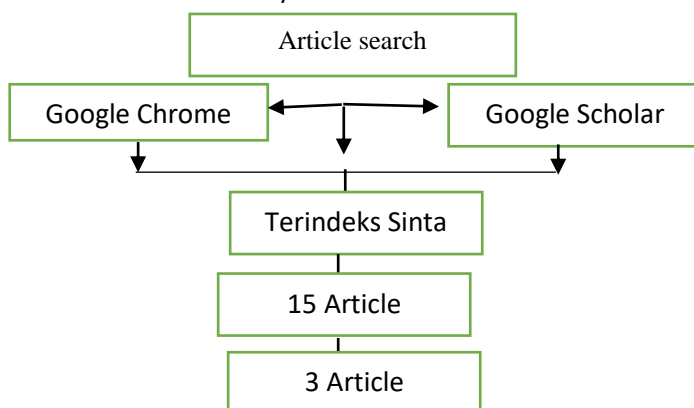


Figure 1. Research Framework

## Project Based Learning, Discovery Learning and Sports Models on Critical Thinking Ability Children Age 5-6 Years: Study Literature

### III. DISCUSSION

Table 1 below is three (3) articles that are the main reference or source for the author in completing this research, because the database in the research comes from the articles listed in the table below which are used as references for reviewing . Third (3) the article has several components or criteria that need to be included in the table below, namely 1). Author's name, 2). Article title, 3). Journal name, 4). The research results include, a. the variable being measured, b. number of samples and c. The following statistical tests are used in detail in 3 articles relevant to this research as follows:

**Table 1. List of articles used as references**

No	Author's Name and Year of Publication	Title	Journal Name	Research result
1	(Noviyana, 2017)	The Influence of the Project Based Learning Model on Students' Mathematical Creative Thinking Ability	Edumath Journal	The research results show: <i>Project Based Learning</i> for early childhood develops a project either individually or in groups to produce a product. The topic in the project approach must be concrete, close to the child's personal experience, interesting, and have emotional and intellectual potential. Implementation of Project Based Learning in early childhood, divided into 3, namely: total project learning, partial project learning and occasional project learning
2	(Safitri & Mediatati, 2021)	Application of the Discovery Learning Model in Science Learning to Improve Critical Thinking Abilities and Learning Outcomes of Elementary School Students	Basicedu Journal	The results of the first cycle of research showed that students' critical thinking abilities were in the high category 3%, in the medium category 37%, in the low category 42%, and in the very low category 8%. In cycle II, the increase was shown in the critical thinking skills of students in the very high category, 54%, in the high category, 30%, in the medium category, 8%, in the low category, 8%, and in the very low category, none. There were 3 students who had completed the KKM or 13c/o, while there were 21 students who had not completed the KKM or 87%. In cycle II, there were 20 students who had completed the KKM or 83%, while there were 4 students who had not completed the KKM or 17%. The research results show that

**Project Based Learning, Discovery Learning and Sports Models on Critical Thinking Ability Children Age 5-6 Years: Study Literature**

				the Discovery learning model is proven to improve critical thinking skills and student learning outcomes.
3	(Masykuri, 2020)	Blended Learning Innovation in Physical Education and Sports Learning in the New Normal Era	National Proceedings of Physical Education, Health and Recreation	The results of this research can show that there are blended learning-based physical education and health learning innovations in teaching and learning activities that can still run according to objectives, even though we are in the new normal era. With the support of various applications that can be used by educators in delivering material to their students.

The project-based learning (PBL) model is a learning approach that emphasizes working on certain projects or tasks as a way to understand and apply knowledge (Nantara, 2021) . At the age of 5-6 years, children are developing basic abilities, and this learning model can be an effective method for improving their critical thinking abilities. Critical thinking skills in children aged 5-6 years involve the ability to observe, analyze, conclude, and assess information in a logical and reflective way. This includes the ability to ask questions, solve problems, and make decisions through critical thinking (Usman et al., 2021) .

Through projects, children are invited to solve problems, make decisions, and think logically. Challenges: Children may need extra guidance to understand the goals and steps of the project. The Project-Based Learning model can be an effective tool for developing critical thinking skills in children aged 5-6 years. By designing projects that are appropriate to the child's developmental level, facilitating collaboration, and providing needed support, PBL can provide meaningful learning experiences and strengthen the critical thinking skills of children of this age.

*Discovery Learning* is a learning approach that emphasizes student exploration and experimentation to build their own understanding (Rosdiana et al., 2017) . In children aged 5-6 years, this stage is often accompanied by high curiosity and a desire to explore the world around them. This model can have a positive impact on the development of critical thinking skills in children (Cahtini et al., 2023) . Critical thinking skills in children aged 5-6 years involve the ability to observe, ask questions, solve problems, and make decisions logically. *Discovery Learning* can stimulate the development of these skills through exploration and hands-on experience.

This model takes advantage of children's natural curiosity to motivate them to learn. Discovery through exploration can stimulate curiosity and trigger critical questions. Discovery Learning can occur in contexts that are relevant and meaningful for children. Discovery Learning builds problem-solving skills by allowing children to find their own solutions. The exploration process helps children develop critical thinking skills to find solutions. The Discovery Learning model can be an effective method for improving critical thinking skills in children aged 5-6 years. By stimulating curiosity, providing hands-on experiences, and encouraging exploration, this approach can help children build the foundations of their critical thinking through an active and meaningful process of discovery.

Sport for children aged 5-6 years not only provides physical benefits, but also contributes to the development of various cognitive skills, including critical thinking abilities (Prawira et al., 2021) . Critical thinking skills at this age involve the ability to observe, analyze, conclude and solve problems logically and through sports, children can develop these skills naturally. Physical activity increases blood flow to the brain, improves cognitive function and increases critical thinking skills. Exercise helps develop motor skills, which are essential for critical thinking abilities. Sports can stimulate children's senses, helping them develop perception and understanding of the surrounding environment (Wondal et al., 2020) .

Sports often require quick problem solving. Children are faced with situations that require quick decisions and creative solutions, advancing critical thinking skills. At this age , it is necessary to pay attention to safety when participating in sports. Supervision and provision of appropriate safety equipment is key to ensuring children's safety. Sport can make a positive contribution to the development of critical thinking skills in children aged 5-6 years. Through a variety of physical activities, children can develop

## Project Based Learning, Discovery Learning and Sports Models on Critical Thinking Ability Children Age 5-6 Years: Study Literature

motor skills, build social skills, and stimulate critical thinking naturally. It is important to create a safe and supportive environment, and focus on the positive experiences and joy of participating in sport at this age.

### IV. CONCLUSION

From the results of the article review, the researcher drew the conclusion that project based learning, discovery learning and sports models on the critical thinking abilities of children aged 5-6 years.

### REFERENCES

- 1) Agnafia, D. N. (2019). Analisis Kemampuan Berpikir Kritis Siswa Dalam Pembelajaran Biologi. *Florea : Jurnal Biologi Dan Pembelajarannya*, 6(1), Article 1. <https://doi.org/10.25273/Florea.V6i1.4369>
- 2) Anggraini, G. F., Pradini, S., Sasmia, S., Haenilah, E. Y., & Wijayanti, D. K. (2020). Pengembangan Kemampuan Berpikir Kritis Anak Usia Dini Melalui Storytelling Di Tk Amartani Bandar Lampung. *Jurnal Pengabdian Dharma Wacana*, 1(1), Article 1. <https://doi.org/10.37295/Jpdw.V1i1.21>
- 3) Cahtini, C., Soekisno, R. B. A., & Yumiati. (2023). Pengaruh Model Pembelajaran Problem Based Learning Dan Discovery Learning Terhadap Kemampuan Pemahaman Matematis Ditinjau Dari Gaya Belajar Siswa. *Pendas : Jurnal Ilmiah Pendidikan Dasar*, 8(2), Article 2. <https://doi.org/10.23969/Jp.V8i2.9635>
- 4) Irianto, T. (2019). Implementasi Kurikulum 2013 Dalam Pembelajaran Pendidikan Jasmani Olahraga Dan Kesehatan Di Sekolah Dasar. *Multilateral : Jurnal Pendidikan Jasmani Dan Olahraga*, 13(1), Article 1. <https://doi.org/10.20527/Multilateral.V13i1.6107>
- 5) Irwanto, & Romas, M. Z. (2019). Profil Peran Psikologi Olahraga Dalam Meningkatkan Prestasi Atlet Di Serang-Banten Menuju Jawara. *Prosiding Seminar Nasional Iptek Olahraga (Senalog)*, 2(1), Article 1.
- 6) Kusumah, R. G. T. (2019). Peningkatan Kemampuan Berpikir Kritis Mahasiswa Tadris Ipa Melalui Pendekatan Saintifik Pada Mata Kuliah Ipa Terpadu. *Ijis Edu : Indonesian Journal Of Integrated Science Education*, 1(1), Article 1. <https://doi.org/10.29300/Ijisedu.V1i1.1762>
- 7) Lally, M., & Valentine-French, S. (2018). Lifespan Development: A Psychological Perspective. *Merlot*. <http://dspace.calstate.edu/handle/10211.3/206327>
- 8) Lestari, A. C., & Annizar, A. M. (2020). Proses Berpikir Kritis Siswa Dalam Menyelesaikan Masalah PISA Ditinjau Dari Kemampuan Berpikir Komputasi. *Jurnal Kiprah*, 8(1), Article 1. <https://doi.org/10.31629/Kiprah.V8i1.2063>
- 9) Maslich, I. Y. (2016). Pengembangan Media Papan Pintar Angka (Papika) Bagi Anak Kelompok A Di Taman Kanak-Kanak Nasional Samirone Caturtunggal Depok Sleman Yogyakarta. *E-Jurnal Skripsi Program Studi Teknologi Pendidikan*, 5(6), Article 6.
- 10) Masykuri, N. M. (2020). Inovasi Blended Learning Pada Pembelajaran Pendidikan Jasmani Dan Olahraga Pada Era New Normal. *Seminar Nasional Keolahragaan*, 0, Article 0. <http://conference.um.ac.id/index.php/fik/article/view/558>
- 11) Mustafa, P. S., & Dwiyo, W. D. (2020). Kurikulum Pendidikan Jasmani, Olahraga, Dan Kesehatan Di Indonesia Abad 21. *Jurnal Riset Teknologi Dan Inovasi Pendidikan (Jartika)*, 3(2), Article 2.
- 12) Musyarofah, M. (2017). Pengembangan Aspek Sosial Anak Usia Dini Di Taman Kanak-Kanak Aba Iv Mangli Jember Tahun 2016. *Inject (Interdisciplinary Journal Of Communication)*, 2(1), Article 1. <https://doi.org/10.18326/Inject.V2i1.99-122>
- 13) Nantara, D. (2021). Menumbuhkan Berpikir Kritis Pada Siswa Melalui Peran Guru Dan Peran Sekolah. *Jurnal Teladan: Jurnal Ilmu Pendidikan Dan Pembelajaran*, 6(1), Article 1.
- 14) Nopriyanti, L. (2012). Peningkatan Kemampuan Membaca Anak Melalui Metode Fonik Di Taman Kanak-Kanak Islam Adzka Bukittinggi. *Jurnal Ilmiah Pesona Paud*, 1(1), Article 1. <https://doi.org/10.24036/1706>
- 15) Noviyana, H. (2017). Pengaruh Model Project Based Learning Terhadap Kemampuan Berpikir Kreatif Matematika Siswa. *Jurnal E-Dumath*, 3(2), Article 2. <https://doi.org/10.52657/Je.V3i2.455>
- 16) Nuryanti, L., Zubaidah, S., & Diantoro, M. (2018). Analisis Kemampuan Berpikir Kritis Siswa Smp. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, 3(2), Article 2. <https://doi.org/10.17977/jptpp.V3i2.10490>
- 17) Pratiwi, I. (2019). Efek Program PISA Terhadap Kurikulum Di Indonesia. *Jurnal Pendidikan Dan Kebudayaan*, 4(1), Article 1. <https://doi.org/10.24832/Jpnk.V4i1.1157>
- 18) Prawira, A. Y., Prabowo, E., & Febrianto, F. (2021). Model Pembelajaran Olahraga Renang Anak Usia Dini: Literature Review. *Jurnal Educatio Fkip Unma*, 7(2), Article 2. <https://doi.org/10.31949/Educatio.V7i2.995>

## Project Based Learning, Discovery Learning and Sports Models on Critical Thinking Ability Children Age 5-6 Years: Study Literature

- 19) Primawanti, E. P., & Ali, H. (2022). Pengaruh Teknologi Informasi, Sistem Informasi Berbasis Web Dan Knowledge Management Terhadap Kinerja Karyawan (Literature Review Executive Support Sistem (Ess) For Business). *Jurnal Ekonomi Manajemen Sistem Informasi*, 3(3), 267–285. <https://doi.org/10.31933/Jemsi.V3i3.818>
- 20) Rahardhian, A. (2022). Kajian Kemampuan Berpikir Kritis (Critical Thinking Skill) Dari Sudut Pandang Filsafat. *Jurnal Filsafat Indonesia*, 5(2), Article 2. <https://doi.org/10.23887/Jfi.V5i2.42092>
- 21) Rosdiana, R., Boleng, D. T., & Susilo, S. (2017). Pengaruh Penggunaan Model Discovery Learning Terhadap Efektivitas Dan Hasil Belajar Siswa. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, 2(8), Article 8. <https://doi.org/10.17977/jptpp.V2i8.9802>
- 22) Rupnidah, R., & Eliza, D. (2022). Analisis Kemampuan Manajerial Kepala Sekolah Taman Kanak-Kanak. *Jurnal Basicedu*, 6(3), Article 3. <https://doi.org/10.31004/basicedu.V6i3.2826>
- 23) Safitri, W. C. D., & Mediatati, N. (2021). Penerapan Model Discovery Learning Dalam Pembelajaran Ipa Untuk Meningkatkan Kemampuan Berpikir Kritis Dan Hasil Belajar Siswa Sekolah Dasar. *Jurnal Basicedu*, 5(3), Article 3. <https://doi.org/10.31004/basicedu.V5i3.925>
- 24) Salsabilafitri, N. S. N., & Izzati. (2022). Pelaksanaan Pengembangan Sosial Anak Di Taman Kanak-Kanak Pertiwi 1 Kantor Gubernur Padang. *Jurnal Pendidikan Aura (Anak Usia Raudhatul Atfhal)*, 3(1), Article 1. <https://doi.org/10.37216/Aura.V3i1.591>
- 25) Sudarsana, I. K. (2016). Pemikiran Tokoh Pendidikan Dalam Buku Lifelong Learning: Policies, Practices, And Programs (Perspektif Peningkatan Mutu Pendidikan Di Indonesia). *Jurnal Penjaminan Mutu*, 2(2), Article 2. <https://doi.org/10.25078/jpm.V2i2.71>
- 26) Usman, K., Uno, H. B., Oroh, F. A., & Mokolinug, R. (2021). Analisis Kemampuan Berpikir Kritis Matematis Siswa Pada Materi Pola Bilangan. *Jambura Journal Of Mathematics Education*, 2(1), Article 1. <https://doi.org/10.34312/jmathedu.V2i1.10260>
- 27) Wondal, R., Samad, R., & Kore, D. (2020). Peran Permainan Ludo Dalam Mengembangkan Kemampuan Kognitif Anak Usia 5-6 Tahun. *Jurnal Ilmiah Cahaya Paud*, 2(2), Article 2. <https://doi.org/10.33387/Cahayapd.V2i2.2068>



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Analysis of the Physical Condition of Long-Term Wushu Sanda Athletes PON Athletes of North Sumatra Province in Facing the North Sumatra / Aceh National Sports Week XXI Year 2024



Nadhira Yasmine Ahmad<sup>1</sup>, Sumaryanti<sup>2</sup>

<sup>1,2</sup>Department of Sport Science, Faculty of Sport and Health Science Yogyakarta State University, Yogyakarta, Indonesia

**ABSTRACT:** The purpose behind this study is to determine the state and readiness of the long-term physical condition of wushu sanda athletes from PON North Sumatra Province in facing the XXI North Sumatra National Sports Week in 2024. This type of research is quantitative descriptive with information or data collection strategies using survey and test methods. The subjects of the study were all long-term wushu sanda athletes from PON training in North Sumatra Province from 8 athletes consisting of 5 men and 3 women who will be prepared to take part in the XXI North Sumatra / Aceh National Sports Week in 2024. The technique of using samples in this study is total sampling. The instruments in this review use tests and measurements. Based on the results of the study, information was obtained from the state of the physical condition of long-term wushu athletes in PON North Sumatra Province, both men and women, on average from the overall 64% are still in physical condition with sufficient categories. thus the need to increase the intensity of training programs to support the improvement of athletes' physical condition, in this case the coach must work extra and athletes must also be active and train and follow all the programs that have been prepared and given by the coach in preparation for PON XXI SUMUT / Aceh 2024.

**KEYWORDS:** Analysis, Physical Condition, Wushu Sanda, Pelatda PON.

### I. INTRODUCTION

Wushu is a martial arts game that started in China and began to be made in Indonesia. Wushu in the true sense comes from the words Wu which means knight or war, and Shu which means procedure or technique (Hardyanti, 2022) Wushu sports in Indonesia are not as popular as other martial sports, even so Indonesia has currently established an institution that oversees wushu sports, namely the Indonesian Wushu Executive Board (PB) while at the international level called the International Wushu Federatoin (IWUF), IWUF was established to promote sports in the world. Wushu sports achievements in Indonesia have now reached international well.

The wushu sport which is officially shaded by IWUF has three numbers that are competed, namely 1) Taolu, Demonstration of moves. 2) Tuida, a fight reenactment. 3) sanhou/sanda i.e. free match (Noviani & Badri, 2019). Based on this information, wushu sports have two groups, namely art and fighting. In coaching athletes at the amateur level, physical condition must be really considered to improve athlete performance. In directing athletes at the local, provincial, national and international levels, physical condition factors are really considered to further develop the athletes' performances so that they can reach the peak of achievement.

Physical condition training is a part used to achieve achievements, while to achieve the desired achievements athletes must make relatively long preparations (Mylsidayu, 2017). In line with this opinion (Harsono, 2016) states that the physical condition of athletes plays a very important role in their training program. Physical condition is a basic ability possessed by an athlete, physical condition also has important aspects possessed by an athlete in increasing and developing the prestige of an athlete. In addition to focusing on physical condition status, there needs to be supporting aspects to support athletes, namely aspects of physical training, technique, tactics, and mental training. The role of physical condition training is very important to support the achievements of athletes, especially fight athletes (Ryzki et al., 2021). In physical condition training there are 10 components including: 1) *Endurance*. 2) *Muscular Power*. 3) *Speed*. 4) *Flexibility*. 5) *Agility*. 6) *Coordination*. 7) *Balance*. 8) *Accuracy*. 9) *Reaction*. 10) *Strenght* (Hanief, 2019).

## Analysis of the Physical Condition of Long-Term Wushu Sanda Athletes PON Athletes of North Sumatra Province in Facing the North Sumatra / Aceh National Sports Week XXI Year 2024

Before the athlete performs the competition, the athlete's initial preparation must be fostered to improve his physical condition. This is useful to stay ready to face the pressure caused by the match both in terms of mental and physical pressure. To achieve maximum athlete readiness before competing, the athlete's condition must achieve good fitness to deal with the stress that will be faced during the match. Therefore, having an optimal or good physical condition during every training session and match physical condition has an important role in every match in addition to mental, technical and tactical.

Wushu sports (Cabor) are very popular in North Sumatra, shortly at the prestigious level event in Indonesia, namely PON Papua XX in 2020, the North Sumatra Wushu Sports (Cabor) won 5 (five) gold medals in the XX Papua PON competition. Not only staying in gold, Cabor Wushu also managed to bring 5 (five) silver medals and 5 (five) bronze medals. And this achievement is dominated by Sanda wushu athletes.

Efforts to achieve achievements are of course many factors which include internal factors and external factors. Performance factors that come from internal certainly cannot be separated from the state of the athlete himself. While external factors come from outside which can be in the form of trainers, management, facilities and infrastructure.

In this study, researchers are interested in seeing how ready the physical condition of Wushu Sanda athletes is the Long-Term PON of North Sumatra PON in 2024 in preparing for PON XXI North Sumatra and Aceh in 2024. Considering that Wushu sports contributed a lot of medals, dominated by Wushu Sanda athletes for North Sumatra in the previous event, namely PON Papua XX in 2020. In addition, the readiness of physical condition is the most important factor to support the achievements of athletes. In line with previous research conducted by (Ambara, 2017) that the influence of physical condition can increase athlete pretation, judging from the results of his research from the homogeneity test of  $0.000 > 0.05$  there is a significant relationship between ranking results and physical condition at that time.

## II. METHOD

In accordance with the questions that have been described, this type of research is descriptive using a quantitative approach. The methods used in this study are surveys and measurement tests. Descriptive research is research that describes what happens in the field about a condition or symptom (Hardiansyah, 2018). A quantitative approach is an approach that relates to using numbers that have been analyzed that use statistical techniques to describe the results (Jariono et al., 2020) The survey method was chosen by researchers because the survey method is a collection of data carried out at this time, to obtain information in the form of characteristics, opinions, and test several hypotheses (Zawawi & Burstiando, 2020).

This research was carried out at Gor TMultipurpose North Sumatra, precisely on Jln. William Iskandar Pancing in January 2023. Data collection techniques in this study used tests. The test was used by researchers to measure the physical condition of athletes in preparing for PON XXI North Sumatra and Aceh in 2024 for the wushu sanda sport. The population in this study was all North Sumatra wushu sanda training athletes totaling 8 athletes, consisting of 5 male athletes and 3 female athletes. The sample of this study involved overall (total sampling) all North Sumatran wushu sanda athletes.

The instruments used in the research are as follows:

1. Flexibility Test, as for the physical condition measurement test method for the flex component is the *v sit and reach* test and *shoulder & wrist*.
2. The abdominal muscle endurance test, while the measurement of the physical condition test for the abdominal muscle endurance component is a *1-minute* sit-up test.
3. Arm muscle endurance test, while the measurement of physical condition test for arm muscle endurance component is a *1-minute* push-up test.
4. Arm muscle explosive power test, while the measurement of physical condition test for the explosive power component of arm muscles is *chest throw medicine ball*.
5. The test of the explosive power of the leg muscles, while the measurement of the physical condition test for the explosive power component of the leg muscles is the *tripple hope jump*.
6. Speed Test, as for the measurement of the physical condition test for the speed component is the *20-meter* sprint test.
7. Core test, while the measurement of physical condition tests for *core test* components is *12 Level Core Stability*.
8. Aerobic endurance test (VO2 Max), while the measurement of physical condition test for aerobic endurance component (VO2 Max) is *bleep* test.

To draw conclusions from the data that has been obtained and collected, then changed in the form of percentages to analyze the descriptive data. The data is then processed using the following formula:



# Analysis of the Physical Condition of Long-Term Wushu Sanda Athletes PON Athletes of North Sumatra Province in Facing the North Sumatra / Aceh National Sports Week XXI Year 2024

$$P = \frac{F}{N} \times 100\%$$

Information:

P = Percentage searched

F = Frequency

N = Number of respondents

### III. RESULT AND DISCUSSION

#### A. Result

The results of the research that have been conducted by this researcher are a description of the physical condition profile of wushu sanda athletes who are long-term PON North Sumatra 2024 in preparing for PON XXI North Sumatra and Aceh in 2024. The data that has been collected in this study are the results of tests and measurements in the form of spasticity tests, abdominal muscle endurance, arm muscle endurance, leg muscle endurance, speed, *core tests*, aerobic endurance (VO2 Max). The following are the test results and measurements of the 2024 North Sumatra PON long-term wushu sanda athletes presented in table form:

**Table 1. Data on Flex Test Results (V Sit and Reach) Wushu Sanda Athletes PON Long-Term Training North Sumatra 2024**

Son				Daughter			
Interval	Frequency	category	Percentage	Interval	Frequency	category	Percentage
<27	1	Excellent	20 %	<27	2	Excellent	66,66 %
26 - 17	3	Good	60 %	26 - 17	0	Good	0 %
16 - 6	1	Enough	20 %	16 - 6	1	Enough	33,33 %
5 - 0	0	Less	0 %	5 - 0	0	Less	0 %
< -1	0	Very Lacking	0 %	< -1	0	Very Lacking	0 %
Sum	5		100 %	Sum	3		100 %

Based on the table above, the data of the *v sit and reach* flex test for male athletes in the very good category was 1 athlete (20%), the good category was 3 athletes (60%), the sufficient category was 1 athlete (20%), the category was less than 0 athletes (0%) while in the category of less than 0 athletes (0%). In this condition, *the most male athletes' v sit and reach* flex test was 3 athletes in the good category.

The condition of the *v sit and reach flex test data* for female athletes in the very good category was 2 athletes (66.66%), the good category was 0 athletes (0%), the sufficient category was 1 athlete (33.33%), the category was less than 0 athletes (0%) while in the category of less than 0 athletes (0%). In this condition, *the most frequency of the female athletes' v sit and reach* flex test was 2 athletes in the excellent category.

**Table 2. Shoulder & Wrist Test Results Data of Wushu Sanda Athletes PON Long-Term Trainers North Sumatra 2024**

Putra				Putri			
Interval	Frequency	category	Percentage	Interval	Frequency	category	Percentage
<12.75	5	Excellent	100 %	<12	3	Excellent	100 %
11.75 - 12.50	0	Good	0%	11 - 11.75	0	Good	0 %
8.50 - 11.50	0	Enough	0%	7.75 - 10.75	1	Enough	0 %
6.25 - 8.25	0	Less	0 %	5.75 - 7.50	0	Less	0 %
< 6	0	Very Lacking	0 %	< 5.50	0	Very Lacking	0 %
Sum	5		100 %	Sum	3		100 %

Based on the table above, the shoulder & wrist flex test data of male athletes in the very good category was 5 athletes (100%), the good category was 0 athletes (0%), the sufficient category was 0 athletes (0%), the category was less than 0 athletes (0%),

## Analysis of the Physical Condition of Long-Term Wushu Sanda Athletes PON Athletes of North Sumatra Province in Facing the North Sumatra / Aceh National Sports Week XXI Year 2024

while in the category of less than 0 athletes (0%). In this condition, *the most male athletes' shoulder & wrist flex tests* were 5 athletes in the excellent category.

The condition of the *v sit and reach flex test data* for female athletes in the very good category was 3 athletes (100%), the good category was 0 athletes (0%), the sufficient category was 0 athletes (0%), the category was less than 0 athletes (0%) while in the category of less than 0 athletes (0%). In this condition, *the most frequency of the female athletes' v sit and reach flex test* was 3 athletes in the excellent category.

**Table 3. Data on Abdominal Muscle Endurance Test Results (1-Minute Crunches) Wushu Sanda Athletes Long-Term PON Trainers North Sumatra 2024**

Putra				Putri			
Interval	Frequency	category	Percentage	Interval	Frequency	category	Percentage
>120	0	Excellent	0 %	>120	0	Excellent	0 %
119 - 108	0	Good	0 %	119 - 108	0	Good	0 %
107 - 95	0	Enough	0 %	107 - 95	0	Enough	0 %
94 - 50	2	Less	40 %	94 - 50	1	Less	33,33 %
<49	3	Very Lacking	60 %	<49	2	Very Lacking	66,66 %
Sum	5		100 %	Sum	3		100 %

Based on the table above, the data of the 1-minute sit-up abdominal muscle endurance test of male athletes in the very good category was 0 athletes (0%), the good category was 0 athletes (0%), the sufficient category was 0 athletes (0%), the category was less than 2 athletes (40%) while in the category of less than 3 athletes (60%). In this condition, *the male athletes' 1-minute sit-up abdominal muscle endurance test* was at most 3 athletes in the less once category.

The condition of the abdominal muscle endurance test data *for 1 minute sit-up* female athletes in the very good category was 0 athletes (0%), the good category was 0 athletes (0%), the sufficient category was 0 athletes (0%), the category was less than 1 athlete (33.33%) while in the category of less than 2 athletes (66.66%). In this condition, the 1-minute abdominal muscle endurance test *of sit-ups* of female athletes of the most frequency was 2 athletes in the less once category.

**Table 4. Arm Muscle Endurance Test Results Data (1-Minute Push-ups) Wushu Sanda Athletes Long-Term PON Training North Sumatra 2024**

Putra				Putri			
Interval	Frequency	category	Percentage	Interval	Frequency	category	Percentage
>60	1	Excellent	20 %	>60	0	Excellent	0 %
59 - 54	0	Good	0 %	59 - 54	0	Good	0 %
53 - 47	1	Enough	20 %	53 - 47	0	Enough	0 %
46 - 40	0	Less	0 %	46 - 40	1	Less	33,33 %
<39	3	Very Lacking	60 %	<39	2	Very Lacking	66,66 %
Sum	5		100 %	Sum	3		100 %

Based on the table above, the data of the 1-minute push-up arm endurance test for male athletes in the very good category was 1 athlete (20%), the good category was 0 athletes (0%), the sufficient category was 1 athlete (20%), the category was less than 0 athletes (0%) while in the category of less than 3 athletes (60%). In this condition, *the male athletes' 1-minute push-up arm muscle endurance test* was at most 3 athletes in the less once category.

The condition of the push-up arm muscle endurance test data *for 1 minute* female athletes in the very good category was 0 athletes (0%), the good category was 0 athletes (0%), the sufficient category was 0 athletes (0%), the category was less than 1 athlete (33.33%) while in the category of less than 2 athletes (66.66%). In this condition, *the female athletes' 1-minute push-up arm muscle endurance test* of the most frequency was 2 athletes in the less once category.

**Analysis of the Physical Condition of Long-Term Wushu Sanda Athletes PON Athletes of North Sumatra Province in Facing the North Sumatra / Aceh National Sports Week XXI Year 2024**

**Table 5. Chest Throw Medicine Ball Test Results Data for Wushu Sanda Athletes Long-Term PON Trainers North Sumatra 2024**

Putra				Putri			
Interval	Frequency	category	Percentage	Interval	Frequency	category	Percentage
<6	0	Excellent	0 %	<4	0	Excellent	0 %
5 - 4	2	Good	40 %	3,9 - 3	0	Good	0 %
3,9 - 2	0	Enough	0 %	2,9 - 2	3	Enough	100 %
2,9 - 1	3	Less	60 %	1,9 - 1	0	Less	0 %
<0,9 - (-1)	0	Very Lacking	0 %	<0,9 - (-1)	0	Very Lacking	0 %
Sum	5		100 %	Sum	3		100 %

Based on the table above, the data on the explosive power test of the arm *chest throw medicine ball* male athletes in the very good category as many as 0 athletes (0%), good category 2 athletes (40%), enough category 0 athletes (0%), less category 3 athletes (60%) while in the category less than 0 athletes (0%). In this condition, the most male athletes' *chest throw medicine ball* arm muscle explosive power tests were 3 athletes in the less category.

The condition of the arm muscle explosive test data *chest throw medicine ball* female athletes in the very good category as many as 0 athletes (0%), good category 0 athletes (0%), enough category 3 athletes (100%), less category 0 athletes (0%) while in the category less than 0 athletes (0%). In this condition, the most *frequency of the female athletes' chest throw medicine ball* arm muscle explosive power test was 3 athletes in the sufficient category.

**Table 6. Tripple Hope Jump Test Results Data for Wushu Sanda Athletes Long-Term PON Trainers North Sumatra 2024**

Putra				Putri			
Interval	Frequency	category	Percentage	Interval	Frequency	category	Percentage
>9.34	0	Excellent	0 %	>9.34	2	Excellent	66,66 %
9.34 - 8.18	0	Good	0 %	9.34 - 8.18	0	Good	0 %
8.17 - 7.60	4	Enough	80 %	8.17 - 7.60	1	Enough	33,33 %
7.59 - 5.87	1	Less	20 %	7.59 - 5.87	0	Less	0 %
<5.87	0	Very Lacking	0 %	<5.87	0	Very Lacking	0 %
Sum	5		100 %	Sum	3		100 %

Based on the table above, the data on the explosive power test of the *trippole leg muscles of* male athletes in the very good category were 0 athletes (0%), the good category was 2 athletes (40%), the sufficient category was 0 athletes (0%), the category was less than 3 athletes (60%) while in the category of less than 0 athletes (0%). In this condition, *the most male athletes' trippole hope jump* leg muscle explosive power test was 3 athletes in the less category.

The condition of the trippole leg muscle explosive test data *for* female athletes in the very good category is 0 athletes (0%), the good category is 0 athletes (0%), the sufficient category is 3 athletes (100%), the category is less than 0 athletes (0%) while in the category of less than 0 athletes (0%). In this condition, *the most frequency of female athletes' trippole hope jump* leg muscle explosive power tests were 3 athletes in the sufficient category.

**Table 7. Speed Test Results Data (20 Meter Sprint) Wushu Sanda Athletes PON Long-Term Training North Sumatra 2024**

Putra				Putri			
Interval	Frequency	category	Percentage	Interval	Frequency	category	Percentage
<3	2	Excellent	40 %	<3	0	Excellent	0 %
3,1 – 3,3	1	Good	20 %	3,1 – 3,3	1	Good	33,33 %
3,4 – 3,6	2	Enough	40 %	3,4 – 3,6	1	Enough	33,33 %
3,7 – 3,8	0	Less	0 %	3,7 – 3,8	1	Less	33,33 %
>3,9	0	Very Lacking	0 %	>3,9	0	Very Lacking	0 %
Sum	5		100 %	Sum	3		100 %

## Analysis of the Physical Condition of Long-Term Wushu Sanda Athletes PON Athletes of North Sumatra Province in Facing the North Sumatra / Aceh National Sports Week XXI Year 2024

Based on the table above, the 20-meter sprint speed test data of male athletes in the very good category was 2 athletes (40%), the good category was 1 athlete (20%), the sufficient category was 2 athletes (40%), the category was less than 0 athletes (0%) while in the category of less than 0 athletes (0%). Under these conditions, *the most men's athletes' 20-meter sprint speed tests* were 2 athletes in the excellent category.

The condition of the 20-meter sprint speed test data for female athletes in the very good category was 0 athletes (0%), the good category was 1 athlete (33.33%), the sufficient category was 1 athlete (33.33%), the category was less than 1 athlete (33.33%) while in the category of less than 0 athletes (0%). In this condition, *the women's 20-meter sprint speed test* is of equal frequency, which is a sufficient category.

**Table 8. Data Hasil Core Test (12 Level Core Stability) Atlet Wushu sanda Pelatda Jangka Panjang PON North Sumatra 2024**

Putra				Putri			
Interval	Frequency	category	Percentage	Interval	Frequency	category	Percentage
12	3	Excellent	60 %	12	2	Excellent	66,66 %
11 - 9	0	Good	0 %	11 - 9	0	Good	0 %
8-6	1	Enough	20 %	8-6	0	Enough	0 %
5-3	0	Less	0 %	5-3	1	Less	33,33 %
<2	1	Very Lacking	20 %	<2	0	Very Lacking	0 %
Sum	5		100 %	Sum	3		100 %

Based on the table above, the core test data of 12 Level Core Stability male athletes in the very good category was 3 athletes (60%), the good category was 0 athletes (0%), the sufficient category was 1 athlete (20%), the category was less than 0 athletes (0%) while in the category of less than 1 athlete (20%). In this condition, *the core test of 12 Level Core Stability* of the most male athletes is 3 athletes in the excellent category.

The condition of *the core test* data is 12 Level Core Stability of female athletes in the very good category as many as 2 athletes (66.66%), good category 0 athletes (0%), sufficient category 0 athletes (0%), less category 1 athlete (33.33%) while in the category of less than 0 athletes (0%). In this condition, *the core test of 12 Level Core Stability* female athletes with the most frequency is 2 athletes in the very good category.

**Table 9. Aerobic Endurance Test (VO2 Max) Test Bleep Test Bleep Wushu Athletes Sanda Long-Term PON Training North Sumatra 2024**

Putra				Putri			
Interval	Frequency	category	Percentage	Interval	Frequency	category	Percentage
>55	0	Excellent	0 %	>55	0	Excellent	0 %
54 - 50	1	Good	20 %	54 - 50	1	Good	33,33 %
49 - 45	3	Enough	60 %	49 - 45	2	Enough	66,66 %
44 - 38	0	Less	0 %	44 - 38	0	Less	0 %
<37	1	Very Lacking	20 %	<37	0	Very Lacking	0 %
Sum	5		100 %	Sum	3		100 %

Based on the table above, aerobic endurance test data (VO2 Max) *bleep test for* male athletes in the very good category as many as 0 athletes (0%), good category 1 athlete (20%), sufficient category 3 athletes (60%), less category 0 athletes (0%) while in the category less once 1 athlete (20%). In this condition, the aerobic endurance test (VO2 Max) *bleep test bleep* most male athletes are 3 athletes in the sufficient category.

The condition of the aerobic endurance test data (VO2 Max) *bleep test for* female athletes in the very good category was 0 athletes (0%), the good category was 1 athlete (33.33%), the sufficient category was 2 athletes (66.66%), the category was less than 1 athlete (33.33%) while in the category of less than 0 athletes (0%). In this condition, the most frequency aerobic endurance test (VO2 Max)

## Analysis of the Physical Condition of Long-Term Wushu Sanda Athletes PON Athletes of North Sumatra Province in Facing the North Sumatra / Aceh National Sports Week XXI Year 2024

**Table 10. Recapitulation of Physical Condition Test Results of Wushu Sanda Athletes Long-Term PON Training North Sumatra 2024**

COMPONENT	NAME &; RESULTS							
	TONGAT	YDRIS	MALIK	RAY	HARRY	TRYDYFA	CATRIN	ELSANDA
Determination <i>V Sit &amp; Reach</i>	4	4	4	5	3	3	5	5
Shoulder & Wrist <i>Deficiency</i>	5	5	5	5	5	5	5	5
Abdominal Muscular Endurance	2	1	2	1	1	1	2	1
Arm Muscle Endurance	5	1	1	1	3	2	1	1
Arm Muscle Explosive Power	2	2	2	4	4	3	3	3
Limb Muscle Explosive Power (Right)	3	3	2	3	3	5	3	5
Speed	5	3	4	3	5	4	2	3
<i>Core Test</i>	1	5	5	5	3	5	2	5
Aerobic Resilience (VO2 Max)	1	4	3	3	3	4	3	3
<b>Sum</b>	<b>31</b>	<b>31</b>	<b>31</b>	<b>35</b>	<b>33</b>	<b>33</b>	<b>29</b>	<b>33</b>
<b>Average Amount</b>	<b>32</b>							
<b>Percentage</b>	<b>62%</b>	<b>62%</b>	<b>62%</b>	<b>70%</b>	<b>66%</b>	<b>66%</b>	<b>58%</b>	<b>66%</b>
<b>Average Percentage</b>	<b>64 %</b>							

Based on the recapitulation table of the test result data above, the physical condition of wushu sanda athletes for men and women of long-term PON North Sumatra Province in 2024 is included in the sufficient category with a percentage of 64%, thus the need to increase the intensity of training programs to support the improvement of athletes' physical condition, in this case the coach must work extra and athletes must also be active and train and follow all the programs that have been compiled and given by the coach to preparation for PON XXI SUMut/Aceh 2024.

### B. Discussion

Based on the results of the above research in measuring the physical condition test of wushu sanda athletes, long-term PON North Sumatra Province in 2024 in preparing for PON XXI North Sumatra / Aceh in 2024, all athletes carry out physical condition tests in the form of spasticity tests, abdominal muscle endurance, arm muscle endurance, leg muscle endurance, speed, *core tests*, aerobic endurance (VO2 Max).

Data collection from the flex test using the *v sit and reach* method, the results of these measurements are generally for male athletes in the good category as many as 3 athletes (60%), for female athletes all athletes in the very good category as many as 2 athletes (66.66%). And for the *shoulder & wrist* flexion test, the results of these measurements are generally for male athletes in the very good category as many as 5 athletes (100%), for female athletes all athletes in the very good category as many as 3 athletes (100%), For this for coaches can improve even better because some athletes are still in the sufficient category. To prepare for PON XXI Sumut/Aceh in 2024, it is hoped that all athletes will be in good condition to maximize when competing. Coaches are expected to further improve the flexibility of athletes because there are still athletes who are in the category of sufficient and lacking. Athlete flexibility is also important to improve because flexibility can be able to move the body as wide as possible from the space of motion of joints, muscles, tendons and ligaments (Irwandi, 2010).

Data collection from abdominal muscle endurance test by sit-up 1 minute. Overall male athletes in the category of less than once were 3 athletes (60%). As for female athletes as a whole, they fall into the category of less than once, namely 2 athletes (66.66%). For this reason, the condition of male and female athletes is still in very poor physical condition to prepare for PON XXI Sumatra / Aceh in 2024. Muscular endurance is the capacity of muscles to contract continuously at submaximal intensity levels. This endurance is also needed to maintain activities that last a long time, so in this case it involves the cardiorespiratory system (Nurhasan, 2005: 19). Therefore, it takes hard work for trainers in making exercise programs, especially abdominal muscle endurance.

Data collection from arm muscle endurance test by push-up 1 minute. Overall male athletes in the category of less than once were 3 athletes (60%). As for female athletes as a whole, they fall into the category of less than once, namely 2 athletes (66.66%). For this reason, the condition of male and female athletes is still in very poor physical condition to prepare for PON XXI Sumatra /

## Analysis of the Physical Condition of Long-Term Wushu Sanda Athletes PON Athletes of North Sumatra Province in Facing the North Sumatra / Aceh National Sports Week XXI Year 2024

Aceh in 2024. Muscular endurance is the capacity of muscles to contract continuously at submaximal intensity levels. In a wushu sanda match, it takes good arm muscle endurance skills to perform hitting movements for a long time. By having good muscular endurance abilities, the movement in fighting will be maximized. In this case, the coach must also provide a program with high intensity for the improvement of the physical condition of wushu sanda athletes.

Data collection from arm muscle explosive power tests by *chest throw medicine ball*. Overall male athletes in the less category were 3 athletes (60%). As for female athletes as a whole, they are included in the sufficient category, namely 3 athletes (100%). For this reason, the condition of male and female athletes is still in poor physical condition to prepare for PON XXI Sumatra / Aceh in 2024. The explosive power of the arm muscles is the ability of the athlete to use maximum force exerted in the shortest possible time to resist the medicine ball. For the explosive power of the trainer's arm muscles, it would be nice to improve even more until it is in good condition. Because there are still athletes in the category of sufficient and less, this if not improved is feared to worsen the performance of athletes during the match later.

Data collection from the limb muscle explosive power test by *chest tripple hope jump*. Overall male athletes in the less category were 3 athletes (60%). As for female athletes as a whole, they are included in the sufficient category, namely 3 athletes (100%). For this reason, the condition of male and female athletes is still in poor physical condition to prepare for PON XXI Sumatra / Aceh in 2024. The explosive power of the limb is the ability of the muscles to cope with loads or resistance with a very high speed of contraction. Muscle explosive power is a combination of several physical elements, namely strength and speed. For the explosive power of the trainer's arm muscles, it would be nice to improve even more until it is in good condition. Because there are still athletes in the category of sufficient and less, this if not improved is feared to worsen the performance of athletes during the match later.

Data retrieval from speed tests using a 20-meter sprint. The results of these measurements are generally male athletes in the very good category, which is 2 athletes (40%). As for female athletes as a whole, they are included in the sufficient category, namely 3 athletes (100%). For this reason, coaches can improve even better because some athletes are still in the category of women's enough to prepare for PON XXI Sumatra / Aceh in 2024. It is hoped that all athletes are in good condition to maximize when competing. Speed training is very influential for athletes because it can develop the speed of movement and the stability of the athlete's kick. In line with previous research conducted by (Yakin & Hasibuan, 2021), speed training can have an effect on increasing kick speed, judging from the t-count test  $> t$ -table ( $2.54 > 0.05$ ).

Data retrieval from *core tests* using the *12 Level Core Stability method*. The results of these measurements are generally male athletes in the very good category, which is 3 athletes (60%). As for female athletes as a whole, they are included in the very good category, namely 2 athletes (66.66%). *Core muscle test* is a test to see core muscle strength. Core muscles function to maintain balance, which affects movement function. In this case, athletes and coaches must maintain their physical condition ahead of PON XXI Sumut/Aceh Year 2024.

The next data is the collection of aerobic endurance test data (VO2 Max) using the *bleep test*. The results of these measurements are generally male athletes in the sufficient category, which is as many as 3 athletes (60%). As for female athletes as a whole, they are included in the sufficient category, namely 2 athletes (66.66%). Cardiovascular endurance is a very important thing for athletes to have. Because cardiovascular endurance determines the endurance of athletes when competing, when competing athletes are required to carry out continuous activities for a long period of time (Nusri & Panjaitan, 2019). For cardiovascular endurance, the trainer would be nice to improve even more until it is in good condition. Because there are still athletes in the category of sufficient and lacking, this if not increased is feared to worsen the performance of athletes during the competition later.

Then based on the recapitulation of the test results data above, the physical condition of wushu sanda athletes for men and women of long-term PON North Sumatra Province in 2024 is included in the sufficient category with a percentage (64%), thus the need to increase the intensity of training programs to support the improvement of athletes' physical condition, in this case the coach must work extra and athletes must also be active and train and follow all the programs that have been compiled and given by the coach in preparation for PON XXI SUMut/Aceh 2024.

#### IV. CONCLUSIONS

The physical condition of wushu sanda athletes long-term PON North Sumatra Province is mostly in the sufficient category. However, it is better for coaches to always evaluate and conduct regular tests to monitor the development of athletes' physical condition so that they are in good condition and ready to take part in the PON XXI Sumut/Aceh championship in 2024. So that the medals that have been won in the previous championship can be maintained and further improved. The implication of this study

## Analysis of the Physical Condition of Long-Term Wushu Sanda Athletes PON Athletes of North Sumatra Province in Facing the North Sumatra / Aceh National Sports Week XXI Year 2024

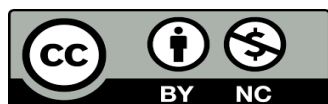
is that the physical condition of wushu sanda athletes for the long-term PON of North Sumatra Province is not good enough and is not optimally ready to take part in the XXI North Sumatra / Aceh PON championship in 2024.

### REFERENCES

- 1) Ambara, A. P. (2017). The relationship of physical condition to the achievements of Sanda wushu athletes at Sasana Kim Tiauw Surabaya. Thesis. Surabaya: Surabaya State University
- 2) Bishop, C., Turner, A., & Read, P. (2018). Effects of inter-limb asymmetries on physical and sports performance: A systematic review. *Journal of sports sciences*, 36(10), 1135-1144.
- 3) Chathuranga, W. M. V. D., & Perera, D. S. L. Determinants of Sports Performance in National Level Wushu Players: A Correlational Study between Anthropometric Variables and Wushu Performances.
- 4) Chattopadhyay, M., Purohit, S. G., & Samania, V. (2023). A COMPARATIVE STUDY OF THE PHYSICAL PERFORMANCE LEVEL OF ELITE INDIAN WUSHU PLAYERS DURING SPECIFIC PREPARATORY AND PRE-COMPETITIVE TRAINING PERIOD. *INTERNATIONAL JOURNAL OF RESEARCH PEDAGOGY AND TECHNOLOGY IN EDUCATION AND MOVEMENT SCIENCES*, 12(02), 146-151.
- 5) Damanik Suryadi. *The Development Model Coaching of Karate Club in the Junior High School of Medan City*. Department Of State University Of Medan, Indonesia. (2018). DOI 10.4108/eai.18-10-2018.2287428. AISTSSE 2018, October 18-19, Medan, Indonesia. <https://eprints.eudl.eu/id/eprint/8701/1/eai.18-10-2018.2287428.pdf>.
- 6) Damrah, Pitnawati, Erianita, Astuti Y (2019). Development of Shorinji Kempo Dojo Bantan Bengkalis Achievements, *International Journal of Social Science and Economic Research*, 4(8). 2455-8834
- 7) Dorschky, E., Camomilla, V., Davis, J., Federolf, P., Reenalda, J., & Koelewijn, A. D. (2023). Perspective on "In The Wild" Movement Analysis Using Machine Learning. *Human movement science*, 87, 103042.
- 8) Edwarsyah, & Linas, I. O. (2018). Review of the Physical Condition of Kerinci Regency Wushu Athletes. *Muara Sports Journal*, 1(1), 98–109. <https://doi.org/https://doi.org/10.24114/ko.v3i2.15240>
- 9) Fort-Vanmeerhaeghe, A., Bishop, C., Buscà, B., Aguilera-Castells, J., Vicens-Bordas, J., & Gonzalo-Skok, O. (2020). Inter-limb asymmetries are associated with decrements in physical performance in youth elite team sports athletes. *PLoS One*, 15(3), e0229440.
- 10) Furley, P., Schütz, L. M., & Wood, G. (2023). A Critical Review of Research on Executive Functions in Sport and Exercise. *International Review of Sport and Exercise Psychology*, 1-29.
- 11) Hanief, Y. N. (2019). Analysis of the Physical Condition of Wushu Puslatkot Kediri Athletes in Facing the 2018 East Java Provincial Championship. *JSES : Journal of Sport and Exercise Science*, 2(1), 1. <https://doi.org/10.26740/jses.v2n1.p1-8>
- 12) Hardiansyah, S. (2018). Analysis of Physical Condition Ability of Students of the Faculty of Sports Sciences, Padang State University. *MensSana Journal*, 3(1), 117. <https://doi.org/https://doi.org/10.24036/jm.v3i1.72>
- 13) Hardyanti, I. (2022). Physical Condition Analysis of Wushu Sanda Athletes Wanoro Seto Academy Surabaya. *Journal of Sports Achievement*, 5(2), 25–31.
- 14) Irwandi. (2010). The Effect of Circuit Training on Agility in Karate Sports Flow KKI Dojo Darul Ulum Banda Aceh in 2009/2010. *VISIPEN JOURNAL*, 1(2), 56–64. <https://doi.org/https://doi.org/10.46244/visipena.v1i2.30>
- 15) Jariono, G., Nursubekti, N., Indarto, P., Hendarto, S., Nugroho, H., & Fachrezy, F. (2020). Physical condition analysis using Kinovea software on taekwondo athlete Dojang Mahameru Surakarta. *Transformation: Journal of Community Service*, 16(2), 133–144. <https://doi.org/10.20414/transformasi.v16i2.2635>
- 16) Lei, Z., & Lv, W. (2022). Feature Extraction-Based Fitness Characteristics and Kinesiology of Wushu Sanda Athletes in University Analysis. *Mathematical Problems in Engineering*, 2022.
- 17) Long, L., Geok, S. K., Hu, L., Talib, O., He, S., & Lam, S. K. (2022). Effect of Core Strength Training on Wushu Performance: A Systematic Review. *Journal of Positive School Psychology*, 1744-1756.
- 18) Mehrosfar, A. H., Strahler, J., Gazerani, P., Khabiri, M., Sánchez, J. C. J., Moosakhani, A., & Zadeh, A. M. (2019). The effects of mindfulness training on competition-induced anxiety and salivary stress markers in elite Wushu athletes: A pilot study. *Physiology & behavior*, 210, 112655.
- 19) Monteiro, J. R. F., Vecchio, F. D., Vasconcelos, B. B., & Coswig, V. S. (2020). Specific wushu sanda high-intensity interval training protocol improved physical fitness of amateur athletes': A pilot study. *Revista de Artes Marciales Asiáticas*, 14(2), 47-55.
- 20) Moore, B. W. (2023). Physical Activity and Mental Health: A Randomised Controlled Trial Examining Martial Arts Training As A Psychosocial Intervention In Schools (Doctoral dissertation, Macquarie University).

## Analysis of the Physical Condition of Long-Term Wushu Sanda Athletes PON Athletes of North Sumatra Province in Facing the North Sumatra / Aceh National Sports Week XXI Year 2024

- 21) Latifa, U. (2017). Koni Strategy of East Java Province through Factors to Increase Athlete Achievement (Study in Wushu Sanda Sport). *Publika*, 5(4), 1–10.
- 22) Mylsidayu, A. (2017). Analysis of the Physical Condition of Porda Athletes in the Martial Arts Category in Bekasi City in 2016. *MOTION*, 8(1), 67–78. <https://doi.org/https://doi.org/10.33558/motion.v8i1.455>
- 23) Noviani, F. T., & Badri, H. (2019). Physical Condition Analysis of Wuhshu Athletes, Fifty City Regency. *Journal of Stamina*, 2(8), 83–93. <https://doi.org/10.24036/jst.v2i8.423>
- 24) Nusri, A., & Panjaitan, S. (2019). Efforts to increase VO<sub>2</sub>max through interval training in junior category Sanda Tobasa wushu athletes. *Health and Exercise*, 3(2), 96–105.
- 25) Ryzki, A., Eri, B., Isaac, A., & Yogi, S. (2021). Level A Physical Condition A Wushu Athlete A Category Taolu A Chang Quan. *Patriot Journal*, 3(March), 71–81. <https://doi.org/10.24036/patriot.v>
- 26) Saiful, M. A., Dra, U., Setyawati, H., Si, M., Yuwono, D. C., & Pd, M. (2013). Wushu martial arts coaching in Salatiga City in 2013. *ACTIVE: Journal of Physical Education, Sport, Health and Recreation*, 2(10), 624–629. <https://doi.org/10.15294/active.v2i10.2017>
- 27) Saputra, J. (2018). The effect of push-up training and pull-up training on the ability of straight punches in martial arts. *Journal of Physical Education*, 2(1), 104–110. <https://doi.org/https://doi.org/10.33369/jk.v2i1.9194>
- 28) Slimani, M., Chamari, K., Miarka, B., Del Vecchio, F. B., & Chéour, F. (2016). Effects of plyometric training on physical fitness in team sport athletes: a systematic review. *Journal of human kinetics*, 53, 231.
- 29) Sukamti, E. R., Budiarti, R., Nugroho, W., Miftachurochmah, Y., & Azeem, K. (2022). A study of physical fitness characteristics of junior wushu players depend on sex difference. *Jurnal Keolahragaan*, 10(1), 31-39.
- 30) Yakin, R. B., & Hasibuan, M. N. (2021). The effect of speed and agility training on increasing the speed of side kicks in male pencak silat athletes of Salam martial arts college in 2020. *Journal of Ilmiah STOK Bina Guna Medan*, 9(1), 15–23. <https://doi.org/https://doi.org/10.55081/jsbg.v9i1.250>
- 31) Zawawi, M. A., & Burstiando, R. (2020). Profile of the physical condition of senior Wushu Sanda Kediri athletes in facing the East Java Provincial Sports Week (Porprov) Year Profile of the physical condition of senior Wushu Sanda puslatkot Kediri athletes in provincial sports event (Porprov) East Java 2019. 6(1), 259–271. [https://doi.org/https://doi.org/10.29407/js\\_unpgri.v6i1.14279](https://doi.org/https://doi.org/10.29407/js_unpgri.v6i1.14279)



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.



## The Role of Exercise Therapy in the Prevention and Treatment of Degenerative Hypertension: Literature Review



Sabda Hussain As Shafi<sup>1</sup>, Enggista Hendriko Delano<sup>2</sup>, Abiyyu Amajida<sup>3</sup>, Wahyu Aji Nugroho<sup>4</sup>

<sup>1,2,3,4</sup> Department of Sport Science, Faculty of Sport and Health Science, Yogyakarta State University, Indonesia St. Colombo No. 1, Karangmalang, Yogyakarta, 55281, Yogyakarta

**ABSTRACT:** Human growth and development can be seen from fine and gross motor skills, cognitive abilities, and the maturity of cells in the body. A person's growth and development will reach the peak phase. People have differences regarding the factors of decline (degeneration) they experience. The process of decline can increase a person's risk of developing various diseases. Hypertension cases make this disease a contributor to the highest risk of death. Hypertension cases caused by lifestyle can be prevented or treated by exercising as a protector and treating hypertension cases. Hypertension cases caused by lifestyle can be prevented or treated by exercising as a protector and treating hypertension cases. This research method used a literature review search from 2018 to 2023 resulting in 556 articles which were selected into 5 articles according to research criteria. Research results of physical activity for 150 minutes/week with moderate intensity or 75 minutes/week with high intensity to improve the quality of fitness and public health. Combining aerobic exercise with weight training at least 2 times/week, with regular physical activity will increase a person's life expectancy, especially in the prevention and treatment of hypertension.

**KEYWORDS:** Hypertension, Exercise Therapy, Physical Activity

### I. INTRODUCTION

Living creatures are creatures that develop and grow. Humans are perfect living creatures. Human growth and development indicates increasing age. Human growth and development can be seen from fine and gross motor skills, cognitive abilities, and the maturity of cells in the body (Fallo, 2013). A person's growth and development will reach the peak phase. People have differences regarding the factors of decline (degeneration) they experience. The process of decline can increase a person's risk of developing various diseases.

Degenerative diseases are a collection of types of diseases that occur due to the inability of internal organs to work normally due to the deterioration of cells in a person's body during the aging process (Santoso et al., 2021). The aging process or decline in cell function on average is experienced by a person when they reach the age of 40 years and over (Kesetyaningsih et al., 2020), with various kinds of disease complaints that often occur such as hypertension, diabetes mellitus, stroke, heart disease, which is usually called the dangerous circle of death, which are interconnected (Ministry of Health, 2022).

In this modern era, many people suffer from degenerative diseases during their productive years. The main factors are sedentary daily activity, body food intake, and lifestyle (Renzo et al., 2021). The average productive age person experiences degenerative disease in the form of hypertension, due to stress, poor diet and sleep patterns, this is supported by research (Kasumayanti et al., 2021) that 36 research samples out of 104 samples experienced hypertension at the age of 20-45 years, with the level of stress and unhealthy lifestyle carried out by the sample. Hypertension is a disease where the blood pressure in the body is  $\geq 140$  mmHg systolic and  $\geq 90$  mmHg diastolic. The prevalence of hypertension worldwide is around 1.28 billion in adults, with 46% of people unaware they have hypertension, 42% of people with hypertension are diagnosed and treated, and 1 in 5 people (21%) can control hypertension (WHO, 2023). Riskesdas in 2018, the prevalence of hypertension in Indonesia was 34.11%, the estimated number of hypertension cases in Indonesia was 63,309,620 people, while the death rate in Indonesia due to hypertension was 427,218 deaths.

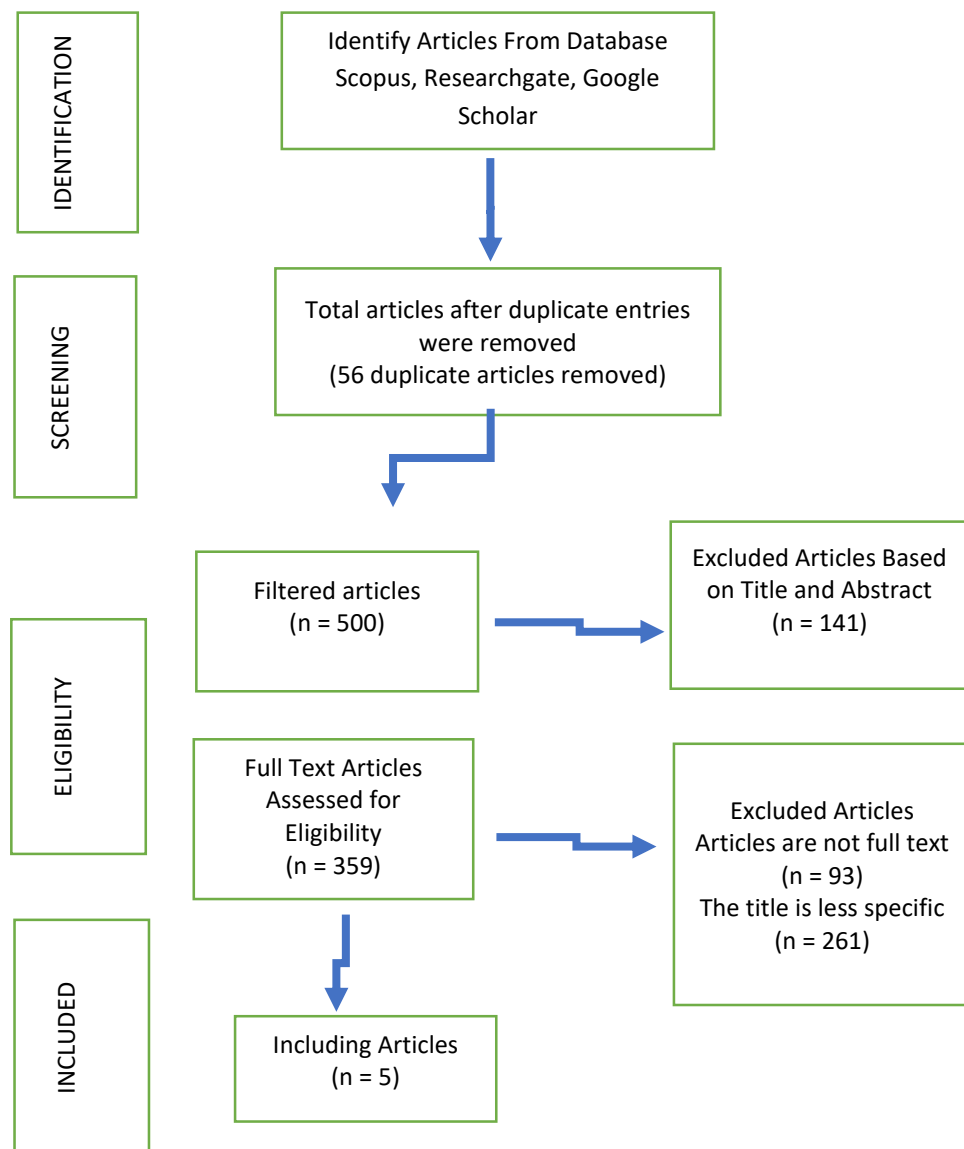
The large number of cases of hypertension makes this disease a contributor to the highest risk of death, so it is necessary to implement preventive or rehabilitative processes. Preventive is a way to prevent disease from entering the body in various ways, while rehabilitative is a way to carry out healing treatment which can be done pharmacologically or non-pharmacologically.

# The Role of Exercise Therapy in the Prevention and Treatment of Degenerative Hypertension: Literature Review

Pharmacological treatment is the provision of therapy using drugs to lower or regulate blood pressure, while management which is included in non-pharmacological therapy is by modifying lifestyle including hypertension diet, physical activity, stress management, patient compliance with regular blood pressure control (Machus et al., 2020) . This article examines in more depth the role of exercise in preventing and treating hypertension.

## II. METHOD

Qualitative research with *literature review studies* uses various literature studies to strengthen research analysis with secondary data. Secondary data is taken indirectly to provide information to the author. Data sources can be reports, articles from accredited and indexed journals related to *exercise therapy in hypertensive patients*. There are four stages in PRISMA: the first stage, identifying selected articles, must meet the requirements, such as articles published from 2018 to 2023; The second stage was screening 556 articles obtained from Scopus, Google Scholar, and Researchgate which were then evaluated, and the selected articles were assessed for their relevance. The third stage is the feasibility of the article, analysis and evaluation of its feasibility. Evaluation of the importance of articles at the eligibility stage was assessed based on the title and abstract carried out by two independent reviewers. The fourth stage is explanation of the results. Articles that meet the exclusion criteria will be removed. The fourth stage is the inclusion of screening results under the criteria. The article search technique uses keywords in Scopus in the form of "exercise therapy", "Hypertension" .



At the filtering stage, the identification results of 556 articles obtained from Scopus, Google Scholar, and Researchgate were evaluated to identify duplicates or articles that indicated the same content. Next, at the suitability stage, the article is analyzed and assessed for suitability, with a focus on the title and abstract by two independent reviewers. Articles that met the inclusion criteria were then reviewed in detail as a whole. Based on the PRISMA Stage, 5 articles met the inclusion criteria, and

## The Role of Exercise Therapy in the Prevention and Treatment of Degenerative Hypertension: Literature Review

these 5 articles were reviewed in this study. A detailed summary of the PRISMA process can be seen in Figure 1. Based on the systematic review process, 5 articles were selected that met the criteria for the Role of Exercise in the Prevention and Treatment of Degenerative Hypertension.

### III. RESULTS AND DISCUSSION

#### A. RESULTS

The results of the search for articles in the literature review showed that there were six articles filtered according to research criteria, based on the title and abstract with a description of the six articles which can be seen in table 1.

Table 1 Literature review

No.	Author	Title	Methods	Sample	Results
1	(Gorostegi-Anduaga et al., 2018)	Effects On Cardiovascular Risk Scores And Vascular Age After Aerobics Exercise And Nutritional Intervention In Sedentary And Overweight/ Obese Adults With Primary Hypertension: The EXERDIET-HTA Randomized Trial Study	CVR and VA were determined (n=167, 53.7±7.8 years) using the Framingham Risk Score (FRS) and the new equation for prediction of 10-year atherosclerotic cardiovascular disease (ASCVD) risk, before and after the 16-week intervention period (program different aerobic exercises+hypocaloric diet). Sex-specific risk factors considered were age, high-density lipoprotein cholesterol (HDL-C), total cholesterol, systolic blood pressure (SBP), diabetes mellitus (DM) and smoking status.	108 men and n=59 women	From baseline to follow-up, participants reduced ( $p \leq 0.001$ ) FRS-CVR and VA scores, and SBP. Total cholesterol decreased significantly, but specifically in men ( $p \leq 0.001$ ), and antihypertensive drugs (%) in women ( $p = 0.047$ ). No significant differences over time were observed for HDL-C, smoking, DM overall for both sexes. For ASCVD-CVR there were no changes overall or for both sexes. After intervention, women had lower CVR scores than men ( $p \leq 0.001$ ). Improvements in CVR factors after a 16-week lifestyle change intervention reduced the risk of suffering a CV event in the following 10 years in overweight/obese adults with HTN assessed with the FRS estimation tool.
2	(Smart et al., 2019)	An evidence based analysis of managing hypertension with isometric resistance exercise—are the guidelines current?	meta-analyses	Twelve studies provided data on 326 participants.	Our recent IPD meta-analysis showed that IRT (three times a week with a total of 8 minutes of squeezing activity) was able to reduce participants' SBP by 6-7 mmHg. Similar levels of blood pressure reduction resulting from prescription drug use have been shown to equate to a 13% reduction in the risk of myocardial infarction and a 22% reduction in the risk of stroke.
3	(Atef & Abdeen, 2021)	Effect of exercise on sleep and cardiopulmonary parameters in patients with	randomized into two equal groups. training group (A) and control group (B).	30 samples	Sleep scores and RVSP showed a significant decrease and VO2max—which represents aerobic fitness showed a significant increase in group (A) compared with group (B)

## The Role of Exercise Therapy in the Prevention and Treatment of Degenerative Hypertension: Literature Review

		pulmonary artery hypertension			
4	(Yasu, 2022)	Comprehensive cardiac rehabilitation program for peripheral arterial diseases	The most useful screening method for PAD is the ankle brachial pressure index (ABI).	25 samples	Exercise therapy is contraindicated in patients with acute arterial occlusion and CLI with infection. PAD is often associated with other atherosclerotic diseases; patients should be monitored for ischemic heart disease during an initial exercise stress test using the Gardner treadmill protocol. Supervised exercise therapy is strongly recommended (Class I, Level of Evidence A). As an alternative, a home exercise program is also feasible (Class IIa, Level of Evidence A). Exercise type (treadmill, track walk, ergometer), frequency (3 to 5 days per week), intensity (speed and incline), and duration (30 minutes) were determined based on the results of an exercise stress test for each patient. Exercise should be continued at least 3 times a week for a minimum of 12 weeks. Cilostazol is highly recommended (Class I, Level of Evidence A)
5	(Trillaud et al., 2023)	Tracking Biomarker Responses to Exercise in Hypertension	systematic approaches and randomized controlled trials in larger cohorts	22 samples	Emerging data suggest that improved aerobic fitness and vascular function as well as reduced oxidative stress, inflammation, and gluco-lipid toxicity are key biomarkers thought to trigger hypertension, but they only explain about half of its pathophysiology. New biomarkers such as EVs or microRNAs provide additional insights to understand the complex mechanisms involved in exercise therapy for HTN patients

### B. DISCUSSION

The results of the five articles show the role of exercise applied to hypertension sufferers, by including exercise as part of lifestyle changes. An appropriate and regular exercise program supported by other healthy living activities such as smoking cessation, stress management and sleep management, reduces the risk of developing primary hypertension. Apart from lowering blood pressure and reducing body weight, exercise also plays a role in the betablocker system in a person's body. A person's awareness of the role of sport influences the number of cases that occur in Indonesia.

The prevalence in Indonesia of hypertension reaches 28% and the Special Region of Yogyakarta occupies the third position in Indonesia (Sudarsono et al., 2017) . Hypertension is a problem that occurs in the cardiovascular system. Hypertension is characterized by systolic blood pressure  $\geq 140$  mmHg and diastolic  $\geq 90$  mmHg which can be caused by lifestyle and genetic factors (Mills et al., 2020) .

Hypertension is referred to as a silent killer, divided into two, namely primary (essential) hypertension and secondary hypertension. Primary hypertension is an increase in blood pressure for which there is no known cause. Cases of primary hypertension are often found in the community because 90% have primary hypertension. Secondary hypertension is an increase in blood pressure due to certain medical conditions such as kidney disease, parathyroid glands, adrenal glands, occurring in society in 5%-10% of cases of secondary hypertension (Bassareo et al., 2023) , factors that influence the symptoms of hypertension Drink coffee ( caffeine), obesity, consumption rich in sodium/sodium, age, genetics, smokers and alcohol drinkers (Siwi & Susanto, 2020) . Obesity can cause hypertension through various mechanisms, both directly and indirectly. Obesity can directly cause an increase

## The Role of Exercise Therapy in the Prevention and Treatment of Degenerative Hypertension: Literature Review

in cardiac output because the greater the body mass, the greater the amount of blood circulating so that cardiac output also increases. Indirectly, through stimulating the activity of the sympathetic nervous system, while smoking can damage the endothelial lining of blood vessels, cigarettes contain nicotine and carbon dioxide which can cause the elasticity of blood vessels to decrease and cause the effect of increasing blood pressure.

Hypertension cases caused by lifestyle can be prevented or treated by exercising as protection and medication for hypertension cases. This is supported by (Yakasai et al., 2021) in their research showing that moderate intensity aerobic exercise plays a role in controlling blood pressure. Exercise is beneficial for hypertension sufferers because it can increase heart rate, vasodilate blood vessels so that blood flow becomes smoother, and reduces the hormone norepinephrine if done regularly. WHO recommends doing physical activity for 150 minutes/week at moderate intensity or 75 minutes/week at high intensity to improve the quality of people's fitness and health. Combining aerobic exercise with weight training at least 2 times/week, with regular physical activity will increase a person's life expectancy, especially in the prevention and treatment of hypertension (Dempsey et al., 2018).

Weight training will burn more calories, stimulate the immune system, and improve the cardiovascular system because it requires a lot of oxygen consumption. Moderate intensity aerobic exercise for 30 minutes a day using 50%-70% of maximum heart rate will reduce blood pressure by 3-7 mmHg measured at rest (Muhammad et al., 2020).

Weight loss is best achieved by combining calorie reduction and physical activity. The ideal approach is gradual and results in long-lasting weight loss, with a weekly loss goal of 1 to 2 kg. A reduction of approximately 1 mmHg is expected for every kilogram of weight loss, among individuals with obesity and hypertension who meet appropriate criteria (body mass index >35 [calculated as weight in kilograms divided by height in meters squared] and uncontrolled hypertension), bariatric surgery can cause major weight loss and significantly increase blood pressure.

Physical activity: Most clinical trials show the effect of lowering blood pressure. Physical activity has used aerobic exercise such as brisk walking, swimming, dancing, or gym exercises, but dynamic resistance such as hand grips or yoga are also beneficial. Based on clinical trial evidence, an exercise duration of 40 to 60 minutes at least 3 times per week is optimal for lowering blood pressure.

Physical activities carried out include cycling, gardening, walking, mopping, washing, while sports exercises carried out must pay attention to Frequency, Intensity, Time, Type and Enjoy (FITTE). Sports that can be done by hypertension sufferers include walking, jogging, swimming, cycling. The following is an explanation from FITT:

**Table 2 Training Program**

	Explanation	Explanation
Frequency	3-4 times a week	2 times a week
Intensity	Moderate (40-60%) maximum heart rate	Medium (10-25%) 1 RM 6-8 repetitions 1-2 sets
Time	40 minutes per training session	40 minutes per training session
Enjoy	Sufferers carry out activities with pleasure and enjoyment	

## IV. CONCLUSION

Implementing a healthy lifestyle by carrying out a sports training program properly and correctly will increase a person's life expectancy. Exercise can prevent and treat hypertension. Exercise must be done with the right program for hypertension sufferers, which can be consulted with a personal trainer and doctor. People with hypertension should not exercise to hold their breath for too long because it can break blood vessels due to the pressure applied.

## REFERENCES

- 1) Atef, H., & Abdeen, H. (2021). Effect of exercise on sleep and cardiopulmonary parameters in patients with pulmonary artery hypertension. *Sleep and Breathing*, 25 (4), 1953–1960. <https://doi.org/10.1007/s11325-020-02286-9>
- 2) Bassareo, P.P., Calcaterra, G., Sabatino, J., Oreto, L., Ciliberti, P., Perrone, M., Martino, F., D'Alto, M., Chessa, M., Di Salvo, G., & Guccione, P. (2023). Primary and secondary pediatric hypertension. *Journal of Cardiovascular Medicine*, 24, E77–E85. <https://doi.org/10.2459/JCM.0000000000001432>
- 3) Dempsey, P.C., Larsen, R.N., Dunstan, D.W., Owen, N., & Kingwell, B.A. (2018). Sitting less and moving more has implications for hypertension. *Hypertension*, 72 (5), 1037–1076. <https://doi.org/10.1161/HYPERTENSIONAHA.118.11190>

## The Role of Exercise Therapy in the Prevention and Treatment of Degenerative Hypertension: Literature Review

- 4) Di Renzo, L., Gualtieri, P., & De Lorenzo, A. (2021). Diet, nutrition and chronic degenerative diseases. *Nutrients* , 13 (4), 13–15. <https://doi.org/10.3390/nu13041372>
- 5) Fallo, I. S. (2013). The initial step in developing prospective athletes is by changing the ability of muscle function which is controlled by the nervous system. appearance . Many changes have occurred as a result of both economic decline. *Analysis of Children's Motor Development Patterns as an Initial Step in the Development of Prospective Athlete* , 2 (88), 141–149.
- 6) Gorostegi-Anduaga, I., Maldonado-Martín, S., Martínez-Aguirre-Betolaza, A., Corres, P., Romarate Zabala, E., Whittaker, A.C., Francisco-Terreros, S., & Pérez-Asenjo, J. ( 2018). Effects on Cardiovascular Risk Scores and Vascular Age After Aerobic Exercise and Nutritional Intervention in Sedentary and Overweight/Obese Adults with Primary Hypertension: The EXERDIET-HTA Randomized Trial Study. *High Blood Pressure and Cardiovascular Prevention* , 25 (4), 361–368. <https://doi.org/10.1007/s40292-018-0281-0>
- 7) Kasumayanti, E., Zurrhami, & Maharani. (2021). *Factors Associated with the Incidence of Hypertension in Productive Age in Pulau Jambu Village, Kuok Public Health Center Work Area* . 5 (23), 1–7.
- 8) MINISTRY OF HEALTH. (2022). Degenerative disease. *Republic of Indonesia Ministry of Health* .
- 9) Kesetyaningsih, TW, Astuti, Y., & Noor, Z. (2020). Regular Physical Activity to Prevent Degenerative Diseases. *BERDIKARI: Journal of Innovation and Application of Science and Technology* , 8 (1), 48–58. <https://doi.org/10.18196/bdr.8176>
- 10) Machus, AL, Anggraeni, A., Indriyani, D., Anggraini, DS, Putra, DP, & Rahmawati, D. (2020). Treatment of Hypertension by Improving Lifestyle in an Effort to Prevent Increased Blood Pressure. *Journal of Science, Technology, and Entrepreneurship* , 2 (NO. 2), 51–56. <https://online-journal.unja.ac.id/jkmj/article/download/12396/10775/33174>
- 11) Mills, K. T., Stefanescu, A., & He, J. (2020). The global epidemiology of hypertension. *Nature Reviews Nephrology* , 16 (4), 223–237. <https://doi.org/10.1038/s41581-019-0244-2>
- 12) Muhammad, M., Nuhu, J., Hassan, T., Baba, S., Radda, M., Mutawakkil, M., & Musa, M. (2020). Therapeutic exercise for hypertension: An update for exercise prescribers. *Nigerian Journal of Cardiology* , 17 (1), 11. [https://doi.org/10.4103/njc.njc\\_24\\_19](https://doi.org/10.4103/njc.njc_24_19)
- 13) Santoso, P., Wahyu Udayani, NN, Sunadi Putra, IMA, & Arman Anita Dewi, NLK (2021). Information on Degenerative Disease Drugs and Alternative Therapies. *COMSERVA Indonesian Journal of Community Services and Development* , 1 (4), 144–149. <https://doi.org/10.59141/comserva.v1i4.19>
- 14) Siwi, AS, & Susanto, A. (2020). Journal of Bionursing Analysis of Factors Affecting the Incident of Hypertension. *Journal of Bionursing* , 3 (2), 164–166.
- 15) Smart, N. A., Gow, J., Bleile, B., Van der Touw, T., & Pearson, M. J. (2019). An evidence-based analysis of managing hypertension with isometric resistance exercise—are the guidelines current? *Hypertension Research* , 43 (4), 249–254. <https://doi.org/10.1038/s41440-019-0360-1>
- 16) Sudarsono, EKR, Sasmita, JFA, Handyasto, AB, Kuswantiningsih, N., & Arissaputra, SS (2017). Increasing Knowledge Related to Hypertension to Improve Blood Pressure in Youth in Japanan Hamlet, Margodadi, Seyegan, Sleman, Yogyakarta. *Journal of Community Engagement (Indonesian Journal of Community Engagement)* , 3 (1), 26. <https://doi.org/10.22146/jpkm.25944>
- 17) Trillaud, E., Klemmer, P., Malin, S. K., & Erdbrügger, U. (2023). Tracking Biomarker Responses to Exercise in Hypertension. *Current Hypertension Reports* , 25 (10), 299–311. <https://doi.org/10.1007/s11906-023-01252-6>
- 18) WHO. (2023). *Prevalence of Hypertension* . 1–10.
- 19) Yakasai, AM, Maharaj, SS, Nuhu, JM, & Danazumi, MS (2021). Moderate intensity endurance exercise: a beneficial intervention for relative cardiovascular parameters of primary and secondary hypertensive patients. Randomized controlled trial. *European Journal of Physiotherapy* , 23 (4), 259–265. <https://doi.org/10.1080/21679169.2020.1720800>
- 20) Yasu, T. (2022). Comprehensive cardiac rehabilitation program for peripheral arterial diseases. *Journal of Cardiology* , 80 (4), 303–305. <https://doi.org/10.1016/j.jjcc.2021.11.011>



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Protection of Bank Customers in Savings Account Hacking Through Illegal Links



Muhamad Shafwan Afif<sup>1</sup>, Yansiska<sup>2</sup>, Theresia Anita Christiani<sup>3</sup>

<sup>1,2</sup>Students Of Magister Of Law Program, Universitas Atma Jaya Yogyakarta, Indonesia

<sup>3</sup>Lecture Of Faculty Of Law Program, Universitas Atma Jaya Yogyakarta, Indonesia

**ABSTRACT:** Research regarding the protection of bank customers in savings account hacking through illegal links aims to determine legal protection for bank customers who are victims of burglary of savings accounts via illegal links based on the Indonesian ius constitutum. Customers are important people in the banking world and the security of both their data and savings must be maintained, however, there are still many irresponsible individuals who steal bank customer data through any application. The results of this research are that there is no ius constitutum regarding burglary via illegal links, but currently what can be used as legal protection for bank customers who are victims of cases of burglary of savings accounts via illegal links is Article 52 paragraph (2) of Law Number 10 of 1998 concerning Banking, then Article 28 paragraph (1) of Law Number 11 of 2008 concerning Information and Electronic Transactions, Article 362 of Law Number 1 of 1946 concerning Regulations on Criminal Law (KUHP).

**KEYWORDS:** Law, Bank, Account Hacking, Illegal Links

the era of globalization, many changes have been made, especially changes in the technology field, which are marked by the shift in media from print media to digital media using the internet in the form of websites or applications that support it. The transaction system in Indonesia has been affected, namely by using systems based on internet technology so that what was originally an ordinary transaction has now changed to an electronic transaction. [1] These changes are also experienced by institutions or agencies operating in the financial sector, both private and public, for example, banks. Banks are categorized as institutions whose function is to be a place to store people's wealth in the form of money and have a responsibility to the people who store them known as customers to safeguard the customers' money. Not only money, but banks also have to protect the identity of their customers, unless certain conditions the bank is allowed to provide customer data such as for court purposes and so on as stated in Law Number 10 of 1998 concerning Amendments to Law Number 7 of 1992 concerning Banking.

Customer data is very important and has its exclusivity because in principle this data is data that can only be owned by the financial institution and the customer. Customer data is very exclusive because it contains information that they own and must not be disseminated to outside parties or unauthorized parties. Indonesia has more than one regulation to guarantee the security of customer data, as is the case in Law Number 10 of 1998 concerning Amendments to Law Number 7 of 1992 concerning Banking, Law Number 27 of 2022 concerning Personal Data Protection, Bank Indonesia Regulations number 22/20/PBI/2020 concerning Bank Indonesia Consumer Protection, Financial Services Authority Regulation number 11/2022 concerning the Implementation of Information Technology by Commercial Banks, and finally in Financial Services Authority Circular Letter number 4/SEOJK.07/2014 concerning Confidentiality and Security Consumer Data or Personal Information.[2]

The fact that we often find in the field is that there are still efforts to fight ius constitutum carried out by irresponsible individuals in the form of leaking or taking data and taking money deposits from bank customers without the knowledge of the bank and the customer. Bank customer data leaks in Indonesia are currently still the center of attention for all components of society, especially in this digital era, all levels of society entrust their finances or funds stored in banks, this is based on the easy conditions for opening deposits, the use of bank deposit facilities is also very easy and can be accessed for 1 full day within 24 hours, even in the hand. The term in this hand refers to the cellphone mediator as a tool used to carry out banking transactions with features provided by the bank known as mobile banking. As time goes by, people rely on mobile banking for their banking transaction

## Protection of Bank Customers in Savings Account Hacking Through Illegal Links

needs without paying attention or considering the security of confidentiality of customer data, which is used by irresponsible individuals. Currently, media are reporting this, such as Jogjaaja.com, which reports that there are many modes of fraud through clicking links on the WhatsApp application in the name of government or private institutions. [3] Detik Jatim also wrote news about Irwan Gema who was a victim of fraud in the form of clicking on illegal links in the eastern Java region (JATIM) and lost Rp. 549 million rupiah. [4] CNN Indonesia on Thursday 20 July 2023 wrote news that the Director General of Applications and Information at the Ministry of Communication and Information, Samuel Abrijani Pangerapan, said that there had been 94 cases of information leaks in Indonesia starting around 2019, and 35 of them occurred in 2023.[5] The news portal Kompas.com also wrote a news article on May 16 2023 that several experts believed that BSI had been hit by a ransomware-type cyber attack.[6]

There have been many previous studies regarding the legal basis for victims of bank customer leaks, such as Fanany's (2020) research with the title "Legal Protection of Bank Customer Personal Data (Case Study at PT Bank Jatim, Mojokerto City Branch)" which focuses on the researcher's analysis of the legal basis. owned by a bank customer regarding personal data. The strength of this research lies in the perception it creates, especially regarding the existing guidelines in Indonesia regarding the legal basis for customer personal data and also the several ways in which the object of the research, namely PT Bank Jatim, Mojokerto City Branch, specifically protects its customers. [7] The weakness of this research is that it only uses 1 type of ius constitutum, namely Law number 10 of 1998 concerning Banking. So, in this research, there is a difference, namely using other ius constitutum such as Law number 27 of 2022 concerning the Protection of personal data.

Another research conducted by Tarantang (2023) with the title "Legal Protection of Bank Customers in Digital Transactions", in this scientific paper analyzes that legal protection of bank customer data is interrelated with the protection of human rights. This research has advantages, because it offers a new legal basis that to protect a customer, the 2008 Information and Electronic Transactions Law can be used.[8] The weakness of this scientific paper is that it does not provide information regarding the protection received by victims of bank account burglary. Based on this description, this research has novelty, especially in explaining the basis for legal protection by victims of bank savings accounts hacked via illegal links.

Meanwhile, research conducted by Sudjana (2022) entitled "Leaking Bank Secrets as a Violation of Privacy Rights and Electronic Personal Data of Bank Customers", in this research analyzes the responsibilities of banks and their regulations. The advantage of this research is that it explains the bank's responsibility for leaking customer personal data.[9] The weakness of this research is that it does not provide a definite explanation about the consitutum for victims of bank account hacking via illegal links. Based on this description, this research has an update, namely linking the theory of legal certainty with the importance of an ius consitututm regarding the burglary of savings accounts through illegal links.

Previous research only focused on the bank's point of view and also the legal basis that protects bank customers in carrying out their activities, but on the other hand, there is a lack of information or explanation regarding ius consitututm regarding victims of savings accounts being hacked through illegal links. Meanwhile, this research has updates, emphasizing the importance of regulations for victims of breaches in bank savings account data via illegal links which are linked to the theory of legal certainty. This research aims to determine protection for bank customers in cases of burglary of savings accounts through illegal links based on the ius constitutum in Indonesia. Based on the objectives of this research, the problem formulation is: How is protection for bank customers in cases of burglary of savings accounts through illegal links based on the ius constitutum in Indonesia?

### I. METHODS

This legal research takes the form of normative juridical research by concentrating on cases viewed from the perspective of norms that are in harmony with current problems. Information collection uses library data collection techniques by utilizing information sources starting from the main important materials, namely Banking Law number 10 of 1998, Personal Data Protection Law number 27 of 2022, as well as the Criminal Code which has not yet been updated. Legal research supporting materials use theories, principles, and research results in books, scientific journals, and websites that discuss customer protection, personal data protection, and cybercrime from trusted sources.[10] The analytical method uses qualitative analysis by connecting cases with norms, principles, theories, or research results to give rise to a deductive conclusion in this research.[11]

### II. RESULT AND DISCUSSION

#### A. Legal Certainty Theory

The idea regarding the principle of legal certainty was originally explained by Gustav Radbruch in a book entitled "*einführung in die rechtswissenschaften*" which states that there are 3 basic legal values, namely the first is justice, the second is benefit, and the last is legal certainty. A legal certainty is a form of guarantee of justice contained in the law, where we know that there is the adigium *Lex nemini operator iniquum, neminini facit injuriam* "the law does not give injustice to anyone and does not wrong



## Protection of Bank Customers in Savings Account Hacking Through Illegal Links

anyone". Another opinion was expressed by Lord Lloyd who said that if there is no legal certainty then uncertainty will arise and this uncertainty can result in fights.[12]

The theory of legal certainty was presented by Michael Jefferson, he argued that a law must have elements such as the law must not be vague, the legislative body is prohibited from creating laws that apply retroactively, the judiciary is prohibited from creating new offenses, and the criminal code must be interpreted strictly. According to Michael Jefferson's view, the law must be firm, there must not be multiple interpretations and the application of the law must remain firm by the principle of legality. Magnis-Suseno also believes that the principle of legal certainty is legality which is an important element in the concept of the rule of law.[13]

Legal certainty can be interpreted as a principle that applies in the world of law, which is useful for guaranteeing the strength of a legal product so that it does not cause uncertainty and also as a guideline for a good society. This is in line with the purpose of law put forward by Peter Mahmud Marzuki, he believes that everything in the universe has its purpose, including law. Law has the aim of being a guide for society regarding activities it carries out in the environment.[14]

### **B. Protection For Bank Customers In Banking Law Indonesia**

If the law is grouped based on the period it comes into force, it is divided into 2 forms, namely *ius constitutum* and *ius constituendum*, the meaning of *ius constitutum* is law that has been in force and is being used by a particular government system, the popular term is positive law, while *ius constituendum* is a law that has not yet been implemented. ratified and stipulated by the competent government, so that it can be interpreted that the law is proclaimed, the popular term is a draft law or *prolegnas*. The function of *ius constitutum* is as a tool to regulate public order in social relations, so the law will always respond to changes and developments in people's behavior in its environment.[15] To maximize the function of law as a tool for regulating society, it goes through a series of processes that are quite numerous and must involve the role of citizens by the zone the law applies to obtain good quality legal products.[16] The series of processes can be started by observing social phenomena and changes in society, then the results are expressed in the form of norms in a draft law using legal language rules by the next big Indonesian dictionary reference called KBBI which contains orders and sanctions for violators, the final authorized by the government authorized by applicable law. *Ius constitutum* was created with the aim of the good of society, but it must be balanced with law enforcement that is running well because if law enforcement is not running well it can cause the articles in the law to be dormant and deemed to have failed to achieve their goals. [17] These things have fundamental similarities with legal theory relating to justice as put forward by several experts such as Gustav Radbruch who holds the view that the value of justice is "material" which must be the substance of legal standards, while valid rules are "structures" which must be maintaining the value of justice, then W.A.M. Luypen has another opinion that regulatory arrangements should be directed at equality. Justice is a fundamental standard in regulations because justice is contained in the content of a regulation which is obtained from interpreting a legal product.[18]

Indonesia, within the scope of wealth storage, has an institution, namely banking. Banking institutions have the aim of helping the implementation of community development to improve justice, monetary development, and community stability in seeking government assistance for the wider community, this is by the points in the fifth principle of Pancasila, namely social justice for all Indonesian people. The era of technological progress has made banking institutions innovate in the form of Internet Banking, which is a service for carrying out banking activities via the Internet network. *Internet Banking is a development that uses web innovation as a mode to complete exchanges and obtain data in the form of mobile banking or bank websites. This innovation uses the internet network as a means of connecting customers with the bank so that there is no need for face-to-face meetings on the spot.* [19] Customers can use a PC, tablet, PC, or cellphone connected to the internet network to connect customers with the bank system. E-banking is a technological innovation used by banks to fulfill the desires of customers who need financial services that are faster, more reliable, more concise, and affordable and can be accessed from anywhere. Regulations regarding Internet banking services are contained in Bank Indonesia Regulation number 9/15/PBI/2007 concerning the Implementation of Risk Management in the Use of Information Technology by Commercial Banks.[20]

The protection provided by the authorized government based on *ius constitutum* to bank customers is divided into 2 types, namely preventive and repressive.[21] Repressive legal protection takes the form of taking action and imposing sanctions such as administrative, criminal, prison, fines, and other additional penalties by the *ius constitutum*. This repressive effort is regulated in Article 52 paragraph (1) of Law number 10 of 1998 concerning Banking, which states that Bank Indonesia provides administrative sanctions to banks that commit acts of default or the leadership of Bank Indonesia has the option to refuse the dangerous bank's operating permit. Article 52 paragraph (2) of Law number 10 of 1998 concerning Banking regulates the types of administrative sanctions ranging from material fines to being branded as a dishonorable person in the banking world. In Article 100 paragraph

## Protection of Bank Customers in Savings Account Hacking Through Illegal Links

(1) of the Republic of Indonesia Government Regulation number 71 of 2019 concerning the Implementation of electronic systems and transactions, it is regulated that administrative sanctions may be imposed. [22]

Apart from repressive efforts, there are also preventive efforts that aim to protect customers from efforts that could harm them and from efforts to violate the law by irresponsible individuals. This preventive effort is regulated in article 1 point 28 of Law number 10 of 1998 concerning Banking which regulates bank secrecy as everything related to information, data about customers and their investment funds. In Article 40 paragraph (1) of Law number 10 of 1998 concerning Banking, it is also regulated that banks must keep information and data about customers and their savings funds confidential.[23] Other regulations that support the confidentiality of customer data are regulated in Article 44 paragraph (1) of Financial Services Authority Regulation number 11 of 2022 concerning the Implementation of Information Technology by Commercial Banks which regulates banks' obligations to realize the principle of protecting personal data when processing it, Article 45 paragraph (1) letter e also regulates that banks are obliged to establish personal data security to realize personal data protection when data exchange activities.[24] *Ius constitutum personal data protection is a manifestation of the 1945 Constitution of the Republic of Indonesia Article 28G paragraph (1) which regulates that every person has the right to protection of himself and his family, honor, dignity, and property under his control, as well as the right to a sense of security and protection from the threat of fear of doing or not doing something that is their human right.*[25] The problem of protecting individual information arises because of concerns that individual information could be misused by irresponsible individuals or groups unlawfully. This violation causes material and immaterial losses for the victim.

Legal protection for customers who provide personal data to banks is regulated in Article 10 paragraph (1) of Law number 27 of 2022 concerning the Protection of personal data which regulates that personal data subjects have the right to submit objections to decision-making actions that are based solely on processing. automated services, including profiling, that give rise to legal consequences or have a significant impact on the subject of personal data.[26] Article 10 paragraph (2) stipulates that further arrangements regarding objections to processing are automatically regulated in Government Regulations. If material and immaterial losses occur, the owner of personal data or the customer has the right to file a lawsuit and/or receive compensation by Article 12 paragraph (1) of Law number 27 of 2022 concerning the Protection of personal data which states that the individual subject of information has the privilege to sue and get rewards for violations of handling its information by legal guidelines".

### C. Cybercrime Via Illegal Links

Cybercrime is a crime in the form of misuse of internet technology, it can be stated as an unlawful act committed intentionally using the internet system based on the sophistication of computer and telecommunications technology. The Encyclopaedia Britannica book discusses cybercrime, namely the use of computer devices to carry out illegal acts, for example, identity theft, fraud, trafficking in pornographic content, and violation of privacy. Cybercrime and conventional crime have striking differences in terms of the use and utilization of technology. Aep S. Hamidin categorizes cybercrime crimes according to their types, namely:

1. *Unapproved Access;*
2. *Unlawful Items;*
3. *Conscious spread of infection;*
4. *Information Fabrication;*
5. *Digital undercover work, harm, and coercion;*
6. *Cyberstalking;*
7. *Carding;*
8. *Hacking and saltine;*
9. *Cybersquatting and typosquatting;*
10. *Piracy;*
11. *Cyberterrorism.*[27]

*Legal links are a combination of two syllables, namely link and illegal, links are also known as url.* Prayogi thinks that a link is a unified series of characters created based on certain standards to indicate an address on an internet network, while Sora's opinion is that a link is a series of characters that are deliberately arranged based on certain formatting rules, then used to describe an internet address in the form of text. , images, and files on the internet network.[28] Illegal has the meaning in the next major Indonesian dictionary reference called KBBI that is not based on the law or against the law. An illegal link can be interpreted as an electronic internet address that is useful as a domain and can be detrimental to its users because it is illegal or against the law with impacts in the banking world in the form of forced access to customers' data and can drain customers' savings, thereby causing great harm to customers.

## Protection of Bank Customers in Savings Account Hacking Through Illegal Links

The way to use this illegal link which is intended for theft in the banking sector is by clicking or inputting a link whose truth and authenticity we do not know, then it is automatically synchronized with the customer's mobile banking. There are many types and modes of sending illegal links to targets, including:

1. Through an illegal link sent via the WhatsApp application;
2. Through illegal links sent via Google Drive;
3. Through an illegal link sent via the Instagram application;
4. Through illegal links sent via email;
5. Through illegal links sent via the Facebook application;
6. Through illegal links sent via the Twitter application;
7. Through illegal links sent via a pop-up window;
8. Via illegal links sent via short message (messenger).

The use of legal links for criminal acts is usually reserved for crimes based on fraud and theft. This is because the main concept of using illegal links aims to take the victim's data by force and without the victim's consent, then use this data irresponsibly. For banking institution customers who are affected by the use of this illegal link, it can result in the customer's savings being lost and all being drained/taken by fraudsters via illegal links.

*The ius constitutum in Indonesia currently states clearly regarding illegal links. There are no regulations yet, but there are several IUS constitutums that have the same elements regarding fraud via illegal links and there are also laws that can be the basis for regulations for a bank customer to feel safe in carrying out savings deposit activities, these regulations include the Constitution of the Republic of Indonesia of 1945, Law number 10 of 1998 concerning Banking, Law number 11 of 2008 concerning Electronic Information and Transactions, Law number 1 of 1946 concerning the Criminal Code, Law number 27 of 2022 concerning Personal Data Protection, Government Regulation number 71 of 2019 concerning Implementation of Electronic Systems and Transactions. Based on the ius constitutum that has been explained, it can more or less create a sense of security and comfort for bank customers in the form of savings accounts.*

### D. Analysis

The Directorate of Cyber Crime, Bareskrim Polri, revealed that when taking bank customers' savings, the perpetrators had their fields of work. The perpetrator's first stage was in the field of application creation (APK) and its development. Apart from that, there was also the role of the perpetrator team to collect a database of potential victims whom they had targeted with the consideration that the potential victims were passive savings customers. *Fraudsters then drain savings accounts through their applications and carry out forced balance withdrawals which are against the law.* [29] According to Teguh Aprianto, a security practitioner, Cybersecurity Consultant, and Founder of Ethical Hacker Indonesia, via his tweet on the X @secgron account, during 2023 customer data leaks will continue to increase and there is no solution or certainty that someone will maintain the confidentiality of their data. It is proven that up to September 2023, there were still many cases of customer data theft among state institutions. In early October 2023, it was reported that OJK was the victim of a Royal ransomware (Blacksuit) attack, which was confirmed by OJK and had an impact on OJK's internal and external services being paralyzed and there was no resolution yet. Teguh Aprianto has created a page [www.periksadata.com](http://www.periksadata.com) to check whether our data has been leaked or not.

According to checkeddata.com records, so far as of September 26, 2023, more than 5 billion personal data has been leaked and there has been no definite response from the government. In its development, there is a cybercrime called Fraud Mode, changing customer data through illegal links, namely:

1. Fraudster contacting customers via WhatsApp by sending a link that is suspected to be illegal, accompanied by information in the opening sentence to get a package, gift, or wedding invitation;
2. The customer clicks on a link that is suspected to be illegal in APK format or other format which directs the customer to fill in an online form in the form of a telephone number and email;
3. From the results of inputting customer data on the allegedly illegal link, the customer gets an OTP (One Time Password) password, which is a secret code when making transactions or carrying out online activities which is sent to the customer's telephone number. The OTP password received by the customer is handed over unconsciously to the fraudster to change the customer's data;
4. The impact is that with customer data that has been changed, fraudsters can gain access to customers' mobile banking and/or request mobile banking activation;
5. Fraudster Fraudsters who succeed in accessing customers' mobile banking then carry out account debit transactions which result in material losses.

## Protection of Bank Customers in Savings Account Hacking Through Illegal Links

The act of fraud using illegal links is an activity of fraud and theft because this act contains an element of coercion for the personal gain of the perpetrators. If we use the interpretive analysis method that we associate with the existing *ius constitutum*, several articles can be charged that have elements similar to fraud via illegal links, although currently there has not been a phrase in the norms of legislation that uses the phrase illegal links until this writing was written.[30] Articles that can trap the perpetrator include Law number 11 of 2008 concerning Information and electronic transactions, Article 45 paragraph (2) which regulates that every person who has fulfilled the components as intended in Article 28 paragraph (1) will receive a maximum prison sanction of 6 years and/or a maximum fine of one billion rupiahs, meanwhile, Article 28 paragraph (1) regulates that every person who has no right and who deliberately conveys false and misleading news can cause losses to buyers on electronic exchanges. Still in the same *ius constitutum* Article 46 paragraphs (1) to paragraph (3) regulates that people who fulfill the components of Article 30 can be threatened with a maximum penalty of 8 years in prison and a maximum fine of Rp. 800,000,000,-, Article 52 paragraph (3) also regulates that any person who violates the provisions of Article 30 belonging to a central banking, banking, or financial institution will have the penalty added to two-thirds of the sentence, Article 30 which is the source of Article 46 and Article 52 regulates that every person who does not have the right to access a computer/ Electronic systems have a place with others. In the old version of the Criminal Code, cases of fraud via illegal links could be subject to Article 362 of the Criminal Code which stipulates that every person who commits an act of taking someone else's property against the law is threatened with an act of theft with a maximum prison sentence of 5 years or a maximum of 900 rupiah. , Article 378 of the Criminal Code can also ensnare perpetrators of illegal link fraud with elements of fraud and the threat of a maximum prison sentence of 4 years. Apart from that, Bank Indonesia can also impose administrative sanctions on banks that do not fulfill their obligations by the *ius constitutum* or the leadership of Bank Indonesia can revoke the business license of the bank concerned as regulated in Article 52 paragraph (2) of Law number 10 of 1998 concerning Banking. [31]

### III. CONCLUSION

Based on the problem formulation, namely how to protect bank customers in the case of burglary of savings accounts through illegal links based on the *ius constitutum* in Indonesia, the conclusion is that currently, cyber crime via illegal links is rampant in Indonesia, but for protection there is still no special *ius constitutum* regarding legal protection for victims of illegal link fraud crimes, especially bank customers. The principle in legal science is to recognize the term *Lex Specialis Derogat Lex Generalis* which can be interpreted as special rules overriding general rules and for illegal link fraud it is necessary to make special rules, but for now, *ius constitutum* can be used as legal protection for bank customers who are victims of burglary cases. savings accounts via illegal links are contained in Article 52 paragraph (2) of Law Number 10 of 1998 concerning Banking, then Article 28 paragraph (1) of Law Number 11 of 2008 concerning Information and Electronic Transactions, and Article 362 of Law Number 1 of 1946 concerning Regulations on Criminal Law (KUHP). Currently, there are no regulations governing the compensation that can be received by bank savings customers who suffer losses and the efforts that can be made by victims of hacking through illegal links, so the only effort that victims can make is to report it to the authorities. A customer is someone who entrusts their savings to a financial institution, namely a bank, but currently, there is no positive law to provide a sense of security to these customers, so victims of cybercrime in the form of illegal links are still not guaranteed security, which results in losing their savings balance.

### ACKNOWLEDGMENT

Gratitude to the founders and Co-Founders of the Law Faculty of Universitas Atma Jaya Yogyakarta and also thank you to Mrs. Theresia Anita Christiani and Mrs. Sundari who have guided the process of writing this scientific work.

### REFERENCES

- 1) Choirul Anam, "E-Money (Uang Elektronik) Dalam Perspektif Hukum Syari'ah", *Jurnal Qawanin* 2, no.1 (2018): 95-112.
- 2) Republik Indonesia, "Surat Edaran Otoritas Jasa Keuangan (SE-OJK) Nomor 4 tahun 2014 Tentang Kerahasiaan Dan Keamanan Data Dan/atau Informasi Pribadi Konsumen.
- 3) Jogja aja, "Begini Ragam Penipuan Nasabah Bank Via Klik Link di WA dan Cara Menghindarinya", <https://jogjaaja.com/read/begini-ragam-penipuan-nasabah-bank-via-klik-link-di-wa-dan-cara-menghindarinya>, 26 September 2023, jam 21.38 WIB.
- 4) Denza Perdana, "Modus Bahaya Link WhatsApp Bobol Rekening Nasabah hingga Miliaran Rupiah", <https://www.detik.com/jatim/hukum-dan-kriminal/d-6823700/modus-bahaya-link-whatsapp-bobol-rekening-nasabah-hingga-miliaran-rupiah>, 26 September 2023, jam 22.00 WIB.

## Protection of Bank Customers in Savings Account Hacking Through Illegal Links

- 5) CNN, "4 Kasus Kebocoran Data Semester I 2023, Mayoritas Dibantah", <https://www.cnnindonesia.com/teknologi/20230720060802-192-975421/4-kasus-kebocoran-data-di-semester-i-2023-mayoritas-dibantah>, 18 September 2023, jam 23.30 WIB.
- 6) Galuh Putri Riyanto, "Data Nasabah BSI Diduga Disebar Hacker, Kominfo Bicara Soal Ancaman Sanksi", <https://tekno.kompas.com/read/2023/05/16/11340077/data-nasabah-bsi-diduga-disebar-hacker-kominfo-bicara-soal-ancaman-sanksi>, 19 September 2023, jam 13.30 WIB.
- 7) Nadiyah Octavia Fanany, "Perlindungan Hukum Terhadap Data Pribadi Nasabah Bank (Studi Kasus di PT Bank Jatim Cabang Kota Mojokerto)", *Dinamika, Jurnal Ilmiah Ilmu Hukum* 26, no. 2 (2020): 136-146.
- 8) Jefry Tarantang, Ibnu Elmi A.S. Pelu, Wahyu Akbar, Rahmad Kurniawan, dan Aldina Sri Wahyuni, "Perlindungan Hukum Terhadap Nasabah Bank Dalam Transaksi Digital", *Morality : Jurnal Ilmu Hukum* 9, no. 1 (2023): 15-25.
- 9) Sudjana, "Pembocoran Rahasia Bank Sebagai Pelanggaran Hak Privasi dan Data Pribadi Elektronik Nasabah Bank", *Refleksi Hukum* 6, no. 2 (2022): 247-266.
- 10) Dr. Jonaedi Efendi, & Prof. Dr. Johnnya Ibrahim, *Metode Penelitian Hukum Normatif Dan Empiris* (Depok: Prenadamedia Group, 2018). Hlm 123.
- 11) Heri Retnawati, *Analisis Kuantitatif Instrumen Penelitian (Panduan Peneliti, Mahasiswa, dan Psikometrian)* (Yogyakarta: Parama Publishing, 2016), Hlm 41.
- 12) Mario Julyano dan Aditya Yuli Sulistyawan, "Pemahaman Terhadap Asas Kepastian Hukum Melalui Konstruksi Penalaran Positivisme Hukum", *Jurnal Crepido* 1, no. 1 (2019): 13-22.
- 13) E. Fernando M. Manullang, *Legisme, Legalitas dan Kepastian Hukum* (Jakarta: Kencana, 2017), Hlm 159.
- 14) Oemar Moechthar, *Eksistensi, Fungsi, Dan Tujuan Hukum Dalam Pespektif Teori dan Filsafat Hukum* (Jakarta: Kencana, 2020), Hlm 87.
- 15) Muhamad Shafwan Afif, dan Heru Sugiyono, "Perlindungan Hukum Bagi Pemegang Merek Terkenal Di Indonesia", *Jurnal USM Law Review* 4, no. 2 (2021): 565- 585.
- 16) Dr. Budi Pramono, *Sosiologi Hukum* (Surabaya: Scopindo Media Pustaka, 2020), Hlm 26.
- 17) Nailah Artanti, Annisa Nurbaiti, dan Wahdan Arum Inaati, "Pengaruh Tekanan Eksternal, Ketidakefektifan Pemantauan, Opini Auditm Dan Pergantian Direksi Terhadap Kecurangan Laporan Keuangan (Studi Pada Perusahaan Keuangan Sub Sektor Perbankan Periode 2016-2020) ", *E-Proceeding of management* 10, no. 2 (2023): 1476-1484.
- 18) Prof. Dr. Peter Mahmud Marzuki, *Teori Hukum* (Jakarta: Kencana, 2020), Hlm 30.
- 19) Salsabila Putrianda, "Analisis Hukum Terhadap Perlindungan Nasabah Dalam Menggunakan Internet Banking Di Indonesia (Studi Kasus Bank X)", *Dharmasiswa* 2, no. 3 (2022): 1469-1478.
- 20) Republik Indonesia, "Peraturan Bank Indonesia Nomor 9 Tahun 2007 Tentang Penerapan Manajemen Risiko Dalam Penggunaan Teknologi informasi Oleh Bank umum.
- 21) Apriani Rani, Grasia Kurniawati, Devi Siti, dan Hamzah Marpaung, "Perlindungan Hukum Nasabah Bank Dalam Hal Terjadinya Kesalahan Sistem Yang Mengakibatkan Perubahan Saldo Nasabah", *Syiar Hukum Jurnal Ilmu Hukum* 18, no. 2 (2020): 135-150.
- 22) Republik Indonesia, "Peraturan Pemerintah Nomor 71 Tahun 2019 Tentang Penyelenggaraan Sistem Dan Transaksi Elektronik", Pasal 100 ayat (1).
- 23) Republik Indonesia, "Undang-Undang Nomor 10 Tahun 1998 Tentang Perubahan Atas Undang-Undang Nomor 7 Tahun 1992 Tentang Perbankan", Pasal 40 ayat (1).
- 24) Republik Indonesia, "Peraturan Otoritas Jasa Keuangan Nomor 11 Tahun 2022 Tentang Penyelenggaraan Teknologi Informasi Oleh Bank Umum", Pasal 44 ayat (1).
- 25) Republik Indonesia, "Undang-Undang Dasar Negara Republik Indonesia Tahun 1945", Pasal 28 G ayat (1).
- 26) Republik Indonesia, "Undang-Undang Nomor 27 Tahun 2022 Tentang Perlindungan Data Pribadi", Pasal 10 ayat (1).
- 27) Akbar Galih Hariyono, dan Frans Simangunsong, "Perlindungan Hukum Korban Pencurian Data Pribadi (*Phising Cybercrime*) Dalam Perspektif Kriminologi, *Bureaucracy Journal:Indonesia Journal of Law and Social-Political Governance* 3, no 1 (2023): 428-439.
- 28) Ahmad Martani, Saripuddin M, dan Nurul Ikhsan, "Design and Build a Company Profile Website Based on the Bootstrap Framework and Code Igniter Framework At The Foundation Independent Scholar Caliph", *Jurnal Multidisiplin Madani* 2, no.6 (2022): 2895-2912.
- 29) Farih Maulana Sidik, " Bareskrim Ungkap Peran 13 Penipu Modus Kirim APK-Link yang Kurang 493 Rekening", <https://news.detik.com/berita/d-6524267/bareskrim-ungkap-peran-13-penipu-modus-kirim-apk-link-yang-kuras-493-rekening>, 11 Oktober 2023, 20.45 WIB.

## Protection of Bank Customers in Savings Account Hacking Through Illegal Links

- 30) Anton Hendrik Samudra, "Modus Operandi Dan Problematika Penanggulangan Tindak Pidana Penipuan Daring", *Mimbar Hukum* 31, no.1 (2019): 59-74.
- 31) MOHD.Yusuf Dm, Addermi, dan Jasmine Lim, "Kejahatan *Phising* dalam Dunia Cyber Crime dan Sistem Hukum di Indonesia", *Jurnal Pendidikan* 4, no.5 (2022): 8018-8023.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Bank Indonesia Independence after the Existing of Law Number 4 of 2023



Theresia Anita Christiani<sup>1</sup>, Chrissantus Kastowo<sup>2</sup>

<sup>1,2</sup> Faculty Of Law, Universitas Atma Jaya Yogyakarta , Indonesia

**ABSTRACT:** This study aims to find the juridical consequences of enacting Law No. 4 of 2023 on Bank Indonesia's Independence. This research is normative juridical research. Secondary data is used in this study. Secondary data divides of primary and secondary legal materials. Data analysis uses qualitative analysis, which is regulative and conceptual. This study aims to determine the position of Bank Indonesia's Independence as a juridical consequence of the enactment of Law No. 4 of 2023. This research is limited to a study based on secondary, not primary data

**KEYWORDS:** Data, Financial, Law, Primary, Secondary

### I. INTRODUCTION

In practice, there are problems in the financial sector, namely the uneven proportion of assets, which is still dominant in the banking sector for short-term sources of financing. Meanwhile, as a source of long-term financing, the non-bank financial sector still plays a minor role. The banking sector also has some fundamental issues. There are challenges to the entry of high-risk financial instruments and regulatory situations that have yet to be fully able to maintain the financial system's stability. Challenges in the financial sector also come from outside Indonesia, such as technological disruptions and the emergence of new financial risks related to climate change and the geopolitical situation. Based on these problems and challenges, it is necessary to reform the financial sector. This reform is expected to deepen and increase the efficiency of Indonesia's financial sector through efforts to broaden the reach, products, and investor base, promote long-term investment, increase competition to support efficiency, strengthen risk mitigation, and increase investor and consumer protection. Law No. 4 of 2023 concerning the Development and Strengthening of the Financial Services Sector (from now on referred to as the PPSK Law) was formed, which has consequences for regulations related to the financial services sector. The Bank Indonesia Law is one of the laws that changed with the issuance of the PPSK Law. One of the changes is regarding Bank Indonesia's Independence. This paper will discuss and analyze whether Bank Indonesia still has an independent position with the PPSK Law. In other words, this paper discusses the juridical consequences of enacting the PPSK Law on the Independence of Bank Indonesia. Financial Services Authority and Bank Indonesia must relate to Law No. 4 of 2023. Other studies discuss central banking institutions and the Financial Services Authority, which are studied from the perspective of regulations in other countries. This research includes research conducted by Monnet, E (2023), Lars P Feld, Volker Wieland (2021), Thomas F Huertas (2022), Istrefi, K. & PiloIU, A (2020), Jones, E. and Knaack, P. (2019). In Indonesia, there is particular research regarding Independence conducted by Inda Fresti Puspitasari (2023), Kusumawati (2023), Dinata AW (2017), and Achmad Fauzi (2023). This study discusses the Independence of Bank Indonesia from a legal aspect before the PPSK Law and an economic aspect. This research analyzes Bank Indonesia and the Independence of Bank Indonesia but has not used the perspective of the PPSK Law. This research discusses the Central Bank from the perspective of other countries' regulations or regulations before forming the PPSK Law. The novelty of this research is compared to previous research in that it discusses the juridical consequences of enacting the PPSK Law on the Independence of Bank Indonesia, which previous researchers have never done. This study aims to analyse the juridical consequences of the enactment of Law No. 4 of 2023 concerning the Development and Strengthening of the Financial Sector on the Independence of Bank Indonesia. In the opinion of Gustav Radbruch, values of legal validity will be used as a philosophical basis in analyzing whether the enactment of the PPSK Law can already contain the values of legal validity, as stated by Gustav Radbruch.

## **Bank Indonesia Independence after the Existing of Law Number 4 of 2023**

### **II. RESEARCH METHODS**

This research is normative juridical research. Secondary data is used in this study. Secondary data in this research consists of primary and secondary legal materials. The data used is secondary, which does not focus on field data. The secondary data used are primary legal materials and secondary legal materials. (Lego K, Said G, Zaidah N, I Gusti A., Abdul K.J., Willy N H, 2020) Secondary data is the same as library data or legal materials. Legal materials consist of secondary and primarily legal materials. Secondary legal materials consist of legal opinions obtained through books, magazines, the internet, journals, papers, research results, opinions of legal practitioners and legal experts, the Indonesian dictionary, and the legal dictionary. Searching for the expected findings in searching for truth is done by searching for legal truth in juridical studies (Andika PP, Muhamad Z. 2019) normative/ doctrinal. The search for truth to obtain an expected finding in the normative realm is finding legal rules, principles, and doctrines to answer legal issues. Methods of Data Collection Data collection is used to search for truth in Law. All the data will be analyzed using qualitative analysis (Mustapha Z et al., 2021). In data analysis, several approaches are assisted: statutory regulatory and conceptual approaches. The statutory approach is to find legal and legal ratios—the ontological basis of each article and the Law. The conceptual approach explains legal concepts related to efforts to find the expected findings. The approach from the aspect of the role of Law in economic activity is essential, although not in detail, and is still used in the analysis, as stated by Grachev (2019), to be instrumental in the research law. After presenting the data findings' results and analyzing and approaching them using the methods described previously, the next stage is concluding, which answers the legal issues raised. Conclusions are drawn from general matters to specific or deductive matters.

### **III. RESULTS AND DISCUSSION**

#### **III.1. Values in The Validity Of Law according to Gustav Radbruch.**

They were related to the previous description of Gustav Radbruch's legal validity (Alexy, Robert, 2021). recognize a law above positive Law, which applies as a norm of the legal system. According to Radbruch (Fernando Manullang, 2022), legal validity is part of the concept of legal certainty. Therefore, before discussing legal validity, it is necessary to reflect on Radbruch's ideas regarding the purpose of Law, one of which is legal certainty. In this context, the Law is determined positively. Because through positive Law, differences will be crushed. The three ideas in the value of Law have an antinomy between justice, legal certainty, and usefulness. The antinomy Radbruch puts the justice and usefulness of the antinomy with legal certainty. Validity becomes an essential part of legal certainty. Positive legal norms are created to realize ideal values that lead to good for society. These values are the value of legal certainty, the value of benefits, and the value of justice. Law No. 4 of 2023 Concerning the Development and Strengthening of the Financial Sector (UU PPSK) was made and enacted to realize the value of legal certainty, the value of benefits, and the value of justice for society.

#### **III.2 Criteria for Independence of Bank Indonesia.**

There have been dynamics in the regulation of Bank Indonesia since its inception until now. Current Bank Indonesia regulations are contained in Law No. 23 of 1999 concerning Bank Indonesia as amended by Law No. The year 2004. That Government Regulation in place of Law No. 2 of 2008 concerning the Second Amendment to Law Number 23 of 1999 ; Law of the Republic of Indonesia Number 6 of 2009 concerning the Stipulation of Government Regulations instead of Law Number 2 of 2008 concerning the Second Amendment to Law Number 23 of 1999 concerning Bank Indonesia to Become Law. The contents of the Law mentioned above have changed with the issuance of Law No. 4 of 2023. The central bank's Independence can also be seen from several criteria (Zainal Azikin, 1997, p. 16): a. Appointment of the governor/director. The position of the Central Bank is said to be independent if the Appointment of the governor must go through parliamentary approval. In this way, the legal Independence of the central bank can be more guaranteed. b. Liability issues. The Central Bank is not being independent if it is not subject to a particular department. An independent central bank is usually accountable to Parliament rather than the President. c. An independent central bank usually has the power to determine monetary policy. If the Government determines monetary policy while the central bank is only the implementer, it can be said that it is not independent.

#### **III.3. Bank Indonesia Independence After Existing of the PPSK Law**

The position of Bank Indonesia's Independence is strictly regulated in Article 4, paragraph 2 (amendments to the PPSK Law), which states that Bank Indonesia is an independent institution in carrying out its duties and authorities. It will be free from interference from the Government and/or other parties, except for matters certain matters which this Law expressly regulates. The definition of Independence under the PPSK Law is that Bank Indonesia is free from interference from any party except as specified in the Law in carrying out its duties. In this regard, Tasks a. determine and implement Bank Indonesia's monetary policy sustainably, consistently, and transparently; b. organize and maintain the smooth running of the Payment System, and c. establish and implement macroprudential policies. Bank Indonesia's objective is to achieve stability in the rupiah value, maintain



## **Bank Indonesia Independence after the Existing of Law Number 4 of 2023**

Payment System stability, and contribute to maintaining Financial System Stability to support sustainable economic growth. It shows that the PPSK Law clearly states an independent position. Below, we will analyse whether the changes to the Bank Indonesia Law contained in part five of the PPSK Law stipulate the Independence of Bank Indonesia.

### **A. Criteria for Appointing Governors.**

This criterion requires that the position of the Central Bank be considered independent if Parliament must approve the governor's Appointment. The PPSK Law stipulates changes to Article 41 (1), which stipulates that the Governor, Senior Deputy Governor, and Deputy Governor are proposed and appointed by the President with the approval of the House of Representatives. This provision stipulates that the amendment to article 41 in the PPSK Law requires the approval of the House of Representatives (Parliament) in the Governor of Bank Indonesia Appointment.

### **B. Bank Indonesia Accountability**

The Central Bank is independent if the central bank is not subject to a particular department. An independent central bank is usually accountable to Parliament, not the President.

Article 58 stipulates that Bank Indonesia must submit written and quarterly reports to the House of Representatives. The reports submitted are annual reports and quarterly reports. The report is evaluated by the DPR and used as material for an annual assessment of the performance of the Board of Governors, members of the Board of Governors, and Bank Indonesia. Bank Indonesia is obliged to announce Bank Indonesia's annual financial reports, which have been examined by the Supervisory Financial Institution in Indonesia, to the public through the mass media.

### **C. Determination of Monetary Policy**

An independent central bank usually has the power to determine monetary policy. If the Government determines monetary policy while the central bank is only the implementer, it can be said that it is not independent.

## **III.4. Requirements and Prohibitions for Members of the Board of Governors to Become Management and/or Members of Political Parties**

As is known, the prohibition on being an administrator and/or member of a political party was a provision that was removed in the Bank Indonesia Law before the PPSK Law came into existence. This provision was deleted in Law No. 3 of 2004. This deletion could provide potential interests for certain political parties in carrying out Bank Indonesia's duties. The requirements and prohibitions for members of the board of governors who are not administrators/and/or members of political parties at the time of nomination are re-established in the PPSK Law (amendments to articles 40 and 47 of the fifth part of the PPSK Law). The PPSK Law amends Article 40 and Article 47 of the PPSK Law to be as follows: Article 40 To be appointed as a member of the Board of Governors, the candidate concerned must meet the requirements: a. Indonesian citizens; b. have high integrity, character and morals; c. have expertise and experience in the fields of economics, finance, banking, or Law; and D. not an administrator and/or member of a political party at the time of nomination. The provisions of Article 47 of the BI Law were amended to read as follows: Members of the Board of Governors, either individually or collectively, are prohibited from having direct or indirect interests in any company; holding concurrent positions in other institutions unless due to his/her position, he is obliged to hold that position; and become an administrator and member of a political party. In the event that a member of the Board of Governors carries out 1 (one) or more prohibitions as intended, the member of the Board of Governors is obliged to resign from his position. These provisions are established to guarantee Bank Indonesia's independent position in carrying out its duties to achieve Bank Indonesia's objectives. This change will provide justice for society because Bank Indonesia will avoid being used for the interests of certain political parties. This change also implements the value of legal certainty because establishing a constitutionally independent position in the form of Law will provide a sense of legal certainty for those parties who implement the Law. These changes will provide more incredible benefits for society.

From the perspective of the values that must exist in the Law, namely the value of justice, the value of legal certainty, and the value of the usefulness of these changes, these values have been realized in the Law as stated by Gustaf Radbruch.

## **IV. CONCLUSIONS**

From the discussion above, the juridical consequences of enacting Law No. 4 of 2023 on Bank Indonesia's Independence are that the PPSK Law stipulates an independent position. Bank Indonesia has an independent position based on three criteria. The first of these criteria is the Appointment of the governor/director, which requires the approval of the House of Representatives. Criteria for accountability of the Central Bank, which is responsible to Parliament. The three criteria for Bank Indonesia's power in determining monetary policy. Apart from these three criteria, the PPSK Law stipulates changes to the requirements and prohibitions for members of the board of governors who are not administrators/and/or members of political parties at the time of nomination to be re-established in the PPSK Law (changes in articles 40 and 47 of the fifth part of the PPSK Law), as an effort

## Bank Indonesia Independence after the Existing of Law Number 4 of 2023

to give them more status. strong and independent Bank Indonesia. From the perspective of the values that must exist in the Law, namely the value of justice, legal certainty, and the value of the usefulness of these changes, these values have been realized in the Law as expressed by Gustaf Radbruch.

### ACKNOWLEDGMENTS

Thanks to Atma Jaya University Yogyakarta, which has funded this research and publication.

### REFERENCES

- 1) Andika PP, Muhamad Z. (2019). Legal Protection For Customer of Non-Bank product in Indonesia (2019), *Journal of Legal, Ethical and Regulatory Issues* 22 (3)
- 2) Alexy, Robert, 'Gustav Radbruch's Concept of Law,' *Law's Ideal Dimension* (Oxford, 2021; online ed, Academic, 19 Aug. 2021), <https://doi.org/10.1093/oso/9780198796831.003.0008>, accessed 24 July 2023.
- 3) Achmad Fauzi, Rudi Laksono, Al Humaira, B., Fitri Amaliyah Sholehah, Nur Hikmah, Putri Netasya Sari, Syifa Febyca Permadi, & Tiwi Nurnezi. (2023). Analisis Status Dan Kedudukan Bank Indonesia Sebagai Pelaksana Kebijakan Moneter Dalam Menangani Inflasi Menggunakan Penerapan Itf (Inflation Targeting Framework). *Jurnal Ekonomi Dan Manajemen*, 2(2), 76–85. <https://doi.org/10.56127/jekma.v2i2.649>.
- 4) Dinata, A. W. 2017 , Bank Sentral Dalam Sistem Ketatanegaraan Indonesia. *University Of Bengkulu Law Journal*, 2(1), 56–79. <https://doi.org/10.33369/Ubelaj.2.1.56-79>.
- 5) E. Fernando M . Manullang , (2022), Misinterpretasi Ide Gustav Radbruch mengenai Doktrin Filosofis tentang Validitas dalam Pembentukan Undang-Undang , *Undang: Jurnal Hukum ISSN 2598-7933* (online); 2598-7941 (cetak)Vol. 5 No. 2 (2022): 453-480, DOI: 10.22437/ujh.5.2.453-480
- 6) Grachev L. (2019). Comparative Institutional Law and Economics: Reclaiming Economics for socio-legal Research. *Maastricht Journal of European and Comparative Law.*; 26 ( 3):372–393. doi:10.1177/1023263X19840522
- 7) Jones, E. & Knaack, P. (2019). Global Financial Regulation: Shortcomings and Reform Options. *Glob Policy*, 10: pp. 193–206. <https://doi.org/10.1111/1758-5899.12656>
- 8) Lars P Feld, Volker Wieland, (2021). The German Federal Constitutional Court Ruling and the European Central Bank's Strategy, *Journal of Financial Regulation*, Volume 7, Issue 2, October 2021, Pages 217–253, <https://doi.org/10.1093/jfr/fjab006>
- 9) Lego K, Said G, Zaidah N, I Gusti A., Abdul K.J., Willy N H,(2020). Patent Policy on the Pharmaceutical In Indonesia, *Journal of Legal, Ethical and Regulatory Issues*, 23 (5).
- 10) Monnet, E. (2023). The Democratic Challenge of Central Bank Credit Policies" *Accounting, Economics, and Law: A Convivium*, 2023. <https://doi.org/10.1515/acl-2022-0113>
- 11) Mustapha, Z., Kunhibava, S.B. and Muneeza, A. (2021). "Legal and Sharī'ah non-compliance risks in Nigerian Islamic finance industry: a review of the literature," *International Journal of Law and Management*, Vol. 63 No. 2, pp. 275–299. <https://doi.org/10.1108/IJLMA-03-2020-0075>
- 12) Istrefi, K. & Piloiu, A. (2020). Public Opinion on Central Banks when Economic Policy is Uncertain. *Revue d'économie politique*, 130, 283-306. <https://doi.org/10.3917/redp.302.0283>
- 13) Inda Fresti Puspitasari, Dhany Efitasari, Siti Masitoh, 2023, Pengukuran Independensi Bank Indonesia Selama Covid-19, *Jurnal Pendidikan Ekonomi*Vol 8 (1) , <https://jurnal.stkippersada.ac.id/jurnal/index.php/JPE/article/view/2247>
- 14) Kusumawati, Alvina Putri Ayu And Maria, Nugroho Sumarjiyanto Benedictus, 2023, Analisis Hubungan Tingkat Independensi Bank Sentral Terhadap Stabilitas Sistem Keuangan Indonesia Pasca Krisis Keuangan Global. <https://repofeb.undip.ac.id/12637/>
- 15) Thomas F Huertas, (2022). Reset Required: The Euro-area Crisis Management and Deposit Insurance Framework, *Journal of Financial Regulation*, Volume 8, Issue 2, September 2022, Pages 187–202, <https://doi.org/10.1093/jfr/fjac007>



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## The Scientific Revolution in Europe and its Impact on Chinese Cosmology during the 16<sup>th</sup>-18<sup>th</sup> Centuries



Sha Ha

School of Foreign Studies, Guangzhou University, 230 Wai Huan Xi Road, Guangzhou Higher Education Mega Center, Guangzhou 510006, P.R. China

**ABSTRACT:** The scientific revolution, which developed in Western Europe during the 16<sup>th</sup>-18<sup>th</sup> centuries, was one of the most significant fruits of the activity of European universities. The cultural movement of Renaissance, born in Italy a century earlier, which moved the center of attention of scholars on man, 'blacksmith of his destiny' and on his dignity, with a marked curiosity for the laws of nature, greatly contributed to it. Another propulsive factor were the maritime expeditions across the Atlantic, the Pacific and the Indian Oceans, promoted by the kingdoms of Portugal and Spain at the end of the 'Reconquista', between the 15<sup>th</sup> and the 16<sup>th</sup> centuries. Their vessels crossed the Equator Line, discovering new lands and new skies. Celestial Mechanics was at the center of that peaceful revolution, owing to the initiative of scholars as Nicolaus Copernicus, Galileo Galilei, Tycho Brahe, Johannes Kepler, Isaac Newton. The Jesuit missionaries, sent to China by the Roman Catholic Church with evangelizing purposes, propagated among the scholars of the imperial court the use of the astronomical telescope and the adoption of the experimental method in science. Unfortunately, the Roman Catholic Church condemned in the same years the propagation of the heliocentric theory, because it contradicted the Bible, of which the Church considered to be its exclusive interpreter. This was a hindrance to the advancement of modern Celestial Mechanics in the Far East, until the Church ceased to obstruct the heliocentric theory toward the middle of the 18<sup>th</sup> century. It took another century for that theory to be fully accepted by Chinese scholars.

**KEYWORDS:** Ptolemaic Geocentric Universe, Copernican Heliocentric System, Tyconic Geo-heliocentric System, Kepler's Solar System

### 1. INTRODUCTION

The *scientific revolution*, which took place during the 16<sup>th</sup>-18<sup>th</sup> centuries, was one of the most significant fruits of the activity of European universities and the astronomical observatories established across the continent in medieval times. The European cultural panorama was not restricted to the academic world: the philosophical movement of *Humanism*, born in Italy during the 14<sup>th</sup> century from the study of classical antiquity by initiative of the scholar and poet Francesco Petrarca (1304-1374), moved the center of attention of scholars from Heaven to man, '*blacksmith of his destiny*'. The subsequent art movement of *Renaissance*, born in Florence towards the end of the same century, stimulated the interest of scholars for Nature and its laws. Over the course of two centuries *Renaissance* spread from Tuscany to the entire Italian peninsula and to the rest of the continent (Monfasani, 2020). Artists like Leonardo da Vinci (1452-1519) and Michelangelo Buonarroti (1475-1564), thinkers like Erasmus from Rotterdam (1466-1536), Michel de Montaigne (1533-1592) and Rene' Descartes (1596-1650), writers like Miguel de Cervantes (1547-1616) and William Shakespeare (1564-1616), were universal geniuses, capable of rejuvenating the way of thinking of the medieval man, transmitting to him enthusiasm for new discoveries in all sectors of knowledge.

As for Celestial Mechanics, European geo-political factors contributed to its extraordinary development: the maritime expeditions beyond the *Pillars of Hercules*<sup>1</sup> organized by the rulers of the Kingdoms of Portugal and Spain toward the end of the 15<sup>th</sup> century, after the conclusion of the *Reconquista*<sup>2</sup>, forced the navigators to carefully turn their eyes to the sky. Under the Spanish flag the Italian navigator Christopher Columbus' sailed westwards from Spain across the Atlantic Ocean, reaching in 1492 the coasts of Central America, while the Portuguese Vasco da Gama, sailing eastwards, crossed South Africa and reached in 1498

<sup>1</sup> *Pillars of Hercules*: The Gibraltar Strait.

<sup>2</sup> *Reconquista*: the military campaigns that Christian kingdoms undertook against the Muslim kingdoms established in the Iberian Peninsula, which initiated in 718 A.D. and ended with the fall of the Nasrid kingdom of Granada in 1492.

## The Scientific Revolution in Europe and its Impact on Chinese Cosmology during the 16th-18th Centuries

the coasts of India. His countryman Jorge de Alvares, sailing in the same direction, reached in 1521 for the first time the coasts of China. Another Portuguese navigator, Fernão de Magalhães (better known as Ferdinand Magellan), trying to find a western route to Asia, crossed the South Atlantic Ocean, and, through the *Magellan Strait* in South America, succeeded in reaching the coasts of Asia. In the Northern Hemisphere those navigators were guided by the *Polar Star* while, crossing the Equator's Line, they discovered the *South Star* and other new constellations (Crowther, 2015).

A religious institution, the Roman Catholic Church, one of the leading spiritual powers of Western Europe, opposed the scientific achievements of two prominent European astronomers of those times, Nicolaus Copernicus and Galileo Galilei, but also exerted a positive role in the intercultural communication between Europe and the Far East through its *Jesuit Mission to China*. The Roman Catholic Church, guided by the Pope, witnessed in the first quarter of the 16<sup>th</sup> century the rebellion by the German monk Martin Luther, whose *Protestant Reform* soon spread over Central and Northern Europe, followed by the *Anglican Schism* in the Kingdom of England, John Calvin's *Protestant Movement* in France and the Low Countries, the *Presbyterian* movement in Scotland and the *Swiss Protestant Reformation*. The Pope reacted with a *Counter-Reform*, strongly reaffirming in the *Council of Trent* (1545-1563) the exclusive right of the Church to interpret the Bible and establishing, in 1542, the Holy Roman Inquisition with the task of monitoring compliance with what proclaimed by the Church. The penalties for offenders, in the countries ruled by Catholic princes, were severe, reaching death at the stake. The Roman Church established also, in 1540, the *Society of Jesus*, whose missionary monks were sent to Central and South America to directly evangelize the natives (following the Spanish and Portuguese colonizer), and to India and the Far East with the purpose of establish contacts with the rulers of those countries (following there a *top-down* evangelizing strategy). The Jesuit monks of the *China Mission* constituted a selected group of men with a sophisticated cultural background, ranging from Humanities to Mathematics, Physics, Astronomy and Applied Sciences. They all spent a training period at *St Paul College* in Macao to learn Chinese, before making themselves known at the Imperial Court in Peking through their scientific knowledge. Over the course of a few decades they made themselves useful to the rulers through their advanced astronomical knowledge.

Purpose of this review paper is to retrace the efforts undertaken by Jesuit missionaries in transmitting the foundation of modern Celestial Mechanics to the Chinese *élite* during late Ming and the Qing dynasties.

As indicated in the References section, the basic texts utilized in this research are K. Crowther (2015), J.S. Heilbron (2018), S. Drake (2017), D.E. Mungello (2005), J. Needham (1995), N. Sivin (1995), as well other research papers and volumes quoted in the text.

The paper is subdivided into the following sections: 1. Introduction, 2. Development of Celestial Mechanics in Europe during the 16<sup>th</sup>-18<sup>th</sup> Centuries, 3. Ancient Chinese Cosmology, 4. The Jesuit Mission in China 5, Conclusions. A References section concludes the paper.

## 2. DEVELOPMENT OF CELESTIAL MECHANICS IN EUROPE FROM PTOLEMY TO THE 16<sup>TH</sup>-18<sup>TH</sup> CENTURIES

The celestial models adopted in the West before the *Scientific Revolution* date back to the 4<sup>th</sup> century B.C., when the Greek philosophers Plato and Aristotle imagined the Earth as a stationary sphere, located at the center of the universe. Moon, Sun, Venus, Mercury, Mars, Jupiter, Saturn and the fixed stars were assumed to be located on several crystal spheres surrounding the Earth, rotating at different uniform speeds around the Earth. The spheres were composed of an incorruptible substance called *aether*.

The *Ptolemaic System* was developed by the Greek astronomer Claudius Ptolemaeus (Ptolemy) (100-170 A.D.) who, in his main astronomical work, the "*Almagest*" (*Greatest Astronomy Text*), similarly assumed that the Earth was a sphere, located in the center of the universe, and each planet (Moon and Sun included) was moved by a system of two spheres, one called *Deferent* (whose center point, called the *Eccentric*, was somehow displaced with respect to the Earth's center) and the other the *Epicyle*, a smaller sphere centered in the planet and embedded in the *Deferent*. A given planet then would move along a circular path on the *Epicyle* and, at the same time, the *Epicyle* would rotate around the *Deferent*. These combined movements would cause the given planet to move closer to and further away from the Earth at different times in its orbit, The model with *Epicycles* is in fact a very good approximation to an *elliptical* orbit with low *eccentricity*. The Ptolemaic order of spheres from Earth outward was the following: Moon, Mercury, Venus, Sun, Mars, Jupiter, Saturn, Fixed Stars. An outermost moving sphere, the *Primum Mobile*, was introduced in the model, to account for the apparent daily motion of the Heavens around the Earth, producing the East-to-West rising and setting of the Sun and stars. In Figure 1 a sketch of the Ptolemaic System is given, where the small, dotted circles around the planets Mercury, Venus, Mars, Jupiter, Saturn (indicated by the capital letters B, C, D, E, F) represent their *epicycles*<sup>3</sup>.

<sup>3</sup> According to Ptolemy, the composition of the circular motion of a planet around the Earth with the circular motion around the *epicycle* gives the actual trajectory of the planet.

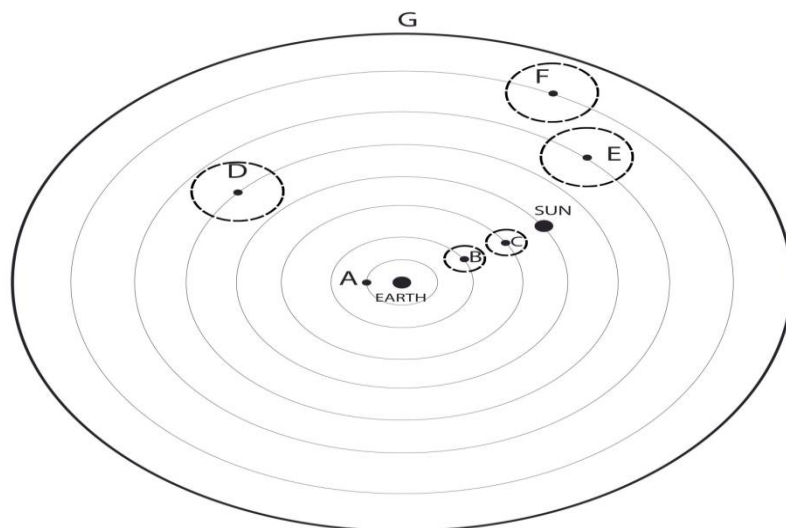


Figure 1 – Sketch of the Ptolemaic Model of the Universe

**A: MOON; B: MERCURY; C: VENUS; D: MARS; E: JUPITER; F: SATURN; G: CELESTIAL SPHERE (STARS)**

The path of the Scientific Revolution in *Philosophia Naturalis*<sup>4</sup> and Celestial Mechanics was rather arduous because it was opposed by two powerful institutions, the academic world, of Aristotelian tradition, and the Roman Catholic Church, which considered the *Geocentric System* of the Sky as absolute faith truth, basing it on the *Bible*. The establishment of the basic laws are mainly due to the joint efforts of the Pole scholar Mikołaj Kopernik (1473-1543), the Danish Tycho Brahe (1546-1601), the Italian Galileo Galilei (1564-1642), the German Johannes Kepler (1571-1630) and the English Isaac Newton (1643-1727) (Gingerich, 1993; Westfall, 2007).

Mikołaj Kopernik, better known as *Nicolaus Copernicus*, was born in the Polish city of Torun. From 1491 to 1495 he studied humanities at Krakow University, then moved to Italy, where from 1496 to 1501 studied Law and Philosophy at the University of Bologna, from 1501 to 1503 Medicine and Astronomy in Padua, and got a doctorate in Canon Law from the University of Ferrara. He finally returned to Poland, devoting himself to Astronomy, while performing administrative duties for the rulers of his country.

As the result of his accurate astronomical observations, he formulated a *Heliocentric Model* of the universe, placing a stationary Sun at the center of the Solar System, with the planets Mercury, Venus, Earth, Mars, Jupiter, Saturn located at increasing distances from the Sun and rotating around it along circular orbits (Armitage, 1990). In 1543, the year of his death, he published a treatise entitled "*De revolutionibus orbium coelestium*" (*On the Revolutions of the Celestial Spheres*), where his *Heliocentric Model* was illustrated.

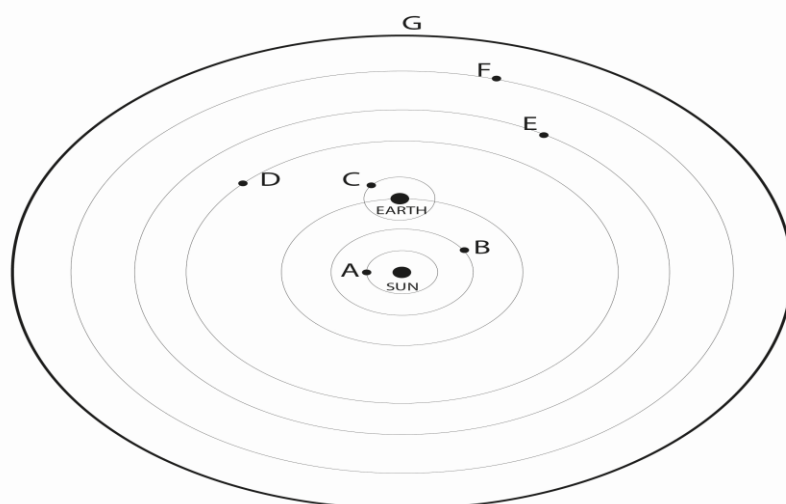


Figure 2- Sketch of the Copernican Solar System

<sup>4</sup> *Philosophia Naturalis*: Physical Sciences.

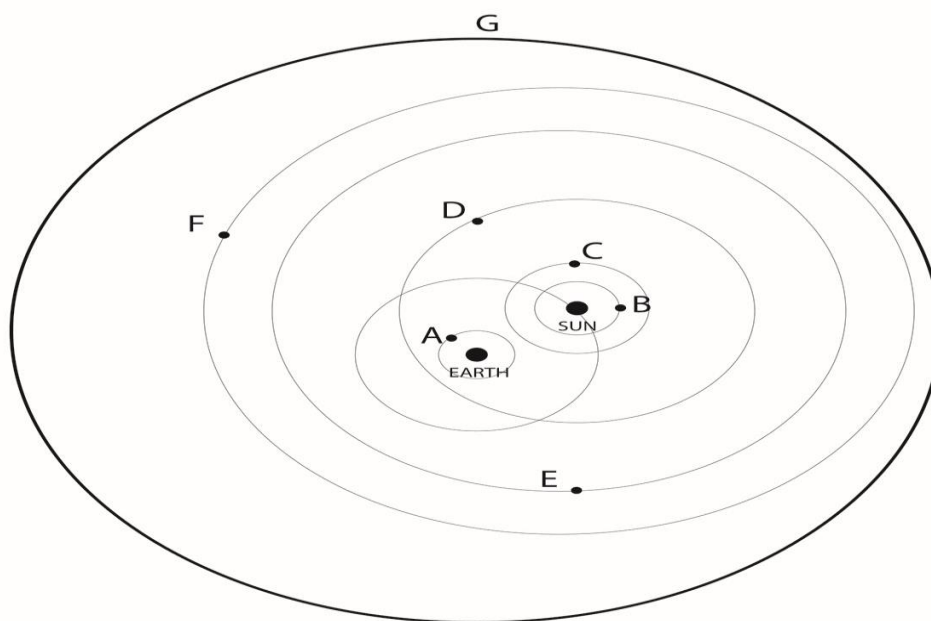
## The Scientific Revolution in Europe and its Impact on Chinese Cosmology during the 16th-18th Centuries

**A: MERCURY; B: VENUS; C: MOON; D: MARS; E: JUPITER; F: SATURN; G: CELESTIAL SPHERE (STARS)**

Copernicus' work appeared with a short unsigned preface, written by the theologian and astronomer Andrea Oseander (Hoseman), who took care to underline how the author considered his model as a simple mathematical construction, useful for calculations, but not necessarily true. Since the preface was anonymous, it was long understood to have been written by Copernicus himself. In 1543, the year of Copernicus' death, his treatise "*De revolutionibus orbium coelestium*" (*On the Revolutions of the Celestial Spheres*) was published.

At first, his astronomical system did not arouse any opposition from the Roman Catholic Church, which claimed absolute authority in astronomical matters as the unique authorized interpreter of the Holy Bible. The ruling Pope Clement VII was very pleased of Copernicus's *Heliocentric System* (Repcheck, 2007, 78–79, 184, 186).

In 1583 the Danish Tycho Brahe, director of the Imperial Astronomic Observatory in Prague, retained from the ancient *Ptolemaic System* the idea of Earth as a fixed center of the Universe, around which the Sun and Moon revolved, but he derived from Copernicus the idea that all other planets revolved around the Sun (and consequently they revolved in turn, together with the Sun, around the Earth). In both the *Tychonic* and the *Ptolemaic* systems, an outer sphere containing the fixed stars was assumed to revolve every day around the Earth. The *Tychonic* theory explained the observed variations of phase of Venus<sup>5</sup>, for which the Ptolemaic system had no explanation (Gingerich, 1993).



**Figure 3 – Sketch of the Tychonic Model of the Universe**

**A: MOON; B: MERCURY; C: VENUS; D: MARS; E: JUPITER; F: SATURN; G: CELESTIAL SPHERE (STARS)**

It was basically a mix between the *Geocentric* and the *Heliocentric Models* of the solar system. The Earth was placed, immobile, at the center of the Universe. The Moon and the Sun orbited around the Earth, while the other five planets known at the time (Mercury, Venus, Mars, Jupiter and Saturn) orbited around the Sun. The Tychonic system is perfectly equivalent to the Copernican system as regards the observation of the relative motions of the Earth and the other planets, once the origin of the *Reference System* is located in the center of the Earth<sup>6</sup>

The German Mathematician and Astronomer Johannes Kepler (1571-16309, convinced of the truth of the Copernican heliocentric model, published in 1596 "*Mysterium Cosmographicum*" (*The Cosmographic Mystery*), the first public defense of the Copernican model. He later improved Copernicus' model, once he became an assistant to Tycho Brahe in Prague and, afterwards, the *Imperial Mathematician* at the Court of the German Holy Emperor Rudolf II, in Prague.

By studying Brahe's data, he published in 1609 "*Astronomia Nova*" (*New Astronomy*), a treatise containing the following Astronomy Laws:

<sup>5</sup> The *Phases of Venus* are variations of lighting seen on the planet's surface, similar to lunar phases. The first recorded observations of them are thought to have been telescopic observations by Galileo Galilei in 1610.

<sup>6</sup> The *Geocentric* and the *Heliocentric Systems*, however, differ from each other with regard to the stars: the *parallax* of the stars and the *aberration of light* of fixed stars (shift of the angular position of the stars with respect to the Earth).

## The Scientific Revolution in Europe and its Impact on Chinese Cosmology during the 16th-18th Centuries

I *The planets move in elliptical orbits with the Sun at a focus.*

II *In their orbits around the Sun, the planets sweep out equal areas in equal times.*

In the triennium 1618-1621, Johannes Kepler published the "*Epitome Astronomiae Copernicanae*" (*Copernican Astronomic Compendium*) containing the additional 'Third Law':

III *The squares of the times of the planets to complete one orbit are proportional to the cubes of their average distance from the Sun*

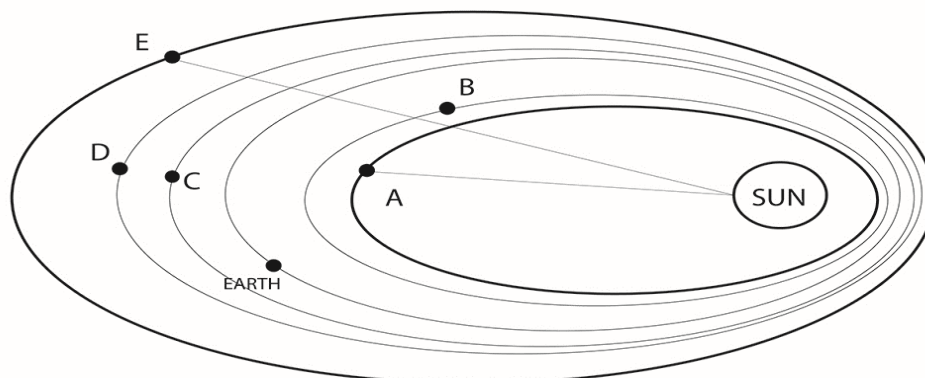


Figure 4 – Sketch of Kepler's Model of the Solar System

On March 5, 1616 the *Sacred Congregation of the Index*, created by Pope Pius V in 1571 for the purpose of examining publications suspected of doctrinal or moral errors (including them, in the positive case, in the *Index of Forbidden Books*) published a decree condemning the "*De revolutionibus orbium caelestium*" and including a general ban on all Copernican books ('*omnes libros idem docentes*'). From the perspective of the Church the *Heliocentric System* was not in agreement with the Bible, which assigned a privileged position to the Earth. The *Copernican Geocentric system*, on the other hand, denied this privileged position of the Earth with respect to other celestial bodies.

Johann Kepler's first volume of "*Epitome Astronomiae Copernicanae*" was also put on the *Index of Prohibited Books* on 28 February 1619. Kepler devoted himself to the composition of "*Tabulae Rudolphinae*" (*Rudolphine Tables*), a star catalogue and planetary tables, using observational data collected by Tycho Brahe, published in 1627. The main purpose of the *Rudolphine Tables* was to allow the accurate computation of the positions of the then known planets of the Solar System. When Tycho Brahe died in 1601, Kepler became the official Rudolf's *Imperial Mathematician*. When Emperor Rudolf died, in 1612, Kepler left Prague.

The Italian Mathematician and Astronomer Galileo Galilei took a strong position in favor of Copernicus' *Geocentric Model*. Born in Pisa, in the Grand Duchy of Tuscany, he attended there his first university studies in Medicine, Philosophy and Mathematics and undertook his first experiments on falling bodies, introducing the *experimental method* in the study of natural phenomena, proving that '*all falling bodies, irrespectively of their weight, take the same time to fall on the ground from a given height*'.

In 1590 he was invited by the rulers of the Venetian Republic to teach Geometry, Mechanics and Astronomy at the University of Padua. There he continued his studies on the movement of rigid bodies, finally arriving at the enunciation of the '*Inertia Principle*', according to which '*a body not subject to external forces, remains in a state of rest or moves with uniform rectilinear motion*'.

From the *Inertia Principle* descends the '*Galileo's Relativity Principle*'. Defining as *Inertial Reference System* any reference system in which the *Inertia Principle* holds, '*Galileo's Relativity Principle*' says that '*the laws of Mechanics have the same form in all Inertial Reference Systems*'.

While in Padua, Galileo as first improved an optical instrument devised for the observation of distant objects which had been invented in 1608 by the Dutch optician Hans Lippershey, thus creating the *astronomic telescope* for the study of celestial phenomena (King, 1955). Thanks to this instrument he discovered four satellites of the *Jupiter* planet, the *sunspots* and the irregularities of the surface of the Moon, finally publishing in Latin, in 1610, the "*Sidereus Nuncius*" (*The Messenger from the Stars*).

In that year he left Padua to Florence, under the invitation of the Grand Duke of Tuscany Cosimo II Medici, becoming his '*First Mathematician and Philosopher*'. The following year Galileo was in Rome, where he was received with great honors by Pope Paul V (1552-1621) and was accepted as a member by the *Accademia dei Lincei* (*Lincean Academy*), which had been established in that city in 1603 by Federico Cesi and other scholars, with the purpose of contributing to the development of the sciences.

## The Scientific Revolution in Europe and its Impact on Chinese Cosmology during the 16th-18th Centuries

In 1624 Galileo published "*Il Saggiatore*" (*The Essayer*), a treatise in which he exposed the fundamental points of his experimental research method. He wrote:

"*The philosophy of Nature is written in this great book that is continually open in front of our eyes (I say the universe), but it cannot be understood unless one first learns to understand the language and know the characters in which it is written. It is written in the language of mathematics, and the characters are triangles, circles, and other geometric figures, without which tools it is impossible to humanly understand a word of them; without these it is a vain wandering inside a dark labyrinth.*"

Some years later, in 1632, Galilei published the "*Dialogue concerning the two chief world systems*" (*Dialogo sopra i due massimi sistemi del mondo*), a refutation of the *Ptolemaic-Aristotelian* system in favor of the *Copernican* system<sup>7</sup>. The Church, which had initially granted its *imprimatur* to this work, radically changed its position, inserting it in the *Index of forbidden books* in 1633 and, after a trial, condemned Galileo (after having forced him to repent) to perpetual house arrest in Arcetri, near Florence, not far from the convent where his two daughters were living as cloistered nuns, in a house offered to him by the Grand Duke of Tuscany. The motivation of the sentence was that his work called into question the Roman Catholic's interpretation of the Bible. Before his death, which took place in 1642, Galileo succeeded in dictating to his secretary (made available to him by the Grand Duke) his last scientific work, "*Discourses and Mathematical Demonstrations Relating to Two New Sciences*" (*Discorsi e dimostrazioni matematiche intorno a due nuove scienze*), published in Leiden by *Elzevier* in 1638. In it, the author illustrated and demonstrated the principles of the *uniformly accelerated motion* (later formalized by Newton as the *Second principle of Dynamics of rigid bodies*) and posed additionally the foundations of the *Theory of Construction Science* (Drake, 2017).

The final triumph of *Heliocentrism* took place by initiative of Sir Isaac Newton. He was born on 25<sup>th</sup> December 1642 at Woolsthorpe Manor, in the county of Lincolnshire, in the Kingdom of England, and in 1661 was admitted as a student of Philosophy and Mathematics at *Trinity College*, in Cambridge. As a student, he began to develop a mathematical theory of *Differential Calculus* and in 1667 he became a *Trinity Colle Fellow*. In 1687 he published his fundamental work, the "*Philosophiae Naturalis Principia Mathematica*" (*Mathematical Principles of Natural Philosophy*), where he formulated the basic principles of *Dynamics* (a branch of Physics that deals with *forces* and the bodies' movement), namely the *Law of Universal Attraction* and the *Three Principles of the Dynamics of Rigid Bodies*.

### **Law of universal gravitation<sup>8</sup>**

*A body of mass  $m_1$ , attracts any other body  $B_2$  (with mass  $m_2$ ) with a force  $F$ , which is directed from the center of mass of  $B_2$  toward the center of mass of  $B_1$ , and whose magnitude is directly proportional to the product of their masses and inversely proportional to the square of the distance between their centers of mass<sup>9</sup>.*

### **Newton's Three Principles of the Dynamics of Rigid Bodies**

- **First Principle:** Galileo's *Inertia Principle*.
- **Second Principle:** a force  $\mathbf{F}$ , acting on a body with mass  $m$ , gives it an acceleration  $\mathbf{a}$  according to the proportionality relation:  $\mathbf{F} = m \mathbf{a}$ .
- **Third Principle** (*Law of Action and Reaction*): if a body  $B_1$  exerts on body  $B_2$  a force  $\mathbf{F}$ , at the same time the second body exerts on the first a force  $\mathbf{F}'$  which is equal to  $\mathbf{F}$  in magnitude, but with has opposed direction ( $\mathbf{F}' = - \mathbf{F}$ ).

Newton demonstrated that the motion of celestial bodies could be accounted for by these physical laws and improved Galileo's telescope. He further developed a Theory of Colors, observing that a Quartz prism separates white light into the colors of the visible spectrum. His work on light was collected in his "*Optics*", published in 1704. He finally studied the speed of sounds and introduced the notion of a *Newtonian Fluid* (Westfall, 2007).

To complete this Section, we must add that the Sun, the Moon and six of the planets of the *Solar System* rotate around their axes in a counterclockwise direction (*prograde rotation*), while the planets Venus and Uranus exhibit a clockwise direction (*retrograde rotation*). The Moon orbits the Earth once every 27.322 days. It also takes approximately 27 days to rotate once on its

<sup>7</sup> Recent theories reveal the inaccuracy of the Galilean proof of the tides in favor of Heliocentrism.

<sup>8</sup>The physical entities under study are of two types, *scalars* and *vector valued* ones. *Scalars* are physical entities which have only a *magnitude* (expressed by a real number, followed by the indication of the measurement's unit) such as the *mass* of a body. *Vector valued* physical entities, such as the *force* acting on a body, and the *velocity* and *acceleration* of a moving body, are characterized by *magnitude* and *direction*. In this text, bold characters indicate *vector valued* physical entities (as *Force, Velocity, Acceleration*).

<sup>9</sup> In mathematical terms, the Law of Universal Gravitation can be expressed in the following form:

$$\mathbf{F} = \mathbf{G} m_1.m_2 / r^2,$$

where  $\mathbf{G}$  is a *vector valued physical constant*, oriented toward the Earth's center of gravity, and whose magnitude is the 'universal proportionality constant  $G$ .



## The Scientific Revolution in Europe and its Impact on Chinese Cosmology during the 16th-18th Centuries

axis (*synchronous rotation*). As a result, the moon does not seem to rotate but it appears from Earth to be keeping almost perfectly still (McBride et al., 2004). Owing to this rotation around its North-South axis, the Earth is crushed at his *North and South Poles*, assuming the shape of an *Ellipsoid*. We must add that Earth's rotation axis has an inclination of about  $23^{\circ} 27'$  (varying from  $22.1^{\circ}$  to  $24.5^{\circ}$ , with a periodicity of about 40.000 years) with respect to the perpendicular to the Ecliptic (the plane of Earth's orbit around the Sun). This inclination of the rotation axis is responsible for the Earth's seasonal changes. The Earth's *Equatorial Plane* has an inclination of  $23^{\circ} 27'$  with respect to the *Ecliptic Plane* (the plane on which the Earth's orbit is located).

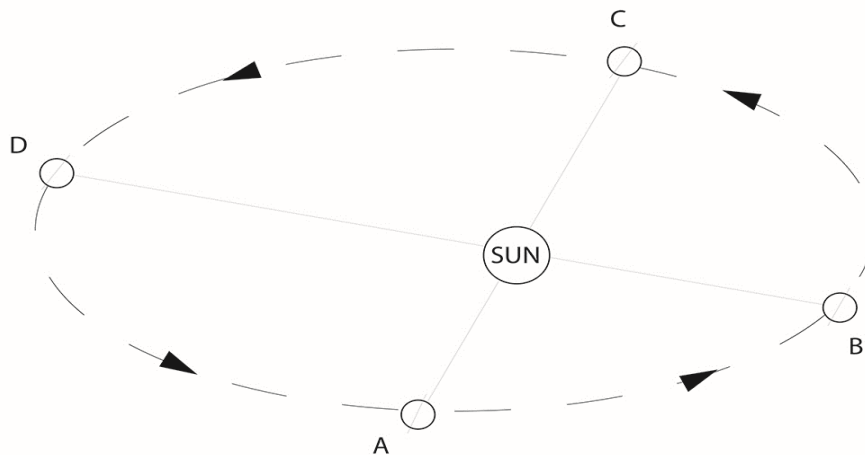


Figure 5 – Sketch of the Earth's movement around the Sun

**A: Autumn Equinox (Northern Hemisphere), Spring Equinox (Southern Hemisphere)**

**B: Winter Solstice (Northern Hemisphere), Summer Solstice (Southern Hemisphere)**

**C: Spring Equinox (Northern Hemisphere), Autumn Equinox (Southern Hemisphere)**

**D: Summer Solstice (Northern Hemisphere), Winter Solstice (Southern Hemisphere)**

**AC: Equinox Line; BD: Solstice Line**

### 3. ANCIENT CHINESE COSMOLOGY

The first traces of astronomical research in China date back to the third millennium B.C. Since the *Zhou* dynasty (1046-256 B.C.) Chinese rulers received the "*Mandate of Heaven*" (天命 *Tiānmìng*) to keep the Earth in total harmony with the Sky (Roberts, 1999). One of the main jobs of the rulers, receiving the '*Mandate of Heaven*' was to announce the first day of every month and predict lunar and solar eclipses. The emperor appointed a special group of imperial officers, who included astronomers, astrologers and meteorologists, which were ordered to monitor the sky, looking for astrological omens and astronomical phenomena. To locate these events, Chinese astronomers took care to describe the visible stars with great accuracy. One of the main functions of astronomy was for the purpose of timekeeping. The Chinese used a *lunisolar calendar*<sup>10</sup>, but as the cycles of the Sun and the Moon are different, leap months had to be inserted regularly (Needham, 1995).

The first theory concerning the structure of the Earth and the Sky was that of the '*Celestial Dome*' (盖天 *gai tian*), a hemispherical cap which covered a flat Earth, followed by that of the '*Celestial Sphere*' (浑天 *hun tian*), a spherical Earth floating inside the Celestial Sphere. The astronomer Shi Shen (石申) (4<sup>th</sup> century B.C.) wrote "*The Astronomy*" (石氏天文, *Tianwen*) and a *Celestial Map*, where 121 stars, were positioned. Astronomers' primary interest was an accurate observation of the sky; the first stellar catalog to have come down to us was composed in the first century B.C. At the time of the Han Dynasty (202 B.C.-220 A.D.), another theory followed, that of the '*Light and Darkness*' (宣夜 *xuan ye*), which hypothesized that the celestial bodies were immersed in an empty and infinite space (a night pervading everything).

*'The cosmological theories had to provide the theoretical sub-stratum to the enormous mass of data collected since the most remote times of astronomical observations. They also had to support the dominating philosophical doctrines: in particular, from the Han Dynasty onwards, Confucianism'* (Iannacone, 1990)

<sup>10</sup> *lunisolar calendar* = A *lunisolar calendar* is a calendar combining *lunar calendars* and *solar calendars*.

## The Scientific Revolution in Europe and its Impact on Chinese Cosmology during the 16th-18th Centuries

A great astronomic advancement was reached by Yu Xi (虞喜) (307-345 A.D.), who discovered the *Precession of the Equinoxes*<sup>11</sup>, independently of the Greek astronomer Hipparchus (190-120 B.C.), and Zu Chongshi (祖冲之) (429-500 A.D.), who in 465 composed the “*Da Ming Calendar*” (大明历), which contains the description of 283 constellation present in the sky of the *Northern Hemisphere*. Some elements of Indian Astronomy reached China with the expansion of Buddhism, especially at the time of the Tang Dynasty (618-907 A.D.). The Buddhist monk and astronomer Yi Xing (一行) (683-727 A.D) organized an *astrogeodetic survey* all over China, with the purpose of obtaining new astronomical data that would aid in the prediction of solar eclipses. (Xu, 2018). ‘*Heavenly bodies were allocated to terrestrial zones, especially 28 constellations roughly along the equator or the ecliptic, the seven stars of the Big Dipper (regarded as the carriage of heaven), and the five planets [Venus (the metal star), Jupiter (the wood star), Mercury (the water star), Mars (the fire star) and Saturn (the earth star), representing the Five Agents (metal, wood, water, fire and earth) on the time dimension]*.’ (Xu, 2018).

Chinese astronomers divided the sky it in four regions, the *Black Turtle* (玄武 *Xuánwǔ*) in the North, the *White Tiger* (白虎 *Báihǔ*) in the East, the *Red Bird* (朱雀 *Zhūquè*) in the South and the *Green Dragon* (青龙 *Qīnglóng*) in the West, each one of them containing 7 constellations, for a total of 28 located in twenty-eight mansions called 宿 (Sù). (Ruggles, 2005).

The *Black Tortoise* (玄武 *Xuánwǔ*) represented both North and Winter. A symbol of longevity, the tortoise of the North was often depicted together with a snake. The union of these two creatures was thought to have created the earth. It was also associated with the element *water*. It contained the following constellations: 角 (*Jiǎo*= Horn), 亢 (*Kàng*=Neck), 氐 (*Dī*=Root), 房 (*Fáng*=Room), 心 (*Xīn*=Heart), 尾 (*Wěi* =Tail), 箕 (*Jī*=Basket).

The *Blue Dragon* (青龙 *Qīng long*) represented both East and Spring; Unlike in western mythology, the dragon was rarely depicted as a malevolent force but generally considered to be both benevolent and auspicious. It was also often associated with the emperor and therefore linked to the Red Bird, associated with the empress. The dragon was associated with the element *Wood*. It contained the following constellations: 斗 (*Dǒu*=Southern Dipper), 牛 (*Niú*= Ox), 女 (*Nǚ*=Woman), 虚 (*Xū*=Emptiness), 危 (*Wēi*=Roof), 室 (*Shì*= Encampment), 壁 (*Bì*=Wall).

The *Red Bird* (朱雀 *Zhūquè*) represented the South and the Summer; the bird was sometimes seen as a phoenix and associated with *good fortune*. It was also often paired with the dragon. It was associated with the element *Fire*. It contained the following constellations: 奎 (*Kuí*=Striding person), 婁 (*Lóu* = Three Stars), 胃 (*Wèi*=Stomach), 昴 (*Mǎo*= Hairy head), 毕 (*Bì*=Net), 觜 (*Zī*=Turtle’s Beak), 参 (*Shēn*=Seven Stars)

The *White Tiger* (白虎 *Báihǔ*) represented the West and Autumn; The tiger was often seen as a protector and was associated with *Metal*- It contained the following constellations:

井 (*Jǐng*=Well), 鬼 (*Guǐ*=Ghost), 柳 (*Liǔ*=Willow), 星 (*Xīng*=Star), 张 (*Zhāng*=Leaf), 翼 (*Yì*=Wing), 軫 (*Zhěn*=Charriot).

In the center there was the polar constellation of *Big Dipper* or *Plough* (北斗星 *Běidǒuxīng*) with the *Polar Star* in it. As for the planets, in Chinese cosmology *Venus* (金星 *Jīnxīng*) represented the *metal star*, *Jupiter* (木星 *Mùxīng*) the *wooden star*, *Mercury* (水星 *Shuǐxīng*) the *water star*, *Mars* (火星 *Huǒxīng*) the *fire star* and *Saturn* (土星 *Tǔxīng*) the *Earthen Star*, all together the *Five Agents* (*Metal, Wood, Water, Fire, Earth*). Most constellations were based on the works of Shi Shen (石申) and Gan De (甘德) who were astrologists during the period of Warring States (战国时代 *Zhànguó Shídài*) (481 – 221 B.C.). The major constellations and planets were assumed to be located in nine distinct layers of Sky, as viewed from the Earth, and their rotational period and path were accurately measured, as follows:

- the 1st layer of the sky was the closest to the Earth: it was the celestial domain of the Moon, which rotated from the west to the east along a circle completed in 27 days plus 7 hours 45 minutes;
- the 2nd layer of the sky was the celestial domain of the planet Mercury, rotating from the west to the east with the circle completed in 365 days plus 5 hours 45 minutes;
- the 3rd layer of the sky was the celestial domain of the planet Venus, rotating from the west to the east with the circle completed in 365 days plus 5 hours 45 minutes;
- the 4th layer of the sky was the celestial domain of the Sun, rotating from the west to the east with the circle completed in 365 days plus 5 hours 45 minutes;
- the 5th layer of the sky was the celestial domain of Mars, rotating from the west to the east with the circle completed in 1 year plus 321 days 23 hours 15 minutes;
- the 6th layer of the sky was the celestial domain of Jupiter, rotating from the west to the east with the circle completed in 11 years plus 313 days plus 17 hours 30 minutes;

<sup>11</sup> *Precession of the Equinoxes*: a slow rotation of the stars around the *Ecliptic Axis* (the axis of the apparent rotation of the Sun around the Earth) during a time interval of 26,000 years.

## The Scientific Revolution in Europe and its Impact on Chinese Cosmology during the 16th-18th Centuries

- the 7th layer of the sky was the celestial domain of Saturn, rotating from the west to the east with the circle completed in 29 years plus 155 days plus 6 hours 15 minutes;
- the 8th layer of the sky was the celestial domain of the 28 Constellations, rotating from the west to the east with the circle completed in 7,000 years;
- the 9th layer of the sky was a celestial domain without any heavenly object, rotating from the East to the West.

Why the Chinese astronomers, who had been studying the sky for more than three millennia, did not put to themselves the problem of a careful study of the structure of the sky over the Southern hemisphere? The reason is that, after Admiral Zheng He (郑和)<sup>12</sup> expeditions across the Indian Ocean and the Pacific Ocean, between 1405 and 1433, under the Ming Dynasty, the emperors of the subsequent Qing Dynasty did not feel the need to embark in risky maritime operations in distant territories located beyond the Equator Line, in such a way that Chinese astronomers had not the means to investigate about the structure of the sky over the Southern Hemisphere.

### 4. FROM THE GEOCENTRIC MODELS TO HELIOCENTRISM IN CHINA

The trading post of Macao (澳门 Àomén), located in proximity of the city of Canton (广州 Guǎngzhōu), in Southern China, had been created in 1557 A.D. (during the late Ming Dynasty) by the Portuguese Kingdom, which paid an annual rent to the Chinese rulers (who kept their jurisdiction on the territory). This agreement continued to hold until 1887 (Pannikar, 1953). The *St Paul Jesuit College* was created by the Portuguese in Macau in 1578-79, with the purpose of training Jesuit missionaries (sent there by the Jesuit Congregation in Rome) in Chinese language and culture. Those missionaries were not only religious people but, at the same time, linguists, geographers, mathematicians, astronomers and even artists, as the Italian Jesuit monk and painter Giuseppe Castiglione (1688-1766). In the time span of over two centuries the following Jesuit missionaries, among others, came to Macao: the Italian Matteo Ricci (1552-1610), the Germans Johann Schreck (1576-1630) and Johann Adam Schall von Bell (1591-1666), the Flemish Ferdinand Verbiest (1623-1688), the Pole Jan Mikolai Smogulecki (1610-1656) and the French Michel Benoist (1715-1774). Their arrival determined a turning point in Chinese astronomical sciences (Mungello, 2005).

Matteo Ricci, known in China as *Lì Mǎdòu* (利玛窦), arrived in Macao in 1588. He studied there, for several years, the Chinese language and thereafter compiled, with his colleague Michele Ruggieri (罗明坚 Luō Míngjiān), a founding father of the Jesuit Mission, a Chinese-Portuguese dictionary. Ricci also translated in Chinese, in cooperation with the Jesuit monk Sabatino De Ursis (熊三拔 Xióng Sānbá), parts of Euclid's "*Elements of Geometry*" as well as other Western mathematical and astronomical works. In 1601 he was invited into the Forbidden City by the Ming emperor *Wanli* (万历帝) (1563-1620), to become an adviser at the imperial court in recognition of his scientific abilities (chiefly due to his predictions of solar eclipses). Ricci never met the emperor, but the latter granted him patronage and supported Ricci's completion of China's first world atlas, the "*Record of Foreign Lands*" (职方外纪 *Zhifang Waiji*). Ricci died on 11 May 1610 and was buried first in a Buddhist temple; thereafter his remains were transferred to the *Zhalan Cemetery*, in Peking.

In spite of his great merits in transmitting his mathematical knowledge to Chinese scholars, Ricci, as a follower of the outdated *Ptolemaic* celestial model, wrote the following in his Chinese text, entitled "*The meaning of the universe (Cosmological Epitome)*" (乾坤体义 *Qiánkūn tǐ yì*), edited in 1608:

*'These nine layers [of sky] enclose each other like the layers of an onion. They are all solid, and the sun, moon, and the planets are fastened into their substance like the layers of an onion. They are all solid, and the Sun, Moon, and planets are fastened into their substance like knots in a board. Their motions are entirely due to those of their proper orbs. The celestial substance is clear and colorless, and thus transparent to light, in the same way as [light] is unimpeded by glass and crystal and the like'* (Sivin, 1995).

Jesuits missionaries continued to be accepted by emperor *Wanli* for their knowledge of astronomy, calendar-making, mathematics, hydraulics, and geography, but they were finally expelled by him from Peking during the last years of his reign. In 1627 the Jesuit Johann Schreck, known in Europe as *Johannes Terrentius* and in China as *Dèng Yùhán* (邓玉函), who had studied Medicine in Freiburg and Mathematics and Astronomy in Paris and in Padua (under Galileo Galilei), was sent in 1618 to Macao, where he published in 1623 "*An Outline of Western Theories of the Human Body*". Invited back to Peking by the new Ming emperor *Chongzhen*, he published there a treatise on Mechanics, entitled "*Diagrams and explanations of the wonderful machines of the Far West*". He died in 1630 and, as Ricci, was buried in the *Zhalan Cemetery*.

---

<sup>12</sup> During its first voyage to the Indian Ocean, an enormous fleet (composed of 317 ships, with 28,000 soldiers on board), sailed toward the Indian Ocean, reaching the Eastern coasts of Africa, the Red Sea, Japan and Korea. Between 1405 and 1433 Zhang He made a total of seven voyages. During the last one he visited the ports of Champa (Vietnam) and Java, as well as Palembang, Malacca, Ceylon and Calcutta.

## The Scientific Revolution in Europe and its Impact on Chinese Cosmology during the 16th-18th Centuries

The Jesuit Johann Adam Schall von Bell, known in China as *Tāng Ruòwàng* (汤若望), studied Mathematics and Astronomy at the *Collegium Germanicum* in Rome, was sent to Macao together with Johann Schreck in 1618. He was later invited to Peking, in 1630, together with his colleague Giacomo Rho (1593-1638), known in China as *Luo Yagu* (罗雅谷), to continue the work of the deceased Johann Schreck on a reform of the Chinese Calendar. In cooperation with the Chinese astronomer Xu Guangqi<sup>13</sup>, he participated in modifying the Chinese calendar and also compiled, from 1638 to 1644, what is known as the *Chongzhen Calendar* (崇禎历 *Chóngzhēn lì*) (after the name of the last emperor of the Ming Dynasty). This calendar provided more accurate predictions of eclipses of the sun and the moon.

The Pole Jan Mikolaj Smogulecki (1610-1656), who studied mathematics and astronomy at Freiburg, philosophy in Rome and law in Padua, moved to Macao in 1646. He taught there Astronomy and Mathematics, being the first to introduce the *Logarithms* in China. In 1653 he was invited by the first Qing emperor *Shunzhi* to his court, but soon later he requested permission to leave the court to continue his missionary travels and died in Zhaoqing in 1656.

When emperor *Shunzhi* died, in 1661, the Muslim court astronomer Yang Guangxian (1597-1669) accused him and his colleague Ferdinand Verbiest of having planned a rebellion, contributing to the death of the emperor's wife. In 1664 Yang took his place at the Imperial Astronomic Observatory, while the two Jesuits were imprisoned and condemned to death. Fortunately, a series of extraordinary events took place, among which a violent earthquake which destroyed part of the prison and of the imperial palace, while an extraordinary meteor was seen in the sky. For these reasons, the Emperor made them free and condemned to exile in Canton. Schall von Bell died within one year of his release.

The new Qing emperor *Kangxi* (1654-1722) recalled Ferdinand Verbiest back to Peking to replace Schall von Bell at the *Qing Astronomical Office*. The emperor became his friend and awarded him complete charge of the imperial astronomy observatory, which he rebuilt in 1673, designing six new astronomic instruments; the *Altazimuth* (used to measure the position of celestial bodies), a *Celestial Globe* (six feet in diameter, used to map and identify celestial objects), an *Ecliptic Armillary Sphere* (six feet in diameter, used to measure the ecliptic longitude and latitudes of celestial bodies), an *Equatorial Armillary Sphere* (six feet in diameter, used for measuring the true solar time), a *Quadrant Altazimuth* (six feet in radius, for measuring altitudes or zenith distances of celestial bodies) and a *Sextant* (eight feet in radius, used to measure the angle of elevation of a celestial object above the horizon). Verbiest composed a table of all solar and lunar eclipses for the next 2000 years and died in Peking in 1688. He was buried in the *Zhalan Cemetery*.

Regarding the nature of the astronomical theories taught by the Jesuits in China until the middle of the 18<sup>th</sup> century, the sinologist Natan Sivin wrote the following in his "*Science in Ancient China: Researches and Reflections*" (Sevin, 1995):

*'Jesuit missionaries, who alone were in a position to introduce contemporary scientific ideas into China before the nineteenth century, were not permitted to discuss the concept of a sun-centered planetary system after 1616<sup>14</sup>. Because they wanted to honor Copernicus, they characterized his world system in misleading ways. When a Jesuit was free to correctly describe it in 1760<sup>15</sup>, Chinese scientists rejected the heliocentric system because it contradicted earlier statements [by Jesuit astronomers] about Copernicus. No European writer resolved their doubts by admitting that some of the earlier assertions about Copernicus had been untrue.'*

The cause of the reticence of the Jesuit missionaries to propagate Nicolaus Copernicus' *heliocentric theory*, enthusiastically supported by Galileo Galilei, is due to the condemnation for heresy, by the Congregation of the Holy Office in Rome, of the work of Nicolaus 'Copernicus "*On the Revolutions of the Heavenly Spheres*" in 1616, and Galileo Galilei's work "*Dialogue concerning the two chief world systems*" in 1633, with a ban on propagating anywhere these scientific works by Roman Catholic scholars.

Johann Schreck, in his "*Outline of Observational Astronomy*" (测天约说 *Cètiān yuēshuō*), wrote the following, without mentioning the name of Galileo Galilei:

*'In modern times a celebrated mathematician in a kingdom in the West has constructed a telescope, with which he has observed planet Venus. [He thus saw that] sometimes the planet is dark, sometimes fully illuminated, and sometimes a crescent illuminated either in the superior or inferior quarter. It was calculated that Venus moves as a satellite of the Sun ...'*

---

<sup>13</sup> Xu Guangqi (1562-1633) was a Chinese agronomist, astronomer and mathematician during the Ming Dynasty. He was a collaborator of the Italian Jesuit Matteo Ricci.

<sup>14</sup> 1616 is the year of condemnation of the Copernican System by the Holy Roman Inquisition', as mentioned in Chapter 2 of this paper.

<sup>15</sup> 1760 is the year when the Roman Holy Inquisition declared void the prohibition to publicly discuss Copernicus' Geocentric System, after Isaac Newton's publication of his "*Philosophiae Naturalis Principia Mathematica*" (*Mathematical Principles of Natural Philosophy*)", and its generalized consensus among western astronomers.

## The Scientific Revolution in Europe and its Impact on Chinese Cosmology during the 16th-18th Centuries

Another Jesuit missionary in China, Giacomo Rho (1592-1638), in his *"Principles of the Planetary Motion"* (五纬历指 *Wǔ wěi lìzhǐ*), published in 1634, was the first who illustrated to Chinese astronomers the compromise solution devised by the Danish astronomer Tycho Brahe, known as the *Tychonic System*, i.e. a mixed *Geocentric-heliocentric System*, where all the planets, excluding the Earth, revolved around the Sun, while at the same time they and the Sun revolved around the Earth.

Johann Adam Schall von Bell, in his text *"Speaking about the Telescope"* (远镜说 *Yuǎn jìng shuō*), published in 1640, didn't dare to mention Galileo's name, while introducing the use of the telescope. Later on, the Pole Jesuit Jan Mikolaj Smoguleski, as well as the Flemish Ferdinand Verbiest, adopted the Tychonic System.

By the mid-eighteenth century things changed. Owing to the work of Isaac Newton, *"Mathematical Principles of Natural Philosophy"*, the new Celestial Mechanics had triumphed in the West and in 1757 the Roman Catholic Church lifted the ban on publishing the works of Nicolaus Copernicus and Galileo Galilei.

The first Jesuit astronomer who explicitly illustrated the Copernican Heliocentric System to Chinese astronomers was Michel Benoist (蒋友仁 *Jiǎng Yǒurén*), in 1761. Born in Dijon in 1715, he studied in Paris Mathematics, Astronomy, Architecture and Hydraulics and arrived in 1744 in China. He served for thirty years at the court of the *Qianlong* Emperor (1711-1799), devoting himself, among others, to architectural and landscape designs of the *Old Summer Palace*, together with his colleague (and emperor's advisor) the Italian Jesuit and painter Giuseppe Castiglione (1688-1766). In a letter to Europe, in 1764, he wrote:

*'I have already written you that, besides the hydraulic works with which I have been occupied for several years in the emperor's service, I have drawn a world map of which the two hemispheres with their margins are thirteen to fourteen feet in length by seven high. In 1761, when the fiftieth birthday of the reigning emperor Qianlong was being celebrated, I presented him with it. His Majesty received my present with kindness and kept me nearly an hour to ask me various questions on Geography and Physics...In my explanation I made a rather thorough exposition of the Copernican system, which was necessary because the Chinese had not yet adopted it.'*

The sinologist Sevin also writes that Benoist, in a second letter, provided a hint concerning the political motivation of his birthday gift to the emperor, in view of the intense rivalry existing between the French and the Portuguese missions of the Jesuit Company in Peking, related to the competition between the French and the Portuguese Kingdoms in the Far East:

*'I have added an explanation of the terrestrial as well as the celestial globe, of the new systems for the movement of the Earth and of the other planets, and on the movement of the comets, the return of which one hopes to succeed in predicting with certainty. I summarized the great enterprises ordered by our monarch for the perfection of arts and sciences, and especially for that of Geography and Astronomy, which were the subject of my writings. I described the expeditions sent to different parts of the world to observe various astronomical phenomena, to measure exactly the degrees of longitude and latitude of our globe ...'*

Benoist did not declare that the *Copernican System* was true. He simply asserted that it was the only system in current use, having *'more precise conformity to calculations'*. Qianlong's response to Benoit was the following:

*"In Europe you have your way of explaining the celestial phenomena. As for us, we have ours too, without making the Earth rotate".*

Benoist died in Peking in 1774 and was buried in *Zhalan Cemetery*.

Since *Heliocentrism* had been until then unmentionable, Chinese scholars got an erroneous conception of *Copernicanism*, in such a way that they reject it at first. As a consequence, once the Roman Catholic Church removed the ban of the *Copernican System*, during the 18th century, the Jesuit missionaries teaching it were accused to be agents of foreign powers and were no longer allowed to reside in Peking (with the exception of a small group of them, who were allowed to reside in the capital to serve the emperor in such fields as Cartography, Clockmaking and Optics). It took another century to Chinese astronomers to fully accept *Heliocentrism*.

The Chinese astronomer Ruan Yuan (阮元, 1764–1849) published in 1799 *"Biographies of Mathematical Astronomers"* (畴人传 *Chóu rén chuán*) and, in 1802/03 another one about Benoist's astronomical teaching, under the title *"World Map with Illustrated Explications"* (地球图说 *Dìqiú túshuō*), where the various Celestial Systems, the Ptolemaic, the Tychonic and the *Heliocentric* models were illustrated in detail.

About this issue, the eminent sinologist J. Needham observed the following:

*'a continuing general and scientific progress manifested itself in traditional Chinese Society, but this was violently overtaken by the exponential growth of modern science after the Renaissance in Europe. China was homeostatic<sup>16</sup>, but never stagnant.'* (Needham, 1995).

---

<sup>16</sup> *Homeostasis*: the tendency to maintain internal stability in an organism to compensate for environmental changes.

## The Scientific Revolution in Europe and its Impact on Chinese Cosmology during the 16th-18th Centuries

### 4. CONCLUSIONS

Before moving on to conclusions, it is appropriate to observe the following: every theory of Physics is based on some basic, unproven hypotheses (we could call 'postulates') which support the entire theoretical apparatus. In the case of Aristotle and the *Aristotelians* after him, the fundamental postulate was that the physical entity called *Force*, responsible for the movement of a material object to which it is applied, is *proportional* to the body's *speed* (i.e. the ratio between the space traveled by the body and the time taken to travel it). Galileo Galilei, on the contrary, through his experimental method, proved that *force* is proportional to the body's *acceleration* (i.e. the ratio between its speed's variation and the time taken to accomplish it). If the *force* is equal to zero (i.e. if no *force* acts on a body), then the body remains at rest or moves with *uniform rectilinear motion*: this is the famous '*inertia principle*'. In addition to that, Galileo assumed the following *postulates*: 1) '*on the Earth surface the space is homogeneous*' (i.e. the *gravity acceleration* of a body, on the Earth surface, is constant); 2) '*time flows uniformly*' (i.e. time flows with *constant speed*).

The first postulate was proven false by Newton's '*universal law of gravitation*'; the second postulate was proved false by Einstein through his '*Special Theory of Relativity*', which states that '*time's flowing speed decreases with the increasing speed of the moving body*' (as a consequence, at the light's speed '*c*' in an empty space, the time flow stops). An additional postulate has been assumed by Einstein's Relativity Theory: '*the light speed  $c$  in an empty space is the maximal one attainable by a moving body*. Today, however, some theoretical physicists are studying the possibility that this insurmountable limit can be overcome, due to the *Quantum nature* of the empty space.

Passing now to the conclusions, we can venture to answer these questions:

- "*How can we explain the impetuous development of the Physical Sciences, Astronomy included, in Europe, starting with the 15<sup>th</sup> century?*"

Our possible answer is that the development of the natural sciences in Western Europe took place in strict connection with the cultural movement of *Humanism*, which moved the center of attention of scholars on man, '*blacksmith of his destiny*', stimulating a marked curiosity for nature and its laws. Another important factor were the maritime expeditions undertaken by the Portuguese and the Spanish Kingdoms, following the *Reconquista* and, afterwards, by the kingdoms of England, the Netherlands and France, looking for new, economically profitable markets.

- "*Why did the Roman Catholic Church so harshly oppose the Heliocentric astronomical model, enunciated by Copernicus and confirmed by Kepler and Galilei?*"

Our answer is that the Roman Catholic Church felt under siege in those times, after the *schism* carried out by Martin Luther in Germany (which spread to Central and Northern Europe), by King Henry VIII Stuart in England, by the *Calvinists* in France, Switzerland, the Netherlands and Scotland. In the same centuries the *Turkish Sultanate* triumphantly advanced from the Near East towards the heart of Europe, imposing the Muslim Religion in those formerly Christian countries. The Roman Catholic Church reacted with a *Counter-Reformation*, reiterating the concept that the interpretation of the Bible was the responsibility of the Church alone. Unfortunately, the Bible (written over two millennia earlier) says that the Sun revolves around the Earth!

The last question is the following: "*How can we explain the refusal by the Jesuit missionaries and astronomers Johann Schreck, Johann Adam Schall von Bell, Ferdinand Verbiest, Jan Mikolai Smogulecki to accept the Copernican System?*"

The answer to this question is rather obvious: they were subdued to the authority of the Roman Catholic Church. In their defense, we must underline the fact that, adopting the Tychonic System and utilizing the astronomical telescope, they were able to formulate sufficiently accurate predictions of celestial phenomena.

### REFERENCES

- 1) Armitage, A. (1990). *Copernicus, the founder of modern astronomy*. Dorset Press, U.K.
- 2) Crowther's (2015). *The Oxford Handbook of Early Modern European History, 1350-1750: Volume II: Cultures and Power*. Oxford University Press, U.K.
- 3) Drake, S. (2017). *Galileo*. University of Toronto Press, Canada.
- 4) Evans, J. (1998). *The History and Practice of Ancient Astronomy*. Oxford University Press, U.K.
- 5) Gingerich, O. (1993). *The eye of heaven: Ptolemy, Copernicus, Kepler*. American Institute of Physics, New York, NY, U.S.A.
- 6) Heilbron, J.S. (2018). *The History of Physics: A Very Short Introduction*, Oxford University Press, Oxford, U.K.
- 7) Iannacone, I. (1990). The structure of the Universe: Syncretism and Continuity of the Chinese cosmological theories. *Memorie Società Astronomica Italiana*, Italy
- 8) King, H. C., ed. (1955). *The History of the Telescope*. Charles Griffin & Co. Ltd, London, U.K.
- 9) McBride, N.; Bland, P.A.; Gilmour, L. (2004). *An Introduction to the Solar System*. Cambridge University Press, U.K.

## The Scientific Revolution in Europe and its Impact on Chinese Cosmology during the 16th-18th Centuries

- 10) Monfasani, J. (2020) "Humanism and the Renaissance", in A.B. Pinn (ed.) *The Oxford Handbook of Humanism*, Oxford University Press, U.K.
- 11) Mungello, D.E. (2005). *The Great Encounter of China and the West, 1500-1800*. Rowman & Littlefield, Lanham, Maryland, U.S.A.
- 12) Needham, J. (1995). *Science and Civilisation in China. Volume 3: Mathematics and the Sciences of the Heavens and the Earth*. Cambridge University Press, U.K.
- 13) Pankenier, D.W. (2013). *Astrology and Cosmology in Early China*. Cambridge University Press, U.K.
- 14) Pannikar, K.M. (1953). *Asia and Western Dominance*. George Allen & Unwin, London, U.K.
- 15) Repcheck, J. (2007). *Copernicus' Secret: How the Scientific Revolution Began*. Simon & Shuster, New York, U.S.A.
- 16) Rogers, J.A.G. (1999). *Concise History of China*. Harvard University Press, U.S.A.
- 17) Ruggles, C.L.N. (2005). *Ancient Astronomy: An Encyclopedia of Cosmologies and Myth*. ABC-CLIO, Santa Barbara, U.S.A.
- 18) Sivin, N. (1995). Copernicus in China or Good Intentions Gone Astray, from: *Science in Ancient China: Researches and Reflections*. Ashgate Publishing, Variorum, Aldershot, U.K.
- 19) Wang, G.C., Wu, Y.H., Sun, X.C. (2008). The impact of the telescope on Chinese Astronomy during the late Ming and the early Qing period. *Studies in the History of Natural Sciences*, Volume 3, Beijing, China.
- 20) Westfall, R.S. (2007). *Isaac Newton*. Cambridge University Press, U.K.
- 21) Xu, F.X. (2018) Astral Sciences in Ancient China, in Keiser, P,T. and Scarborough, J.: *Oxford Handbook of Science and Medicine in the Classical World*, Oxford University Press, U.K.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## The Effect of Bitter Melon Extract on Cholesterol, IL-6, and Malondialdehyde Serum Levels



Novia Aprilia Rahma<sup>1</sup>, Hadi Sarosa<sup>2</sup>, Joko Wahyu Wibowo<sup>3</sup>

<sup>1,2,3</sup> Faculty of Medicine, Sultan Agung Islamic University, St Kaligawe KM 4 Semarang 50012, Indonesia

**ABSTRACT:** Hypercholesterolemia is a condition by an increase total cholesterol and Low Density Lipoprotein (LDL) cholesterol levels, which can lead the secretion of proinflammatory cytokines Interleukin-6 (IL-6) through the activation of the NF- $\kappa$ B pathway oxidative stress, and increase in Malondialdehyde (MDA) levels. Studies showed that the extract of bitter melon contains flavonoids as antioxidants can reduce cholesterol levels. To find out the effect of bitter melon extract on total cholesterol levels, IL-6, and MDA in hypercholesterolemic rats. Experimental research with Post Test Only Group Design. The research subjects were 25 wistar rats divided into 5 groups. Group K(N) normal rats, K(-) were only given a hypercholesterol diet for 28 days, groups K(+), P1, and P2 were given a hypercholesterol diet for 14 days followed by 14 days of hypercholesterol diet along with simvastatin at 0.09 mg/kgBW, bitter melon extract at 150 mg/kgBW, and combination of bitter melon extract at 75 mg/kgBW and simvastatin at 0.045 mg/kgBW. On the 29th day the rats were examined. The results of the Shapiro-Wilk and Levene tests showed that the data were normally distributed and homogenous. One-Way ANOVA and Tukey test was found that the levels of cholesterol, IL-6, and MDA in the P1, P2, and P3 hypercholesterolemic rat groups underwent significantly ( $p < 0.05$ ) compared to the control group. The extract of bitter melon, simvastatin, and the combination of simvastatin and bitter melon extract have effect on reducing cholesterol levels, IL-6, and MDA in hypercholesterolemic rats.

**KEYWORDS:** Bitter Melon, Interleukin-6, Malondialdehyde, Total Cholesterol, Simvastatin

### I. INTRODUCTION

Hypercholesterolemia is a condition characterized by an increase in total cholesterol and an increase in Low-Density Lipoprotein (LDL) cholesterol (Kumar, Singh and Dhakal, 2017). Uncontrolled cholesterol levels are a risk factor for stroke, atherosclerosis, and atherogenic (Destiana and Timan, 2018; Vijayan *et al.*, 2018). Stroke is one of the leading causes of death in Indonesia and can significantly reduce the quality of life for the affected individuals (Destiana and Timan, 2018; Vijayan *et al.*, 2018; Saraswati and Khariri, 2021). The increase of fats in the blood will activate the NF- $\kappa$ B signaling pathway, which can trigger macrophages to secrete proinflammatory cytokines, including Interleukin-6 (IL-6), leading to systemic inflammation (Destiana and Timan, 2018; Vijayan *et al.*, 2018). Hypercholesterolemia can result in changes in the physical properties of cell membranes, facilitating the leakage of Reactive Oxygen Species (ROS), which causes an increase in lipid peroxidation and lipid membrane damage. Unsaturated fatty acids undergoing peroxidation are toxic and can produce Malondialdehyde (MDA), which serves as a marker of lipid peroxidation and the occurrence of oxidative stress (Kumar, Singh and Dhakal, 2017).

Bitter melon extract containing polysaccharides, flavonoids, and saponins, plays a role as an antilipidemic, antioxidant, hepatoprotector, and anti-inflammatory agent that acts through the mechanisms of Peroxisome Proliferator-Activated Receptor (PPAR- $\alpha$ ),  $\beta$ -Hydroxy  $\beta$ -methylglutaryl-CoA (HMG-CoA reductase), AMP-activated protein kinase (AMPK), and inhibits the Nuclear Factor Kappa B (NF- $\kappa$ B) signaling pathway. Previous studies have extensively examined about the reduction of hypercholesterolemia with combinations of bitter melon extract and other extracts, the effect of bitter melon in reducing triglyceride levels and anti-inflammation, as well as the effect of bitter melon juice on MDA levels (Fernández-Real *et al.*, 2000; Jia *et al.*, 2017; Saraswati and Khariri, 2021). Pharmacological treatment with simvastatin operates through similar mechanisms to a bitter melon extract in lowering cholesterol levels. This study examined the effect of bitter melon extract at a dose of 150 mg/kgBW on total cholesterol levels, IL-6, and MDA, comparing it with simvastatin therapy in hypercholesterolemic rats.



# The Effect of Bitter Melon Extract on Cholesterol, IL-6, and Malondialdehyde Serum Levels

## II. MATERIAL AND METHODS

This research was conducted in the laboratory of the center for food and nutrition studies at Gadjah Mada University from 12 June 2023 to 17 July 2023. This research has gone through an ethical review test from the Ethics Committee of Medical Faculty of Sultan Agung University (No.210/VI/2023 Komisi Bioetik). This research used 25 male white Wistar strain rats and they were divided into 5 groups that have already met the inclusion criteria. The group of rats was then divided into (1) normal group: healthy rats on standard feed without any treatment, (2) Control -: rats were given hypercholesterol only feed for 28 days, (3) Control +: rats were given hypercholesterol feed for 14 days, then for the next 14 days were given hypercholesterol feed and simvastatin at a dose of 0.09 mg/kgBW. (4) treatment 1: Rats were given hypercholesterol feed for 14 days, then for the next 14 days, they were given hypercholesterol feed and bitter melon extract at a dose of 150 mg/kgBW, (5) Rats were given hypercholesterol food for 14 days, then for the next 14 days, they were given hypercholesterol feed and bitter melon extract at a dose of 75 mg/kg BW and simvastatin 0.045 mg/kg BW. The hypercholesterol feed in this research was quail egg yolks 10 mg/Kg/BW/day. The sampling was carried out on the 29th day.

Total cholesterol blood samples were taken twice on the fifteenth day and the twenty-ninth day. Blood cholesterol levels were measured by taking blood through the retro-orbital plexus. Total cholesterol levels were measured by using the CHOD-PAP method (Rahma and Syauqy, 2013; Kusuma *et al.*, 2017). Rats were declared hypercholesterolemic if cholesterol levels were >88 mg/dL (Kusuma *et al.*, 2017). IL-6 levels were measured by using the ELISA method, blood samples were taken on the twenty-ninth day through the retro-orbital plexus using a hematocrit tube. The results of the Elisa reader reading contained standard values, then the standard values and absorbance results obtained were made into a standard curve, and the results of IL-6 levels in pg/ml were obtained (Darwin, Afriani and Hanam, 2016). MDA levels were measured by using the Thiobarbituric Acid-Reacting Substances (TBARS) method with a wave length of 532 nm (Tubagus, Momuat and Pontoh, 2015; Rahmawati *et al.*, 2022). Normal MDA levels were between 0.12-1.71 nmol/ml. with an average of 0.26 nmol/ml. After the twenty-ninth day, blood was collected from the rats through the retro-orbital plexus. The MDA absorbance value was measured which was then calibrated using the Tetra Metoxy Propane (TMP) curve. Then the MDA levels were obtained in nmol/ml (Dixon *et al.*, 1998; Purwastyastuti, 2000).

Data on average levels of cholesterol, IL-6, and MDA were presented descriptively in tabular form. The data obtained were processed using computerized methods, and the analysis was performed using SPSS 21.0 for Windows. The data were then tested for normality with the Shapiro Wilk test and homogeneity test with the Levene's test. The distribution of data on cholesterol, IL-6, and MDA levels obtained normal and homogeneous results, so the One Way Anova test was conducted ( $p < 0.05$ ) then continued with the post hoc test with the Tukey test.

## III. RESULT

A study of bitter melon extract on cholesterol, IL-6, and MDA levels in male rats with a high cholesterol diet showed the results shown in Figure 1 and Table 1.

**Table 1. Mean serum of Cholesterol, IL-6 and MDA levels**

Groups (Mean)	Cholesterol levels mg/dl Day 15	Total Cholesterol Total levels mg/dl Day 29	IL-6 levels nmol/ml Day 29	MDA levels ( pg / ml ) Day 29
K N	79,12	80,93	25,19	0,92
K (-)	189,71	191,19	62,09	10,24
K (+)	188,09	129,11	32,59	3,85
P 1	187,06	101,47	27,97	1,14
P 2	189,41	112,28	29,65	1,98

Table 1 showed that the lowest average total cholesterol levels were in the normal control group, followed sequentially by treatment group 1, treatment group 2, control group +, and lastly, the control group -. Based on the Shapiro-Wilk test, all groups' cholesterol levels indicated a normal distribution data ( $P > 0.05$ ), and the homogeneity test using Levene's Test resulted in homogeneity ( $p > 0.05$ ). Data analysis was continued using One-Way ANOVA test and Tukey's test. The One-Way ANOVA test results indicated a significant difference between the groups ( $p = 0.000$ ). The results of Tukey test showed that the cholesterol levels between any two groups had a significant difference in all groups ( $p < 0.05$ ).

The IL-6 levels were lower in group 1 (P1) after being given a high cholesterol diet and bitter melon extract at a dose of 150 mg/kgBW/day compared to groups K-, K+, and P2. Based on the Shapiro-Wilk normality test, all groups' IL-6 levels showed a

## The Effect of Bitter Melon Extract on Cholesterol, IL-6, and Malondialdehyde Serum Levels

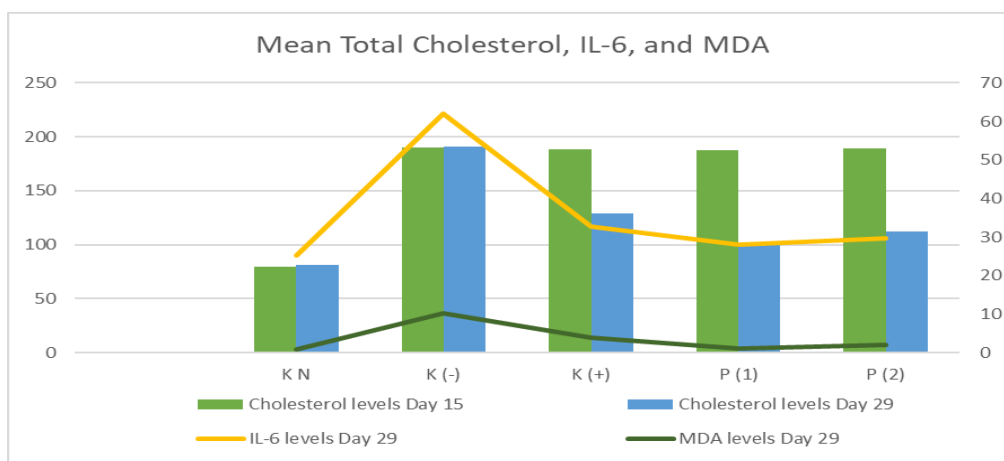
normal distribution of data ( $P > 0.05$ ), and the homogeneity test using Levene's Test showed a homogenous distribution of data ( $p > 0.05$ ). Data analysis was continued with One-Way ANOVA test, which indicated a significant difference between the groups ( $p = 0.000$ ). Subsequently, the data was further analyzed with Tukey's test, which revealed a significant difference in all groups ( $p < 0.05$ ).

The lowest average MDA levels after being given a high cholesterol diet were in treatment group 1, rats were only given bitter melon extract at a dose of 150 mg/kgBW/day. Tests for normality and homogeneity of MDA levels in this research showed that the data were normally distributed ( $P > 0.05$ ) and homogeneous ( $p > 0.05$ ). The results of the One Way Anova test showed a significant difference between the treatment group and the control group ( $p = 0.000$ ). Tukey's test showed that MDA levels between groups had significant differences in almost all groups ( $p < 0.05$ ), except treatment group 1 (P 1) against the normal control group (K N) and vice versa K N against P 1 with a significant value of 0.807 ( $p > 0.05$ ). Tukey's test on the MDA levels of group P 1 on K N was not significant or there was no difference because P 1 in rats given 150 mg/kgBW/day of bitter melon extract which were given high cholesterol feed had the lowest effect similar to MDA levels on K N (normal rats without being fed high cholesterol feed).

**Table 2. Analysis mean serum of Cholesterol, IL-6 and MDA levels**

		Uji Oneway Anova		
		Sum of Squares	Mean Square	Sig
Kolesterol	Between Groups	351852565.360	87963141.340	.000
	Within Groups	3582866.400	179143.320	
	Total	355435431.760		
IL-6	Between Groups	3001301.440	750325.360	.000
	Within Groups	19452.000	972.600	
	Total	3020753.440		
MDA	Between Groups	45643569.040	11410892.260	.000
	Within Groups	107504.800	5375.240	
	Total	45751073.840		

**\*\*sig p < .05**



**Figure 1. Mean Total of Cholesterol, IL-6, and MDA serum levels**

## IV. DISCUSSION

The K-, K+, P1, and P2 groups in this study showed hypercholesterolemic rats (cholesterol levels  $> 88$  mg/dL) with total IL-6 levels, and MDA levels were higher after being given a high cholesterol diet of 10 mL/kgBW orally for 14 days compared to the KN group. This was in accordance with Kusuma's research (2017) that hypercholesterolemia feed in experimental animals using quail egg yolk as much as 10 ml/kg for 14 days can cause an increase in cholesterol levels beyond the normal threshold (47-88 mg/kg). dl) (Binmowyna *et al.*, 2021). Aprilia's (2018) study stated that there was an increase in LDL and MDA cholesterol levels in rats after being given a high cholesterol diet for 14 days. Wulandari(Wulandari, Padaga and Herawati, 2012) in his research stated that high cholesterol feed can increase free radicals which can be seen from increased levels of MDA. Sarihati's research(2020) also showed an increase in IL-6 levels in rats given a high cholesterol diet. This proves that a high cholesterol diet can trigger an inflammatory process mediated by IL-6.

## The Effect of Bitter Melon Extract on Cholesterol, IL-6, and Malondialdehyde Serum Levels

Wahjuni (2015) stated that the increase in cholesterol levels in rats given a hypercholesterolemia diet induced the production of reactive oxygen species in adipose tissue and liver. Free radicals that increased in the body then took structural components and atomic electrons which cause a chain reaction resulting in ROS (Wahjuni, 2015). Assessment of lipid peroxidation and antioxidant activity in bitter melon extract can be seen through MDA levels in hypercholesterolemic rats. This research showed that MDA levels in the treatment group were lower than the K- group. This was in accordance with research conducted by Andiani<sup>7</sup> that there were significantly lower changes in MDA levels in rats given a high cholesterol diet and bitter melon extract. Maulidia (2021) in her research stated that a high cholesterol diet can affect the inflammatory process which is characterized by higher IL-6 levels.

Isnawati (2014) in her research also mentioned that the content of bitter melon in total cholesterol levels was significantly lower in rats given a high cholesterol diet. Chaturvedi's research (2004) gave bitter melon extract for 30 days and significantly reduced triglycerides, LDL and increased HDL in diabetic rats fed a high-fat diet. However, this research was not in line with research conducted by Rita<sup>103</sup> on mice fed high cholesterol diet and bitter melon juice at a dose of 0.5 ml/40 gBW. The results of the study did not show significantly lower cholesterol levels.

The control group + who was given simvastatin therapy on a high cholesterol diet experienced a significant decrease because simvastatin works by inhibiting the HMG-CoA reductase enzyme, increasing the affinity of the LDL receptor, increasing the rate of LDL catabolism, extraction of LDL precursors in the liver and resulting in a decrease in LDL in plasma. This research was in line with research conducted by Artha (2017) that there was a decrease in cholesterol levels in mice on a high cholesterol diet given simvastatin. Decreased cholesterol levels with simvastatin through the inhibition mechanism of HMG-CoA which is the main enzyme for cholesterol synthesis.

The average levels of cholesterol, IL-6, and MDA in the treatment group 1 were the lowest levels compared to the other treatment groups. This research was in line with Andiani (2018) that bitter melon extract can influence lower MDA levels in male white Wistar rats (*Rattus norvegicus*) fed a high-fat diet. Bitter melon extract can reduce cholesterol through many pathways, including increasing the activity of the enzyme Cholesterol 7 alpha-hydroxylase (CYP7A1) by converting cholesterol into bile acids which are then excreted by the body (Zeng *et al.*, 2018). The flavonoid compounds in bitter melon can inhibit the effects of the HMG-CoA reductase enzyme in the body in reducing cholesterol synthesis (Yu *et al.*, 2015). Lutein in bitter melon plays a role in reducing cholesterol levels by capturing free radicals so that it does not cause LDL oxidation (Kurniawaty and Liani, 2013). The polysaccharides in bitter melon extract can trap fat in the small intestine, thus reducing cholesterol levels in the blood by up to 5 % or more, can bind bile salts (cholesterol end product), and excreted along with feces.

Treatment group 2 with a combination of bitter melon extract 75mg/kgBB and simvastatin 0.045mg/kgBB experienced significantly lower changes in total cholesterol, IL-6, and MDA levels but the average value of the results was higher than treatment group 1. This is suspected because the dose of bitter melon extract given was half the dose of bitter melon extract and half the dose of simvastatin. Simorangki's research (2021) stated that using a dose of 150 mg/kgBW/day bitter melon extract is effective in reducing cholesterol levels. Simorangkir (2021) stated that a dose of simvastatin for humans is 10 mg/day, whereas in this research, the combined dose of simvastatin given was only 0.045 mg/kgBW, which is equivalent to a dose of 5 mg/day in humans.

Based on the research results obtained and the theoretical studies that have been described, the hypothesis of bitter melon extract can reduce cholesterol, IL-6 and MDA levels on high cholesterol diet rats has been proven. However, this research only conducted qualitative phytochemical testing of flavonoids. Further researches can conduct quantitative phytochemical testing of other compounds in bitter melon extract.

## V. CONCLUSIONS

The extract of bitter melon, simvastatin, and the combination of simvastatin and bitter melon extract have effect on reducing cholesterol levels, IL-6, and MDA in hypercholesterolemic rats.

## ACKNOWLEDGEMENT

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors. The author would like to thank to everyone who have provided criticism and suggestion during the process of preparing the manuscript

## REFERENCES

- 1) Andiani and Harsa, M. S. (2018) 'Effect administration of ethanol extract of bitter melon (*Momordica charantia* L.) on the reduction of MDA (malondialdehyde) levels serum in rats given a high-fat diet', *Jurnal Ilmiah Kedokteran Wijaya Kusuma*, 7(2), p. 196. doi: 10.30742/jikw.v7i2.466.

## The Effect of Bitter Melon Extract on Cholesterol, IL-6, and Malondialdehyde Serum Levels

- 2) Aprilia, C. A. and Marlina Dewiastuti (2018) 'Efektivitas Hipolipidemia dan Antioksidan Ekstrak Daun Binahong pada Tikus Putih yang Diinduksi Pakan Hiperkolesterol', *YARSI Medical Journal*, 25(3), p. 150. doi: 10.33476/jky.v25i3.362.
- 3) Artha, C., Mustika, A. and Sulistyawati, S. W. (2017) 'Pengaruh ekstrak daun singawalang terhadap kadar ldl tikus putih jantan hiperkolesterolemia', *eJournal Kedokteran Indonesia*, 5(2), pp. 105–109. doi: 10.23886/ejki.5.7151.
- 4) Binmowyna, M. N. et al. (2021) 'Hypolipidemic and antioxidant effects of the juice and water seed extracts of two pomegranate species in high-cholesterol diet fed rats', *Food Science and Technology*, 41(December), pp. 732–740. doi: 10.1590/fst.31220.
- 5) Chaturvedi et al. (2004) 'Effect of momordica caharantia on lipid profile and oral glucose tolerance in diabetic rats', *Phytother Res*, 18(11), pp. 956–6.
- 6) Darwin, E., Afriani, N. and Hanam, N. N. (2016) 'Pengaruh arginin terhadap kadar IL\_6, IL-17, dan TGF-B pada rattus norvegicus dengan diet tinggi lemak', *PIN PAAI*, pp. 130–136.
- 7) Destiana, D. and Timan, I. S. (2018) 'The relationship between hypercholesterolemia as a risk factor for stroke and blood viscosity measured using digital microcapillary', *Journal of Physics: Conference Series*, 1073(4). doi: 10.1088/1742-6596/1073/4/042045.
- 8) Dixon et al. (1998) 'The effect of low carotenoid diet on malondialdehyde-thiobarbituric acid (MDA-TBA) concentrations in women: a placebo-controlled double blind study', *J. AM. Coll. Nut*, 62, pp. 149–150.
- 9) Fernández-Real, J. M. et al. (2000) 'Interleukin-6 gene polymorphism and lipid abnormalities in healthy subjects', *Journal of Clinical Endocrinology and Metabolism*, 85(3), pp. 1334–1339. doi: 10.1210/jc.85.3.1334.
- 10) Jia, S. et al. (2017) 'Recent advances in momordica charantia: Functional components and biological activities', *International Journal of Molecular Sciences*, 18(12). doi: 10.3390/ijms18122555.
- 11) Kumar, S., Singh, U. N. and Dhakal, S. (2017) 'Study of oxidative stress in hypercholesterolemia', *International Journal of Contemporary Medical Research*, 4(5), pp. 2454–7379. Available at: [www.ijcmr.com](http://www.ijcmr.com).
- 12) Kurniawaty and Liani, S. (2013) 'Pengaruh pemberian ekstrak biji jengkol (pithecellobium lobatum benth.) terhadap kadar kolesterol total dalam darah tikus diabetes yang di induksi aloksan', *Medical Faculty of Lampung university*, 4, pp. 70–76.
- 13) Kusuma, A. M. et al. (2017) 'Efek ekstrak bawang dayak (eleutherine palmifolia (l.)merr) dan ubi ungu (ipomoea batatas l) terhadap penurunan kadar kolesterol dan trigliserida darah pada tikus jantan', *Jurnal Kefarmasian Indonesia*, 6(2), pp. 108–116. doi: 10.22435/jki.v6i2.6225.108-116.
- 14) Maulida, M. (2021) *Pengaruh pemberian VCO ( virgin coconut oil ) terhadap kadar kolesterol HDL ,LDL, dan IL-6, Universitas Islam Sultan Agung Semarang.*
- 15) Purnamasari, A. W. and Isnawati, M. (2014) 'Pengaruh pemberian jus pare (momordica charantia l.) dan jus jeruk nipis (citrus aurantifolia) terhadap kadar kolesterol total tikus sprague dawley hiperkolesterolemia', *Journal of Nutrition College*, 3(4), pp. 647–654.
- 16) Purwastyastuti (2000) *Relation of lipid peroxide to food habits, selected coronary heart disease risk factors and vitamin e supplementation in the elderly.* UI.
- 17) Rahma, N. L. and Syauqy, A. (2013) 'Pengaruh pemberian jus biji pepaya (carica papaya linn.) terhadap kadar trigliserida tikus sprague dawley dislipidemia', *Journal of Nutrition College*, 2(3), pp. 118–125. Available at: <http://ejournal-s1.undip.ac.id/index.php/jnc>.
- 18) Rahmawati, Y. et al. (2022) 'Hiperkolesterolemia pada pasien lanjut usia', *Jurnal Kesehatan Tambusai*, 3, pp. 157–163.
- 19) Saraswati, R. D. and Khariri (2021) 'Transisi epidemiologi stroke sebagai penyebab kematian pada semua kelompok usia di indonesia', *Seminar Nasional Riset Kedokteran*, 2(1), pp. 81–6. Available at: <https://conference.upnvj.ac.id/index.php/sensorik/article/view/1001>.
- 20) Sarihati, I. G. A. D. and Dhyana Putri, I. G. A. S. (2020) 'Pengaruh Ekstrak Etanol Daun Kenikir (Cosmos caudatus) terhadap Kadar Glutathion Dan Interleukin 6 Serum Tikus Wistar Jantan yang Diberi Pakan Tinggi Kolesterol', *Jurnal Kesehatan*, 11(1), p. 77. doi: 10.26630/jk.v11i1.1836.
- 21) Simorangkir, D. and Wahyudi (2021) 'Formulasi dan uji efektivitas antihiperlipidemia kombinasi ekstrak etanol buah pare (momordica charantia l.) dan jahe merah (zingiber officinale rosc var.rubrum) terhadap tikus jantan putih (rattus norvegicus)', *Jurnal Biosains (The Journal of Biosciences)*, 7(3), pp. 115–120. Available at: <https://doi.org/10.24114/jbio.v5i2.13984%0AIAISSN>.
- 22) Tubagus, T. A., Momuat, L. I. and Pontoh, J. S. (2015) 'Kadar kolesterol plasma tikus wistar pada pemberiak ekstrak etanol dan heksana dari daun gedi merah ( abelmoschus manihot)', *Jurnal MIPA UNSRAT*, 4(1), pp. 63–68.

## The Effect of Bitter Melon Extract on Cholesterol, IL-6, and Malondialdehyde Serum Levels

- 23) Vijayan, J. *et al.* (2018) 'Hypercholesterolemia', *European Journal of Biomedical and Pharmaceutical Sciences*, 5(3), pp. 245–249.
- 24) Wahjuni, S. (2015) *Dislipidemia menyebabkan stress oksidatif ditandai oleh meningkatnya malondialdehid*, Udayana Unersity Press. Edited by I. H. Utama. Denpasar, Bali.
- 25) Wulandari, D. Y., Padaga, M. C. and Herawati (2012) 'Kadar MDA dan gambaran histopatologi organ hati tikus hiperkolesterolemia setelah terapi ekstrak air benalu mangga', *Jurnal Medik Veteriner Universitas Brawijaya*. Available at: <https://fkh.ub.ac.id/wp-content/uploads/2012/10/0911310007-DebinYuniarW.pdf>.
- 26) Yu, G. J. *et al.* (2015) 'Anti-inflammatory potential of saponins derived from cultured wild ginseng roots in lipopolysaccharide-stimulated RAW 264.7 macrophages', *International Journal of Molecular Medicine*, 35(6), pp. 1690–8. doi: 10.3892/ijmm.2015.2165.
- 27) Zeng, Y. *et al.* (2018) 'Bitter melon (*Momordica charantia*) attenuates atherosclerosis in apo-E knock-out mice possibly through reducing triglyceride and anti-inflammation', *Lipids in Health and Disease*. *Lipids in Health and Disease*, 17(1), pp. 1–7. doi: 10.1186/s12944-018-0896-0.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Advocates of the Future: Challenges and Opportunities of Robot Lawyer in Indonesia



**Septa Chandra**

Fakultas Hukum, Universitas Muhammadiyah Jakarta, Jakarta, Indonesia.

**ABSTRACT:** The digital age has brought significant changes in various sectors, including the legal field. The emergence of robot lawyers, or artificial intelligence (AI) in legal practice, offers unprecedented efficiency and accuracy. This study explores the potential impact of robot lawyers in the context of Indonesia's Advocates Law, considering legal, ethical, and practical aspects. This research applies the normative legal method, which combines statutory, conceptual, comparative, and futuristic approaches. The characteristics of this research are descriptive-prescriptive, where the data collected is analyzed using the content analysis method. This research shows that robot lawyers have the potential to improve access to legal services, reduce costs, and offer more consistent and unbiased solutions. However, challenges such as data security, legal liability, and ethical concerns related to replacing human labor with AI also arise. Further analysis shows that Indonesia's current Advocate Law is not fully prepared for the era of robot lawyers. This research recommends updating the policy and legal framework to effectively integrate AI in legal practice while maintaining the integrity of the profession and protecting the public interest. We also highlight the importance of adaptive legal education and training to prepare legal practitioners for technological change.

**KEYWORDS:** Robot Lawyer, Artificial Intelligence, Indonesia Advocate Law, Legal Technology Innovation, AI Ethics in Legal Practice

### I. INTRODUCTION

In February 2023, the development of AI technology in the legal world reached a significant milestone with the first use of a robot lawyer in a trial in the United States. The DoNotPay app utilized AI as an assistant to the defendant, providing real-time legal advice during the trial.[1] The defendant will receive instructions through earphones based on the AI's analysis of the arguments taking place in court. Two speeding ticket cases will pilot the use of this technology, with one defendant attending the court in person and the other following the proceedings via Zoom. The application of AI in this context marks a step forward in the interaction between technology and legal practice.[2] DoNotPay CEO Joshua Browder points out that law can be seen as a combination of code and language, making it an ideal use case for AI and language modeling technology. In this context, AI has the potential to be a very powerful tool to assist individuals in understanding and navigating the legal system. Rapid developments in artificial intelligence (AI) technology have opened up new possibilities in various fields, including the legal sector.[3] The concept of robot lawyers, which refers to the application of AI in legal practice, has become a hot topic that generates serious discussion among academics, legal practitioners, and policymakers. Given Indonesia's constantly evolving legal system, it is crucial to explore the integration of this technology into legal practice within the framework of the existing Advocates Law. This research focuses on analyzing the potential integration of robot lawyers in the Indonesian legal system, examining the legal, ethical, and practical aspects relating to the use of AI in advocacy. Against this backdrop, the research aims to answer important questions on how AI may change the face of legal practice in Indonesia, as well as the challenges and opportunities that arise from the integration of this technology. Some of the key aspects explored include the ethical implications and legal responsibilities related to the use of AI in law, as well as its impact on access to justice and the efficiency of legal processes. The research also highlights the need for adjustments in the Advocates Law to accommodate this new technology, given that the current law does not fully provide a framework for the integration of AI in legal practice.

Finally, this research aims to provide recommendations for policymakers, academics, and legal practitioners in Indonesia to anticipate and capitalize on these technological advancements while ensuring that such changes do not compromise the integrity and fairness of the legal system. This is an important step towards preparing for a future of legal practice in Indonesia that is more innovative, efficient, and adaptive to technological developments.

# Advocates of the Future: Challenges and Opportunities of Robot Lawyer in Indonesia

## II. METHOD

The research entitled "Advocates of the Future: Challenges and Opportunities of Robot Lawyers in Indonesia's Advocate Law" introduces an innovative multidisciplinary approach to exploring the impact and integration of robot lawyers in Indonesia's advocate law. Using normative legal methods as a foundation, the research focuses on analyzing relevant regulations and laws, using a statutory approach to understand and interpret the existing legal text.[4] This approach is important to ensure that the analysis is not only legally accurate but also relevant to the Indonesian legal context. In addition, this research adopts a conceptual approach to understand the underlying theories and concepts related to the use of AI in legal practice. This approach assists in building a solid theoretical understanding of how a robot lawyer may interact with existing legal principles and how it may change current legal practice. In this research, a comparative approach was also used to compare the regulation, practice, and application of robot lawyer across different jurisdictions. This allows the researcher to identify trends, challenges, and opportunities that may be relevant to the Indonesian context while also providing insight into the ways in which other countries have addressed similar issues. The futuristic approach in this research is particularly important, given the dynamic and rapidly evolving nature of AI technology.[5] This research attempts to form a vision of how law and society can adapt to the robot lawyer phenomenon, considering its long-term impact on legal practice and the legal system in general. This approach encourages the formation of proactive strategies and policies to deal with the coming changes. The descriptive-prescriptive nature of this research allows not only the description of the phenomenon at hand but also the development of practical and informed recommendations to address the challenges identified.[6] This creates a balance between theoretical understanding and practical application, providing valuable guidance for policymakers, legal practitioners, and other involved parties. Finally, to ensure accurate and objective interpretation of the data, this research utilized the content analysis method in evaluating and understanding the collected data.[7] This method allows for a detailed and thorough analysis of legal texts, policy documents, and other sources, ensuring that the conclusions drawn are based on solid evidence and analysis. In this way, this research makes an important contribution towards a broader understanding of how AI can be integrated into the Indonesian legal system and the implications that may arise from this integration.[8]

## III. RESULT AND DISCUSSION

### a. Robot Lawyer: Regulatory Compliance and Professional Ethics

The rapid growth in the field of artificial intelligence (AI) has opened up unprecedented opportunities and challenges. One aspect that has attracted particular attention is the interaction between AI and humans, especially in the legal context. [6] In the future, we can imagine robot lawyers that function as autonomous decision-making agents. These robots will not only be able to provide legal advice but also represent human interests in court or in other legal proceedings. These advancements raise important questions about how science can evolve through the use of AI and how this will affect the development and enforcement of law in Indonesia. It is important to discuss and explore this potential further, with the aim of finding the best solutions that utilize AI for the benefit of law and justice.

The future use of artificial intelligence (AI) in the form of robot lawyers in the practice of law in Indonesia poses significant regulatory challenges, particularly in relation to Law Number 18 of 2003 on Advocates. This law, which includes Chapters I and II, explicitly defines an advocate as "a person whose profession is to provide legal services," thereby clearly excluding non-human entities such as AI. Humans are the only entities to which other aspects such as citizenship, formal legal education, taking an oath or pledge, and professional ethics, all enshrined in the law, can be applied. Another example of linking robot lawyers or AI in legal practice with Article 4 of the advocate's oath raises new questions in the context of law and ethics. This article stipulates that before practicing their profession, an advocate in Indonesia must take an oath according to their religion or promise solemnly in the open court of the High Court in the area of legal domicile. In the context of AI, such as robot lawyers, the main challenge is how to ensure that the use of this technology remains in accordance with the ethical principles and legal responsibilities required of human advocates. Since AIs cannot take personal oaths or promises, there is the question of how to ensure that the legal services provided through these AIs remain fair, accurate, and adhere to professional ethics. In this context, robot lawyers operate in a legal gray area. While they can improve efficiency in document analysis, case research, and even provide initial legal assistance, they cannot be considered advocates in the traditional sense. These concerns raise important questions about adapting or expanding current regulations to cover the roles and responsibilities of AI in legal practice. Not only are there concerns about the appropriateness of legal advice provided by AIs, but also about how AIs align with the core values of the legal profession, such as confidentiality, integrity, and independence. Faced with this situation, it is important for Indonesian policymakers to consider establishing new regulations or standards specifically aimed at regulating the use of AI in the legal field. Such regulations should specifically address issues such as data protection, ethics in the use of AI, and legal liability when AI provides false or misleading advice. Such regulations should specifically address issues such as data protection, ethics in the use of AI, and legal liability when

## **Advocates of the Future: Challenges and Opportunities of Robot Lawyer in Indonesia**

AI provides false or misleading advice, ensuring that AI technology improves access and efficiency in legal services while maintaining the ethical and legal standards that have long prevailed in the legal profession.

Given the rapid development of AI technology and its applications in various fields, including law, there is an urgency to anticipate the impact it will have on traditional legal practices and existing regulations. In Indonesia, this means considering revisions or additions to Law Number 18 of 2003 on Advocates to explicitly accommodate and regulate the use of AI in a legal context. This revision should not only focus on the technical aspects of AI use, such as data security and AI ethics, but also on its social and professional implications. For example, AI can be used to support advocates in their work without completely replacing the role of humans, particularly in aspects that require ethical considerations, empathy, and complex legal judgments. It is also important to establish a clear boundary line between automated legal assistance and legal advice that requires human judgment.

### **b. Impact of AI Technology on Access to Justice**

The impact of AI technologies on access to justice is a broad and multifaceted topic, stretching from potential benefits to complex ethical and legal questions. At its core, AI has the ability to dramatically improve access to justice, particularly by making legal services more affordable, efficient, and accessible to the wider public.[9] However, careful implementation and use of these technologies is necessary to ensure that they not only adhere to legal and ethical principles but also genuinely serve the interests of justice. The use of artificial intelligence (AI) in legal practice has the potential to significantly improve access to justice, particularly through efficiency, cost reduction, uniformity in decision-making, and improved access to legal information.[10] AI, with its ability to automate routine tasks such as case tracking, document analysis, and certain aspects of legal writing, can cut the time and resources required in legal procedures.[11] As a result, the cost of legal services can go down, allowing individuals and organizations that previously did not have enough resources to access legal services to do so. In addition, AI provides the potential for more consistent and unbiased legal decisions.[12] In terms of legal analysis and interpretation, AI can help in achieving uniformity, reducing human subjectivity that could affect the consistency of legal application. Ensuring that all cases are handled to a uniform standard enhances fairness and trust in the legal system. AI also paves the way for improved access to legal information.[13] With AI-based tools, legal information becomes more accessible to the general public, including those who are not legal experts. This enables individuals to gain an initial understanding of legal issues, prepare basic legal documents, and make more informed decisions about when and how to seek professional legal assistance.[14] Thus, AI not only expands the reach of legal services but also increases legal awareness and empowers individuals to deal with legal issues.

The application of artificial intelligence (AI) in law brings various challenges and risks that must be addressed to ensure its effective and ethical use:

#### **1) Quality and Accuracy of Legal Advice**

One of the biggest challenges in integrating artificial intelligence (AI) into legal practice is ensuring the quality and accuracy of the legal advice provided. Accurate and reliable legal advice is at the core of an effective justice system. However, AI, which relies on data and algorithms to make conclusions and recommendations, can be susceptible to a number of issues that could potentially degrade the quality of its advice. Errors in AI can come from a variety of sources, including biased data, improper algorithm programming, or the AI's lack of ability to understand complex legal contexts. Biased data, for example, can arise from training datasets that do not fairly reflect the diversity of legal cases or populations. This may cause the AI to make recommendations that are inappropriate for specific situations or discriminatory. In addition, algorithms designed without a deep understanding of legal and ethical principles may result in incorrect or misleading legal interpretations. Such errors not only undermine trust in AI as a legal tool but can also cause real harm to individuals who rely on such advice, undermine the integrity of the legal process, and impede access to justice. In this context, it is imperative to establish strict checks and balances procedures for the development and application of AI in law. This includes, but is not limited to, the use of extensive and diverse training datasets, periodic audits of algorithms to ensure fairness and accuracy, and rigorous oversight by legal professionals. Awareness of the limitations and potential biases of AI is key to ensuring that these technologies are used in a way that enhances, not detracts from, the quality of legal advice and access to justice. This approach must also be accompanied by an ongoing commitment to improving the technology and correcting errors, as well as developing policies and regulations that ensure the ethical and responsible use of AI in legal practice.

#### **2) Data Confidentiality and Security**

Data confidentiality and security are important issues in the use of artificial intelligence (AI) in the legal field. Legal practitioners often handle sensitive information, such as clients' personal data and confidential case information, which necessitates protecting this data with high security standards. This involves the use of advanced encryption technologies, strict access policies, and cybersecurity protocols to protect against unauthorized access or data breaches.[15]



## Advocates of the Future: Challenges and Opportunities of Robot Lawyer in Indonesia

Furthermore, the AI system must withstand cyberattacks, ensuring that unauthorized parties cannot manipulate or steal algorithms and databases. In the legal context, where trust and confidentiality are the foundation of the relationship between lawyer and client, maintaining data security is not only a matter of legal compliance but also of professional ethics. Therefore, AI developers and users in law must proactively implement best practices in cybersecurity and continually monitor and update their systems to respond to evolving security threats.

### 3) Over-reliance on Technology

Over-reliance on technology, particularly artificial intelligence (AI), in the legal field may raise several significant issues.[16] First, there is a concern that excessive use of AI could diminish the importance of traditional legal skills, such as critical reasoning, legal analysis, and statutory interpretation. Legal practitioners who rely on AI to perform complex tasks may find their skills less sharp over time as they use AI to perform work that would normally challenge and develop their intellectual abilities. Secondly, over-reliance on AI can also lead to what is often referred to as the 'black box' problem, where the user does not fully understand how the AI arrived at its conclusions. This can be a serious problem in law, where decisions and arguments need to be accountable and transparent. The inability to fully understand an AI's decision-making process can undermine trust in the legal system and make it difficult to challenge or question the results produced by the AI. Therefore, it is important for legal professionals to maintain a balance between the utilization of technology and the maintenance of traditional legal skills and demand a certain level of transparency from the AI solutions they use.

### 4) Digital and Access Gap

The digital divide and access issues are among the key challenges faced in the integration of artificial intelligence (AI) in legal services. While AI has the potential to make legal services more efficient and affordable, not all individuals or communities have equal access to these technologies.[17] This gap often relates to factors such as geographic location, economic conditions, education levels, and digital literacy. For example, individuals living in remote areas or underprivileged communities may not have reliable internet access or the necessary devices to utilize AI-based legal solutions. In addition, the lack of ability to use advanced technology can be a barrier for some, particularly for the elderly or those who have no experience with digital technology. This access gap can lead to greater inequality in terms of receiving legal services. People who are unable to access or use AI for their legal needs may find themselves further left behind, not only in obtaining legal aid but also in understanding their legal rights and obligations. This can deepen social and legal inequities, reducing the effectiveness of AI in making legal services more inclusive. Addressing this gap requires coordinated efforts from various parties, including legal service providers, governments, non-profit organizations, and the technology sector. Possible steps include improving digital infrastructure in underserved areas, education and training programs to improve digital literacy, and the development of AI-based legal solutions that are more accessible and user-friendly for all groups of society

Responsible implementation of artificial intelligence (AI) in the practice of law requires a holistic approach that covers various aspects, from regulation to social awareness:

#### 1) Regulations and Standards

The responsible implementation of artificial intelligence (AI) in legal practice requires the development and implementation of comprehensive regulations and standards.[18] These regulations should be designed to ensure that the use of AI is not only efficient and effective but also ethical and compliant with legal principles. One important aspect of these regulations is transparency, which ensures that AI decision-making processes can be understood and analyzed by users and other interested parties. This is important to maintain accountability and enable the review or challenge of decisions made by AI systems. Furthermore, the aspect of accuracy is crucial, as errors in AI systems can have serious legal consequences, including errors of judgment or legal interpretation. Regulations should also emphasize the importance of confidentiality and data security, given the sensitivity of information often handled in legal practice. This includes protecting client data from unauthorized access and cyberattacks, as well as ensuring that data used by AI is not misused or disseminated without authorization. In addition, regulations should cover aspects such as nondiscrimination to prevent bias and errors in AI systems, as well as ensuring that the use of AI complies with societal norms and values. The establishment of these standards requires collaboration between policymakers, legal practitioners, technologists, and other relevant parties to create a balanced framework between innovation and protection of individual rights.

#### 2) Training and Awareness

Training and raising awareness about AI among legal professionals is a critical component in the responsible implementation of this technology in legal practice. Equipping legal professionals with adequate knowledge of how AI

## Advocates of the Future: Challenges and Opportunities of Robot Lawyer in Indonesia

works, including an understanding of basic algorithms, data intelligence, and machine learning processes, is crucial. By understanding the technical underpinnings of AI, they can be more effective in integrating these tools into their practice, as well as in identifying and addressing potential flaws or biases in the system. In addition, it is crucial for legal professionals to understand the ethical and legal implications of using AI. These include issues such as the confidentiality and privacy of client data, accountability for decisions made with the help of AI, and the risk of unfair discrimination or bias in AI systems. Training should also include ways to identify and address 'black box' problems, where decisions made by AI are not fully transparent or understandable. Ongoing education and training are essential, given that AI technology is evolving rapidly. Regular updates to training programs should reflect the latest developments in technology and applicable regulations. In addition, building awareness about the benefits and risks of AI can help ensure that these technologies are used in ways that improve the quality of legal services while maintaining high standards of ethics and professionalism. Universities, law associations, and other educational institutions play an important role in providing resources and training programs to meet these needs.

### 3) Multidisciplinary Collaboration and Supervision

Multidisciplinary collaboration and oversight are important aspects of the development and application of artificial intelligence (AI) in law.[19] This approach involves cooperation between various stakeholders, including technology developers, legal professionals, regulatory bodies, and the general public. Technology developers play an important role in creating AI solutions that fit the needs of legal practice, while legal professionals provide insights into integrating AI into existing legal processes and meeting ethical standards and legal regulations. Regulatory authorities must be involved to ensure that the use of AI in law complies with existing regulations and protects human rights and the public interest. Ongoing oversight of AI in law is also crucial. This involves regular assessment and evaluation of AI systems to ensure they work as intended and do not lead to legal or ethical errors. This oversight should consider aspects such as fairness, transparency, accuracy, and data security. In addition, the general public should also be involved in this process. Effective education and communication on the use of AI in law can help raise public awareness and understanding of the benefits and risks of this technology. It also ensures that public voices and concerns are recognized and integrated into the development and implementation of AI. This multidisciplinary collaboration and oversight are essential to ensuring that AI technologies in law are not only innovative and efficient but also fair, transparent, and responsible. With this approach, we can ensure that AI contributes to greater access to justice and strengthens the integrity of the legal system.

### 4) Improved Access and Equity:

Improving access and equity is one of the main goals of implementing artificial intelligence (AI) in law. This goal can be achieved by ensuring that AI not only serves those who already have access to legal resources but also helps those with limited resources or who do not usually have adequate access to legal services.[20] To make this happen, it is first important to address the digital divide. This means ensuring that AI technologies are accessible to people in remote areas, communities with limited economic means, and those who may not have advanced technological knowledge. Initiatives such as improving internet access, enhancing the user-friendliness and accessibility of AI applications, and providing training and educational resources to enhance digital literacy can achieve this goal. Furthermore, it is important to develop AI solutions that are inclusive and accessible to different groups of people, including people with disabilities. This could mean designing accessible interfaces, using easy-to-understand languages, and ensuring that these technologies meet the needs of diverse users. In addition, community-based approaches can also help expand access. Working with civil society organizations, pro bono legal institutions, and others to spread awareness about these technologies and provide access to AI for those in need is an important step. With a focus on improving access and equity, the implementation of AI in law will not only make legal services more efficient and affordable but will also help in realizing more equitable and inclusive justice for all.

## c. The Relationship Between Human Advocates and Robot Lawyers in the Future of Indonesian Legal Practice

The relationship between human advocates and robot lawyers in the future of legal practice in Indonesia is an interesting and complex topic.[21] On the one hand, there is great potential for AI to improve the efficiency and accessibility of legal services, but on the other hand, there are important questions about the role and relevance of human advocates in the digital age.[22] In the Indonesian context, where law and technology are rapidly evolving, this dynamic offers both significant opportunities and challenges. The utilization of artificial intelligence (AI) in legal practice offers a number of significant opportunities, particularly in improving the efficiency, accuracy, and accessibility of legal services.

## Advocates of the Future: Challenges and Opportunities of Robot Lawyer in Indonesia

### 1) Efficiency and Accuracy

The efficiency and accuracy offered by artificial intelligence (AI) have transformational potential in legal practice. AI's ability to process large amounts of data and information quickly and accurately offers a level of efficiency that human efforts struggle to achieve. For example, in legal document analysis, AI can quickly sift through thousands of pages of documents to identify key information, patterns, and trends. This is particularly useful in the due diligence process, where an in-depth review of large volumes of legal documents is required. AI can also play an important role in case research with its ability to identify legal precedents and relevant court decisions from vast legal databases, allowing advocates to access relevant information more quickly than traditional research methods. Furthermore, AI can aid in the preparation and review of legal documents. Using sophisticated algorithms, AI can assist in generating draft contracts, legal filings, and other legal documents, reducing the time required for this process.[23] The technology can also help in ensuring the consistency and accuracy of documents, reducing the risk of human error. Professionals must still perform tasks that require human judgment and legal interpretation, even as AI increases efficiency. AI acts as a tool that empowers advocates, freeing them from administrative and repetitive workloads so that they can focus on the more complex aspects of the law that require experience-based judgment and expertise. As such, the use of AI in law results in a more integrated approach where technology and human expertise complement each other to provide more effective and accurate legal services.

### 2) Decision Support

The use of robot lawyers, or artificial intelligence (AI) systems in law, as decision support tools opens up huge opportunities for improving the quality of legal services. With access to vast databases of legal information and the ability to analyze legal precedents in a sophisticated manner, AI can provide human advocates with in-depth and detailed insights that may be difficult or time-consuming to obtain through traditional methods. AI can assist advocates in understanding patterns in previous court decisions, trends in legal interpretation, and even the likely outcome of cases based on existing factors. With such extensive information and analysis, advocates can create more informed and data-driven case strategies. It's not just about gathering relevant information but also about understanding the context and application of the law in similar cases in the past. Additionally, AI can assist in identifying unique aspects of a client's case that may require special attention or a different approach, allowing advocates to customize their legal advice and representation according to the client's specific needs. This is especially important in law, where each case can have its own nuances and complexities. However, it is important to remember that AI serves as a supporting tool and not a substitute for the professional judgment of human advocates. While AI can provide information and analysis, the final decision and legal strategy should remain in the hands of the advocate, who has a deep understanding of the law, ethics, and client needs. As such, the use of robot lawyers as decision-support tools can significantly improve the quality and effectiveness of legal services provided to clients.

### 3) Improved Access to Legal Services

The application of artificial intelligence (AI) in legal services has significant potential to improve the accessibility of legal services in Indonesia, especially in the context of developing countries. AI can transform the way people access legal services, particularly those hindered by cost and geographical factors, due to its more affordable operational costs and faster processes. In many developing countries, including Indonesia, the cost of traditional legal services is often a major barrier for most people to access justice. AI, with its ability to automate certain tasks and provide fast and accurate legal information, can offer a more cost-effective alternative. For example, AI-based tools can assist the public in drafting basic legal documents, providing general legal information, or even conducting preliminary analysis of legal issues, all at a lower cost than direct consultation with a lawyer. In addition, AI can help overcome geographical barriers. In many parts of Indonesia, especially in remote or less developed areas, access to legal professionals can be very limited. AI can provide access to legal resources through online platforms, allowing those living in remote areas to get legal information and support without having to travel far. However, to realize this potential, there needs to be a sustained effort to ensure that AI technology is easily accessible and usable by the wider community. This includes providing adequate digital infrastructure, ensuring that AI-based platforms are accessible through mobile devices widely used in Indonesia, and providing educational resources to improve digital literacy. Furthermore, it is crucial to design AI solutions with the local context in mind, considering language, legal culture, and the specific needs of the Indonesian people. With the right approach, AI can play a key role in unlocking wider and fairer access to legal services in Indonesia, positively impacting social development and justice in the country.

## Advocates of the Future: Challenges and Opportunities of Robot Lawyer in Indonesia

The incorporation of AI in legal practice in Indonesia should ideally follow a collaborative model where human advocates and robot lawyers work side by side, each with their own strengths.

### 1) Complementary Role

The integration of AI into legal practice in Indonesia should ideally adopt a complementary model where human lawyers and AI-powered 'robot lawyers' work in tandem, leveraging their respective strengths. Human lawyers will continue to play a pivotal role in judgment, advocacy, and the interpersonal aspects of legal practice. Their expertise in understanding the nuances of the law, ethical considerations, and the ability to empathize with and interact with clients remains irreplaceable. Human lawyers' skills in negotiating, arguing in court, and offering personalized legal advice are aspects where the human touch is essential. On the other hand, AI can automate tasks like legal research and data processing. AI's ability to quickly analyze large volumes of legal data and identify relevant case laws and precedents can significantly enhance the efficiency of legal research. It can process information at a speed and scale that is unattainable for human lawyers, thereby freeing them from time-consuming tasks and allowing them to focus more on strategic and complex aspects of legal cases. Furthermore, AI can assist in organizing and managing legal documents, scheduling, and basic client interactions, which are integral yet time-consuming parts of legal practice. In this collaborative model, AI acts as a powerful tool that complements the human lawyer's capabilities, leading to a more efficient, accurate, and accessible legal service. This partnership between human intelligence and artificial intelligence holds the potential to revolutionize the legal landscape in Indonesia, making legal services more streamlined and accessible while maintaining the essential human elements of the legal profession.

### 2) Adjustment to Changes in the Legal Environment

Adapting to the continuously evolving legal landscape in Indonesia necessitates that advocates remain agile and receptive to new technologies. AI has a crucial role in assisting lawyers to stay abreast of legal changes and emerging trends. The dynamic nature of the legal environment, marked by frequent updates to laws, regulations, and precedents, can be challenging for human practitioners to track comprehensively. AI, with its advanced data processing and machine learning capabilities, can monitor and analyze vast amounts of legal information, including new legislation, regulatory changes, court decisions, and legal publications. By leveraging AI, lawyers can gain quick and efficient access to the latest legal developments. AI-driven tools can provide timely updates and insights, helping lawyers understand how these changes might impact their current cases or alter their legal strategies. This aspect is particularly valuable in areas of law that are rapidly evolving, such as technology, intellectual property, or environmental law. AI can also identify patterns and trends in legal decisions, offering a strategic advantage in predicting case outcomes or understanding judicial tendencies. Moreover, AI's real-time processing and analysis of legal information keeps lawyers informed and provides them with a more nuanced understanding of the implications of legal changes. This empowers them to provide more informed advice to clients, prepare more robust case strategies, and make more accurate risk assessments.

### 3) Cooperation in Improving Access to Justice

The use of AI in Indonesia has the potential to significantly broaden justice access initiatives, playing a transformative role in democratizing legal services. One of the primary ways AI can contribute is by providing basic legal information to the public. This involves the creation of AI-powered platforms or applications that can offer general legal guidance on common issues, such as property laws, family law, labor rights, and more. These platforms can answer FAQs, guide users through legal processes, or explain complex legal terms in simpler language, making the law more accessible and understandable to the general populace. Additionally, AI can play a vital role in enhancing the provision of pro bono legal services. Many legal aid organizations and lawyers providing pro bono services often face resource constraints. AI can help optimize these limited resources by assisting in tasks such as case triaging, where it identifies and categorizes cases based on urgency or complexity. This allows pro bono lawyers to prioritize and manage their caseloads more effectively. AI can also assist in the initial stages of legal research, document preparation, and even in drafting simple legal documents, thus reducing the workload on pro bono lawyers and enabling them to assist more clients. Moreover, in a country as geographically diverse and widespread as Indonesia, AI can bridge the geographical gap by providing remote legal assistance. This is particularly beneficial for individuals in rural or remote areas who may not have easy access to legal advice. By using AI-driven platforms, they can receive preliminary legal support without the need for physical travel. In essence, the integration of AI into the legal ecosystem in Indonesia has the potential to significantly enhance access to justice. It opens up new avenues for delivering legal information and services, especially to underrepresented and underserved communities, thereby promoting a more inclusive and equitable legal system.

## Advocates of the Future: Challenges and Opportunities of Robot Lawyer in Indonesia

### 4) Ethical and Regulatory Leadership

It is indeed crucial for stakeholders in Indonesia, including legal associations, educational institutions, and the government, to take the lead in developing an ethical and regulatory framework for the use of AI in law. This initiative is vital to ensure that the deployment of AI is not only effective but also ethically sound and in compliance with prevailing legal standards. Legal associations play a key role in setting professional standards and guidelines. They can develop codes of conduct and ethical guidelines specifically addressing AI's use in legal practices. These guidelines can cover aspects like data privacy, client confidentiality, transparency in AI decision-making processes, and accountability for AI-driven advice or conclusions. Educational institutions, particularly those offering legal and technological studies, should integrate courses on AI and law into their curricula. These courses should not only cover the technical aspects of AI but also its ethical, legal, and social implications. By doing so, the next generation of lawyers will be well-equipped with the knowledge and skills to navigate the evolving landscape of legal technology. The government's role is equally pivotal. It should consider enacting legislation or regulations that govern the use of AI in legal contexts. This includes setting standards for data use, AI algorithms' transparency, and ensuring these technologies are not biased or discriminatory. The government can also invest in research and development in this area, fostering innovation while safeguarding ethical and legal standards. Furthermore, collaboration between these stakeholders is essential. Joint efforts can lead to the creation of a robust framework that addresses all facets of AI in law, including technical capabilities, ethical considerations, legal compliance, and societal impacts. Public consultations and discussions involving AI experts, legal professionals, academics, and the public can provide diverse perspectives, ensuring a well-rounded and inclusive approach.

## IV. CONCLUSION

The integration of artificial intelligence (AI) into Indonesia's legal practice presents a landscape rich with opportunities, challenges, and the necessity for careful consideration of ethical, legal, and practical implications. This research has underscored the transformative potential of AI, particularly in enhancing the efficiency, accuracy, and accessibility of legal services, while also highlighting the need for a well-thought-out framework to guide its integration. AI's ability to process vast amounts of data expeditiously and its advanced analytical capabilities can significantly improve the efficiency of legal processes. This advancement is not only about automating routine tasks but also about providing in-depth insights and support in legal decisionmaking. The introduction of AI in the legal sector promises to revolutionize traditional practices, making legal services more accessible and affordable, especially in a developing country like Indonesia. However, this integration is not without challenges. The foremost among these is the need for a robust ethical and regulatory framework. It is imperative for stakeholders in Indonesia—including legal associations, educational institutions, and the government—to collaborate in developing regulations and standards that address AI's use in legal practices. These guidelines should encompass data privacy, client confidentiality, transparency, and accountability in AI-driven processes. Moreover, the training and awareness of legal professionals regarding AI are crucial. It's essential that lawyers understand not only the technical underpinnings of AI but also the ethical and legal implications of its use. This understanding will be critical in maintaining a balance between leveraging technology and preserving the traditional skills and judgment that define legal practice. The potential digital divide and the risk of over-reliance on technology are additional concerns. There is a need to ensure that AI technology is inclusive and accessible to all segments of society and that its use does not diminish the importance of human judgment and traditional legal skills. Also, addressing the 'black box' problem of AI is essential to maintaining transparency and trust in legal processes. Looking forward, the relationship between human lawyers and AI in legal practice should be complementary. Human lawyers will continue to play a critical role in areas requiring judgment, empathy, and ethical considerations, while AI can enhance their work by handling data-intensive and routine tasks.

## ACKNOWLEDGMENT

In the process of developing this manuscript, we have made a concerted effort to consult a wide array of academic sources, aiming to bring new perspectives and insights to contemporary legal issues. We extend our gratitude to all those who have supported us in this endeavor, including authors of significant texts, journal contributors, and other scholarly voices that have enriched the depth of our work. We recognize, however, that this document is an evolving project and openly invite constructive feedback and suggestions from all interested parties. Despite its current limitations, our hope is that this article will serve as a useful tool for academics, professionals in the field, and the broader community in their exploration and understanding of legal landscapes.

### REFERENCES

- 1) DoNotPay, "DoNotPay - The World's First Robot Lawyer," <https://donotpay.com/>, 2023. <https://donotpay.com/> (diakses Jun 05, 2023).
- 2) Z. Xu, Y. Zhao, dan Z. Deng, "The Possibilities and Limits of AI in Chinese Judicial Judgment," *AI Soc.*, vol. 37, no. 4, hal. 1601–1611, Des 2022, doi: 10.1007/S00146-021-01250-9/METRICS.
- 3) Z. J. Fernando, K. Kristanto, A. W. Anditya, S. Y. Hartati, dan A. Baskara, "Robot Lawyer in Indonesian Criminal Justice System: Problems and Challenges for Future Law Enforcement," *Lex Sci. Law Rev.*, vol. 7, no. 2, hal. 1–24, Nov 2023, doi: 10.15294/LESREV.V7I2.69423.
- 4) Zico Junius Fernando et al, "The Freedom of Expression in Indonesia," *Cogent Soc. Sci.*, vol. 8, no. 1, hal. 1–11, 2022, doi: 10.1080/23311886.2022.2103944.
- 5) Zico Junius Fernando et al, "Revenge Porn: Digital Crimes and Implications for Victims," *Kosmik Huk.*, vol. 23, no. 2, hal. 157–171, 2023, doi: 10.30595/kosmikhukum.v23i2.18542.
- 6) Agusalim et al, "Green Victimology: Sebuah Konsep Perlindungan Korban dan Penegakan Hukum Lingkungan di Indonesia," *Bina Huk. Lingkung.*, vol. 7, no. 1, hal. 60–79, Okt 2022, doi: 10.24970/BHL.V7I1.302.
- 7) Herlambang et al, "Kejahatan Memperkaya Diri Sendiri Secara Melawan Hukum (Illicit Enrichment) Dan Aparatur Sipil Negara: Sebuah Kajian Kritis," *RechtsVinding*, vol. 11, no. 2, hal. 247–264, 2022, doi: <http://dx.doi.org/10.33331/rechtsvinding.v11i2>.
- 8) Zico Junius Fernando et al, "Preventing Bribery in the Private Sector Through Legal Reform Based on Pancasila," *Cogent Soc. Sci.*, vol. 8, no. 1, hal. 1–14, 2022, doi: 10.1080/23311886.2022.2138906.
- 9) N. Xu dan K. J. Wang, "Adopting Robot Lawyer? The Extending Artificial Intelligence Robot Lawyer Technology Acceptance Model for Legal Industry by an Exploratory Study," *J. Manag. Organ.*, vol. 27, no. 5, hal. 867–885, Sep 2021, doi: 10.1017/JMO.2018.81.
- 10) N. Xu, K.-J. Wang, dan C.-Y. Lin, "Technology Acceptance Model for Lawyer Robots with AI: A Quantitative Survey," *Int. J. Soc. Robot.*, vol. 14, no. 4, hal. 1043–1055, 2022, doi: 10.1007/s12369-021-00850-1.
- 11) N. V. Deltsova, "Artificial Intelligence Technologies in the Field of Legal Services: Relevant Aspects," *Lect. Notes Networks Syst.*, vol. 133, hal. 389–396, 2021, doi: 10.1007/978-3-030-47458-4\_47/COVER.
- 12) R. Sil, A. Roy, B. Bhushan, dan A. K. Mazumdar, "Artificial Intelligence and Machine Learning based Legal Application: The State-of-the-Art and Future Research Trends," in *2019 International Conference on Computing, Communication, and Intelligent Systems (ICCCIS)*, 2019, hal. 57–62, doi: 10.1109/ICCCIS48478.2019.8974479.
- 13) G. Greenleaf, A. Mowbray, dan P. Chung, "Legal Information Institutes and AI: Free Access Legal Expertise," *Front. Artif. Intell. Appl.*, vol. 317, hal. 199–211, Jul 2019, doi: 10.3233/FAIA190022.
- 14) J. Soukupová, "Ai-Based Legal Technology: a Critical Assessment of the Current Use of Artificial Intelligence in Legal Practice," *Masaryk Univ. J. Law Technol.*, vol. 15, no. 2, hal. 279–300, 2021, doi: 10.5817/MUJLT2021-2-6.
- 15) Tara Prasad Sapkota, Shila Kunwar, Mahima Bhattarai, dan Shreya Poudel, "Artificial Intelligence That Are Beneficial for Law," *US-China Law Rev.*, vol. 17, no. 5, hal. 217–223, 2020, doi: 10.17265/1548-6605/2020.05.004.
- 16) G. Buchholtz, "Artificial Intelligence and Legal Tech: Challenges to the Rule of Law," *Regul. Artif. Intell.*, hal. 175–198, Jan 2019, doi: 10.1007/978-3-030-32361-5\_8/COVER.
- 17) J. Kiršienė, D. Amilevičius, dan D. Stankevičiūtė, "Digital Transformation of Legal Services and Access to Justice: Challenges and Possibilities," *Balt. J. Law Polit.*, vol. 15, no. 1, hal. 141–172, Okt 2022, doi: 10.2478/BJLP-2022-0007.
- 18) I. Golbin, A. S. Rao, A. Hadjarian, dan D. Krittman, "Responsible AI: A Primer for the Legal Community," in *2020 IEEE International Conference on Big Data (Big Data)*, 2020, hal. 2121–2126, doi: 10.1109/BigData50022.2020.9377738.
- 19) I. K. Nti, S. Boateng, J. A. Quarcoo, dan P. Nimbe, "Artificial Intelligence Application in Law: A Scientometric Review," *Artif. Intell. Appl.*, no. May, hal. 1–13, 2023, doi: 10.47852/bonviewaia3202729.
- 20) B. Alarie, A. Niblett, dan A. Yoon, "How Artificial Intelligence Will Affect the Practice of Law," *SSRN Electron. J.*, hal. 1–15, Nov 2017, doi: 10.2139/SSRN.3066816.
- 21) F. P. Kalalo dan K. C. Pontoh, "The Use of Artificial Intelligence (AI) in Legal Framework for International Arbitration Practices in Indonesia BT - Proceedings of the Arbitration and Alternative Dispute Resolution International Conference (ADRIC 2019)," 2020, hal. 6–10, doi: 10.2991/assehr.k.200917.002.
- 22) A. E. Davis, "The Future of Law Firms (and Lawyers) in the Age of Artificial Intelligence," *Rev. Direito GV*, vol. 16, no. 1, hal. 1–4, 2020, doi: 10.1590/2317-6172201945.
- 23) W. Gravett, "Is the Dawn of the Robot Lawyer Upon Us? The Fourth Industrial Revolution and the Future of Lawyers," *Potchefstroom Electron. Law J.*, vol. 23, no. 23, hal. 1–37, 2020, doi: 10.17159/1727-3781/2020/V23I0A6794.

## Navigating the Data Security Landscape: Challenges and Solutions in Financial Markets amid Digitalization and Artificial Intelligence



Mithilesh Gupta<sup>1</sup>, Urvi Naresh Shah<sup>2</sup>

<sup>1</sup>Assistant Professor at St. Peter Degree College

<sup>2</sup>Assistant Professor at Mount Carmel Junior College

**ABSTRACT:** Financial markets have the risk of data mishandling or leakage of information. Regarding consumer, privacy breach and information mismanagement affects the overall trust in the system. With faster digitalization and online usage of information, a large section of economic markets require that consumers reveal their individual information constituting a part of regulatory requirements and privacy agreements. Financial systems gather information such as identity, payment passwords, shopping choices, and other similar details that can be shared online. Financial data is prone to misuse and leakage through big data pricing discrimination and over-marketing. Furthermore, the adoption of artificial intelligence/ Machine learning (AI/ML) creates new, distinct cyber risks and expands possibilities for cyber-attacks. AI/ML systems are susceptible to new threats along with the usual cyber threats posed by human error or software malfunctions. Encroachment of personal details and disruption of law by certain organizations make it difficult for individuals to assess the challenges or problems encountered within financial markets. Therefore, the lack of systematic arrangement of the financial system results in financial losses and psychological disruption presenting as mistrust of the government's accountability, impairment of the social balance, and erratic behavior. The present study aims to assess: 1) The scope of data security in financial markets; 2) the Challenges encountered by financial markets in maintaining data security, 3) the Role of Artificial intelligence in data breaches and Current methods (Technical and non-technical) utilized for data security.

**KEYWORDS:** Data protection, data privacy, financial markets, financial data, personal, AI

### I. INTRODUCTION

Data plays a significant role in all types of business markets with the growing popularity of digitalization and globalization. Individuals often share their details unintentionally and intentionally while using the internet or their smartphones [1, 2]. With the international localization of internet servers, it is challenging to restrict data collection within national borders or under a specific jurisdiction. The initial landmark of framing data security guidelines in the European Economic Area (EEA) came into being with the establishment of the General Data Protection Regulation (GDPR) in 2018. The role of GDPR is not only limited to its national territories but also involves outside locations in case European data is involved. One such industry that collects large amounts of confidential information is the financial sector. Financial markets have adopted novel Financial Technology (FinTech). Data about payment encompasses information related to ethnicity, racial origin, religious customs, health life, and other political life. Different types of FinTech business markets are dependent on cloud computing, artificial intelligence, and big data. Therefore, the financial sector is a suitable industry to identify the role of GDPR on data security processes. To simplify the data privacy regulations across nations, different policies have been introduced to create stricter regulations [3]. To implement various practices in financial markets, the difference between data privacy, data security, system security, and information privacy needs recognition. The present article aims to investigate data protection in financial markets.

### A. DATA PRIVACY

Data privacy denotes a systematic utilization of data generally offered to organizations and corporations for certain specific purposes. To fulfill business needs, data is gathered through the customers. The main aspect of such a privacy approach includes providing detailed information to the customers that is acceptable to them. For example, the Australian Federal Government has strict rules for organizations that restrict sharing complete information to customers about data privacy. In financial markets, data collection aims to assign a unique identity to the customers called Personally Identifiable Information (PII) [4].

# Navigating the Data Security Landscape: Challenges and Solutions in Financial Markets amid Digitalization and Artificial Intelligence

## DATA SECURITY

Data security denotes the availability, confidentiality, and unification of data [5]. Data security refers to the accessibility, and utilization of data by only authorized individuals. This means that data is available and accessible. The security plan includes a systematic collection of information, maintenance of its safety, and disruption of the details that are no longer relevant. Therefore, data security and data privacy are interrelated where the former represents the protection laid out for the collected information, and the latter denotes the way of data collection for customer identification [6].

## B. INFORMATION PRIVACY

Information privacy means the inclination of individuals to have some authority over data related to them [7]. Broadly, there are four main areas where the issue of information privacy occurs: privacy, accuracy, property, and accessibility (PAPA). According to Phillips (2014), privacy consists of four aspects: Personal data privacy, privacy of person, personal communication, and personal behavior. In the digital age, the majority of communication occurs through the Internet and mobile phones, hence this has led to the unification of personal data privacy and personal communication privacy within the information privacy spectrum [7].

## C. SYSTEM SECURITY

System security can be defined as a process that prevents attacks from external sources. In the banking and financial markets, secured systems achieve desirable outcomes when they regulate functions without disruptions [8].

## D. CHALLENGES

At a microscopic level, mishandling of personal details, or disclosure of organizational information constitutes the personal information and disrupts the systematic processes of the financial markets. In case of severe circumstances, such activities impose risk on financial security with regards to a specific organization, that may threaten the economy as a whole in certain situations [9]. Similarly, encroachment of personal details and disruption of law by certain organizations make it difficult for individuals to assess the challenges or problems encountered within financial markets. Therefore, the lack of systematic arrangement of the financial system results in financial losses and psychological disruption presenting as mistrust of the government's accountability, impairment of the social balance, and erratic behavior.

Lack of economic stability affects how the population sees consumers and other financial organizations [10]. Regarding consumer, privacy breach and information mismanagement affects the overall trust in the system. With faster digitalization and online usage of information, a large section of economic markets require that consumers reveal their individual information constituting a part of regulatory requirements and privacy agreements. Financial systems gather information such as identity, payment passwords, shopping choices, and other similar details that can be shared online. Financial data is prone to misuse and leakage through big data pricing discrimination and over-marketing.

Financial markets have the risk of data mishandling or leakage of information. For example, senior individuals can be bribed to sell personal information illegally or receive support from hackers resulting in data leakage. This eventually contributes to financial loss as the market may have less than predicted. Additionally, data contamination is probable. In digital transactions, the occurrence of copying and data tampering of unlabelled information is highly possible. If the information is damaged, the model outcome will have different results than expected. Such inadequacy may contribute to additional clean-up costs required by financial institutions, and compromise the financial market decision-making [11].

## II. AIMS AND OBJECTIVES

To address the challenges and current situation of data protection in financial markets, it is critical to assess the existing situation and define the questions.

Therefore, with the present study, we aim to assess:

- The scope of data security in financial markets
- Challenges encountered by financial markets in maintaining data security
- Role of Artificial intelligence in data breach
- Current methods (Technical and non-technical) utilized for data security
- Future perspective and the way forward to combat the problem of data security in financial markets.



# Navigating the Data Security Landscape: Challenges and Solutions in Financial Markets amid Digitalization and Artificial Intelligence

## III. CURRENT SITUATION

Privacy and security information of various financial companies have been evaluated in recent times. According to a survey [12] including the German population, the results denoted that the adoption of FinTech and identification of data security was dependent on the user-design interface and trust placed by consumers. In another study [13], a framework was provided to create a robust construct for FinTech companies based on strong sound security methods. Researchers have stressed the specificity and utilization of data processing by FinTech organizations. According to a study [14], data is used for the identification of an individual, and metadata is useful for the data processor. Based on a large collection of information from a German e-commerce website involving 2.5 lakh purchases, the author mentioned an immense opportunity for data collection [15]. Needless to say, such information exhibits an opportunity to assess the credibility of information. For example, a study [16] investigated the privacy reports of German financial organizations (FinTech) before and after the adoption of GDPR to evaluate the approach toward policy recommendations. However, most of the preliminary information does not specifically pay attention to the privacy statements of these companies when it comes to privacy regulatory laws and GDPR adoption. It was identified that the standardized approach for adopting privacy statements can be implemented through text analysis.

Recent studies have shown that Big Data Analytics (BDA) can pose serious implications related to data privacy and security (DPS) [17]. A study assessed how DPS investment can impact the economic stability of firms that are dependent on big data analytics (BDA) and those that are without BDA investment (non-BDA firms). The study followed a difference-in-difference methodology and application of propensity score related to >1000 DPS performed by 228 US organizations and whose stocks were offered publicly from 2004-2018 on US financial markets. The findings of the results revealed that investing in DPS diminishes any organization's risk of leakage of data. Furthermore, the risk of a data breach is greater for non-BDA firms compared to BDA firms. Therefore, it is reported that DPS investment minimizes the firm risk, and the role of information technology is greatly dependent on the other aspects of BDA. It is noticeable that the risk of a data breach is greater for non-BDA firms as they are exposed to systematic risk. This research highlights the role of security-led investment in improving financial market stability by minimizing the scope of risk [18]. Additionally, it denotes that DPS can act as a risk-changer [19].

Financial firms that include DPS strategies within their technology set-up tend to improve their market proposition by avoiding financial risks. Authentic data security solutions such as decentralized identifiers, encryption, and random identifiers can safeguard the user's information from hacking attempts and harmful exposure. Other studies have revealed that data breaches can be avoided by safely securing customer credentials, through channelizing the customer experience via a two-factor authentication process [18]. Apart from this approach, before the collection of customer data, the privacy firms should ensure that users have information regarding the reason for their data collection and understand the process of why data collection is important [20].

## IV. AI AND DATA BREACH

The adoption of artificial intelligence/ Machine learning (AI/ML) creates new, distinct cyber risks and expands possibilities for cyber-attacks. AI/ML systems are susceptible to new threats along with the usual cyber threats posed by human error or software malfunctions. To take advantage of the intrinsic limits of AI/ML algorithms, these threats concentrate on data manipulation at some point in the AI/ML lifecycle. This kind of manipulation makes it possible for hackers to avoid detection and causes AI/ML to extract data or make incorrect decisions. Because of their intricacy and the possible consequences for finance-related organizations, machine learning models demand ongoing supervision to ensure that attacks of this kind are accurately identified and immediately addressed. By including unique examples in the training database of an ML algorithm, data poisoning attacks attempt to influence the algorithm during training. The AI learns to categorize or recognize data inappropriately due to these attacks. According to Liu et al. [21], data poisoning is another way to develop Trojan models, which conceal malicious activities that require specific inputs to be activated. Attacks using data poisoning need superior access to training and model input. After it is done correctly, infected models might go undetected until the malicious activity doesn't interfere with routine diagnostic tests [22].

Authorities in the financial sector are worried about AI/ML cybersecurity. AI/ML cyber threats have the potential to erode public confidence in the financial industry and its integrity. The ability of the finance industry to appropriately analyze, price, and handle risks might be compromised by corrupted structures, which could result in the accumulation of unnoticed systemic risks [22]. Additionally, training data sets containing private and confidential financial data might be obtained by attackers. The banking industry may decide to include AI/ML-specific cyber threats within the legal boundaries of cybersecurity standards. It should be mandatory for service providers and consumers of AI/ML algorithms in the finance industry to implement mitigation procedures as part of a larger cybersecurity structure [22]. These include methods to safeguard model and data confidentiality, effective security for training data sets, and detection and tracking systems.

## **Navigating the Data Security Landscape: Challenges and Solutions in Financial Markets amid Digitalization and Artificial Intelligence**

Large-scale data privacy issues are prevalent and have existed before AI and ML became widely used. Tools have been created to support the safeguarding of data participants' anonymity and private information. Globally, structures for legal data policies are being established to deal with these issues. Nonetheless, new privacy concerns are brought up by how well AI/ML models work to stop the loss of information from the data used for training [22]. By using inferences, AI/ML, for instance, can reveal anonymized data (i.e., determining identities from behavioral structures). Likewise, after using the data, AI/ML may recall details about people in the sample set, or the results of AI/ML may either explicitly or implicitly reveal private information. Tools are created to solve these problems and improve the security of AI/ML models in protecting private information. However, efforts are required, as well as a suitable revision to the regulation and law that mandates increased privacy regulations for AI/ML systems and associated databases, along with pertinent anti-money laundering and counterterrorism financing requirements [22].

### **V. TECHNICAL APPROACH TO DATA PROTECTION**

#### **A. Information security management in banking and financial services**

When utilizing cloud computing architecture infrastructure, the finance industry takes the following precautions for data safety and confidentiality [23].

1) Identity Access Management: Using credentials and other attributes, this process aids in the authentication of users and services. The terms "User Identity" (also known as a Unique Network ID and Password) and "Characteristics" refer to the specified way that cloud services are to be operated. It is crucial to identify consumers who have access to data within the finance industry when private data about customers and their financial habits is accessible via cloud architecture. By classifying users according to their positions and duties, an IDM system assists in safeguarding their access levels [23].

2) Controlling Access and Logging Mechanism: The framework of cloud service provider models is intricate. Integration of this intricate architecture with a controlled access interface necessitates a structure for implementation and a policy-neutral access specification. The Single Sign-On (SSO) is a technique used in finance and banking to provide users access across numerous apps while controlling access [23]. These access methods verify a user's one-time identity using their "Single User ID / Network ID" and a password that complies with security regulations. The process of collecting and keeping track of user activity logs for cloud infrastructure maintenance, operation, and access is known as user activity or access logging monitoring. Monitoring user activity on cloud infrastructure aids in keeping track of all the modifications made to data and apps [23].

3) Governance and Compliance: Information safety procedures, organizational structure, and leadership comprise cloud security governance. Authorities must enforce compliance for their operations to take place. Governance and compliance guarantee that the system is strategically aligned with the demands of the business, employees, and customers. In the finance and banking sectors, the section on governance and compliance contributes to the altogether structure for working, measuring, communicating, and overseeing the security of cloud architecture [24].

4) Secure Data Removal: When a goal is accomplished, financial and banking organizations gather pertinent data and securely destroy it. Erasing data is an operational task that must be completed to maintain space for storing new data. Secure removal of information is essential when storing data on the cloud and allowing users to access it, to prevent future fraud or misuse. When using cloud infrastructure that is managed by an outside entity, it is crucial to guarantee that data is erased and verify that it is unable to be recuperated. If the information is not removed, it may be accessed later on and used dishonestly to establish fake profiles and identities for clients to carry out fraud. Financial crimes and additional problems with building trust in cloud infrastructure will result from this. Removing data securely contributes to data security maintenance [24].

#### **B. NON-TECHNICAL APPROACHES TO DATA PRIVACY**

When it comes to taking steps to address privacy issues, non-technical methods like guidelines and protocols can be highly successful along with comprehending the advantages and drawbacks of technical alternatives for data privacy in new markets. For example, government organizations in the United States are often constrained by written rules and regulations that specify acceptable uses of information [25]. Limits on privacy are typically stricter in Europe. There are legal limitations on collecting, storing, processing, and disclosing private information under the General Data Protection Regulations. Additionally, the GDPR mandates adherence to seven data protection and transparency principles, even in cases where using personal details is deemed permissible. There is a fine of up to 4% of worldwide revenue or 20 million Euros for noncompliance with the GDPR. The goal of these hefty fines is to encourage proactive data privacy practices by encouraging adherence to the GDPR. Businesses in the private sector also commonly implement policies that help staff members respect the privacy of customers [26].

Sector-driven regulations regarding data protection and privacy establish general guidelines for how and when details may be obtained, stored, safeguarded, retrieved, used, and erased, even though these policies differ amongst businesses. Some typical

## **Navigating the Data Security Landscape: Challenges and Solutions in Financial Markets amid Digitalization and Artificial Intelligence**

methods involve data reduction, use limits, disclosing requirements and restrictions, and deidentification [27]. These procedures aid in keeping organizations in check and adhering to the guidelines. According to Bowman et al. [28], other accountability mechanisms can be employed to identify any discrepancies in these rules and procedures, including audit logging and access restrictions. Yet, these rules and procedures must be based on local notions of privacy to guarantee that they are appropriately calibrated to the particular setting. Several eminent scholars have contended that the data privacy "Silicon Valley paradigm" is unsuitable for growing market environments [29]. This implies that numerous data-sharing customs that are acceptable in the United States might be considered privacy infractions in the Global South.

Numerous legislative reactions have resulted from the quick development of AI and ML. Some jurisdictions, like De Nederlandsche Bank and the Monetary Authority of Singapore, have approached the problems more comprehensively, while others have concluded that the laws currently in place and the standards for good governance are adequate to deal with the issue of data privacy. Authorities have typically concentrated on managing risks, internal controls, improved model and data controls, and AI/ML governing structures through new or updated regulations [29]. To tackle these obstacles, regulatory measures and cooperative endeavors are necessary. Building precise minimum requirements and rules for the industry along with a greater emphasis on obtaining the requisite technical skills are essential components of an appropriate policy framework. Collaboration between the banking industry, economic supervisors, and other parties is important for preventing work duplication and mitigating potential risks associated with the implementation of AI/ML systems in the world of banking. To foster AI/ML development and prevent regulatory gaps, many prominent jurisdictions are in the process of establishing clearly defined national AI plans [29].

### **VI. CONCLUSION**

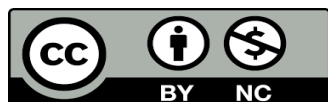
The present article describes the difficulties financial institutions face in protecting their data. Strict procedures are desperately required, even in the face of innovative laws, regulations, and policies. It is clear from the body of research that financial institutions recognize the importance of data protection and its growing necessity. The data protection regulators make an effort to reveal the caliber of data security measures implemented for financial institutions to foster openness and user-friendliness. Furthermore, to comprehend how financial policies correspond with privacy claims, they must adhere to the GDPR's laws and protocols. For example, users could actively give up parts of their data privacy in exchange for better prices or more usage rights, and conversely pay more to maintain greater data privacy. More transparency also leads to more trust and reputation gains for companies. Simple-to-use menus, for instance, might assist consumers in stopping businesses from disclosing personal data to specific third parties when it isn't strictly required for the fulfillment of a contract. In this case, technological advancements may make it possible for FinTechs and customers to implement in tandem. Lastly, data processing should be standardized and stored as tabular data. Standardization would, however, necessitate cooperation between FinTech companies and perhaps new legislative initiatives. Now that the EU and other nations have enacted a privacy law linked to the GDPR, legislators, and policymakers can understand the implications and unintended consequences of the law. This could open the door for the GDPR to be readjusted in the future or provide more useful advice on how to draft privacy statements that will guarantee compliance with all relevant legal requirements. Our research highlights the role of efficient privacy policies in protecting consumer data and future considerations to mitigate the issue of mishandling of data in financial sectors

### **REFERENCES**

- 1) Lindgreen, E. R. (2018). Privacy from an economic perspective. *The Handbook of Privacy Studies: An Interdisciplinary Introduction* (pp. 181–208). Amsterdam: Amsterdam University Press
- 2) World Bank. (2021). *World Development Report 2021: Data for Better Lives*. Washington, D.C.: World Bank.
- 3) Fara Soubouti, *Data Privacy and the Financial Services Industry: A Federal Approach to Consumer Protection*, 24 N.C. BANKING INST. 527 (2020).
- 4) Sophia et al., (2014) A survey of Cryptographic approaches to securing BigData Analytics in Cloud, *Sophia*, p1-p2, 978-1-4799-6233- 4/14, @IEEE, 2014
- 5) France Belanger *Privacy in the Digital Age: A review of Information privacy research in Information systems*, *MIS Quarterly*, Vol. 35, No.4, pp 1017-1041/December 2011
- 6) An overview of the security concern in enterprise cloud computing, Anthony Bisong et. al., *International Journal of network security & its applications (IJNSA)*, Vol.3, No.1, January 2011, P.36
- 7) *Data-Intensive Applications, challenges, techniques and technologies: A survey on Big Data*, C.L. Phillip Chen, C.-Y. Zhang / *Information Sciences*, 275, (2014). p 314 – p 347

## Navigating the Data Security Landscape: Challenges and Solutions in Financial Markets amid Digitalization and Artificial Intelligence

- 8) Mahalle et al., Data Privacy and System Security for Banking and Financial Services Industry based on Cloud Computing Infrastructure, 2018 IEEE 22nd International Conference on Computer Supported Cooperative Work in Design
- 9) Huo, H.; Guo, J.; Yang, X.; Lu, X.; Wu, X.; Li, Z.; Li, M.; Ren, J. An Accelerated Method for Protecting Data Privacy in Financial Scenarios Based on Linear Operation. *Appl. Sci.* 2023, 13, 1764. <https://doi.org/10.3390/app13031764>
- 10) Tramer, F.; Boneh, D. Slalom: Fast, verifiable and private execution of neural networks in trusted hardware. *arXiv* 2018, arXiv:1806.03287
- 11) Sun, Y.; Shi, Y.; Zhang, Z. Finance big data: Management, analysis, and applications. *Int. J. Electron. Commer.* 2019, 23, 1512270.
- 12) Stewart, H., & Jürjens, J. (2018). Data security and consumer trust in fintech innovation in Germany. *Information and Computer Security*, 26(1), 109–128
- 13) Gai, K., Qiu, M., Sun, X., & Zhao, H. (2017). Security and privacy issues: A survey on fintech. In M. Qiu (Ed.), *Smart Computing and Communication* (pp. 236–247). Cham: Springer International Publishing
- 14) Ingram Bogusz, C. (2018). Digital traces, ethics, and insight: Datadriven services in FinTech. In R. Teigland, S. Siri, A. Larsson, A. M. Puertas, & C. Ingram Bogusz (Eds.), *The Rise and Development of Fintech: Accounts of Disruption from Sweden and Beyond* (pp. 207–222). London: Routledge
- 15) Berg, T., Burg, V., Gombović, A., & Puri, M. (2020). On the rise of FinTechs: Credit scoring using digital footprints. *The Review of Financial Studies*, 33(7), 2845–2897
- 16) Dorfleitner, G., & Hornuf, L. (2019). *FinTech and Data Privacy in Germany: An Empirical Analysis with Policy Recommendations*. Cham: Springer International Publishing
- 17) Yueyue Zhang, Effect of data privacy and security investment on the value of big data firms, *Decision Support Systems*, <https://doi.org/10.1016/j.dss.2021.113543>
- 18) Bose, A. Chung, M. Leung, Adoption of identity theft countermeasures and its short-and long-term impact on firm value, *MIS Q.* 43 (2019) 313–327
- 19) S. Dewan, F. Ren, Risk and return of information technology initiatives: evidence from electronic commerce announcements, *Inf. Syst. Res.* 18 (2007) 370–394
- 20) J. Brill, P. Lee, Preserving privacy while addressing COVID-19, Microsoft (2020). <https://blogs.microsoft.com/on-the-issues/2020/04/20/privacy-covid-19-data-collection/>
- 21) Liu et al., (2018). Fine-Pruning: Defending Against Backdooring Attacks on Deep Neural Networks, Available at: <https://arxiv.org/abs/1805.12185>
- 22) El Bachir Boukherouaa (2021). Powering the Digital Economy: Opportunities and Risks of Artificial Intelligence in Finance, 24, 1-34
- 23) Hassan Takabi (2011). Security and privacy challenges in cloud computing environments, , Jmaes Joshi, p.5- p.8, IEE Security and privacy magazine, January 2011
- 24) Secure use of cloud computing in the finance sector, Good Practices and recommendations, European network for network and information security, p.7-p36, December 2015.
- 25) Officer, Chief Privacy, and Timothy J Keefer. 2009. "Privacy and Civil Liberties Policy Guidance Memorandum."
- 26) Bamberger, Kenneth A, and Deirdre K Mulligan. 2015. *Privacy on the ground: driving corporate behavior in the United States and Europe*. MIT Press
- 27) Sedenberg, Elaine M, and Deirdre K Mulligan. 2015. "Public Health as a model for cybersecurity information sharing." *Berkeley Tech. LJ*, 30: 16
- 28) Bowman, Courtney, Ari Geshler, John K Grant, Daniel Slate, and Elissa Lerner. 2015. *The architecture of privacy: On engineering technologies that can deliver trustworthy safeguards.* " O'Reilly Media, Inc."
- 29) Abebe, Rediet, Kehinde Aruleba, Abeba Birhane, Sara Kingsley, George Obaido, Sekou L Remy, and Swathi Sadagopan. 2021. "Narratives and counternarratives on data sharing in Africa." 329–341.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Botanical Leaf Extracts and Mulching Materials in Organic Eggplant (*Solanum Melongena* L.) Off Season Production



Marites U. Peralta

Ilocos Sur Polytechnic State College

**ABSTRACT:** The extensive use of pesticides and the risk they pose to human and the environment requires safe alternatives in crop production hence the study on the efficacy of botanical leaf extracts and mulching materials in organic eggplant production. This study determined the best level combination of botanical leaf extracts that has repellent and knockdown effects on major eggplant insect pest, best level combination of botanical leaf extracts that produces the highest marketable yield; best mulching materials; best level combination of botanical leaf extracts and mulching; correlation of infestation to yield; profitability of eggplant production using botanical leaf extracts and mulching materials combined; and evaluate the effects of botanical leaf extracts and mulching materials on soil chemical properties.

A Bioassay test on the botanical leaf extracts was conducted prior to field experiment. Mass rearing the test insects was done to ensure uniform number of insect in eggplant per treatment. A Split-plot in Factorial Design was used in the study with three blocks. The main plot were the leaf extracts of Neem, Madre de Cacao+ Guava at 1:1:1 ratio were: P0 – No Application, P1 –250 ml leaf extract/16 li water, P2 –500 ml leaf extract /16 li water, P3 –750 ml leaf extract /16 li water, P4 – 40 ml Commercial insecticide/16 li water. The sub-plot was: M1 – Black Plastic mulch, M2 – Carbonize Rice Hulls, and M3 – Saw Dust.

Results of the bioassay showed highly significant knockdown effect in the application of 500-750ml leaf extract/16 li water on fruit and shoot borer, lady spotted beetle and white flies comparable to application of commercial insecticide/16 li water. Significant repellent effects on Fruit Shoot Borer and Lady spotted beetles but no repellent effects on white flies for an application of 250ml botanical leaf extracts/16li water. Results under field condition showed that plants applied with 750ml botanical leaf extracts/16 li water is more effective than commercial insecticide/16 li water in reducing damaged leaves during the early vegetative stage of development (2<sup>nd</sup> WAT) and at reproductive stage of development (10<sup>th</sup> WAT). Highly significant difference was obtained in terms in weight of non-marketable fruit. No significant interaction was registered between botanical leaf extracts and mulching materials. Regression correlation analysis revealed that there was a direct correlation between the numbers of damaged leaves to yield. Combined application of botanical leaf extracts at 750ml/16 li water + carbonized rice hulls obtained Php 797,635.15 net for organic off-season eggplant production. Soil pH, OM, P, and K were increased with application of sawdust, carbonized rice hulls and plastic mulch.

**KEYWORDS:** botanical extracts, mulching, guava, neem, madre de cacao, knockdown effect, bioassay

### INTRODUCTION

#### Situation Analysis

Eggplant (*Solanum melongena* L.) is known as aubergine and brinjal (English), talong (Tagalog), tarong (Ilocano), or bringhinas (Bisaya), is one of the most economically important and popular vegetables in the country. It is the leading vegetable crop in terms of both plant area and production volume. According to the Philippine Statistics Authority (2005 to 2014), eggplant production contributes over 30% to the total production volume of the country's most significant vegetables. These vegetables are known for their unique taste and texture and are available throughout the year. Major production areas for lowland vegetables are: Regions I (Ilocos, Pangasinan), III (Nueva Ecija and Tarlac), and IV (Carlabarzon). Generally, returns from vegetables improved in 2006 (BAS, 2007c) whereas eggplant, gains 32.4% in 2005.

In addition to featuring a host of vitamins and minerals, eggplant is known as “the king of all vegetables” It contains important phytonutrients, many of which have antioxidant activity. Phytonutrients contained in eggplant include phenolic compounds, such as caffeic and chlorogenic acid, and flavonoids, such as nasunin (George Mateljan, @ World Healthiest

## Botanical Leaf Extracts and Mulching Materials in Organic Eggplant (*Solanum Melongena* L.) Off Season Production

Vegetables Foundation, July 17, 2017). In addition, it can be a good source of medicine, wherein Australian researchers developed an organic topical cream from glycol-alkaloids, a group of cancer-killing compounds present in eggplants. (Health and Home May-June 2007 p.39 ).

Eggplant is a widely cultivated crop, favored by many farmers. However, it is unfortunately prone to insect infestations, particularly by pests like spotted lady beetles, white flies, and fruit shoot borers (FSB). As a result, farmers tend to employ excessive amounts of harmful chemicals to control these pests. Eggplant is also commonly grown as a mono-crop all year round, which contributes significantly to the problem of insect infestations. While pest control is necessary to protect crops, it's important to note that commercial insecticides and pesticides come with additional expenses and pose hazardous impacts on both human health, and the environment and has become a matter of national concern.

The average yield of eggplant ranges from 30 to 40 tons/ha. Six to twelve marketable fruits may be expected per plant for the large-fruited varieties, weighing 300 to 400 g each. The elongated varieties may produce twice as many fruits, with individual fruits weighing 100 to 150g each. (N.C. Chen, T. Kalb, N.S. Talekar, J.F. Wang and C.H. Ma, 2002). Cultivation of eggplant with 3 main branches has resulted better growth and fruit yield than 1 and 2 main branches, 50.85, 47.91 and 30.79 t ha, respectively Moch. Dawam Maghfoer, Roedy Soelistyono and Ninuk Herlina, (2014). Sarian, S.V. (2017) reported that Manalo, Monte G., a farmer from Pinamucan Ibaba, Batangas City. A recent crop of Morena and Fortuner eggplant earned him Ph900,000. The new hybrid 'Morena' gave an average yield advantage of 29% over existing commercial varieties. In addition to its prolificacy, 'Morena' was also preferred because of its vigorous plant, good transportability and long glossy dark purple fruits. (Panergayo, K.S., Magos, R.C., Baletaryo, C.H., Panergayo, R.A. *et. al* (2008).

The main expenditure in conventional farms is agrochemical inputs which comprise (65% of fertilizer and 18.2% of pesticides). In the Philippines, despite the promotion of the Integrated Pest Management (IPM) Program, the use of pesticides in agriculture continues to increase. Insecticides account for around 55%, fungicides for 22%, and herbicides for 16% of the pesticides used in the country for rice, corn, vegetables, and plantation crops. Chemicals used in pesticides hurt the environment. They pollute ground and surface water, contribute to the development of pesticide-resistant pest populations, and harm non-target organisms such as beneficial insects and soil micro and macro-organisms. Additionally, the transmission of pesticide residue within the food chain and biomagnification are serious issues that need to be addressed (Corazon C. Davis, 1993.)

Farmers use chemical-based fertilizers and pesticides as the easiest solution for high production and profit. However, the improper and excessive use of these chemicals has caused tremendous environmental and health problems. Moreover, an average amount of Php 264,000/ha is needed for inputs in conventional eggplant production (DA RO2 2015).

Toxic pesticide residues which can also pollute water bodies used for drinking are toxic to fish and can accumulate in many aquatic organisms. Between 1995 and 1999, residues of the pesticides Azin and Butachlor were found in groundwater wells around farming areas in Ilocos Norte in concentrations higher than the European Union (EU) safety limits. Recently, researchers at the Benguet State University have found pesticide residues of organophosphates, organochlorines, and pyrethroids in soil and vegetables grown in the Benguet municipality. In 1992, the illegal use of cyanide compounds by cabbage farmers in the Cordillera region activated a public outcry. (Tacio, Henrylito D., 2009)

Consequently, natural farming methods such as organic farming are gaining popularity. Organic farming is a sustainable agricultural system that focuses on growing crops and raising livestock without the use of synthetic pesticides, herbicides, genetically modified organisms (GMOs), and synthetic fertilizers. Instead, organic farming relies on natural processes, such as crop rotation, biological pest control, and the use of organic materials like compost and manure to improve soil fertility and plant health. Farmers face a constant battle against pests and diseases that can harm their crops. While conventional farming often relies on synthetic insecticides to reduce pests, organic farming takes a different approach. Organic farmers use naturally derived pesticides, beneficial insects, birds, and traps to control pests. On the other hand, conventional farming typically uses synthetic herbicides to manage weeds. In organic farming, weeds are controlled through methods such as tilling, manual weeding, using mulch made from decaying leaves, bark, or compost, crop rotation, and plant-killing compounds that are environmentally friendly. The future of farming lies in modern agriculture which works in harmony with nature while benefiting people instead of harming them. Organic and sustainable farming practices have already been successfully implemented on millions of farms across the world.

There is a growing concern among farmers regarding the potential health risks associated with conventional pesticides. As a result, many are opting for biopesticides which are much safer and effective alternatives to chemicals when it comes to controlling insects. Biopesticides are designed to specifically target insects without being non-toxic to humans, pets, wildlife, and beneficial insects. They are also less likely to produce insect resistance compared to synthetic chemicals. Unlike traditional chemical pesticides, biopesticides are safer for both users and the environment as they break down into harmless compounds

## Botanical Leaf Extracts and Mulching Materials in Organic Eggplant (*Solanum Melongena* L.) Off Season Production

within hours or days after application, especially in the presence of sunlight. It's worth noting that some of the most deadly, fast-acting toxins and potent carcinogens occur naturally (Regnault-Roger et al. 2005; Regnault-Roger and Philogène 2008).

Pesticides can provoke acute and chronic toxic effects in humans. The effect of pesticide application also affects other populations which consume contaminated food and water. Pesticide exposure can trigger chronic eye, skin, pulmonary, neurological, and renal problems in people who manage pesticides or are exposed to them. In 1992, a comparative study between farmers who had been exposed to ©Greenpeace Agrochemical use in the Philippines and its consequences to the environment 10 pesticides and farmers who had not been exposed was performed in Nueva Ecija and Quezon areas. Eye, skin, pulmonary, neurological, and renal problems were clearly associated to pesticide exposure (UNDP 1996).

While modern agriculture produces high yields, more often than not, it is not sustainable. Expensive seeds and farm chemicals eat into profit while pesticides upset the natural balance between predators and pests, and chemical poison groundwater and rivers, thus, people who consume chemical-laced vegetables risk their lives since chemicals are not always dissipated. The Geneva-based World Health Organization reports three people are poisoned by pesticides every minute around the world. All in all, about 10,000 die annually because of pesticides. Reports show that 62% of pesticides sold in the Philippines are insecticides. Of these, 46% are applied to rice and 20% to vegetables. Insecticides had become one of the major expenses of farmers that account for about 40% of total production cost. The lack of regulation in most developing countries often accounts for the importation of banned pesticides.

Botanical pesticides are naturally occurring chemicals extracted from plants. Natural pesticide products are available as an alternative to synthetic chemical formulations but they are not necessarily less toxic to humans. Some of the most deadly, fast acting toxins and potent carcinogens occur naturally (Regnault-Roger et al. 2005; Regnault-Roger and Philogène 2008).

“Botanical pesticide is one answer to the pest problem in developing countries,” says Gaby Stoll, a German agrobiologist and author of *Natural Crop Protection*. Stoll says the move from chemical to botanical pesticides is, “an important step in the search for a balanced, self-regulating agricultural system.” (Stoll, G. 2000).

Better and safer than chemicals, these products are very effective against their target insects but are non-toxic to humans, pets, wildlife and beneficial insects. Bio-pesticides are also short-lived in the environment and are less likely to produce insect resistance than synthetic chemicals.

Madre de cacao, also known as *Gliricidia sepium*, is a plant that has tannins that are believed to have antibacterial, nematocidal, and insecticidal properties. This makes it an effective natural solution for controlling plant hoppers, cutworms, flies, ticks, and fleas. It works as an insect-repellent by suffocating the insect. According to the United Nations Food and Agriculture Organization (FAO, 2009), the leaves of madre de cacao contain coumarin which can be converted into an anticoagulant called “dicoumarol” which is found to be an efficient rat killer. This method of pest control is known as “Anticoagulant” because it reduces the protein prothrombin, a clotting agent in the liver, and eventually causes death from bleeding.

Neem (*Azadirachta indica*), is a natural, non-toxic, and 100% biodegradable pesticide that contains active ingredients like azadirachtin, and salannin. This botanical-based product is a broad-spectrum insecticide, which means it can effectively control over 600 species of insects. Neem pesticide is environmentally friendly and safe for beneficial insects such as honey bees and humans. Azadirachtin is the most effective ingredient in neem pesticides, and it disrupts the metamorphosis of insect larvae. The product exhibits various behavioral and physiological responses such as antifeedant, feeding deterrent, insect growth regulator, molting inhibitor, anti-fertility, ovipositor deterrent, and repellent. The leaves of neem also contain other beneficial compounds such as (Acetyloxy) acetic acid (C<sub>4</sub>H<sub>6</sub>O<sub>4</sub>), Hydroxy pivalic acid (C<sub>5</sub>H<sub>10</sub>O<sub>3</sub>), Phytol (C<sub>20</sub>H<sub>40</sub>O), 4-Cycloocten-1-ol, 8,8'-(imino di-2,1-phenylene) bis- (C<sub>28</sub>H<sub>35</sub>NO<sub>2</sub>), 1,3-Diphenyl-2-azafluorene (C<sub>24</sub>H<sub>17</sub>N), Lup-20 (29)-2n-3-ol, acetate, (3β)- (C<sub>32</sub>H<sub>52</sub>O<sub>2</sub>), Germanicol (C<sub>30</sub>H<sub>50</sub>O), tannins and phenolic compounds, flavonoids, glycosides, all of which contribute to its effectiveness. (Prashanth G.K1, G.M. Krishnaiah2, 2014).

The possibility of using nontoxic deterrents and repellents as crop protectants is intuitively attractive. The concept of using insect antifeedants (feeding deterrents) gained strength in the 1970s and 1980s with the demonstration of the potent feeding deterrent effect of azadirachtin and neem seed extracts to a large number of pest species. In reality, it is the physiological actions of azadirachtin that appear most reliably linked to held efficacy of neem pesticides (Immaraju 1998).

Guava (*Psidium guajava*) is an evergreen small tree whose leaves have essential oil that is rich in cineol, tannins, triterpenoid acids, phenolic compounds, flavonoids, resin engenol, malic acid, sesquiterpene alcohols, fat, cellulose, chlorophyll, mineral salts, and various other fixed substances ( Haida KS, Baron A, Haida KS, 2011).

The study of the unpublished thesis of Josue et.al.(2017), revealed that the rate of 250 ml guava leaf extract per 2 liters of water sprayed on eggplant showed the lowest mean in terms of damaged leaves. The result shows that there was a variable effect of guava leaf extract sprayed on the leaves of the eggplant. The leaves of guava contain an essential oil rich in cineol, tannins, triterpenes, flavonoids, resin, eugenol, malic acid, fat, cellulose, chlorophyll, mineral salts, and several of other fixed substances

## Botanical Leaf Extracts and Mulching Materials in Organic Eggplant (*Solanum Melongena* L.) Off Season Production

H. M. Burkill, 1997, N. S. Ncube, A. J. Afolayan, and A. I. Okoh, 2008). The leaf oil of *Psidium guajava* L. obtained from Soxhlet extraction was tested for insecticidal effect and phytochemical screening against khapra beetle, *Trogoderma granarium* Everts (Coleoptera Dermicide) on groundnut seeds treated with the oil significantly performed better than the control in terms of reduced population and emergence of *T. granarium* larvae and adults. The presence of flavonoids, alkaloids, steroids, triterpenoidscynogenic glycoside, in various amounts is an indication of the insecticidal properties of the oil (Musa, A. K. and Olaniran, R. O. 2014)

Due to a lack of effective means of controlling pests, most farmers resort to synthetic pesticides that are both hazardous to human health and the environment. Compared to other forms of control, synthetic pesticides are highly effective. On the other hand, these pesticides are not only toxic to the target organisms but are also toxic or hazardous to a certain degree to man, plants, and the environment. Moreover, continued use of pesticides can promote the development of resistant pest populations. With the rising costs coupled with the health and environmental hazards of synthetic pesticides, there is a need to find and develop practical, safe and effective alternatives. The use of plant derivatives has been studied throughout the world. Over 2, 000 plant species have been reported to possess pest control characteristics. As natural pesticides are prepared from natural products, application of these materials has a less unfavorable impact to the environment than chemicals. Once proven that certain botanical plants are effective and comparable to their synthetic counterparts, more farmers will adopt these alternatives without reservations. (Baloc H. A.1, Bulong M. P. 2; 2012).

Mulching is a simple and highly beneficial practice for gardening. It helps to enrich and protect soil, creating a more favorable growing environment for plants. Essentially, mulch is a protective layer of material that is spread on top of the soil, and it can be either organic or synthetic. Materials like carbonized rice hulls, hay, sawdust, leaves, barks, grass, and plastic can be used to insulate plants and protect them from weed infestation, water and wind erosion, and nutrient leaching. (Kołota and Słociak 2003, Romić et al. 2003, Moreno and Moreno 2008).

Materials such as carbonize rice hulls, hay, saw dust, leaves, barks, grass and plastic can be used that will help insulate the plants. Mulches protect the plantation against weed infestation, prevent water and wind erosion of soil, as well as leaching nutrients out of the reach of plant roots Mulches may contribute to the decrease of the amount of pathogens on vegetables (Diaz Perez et al. 2007)

The high cost of inputs poses a significant challenge in eggplant production and other crops. Therefore, exploring alternative sources of inputs can greatly benefit farmers, crops, and the environment. The use of botanical extracts and mulching materials as an alternative to toxic pesticides and chemicals is a motivating factor, and this study aims to investigate their effectiveness.

The conditions for vegetable growth can be practice by using various agro-technical solutions, like different soil mulching. In such weather conditions, using mulches appeared to favour eggplant yielding (Katarzyna Adamczewska-Sowińska\*, Magdalena Krygier, Joanna Turczuk 2012). Mulch was efficient in conserving soil moisture favorable to plant growth and beneficial effects in suppressing pests Liberato M.O. (2017).

Plastic mulch was first used for vegetable production in the 1960s and more growers are using plastics each year because of the advantages they provide. They are used commercially for both vegetables and small fruit crops. Vegetable crops that are well suited to production with plastic mulch are typically high-value row crops such as tomatoes, peppers, melons, squash, and cucumbers. Although other crops such as sweet corn, snap peas, and pumpkin may benefit from plastic mulch, the increased costs may not be justified. Research shows some different effects with each color. Green or brown infrared transmitting (IRT) plastic is yet another option. IRT plastic selectively allows only infrared light waves through the plastic; allowing significant soil warming without having any weed growth. Plastic mulches affect the microclimate around the plant by modifying the absorptivity and reflectivity of the soil around the plant. Each color changes the microclimate differently. Soil temperature, radiation, and weed control are the effects of different plastic materials (Maughan, Tiffany and Dan Drost, 2016). Mulching can make effective change in increasing horticultural crop production in water scarcity regions. Plastic mulching using black polyethylene is recommended for other vegetables and has the advantages of attaining earliness in production, better fruit quality and greater total yield (Shweta, D. Mal, L. Singh, S. Gharde, P. Kaur and Datta, S. 2018). Mulching with crop residue is reported to be best for more yields in crop like groundnut and cassava (Chakraborty et al., 2008 and Ghosh et al., 2006). Organic mulches improves soil properties, add organic matter to the soil and attracts many insects like cut worm, slugs etc. that's why these are used in agriculture on large scale (Memon et al., 2017).

In the country, 2.5 million tons of rice hulls that accumulate from milling of 13 million tons of palay are just thrown or burned. However, this "waste material" can be converted into a soil conditioner, bioorganic fertilizer (CRH) and mulching materials. A hydrophilic material made from the incomplete or partial burning of rice hull. Carbonize Rice Hull contains potassium, phosphorous, calcium, magnesium, and other microelements needed for growing crops like garlic. As a soil conditioner, CRH helps replenish air and enhances water retention in the soil. Because of the heat it undergoes, it is sterile and thus, free from pathogens.



## **Botanical Leaf Extracts and Mulching Materials in Organic Eggplant (*Solanum Melongena* L.) Off Season Production**

As such, it makes an excellent host for beneficial microorganisms and ingredient for bioorganic fertilizer in garlic (Domingo, O. F., 2007). The plant characteristics like plant height, stem girth, and fruit yield were increased efficiently by the use of both organic as well as synthetic mulches. (Singh et al., 2006)

The easiest method of using grain hulls in the home garden is as the first layer in sheet composting rather than your vegetable growing area during the season. Rough up the top 1 inch, (2.5 cm), of soil. Then spread the hulls 1-2 inches, (2.5 -5.0 cm) thick and cover with a 1-2 inches (2.5 -5.0 cm) of hay straw or any other mulch that will keep the hulls in place. Thoroughly wet the top mulch, this will percolate down to the hulls. (Better Vegetable Gardening.com: Different Types of Mulch, July 18, 2017).

Sawdust is inexpensive, readily available, and has many practical uses in the garden. It often gets a bad rap for "stealing" nitrogen from growing plants, but when used properly it can support the growth of your plants by helping to improve your soil. Sawdust can also be used to store crops, repel pests, deter weeds, and is handy for cleaning up accidental spills. Sawdust has an acidifying effect on the soil, and is a good choice for mulching around acid-loving plants like conifers, blueberries, strawberries and rhododendrons. A coarser sawdust can help keep slugs at bay. Raise the foliage around susceptible plants and apply several inches around the base of stems. The best sawdust for garden use has a slightly coarse texture - the type created as a by-product of sawmills or chain saws.

Saw dust consist chiefly of organic materials that synthesized by the tree from water, and from carbon dioxide and oxygen of the air. The ultimate composition in terms of the elements does not differ markedly for various woods. The variations are approximately as follows: Carbon 48 to 54 percent, hydrogen 5.8 to 6.3, oxygen 39 to 45 and nitrogen 0.1 to 0.6. The nitrogen percentage rarely is a high as 0.6 percent; it usually varies between 0.1 to 0.3 percent. The principal organic constituents of wood that are of agricultural interest are cellulose, lignin, and pentosans. When added to soil, the cellulose and pentosans are attacked most rapidly by microorganisms. Lignin and lignin- degradation products, along with residues of micro-organisms, tend to remain as constituents of humus and lignin is considered to be the most important ([https://archive.org/stream/useofsawdustform891alli/useofsawdustform891alli\\_djvu.txt](https://archive.org/stream/useofsawdustform891alli/useofsawdustform891alli_djvu.txt)).

Saw dust is a soil improver and weed suppressor as it conserves soil moisture, decreases run-off, increases infiltration and percolation, decreases evaporation and weed growth can be substantial under clear mulch (Waterer, 2000).

High cost of inputs is one of the problems in eggplant production and other growing crops, thus, looking for alternative source of inputs could be of great help for the farmers, crops, and to the safety of the environment as a whole. One motivating factor is by using botanica extract and mulching that could replace chemicals and toxic pesticides, hence, the use of botanical extracts and mulching materials will be tried in this study.

### **OBJECTIVES**

Generally, this study was conducted to determine the best level combination of botanical leaf extracts application and best mulching material to increase growth and yield of eggplant.

Specific objectives were the following:

1. To determine the best level combination of botanical leaf extracts that has repellent and knockdown effects on major eggplant insect pest.
- 2 To determine the best level combination of botanical leaf extracts that produces the highest marketable yield;
3. To determine the best mulching materials for eggplant;
4. To determine the best level combination of botanical leaf extracts and mulching for eggplant production;
5. To determine the correlation of infestation to yield;
6. To determine the profitability of eggplant production using botanical leaf extract and mulching materials combined; and
7. To evaluate the effect of botanical leaf extracts and mulching materials on soil chemical properties.

### **TIME AND PLACE OF THE STUDY**

This study was conducted from August, 2017 to January, 2018 which was considered as an off-season planting of eggplant at barangay Imus, Santiago, Ilocos Sur. The rain value (mm) during the conduct of the study was almost 123.8 mm for October, and 3mm of December (Appendix Table F). The location of the study has an abundant water supply from the nearby spring brought down by gravity force. The prevailing metrological condition during the conduct of the study was good enough for the production of eggplant. The mean soil temperature was 29.33 °C with 50 % RH from the month of November and with a soil moisture of 13.5 and soil temperature of 29.7 °C and 50% RH for the month of December with 12.5 °C soil moisture and soil temperature of 29.2 °C. (Appendix Table F) which was favourable for the optimum temperature for growth and fruit development of the crop. According to the study of Chen and Li (1997), the optimal temperature for eggplant growth is between 21-29°C.

# Botanical Leaf Extracts and Mulching Materials in Organic Eggplant (*Solanum Melongena* L.) Off Season Production

## DEFINITION OF TERMS

**Botanical extracts** are certain substance of pesticides removed from the tissue of a plant specifically the leaves of neem, madre de cacao, and guava.

**Carbonized rice hulls** are the black and porous material obtained by burning the rice hull in low flame. It contains calcium, phosphorous, potassium, magnesium, silicon and sodium.

**DAT** refers to the days after transplanting of an eggplant.

**Extracts** refers to the concentrated solution extracted from the leaves of Guava, Madre de cacao, and Neem.

**Growth** refers to the plant height of the eggplant.

**Guava leaves (*Psidium guajava*)** one of the used ingredients in botanical extract spray in eggplant.

**Madre de cacao (*Gliricidia sepium*)** one of the use ingredients in botanical extract spray in eggplant.

**Marketable fruits** are those with no damage and of good quality which are suitable for selling.

**'Morena F1'** refers to the variety of eggplant that bear flowers at 43-46 DAT which is long in shape and purple color with a good fruiting characteristics.

**Mulch** is a layer of different material like plastic, carbonize rice hulls, and saw dust applied to the surface of the experimental plot.

**Neem (*Azadirachta indica*)** one of used ingredient in botanical leaf extract sprays in eggplant.

**Plastic Mulch** a black polyethylene that are laid on and prepared soil surface covered and anchored using the weight of the soil on the edges.

**Priority commodity** refers to the dominant crop like eggplant regularly planted in the region with economic importance that contributes to food security, profitability and sustainability.

**Rice hulls** are the waste materials obtained after milling rice grains.

**Saw dust** is small pieces of wood dust that is a by-product or waste product of woodworking operations such as sawing, milling, planing, routing, drilling, and sanding which can be added to the soil as mulch.

**Seedling trays** are suitable for starting seeds, thus producing uniform and healthy seedlings and reducing transplanting shock due to healthier and stronger roots.

**Synthetic fertilizer** refers to the inorganic fertilizer like 14-14-14 (N, P, K) that were used in the study.

## MATERIALS AND METHODS

### Materials

In this study, the following equipment, facilities, supplies, materials, and tools were used: an experimental area, a tractor rotavator, a hand plow, a planting guide, a water pump with complete accessories, Morena F1 (long purple eggplant seeds, and leaves of neem (*Azadirachta indica*), madre de cacao (*Gliricidia sepium*), and guava (*Psidium guajava*). Additionally, commercial insecticide, sawdust, plastic mulch, rice hulls, an atomizer sprayer, pails, measuring tools, a weighing scale, a mortar and pestle, a record book, placards, measuring tools, a petri dish, mosquito nets.

## CULTURAL MANAGEMENT OF EGGPLANT

### Land Preparation

The study area was thoroughly cleaned one month before conducting the study. Debris and weeds were removed, and all planting materials and necessary tools were secured and prepared for use. The soil was carefully prepared using a tractor rotavator, with plowing and harrowing done twice to ensure proper soil tilt. Furrowing was also done manually, with a distance of 50 cm between hills and 75 cm between rows. The plot size was 3.0 meters by 3.5 meters, with 15 plots per replication, and 1-meter space between plots, and 2-meter spacing between replications.

### Procurement of Eggplant Seed

Eggplant seeds 'Morena F1' (long purple) were procured at Galano Agricultural Supply, Caburao, Santiago, Ilocos Sur.

Botanical leaf extract combinations were prepared by the researcher.

Mulching materials, like black polyethylene sheets were bought, sawdust was collected at the nearest furniture and sun-dried for 1 month before its use, and rice hulls were collected at rice milling and carbonized before their use. The Carbonizing of rice hull is shown in Figure 1.

The culture and management of eggplant was based on the eggplant production guide. The area was sprayed with botanical leaf extract then mulching materials were incorporated before transplanting.

The botanical leaf extract procedure is presented in Figure 2.

## **Botanical Leaf Extracts and Mulching Materials in Organic Eggplant (*Solanum Melongena* L.) Off Season Production**

Eggplant seeds were sowed on a rectangular pot and transplanted 35 days after sowing. The treatment plots were covered by mosquito nets with a 1.5-meter width x 3-meter length x 1.5-meter height.

There was a separate area for eggplant seedlings planted earlier that served as the host for insect pests. Collection of pests was conducted before injection. After two weeks of transplanting, three kinds of insect pests of eggplant namely Fruit and Shoot Borer, Lady Spotted Beetle, and White Flies were collected. Early in the morning, five insect pests of different types were incorporated in the treatment plots, and sprayed with different levels of botanical leaf extract late in the afternoon.

After a day of application, the insect pests left were counted and the degree of damaged leaves and diseases were noted. Spraying was every week intervals until the eggplant reached its termination period.

### **Insecticidal properties of the plant extracts**

Mass rearing of test insect pests was done to have a uniform age of sample larvae. The major insect-pest of eggplant were Fruit and Shoot Borer (FSB), Lady Spotted Beetle (LSB), and White Flies (WF). There were 10 samples per insect pest placed in a petri dish and sprayed with botanical leaf extracts at different levels of concentrations, 250 ml, 500 ml, and 750 ml respectively. Percent mortality was observed between 5 minutes to 2 hours.

Preliminary screening was done through bioassay using the different levels of botanical leaf extracts.

The bioassay procedure is presented in Figure 3.

Eggplant seeds were sowed on a rectangular pot and transplanted 35 days after sowing. The treatment plots were covered by mosquito nets with a 1.5-meter width x 3-meter length x 1.5-meter height.

There was a separate area for eggplant seedlings planted earlier that served as the host for insect pests. Collection of pests was conducted before inoculation. After two weeks of transplanting, three kinds of insect pests of eggplant namely Fruit and Shoot Borer, Lady Spotted Beetle, and White Flies were collected. Early in the morning, five insect pests of different types were incorporated in the treatment plots, and sprayed by different levels of botanical leaf extract late in the afternoon.

After a day of application, the insect pests left were counted and the degree of damaged leaves and diseases were noted. Spraying was every week intervals until the eggplant reached its termination period.

## **METHODS**

### **Research Design**

The study employed a split plot in Factorial Design, with three blocks and 15 treatment combinations in each block. Each plot had a dimension of 3m x 3.5m, which is equivalent to 10.5 sq.m. The plot had four rows that were spaced 0.75m apart, with a distance of 0.5m between hills and 1m between plots. Additionally, there was a 2-meter alley between the blocks for convenience in carrying out field operations.

A sample of soil weighing one kilogram was collected, air-dried, pulverized, and taken to the Soils Laboratory at the Department of Agriculture in the City of San Fernando, La Union for the analysis of its chemical properties including pH level, percentage of moisture, total Nitrogen, Phosphorous, and exchangeable Potassium. This analysis was carried out before a thorough land preparation.

The different treatments were as follows:

### **Mainplot: Different Levels of Botanical Leaf Extract Application**

P0 – Control

P1 –250 ml leaf extract (Neem + Madre de Cacao + Guava):16 li water

P2 –500 ml leaf extract (Neem + Madre de Cacao + Guava):16 li water

P3 –750 ml leaf extract (Neem + Madre de Cacao + Guava):16 li water

P4 – Commercial insecticide 40ml/16 li water

### **Subplot: Mulch**

M1 – Plastic Mulch (PM)

M2 – Carbonize Rice Hulls (CRH)

M3 – Saw Dust (SD)

### **Analysis of Data**

The collected data was organized, tabulated, presented, and analyzed using Analysis of Variance (ANOVA). To compare treatment means, the Least Significant Difference was utilized. Furthermore, the Statistical Analysis for Agricultural Research (STAR) version 20.1. (2013) was used for regression analysis to establish the relationship between various parameters.

Steps in Making Carbonized Rice Hull



Fig. 1. Procedure in Making Carbonized Rice hulls

Procedure in Making Neem, Madre de Cacao and Guava Botanical Leaf Extracts

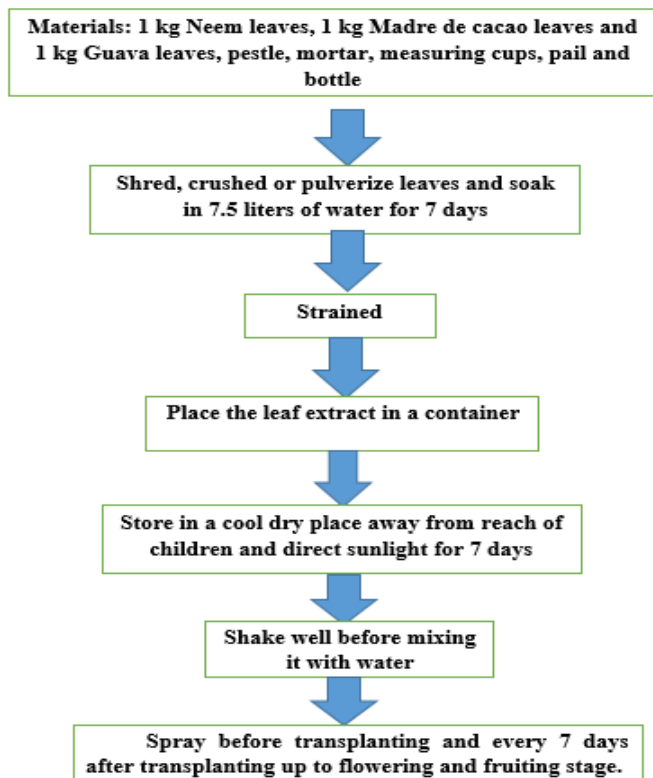


Fig. 2. Steps in making botanical leaf extracts

PROCEDURE IN BIOASSAY

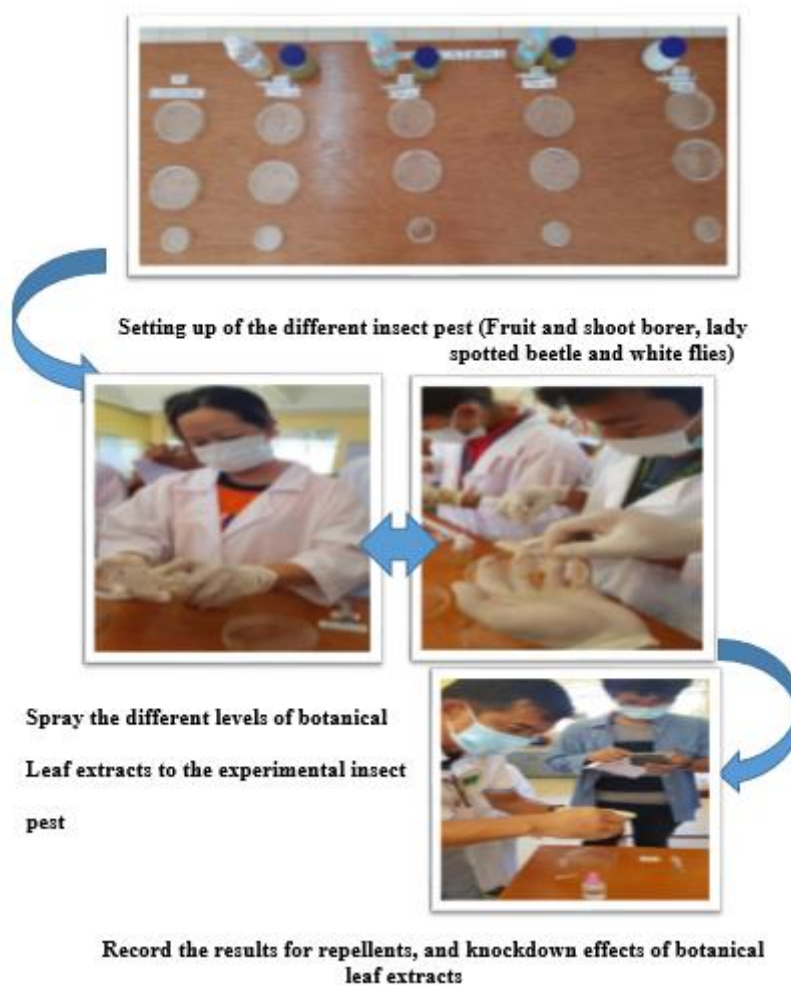


Fig. 3. Procedure in Bioassay

**Data Gathered**

The data was collected at random from 10 sample plants per plot.

**Chemical Soils Laboratory Analysis.** Soil samples were collected from the experimental plots before and after planting to determine the levels of soil pH, organic matter (OM), and the concentration of P (ppm), and K (ppm). These samples were analyzed by the Department of Agriculture Region I Soils Laboratory.

**Bioassay.** The Crop Protection Laboratory conducted a bioassay to test the efficacy of botanical leaf extracts on insect pests like fruit and shoot borers, lady-spotted beetles, and whiteflies.

**Initial plant height (cm).** This data was collected one day before transplanting. Plant height was measured from the base to the tip of the highest leaves.

**Final height (cm).** This was collected one week after the end of data gathering for 140 DAT. The plant height was measured from the base to the top of the highest leaves.

**Number of leaves.** The number of leaves was counted 140 days after transplanting (DAT).

**Number of damaged leaves.** This was gathered 2 weeks after transplanting, 4 WAT, and 10 WAT. The number of leaves damaged by insects was counted, starting from the first leaves to the top of the plant.

**Number of days to flowers.** 50% of the plants per plot flowering date is used to determine the transplant-to-flower time.

**Number of harvested fruits.** The process involved tallying both marketable and non-marketable fruits that were harvested.

**Weight of harvested fruits per plant (grams).** The weight of each sample plant per treatment was measured to calculate the average weight.

**Number of Marketable Fruits.** The process involved counting the number of fruits that were suitable for sale per plant.

**Number of Non-Marketable Fruits.** Counted fruits damaged by insects, pests, and diseases to determine non-marketable fruits.

**Weight of Marketable Fruits (g).** The marketable fruits were weighed to determine their weight.

## Botanical Leaf Extracts and Mulching Materials in Organic Eggplant (*Solanum Melongena* L.) Off Season Production

**Weight of Non-Marketable fruits (g).** This was evaluated by weighing the fruit damaged by insect pests and diseases.

**Length of the fruits (cm).** The measurement was taken after the first, second, and final fruit harvest.

**Yield per hectare (kg).** This was computed by using the formula:

$$\text{Yield per hectare} = \text{Average Yield per Plant (grams)} \times \text{Plant Population per ha.}$$

$$\text{Where: Plant Population per hectare} = \frac{1 \text{ ha}}{\text{Planting distance}}$$

$$= \frac{10,000\text{m}^2 / \text{ha}}{0.75 \text{ m} \times 0.5 \text{ m}}$$

$$= 26,667 \text{ plants/ha}$$

**Gross income (Php).** This was taken by determining the yield per hectare in kilograms and multiplying it by the farm gate price.

**Total expenses (Php).** This was the total capital incurred in the study.

**Net income (Php).** This was computed by subtracting the total expenses from the gross sales.

**Return on Investment.** To compute this, the net returns were divided by the total investment.

## RESULTS AND DISCUSSION

### I. Laboratory Bioassay

**Repellent effects of botanical leaf extracts.** **Repellent effects of botanical leaf extracts.** The botanical leaf extracts were found to have a higher repellent effect on fruit and shoot borer, regardless of the rates used being obtainable in Figure 4. When a mixture of only 250 ml botanical leaf extract and 16 liters of water was applied, a higher repellent effect was observed on lady-spotted beetle, but no repellent effect was noticed on whiteflies. It is believed that the botanical extract mixture had an inherent pesticide content that made the fruit and shoot borer and spotted lady beetle uncomfortable. Musa, A.K. and Olaniran, R. O. (2014) reported similar results to the study at hand. They found that the leaf oil of *Psidium guajava* L. obtained through Soxhlet extraction was effective in exhibiting insecticidal properties. The oil also underwent phytochemical screening against khapra beetle, and *Trogoderma granarium* Everts (Coleoptera Dermicide) on groundnut seeds. The study found that the oil-treated seeds performed better than the control group in terms of reduced population and emergence of *T. granarium* larvae and adults. The presence of flavonoids, alkaloids, steroids, triterpenoids, and cyanogenic glycosides in varying amounts is an indication of the insecticidal properties of the oil. In conclusion, this study suggests that these properties of the oil can be used to protect eggplants from destructive insects.

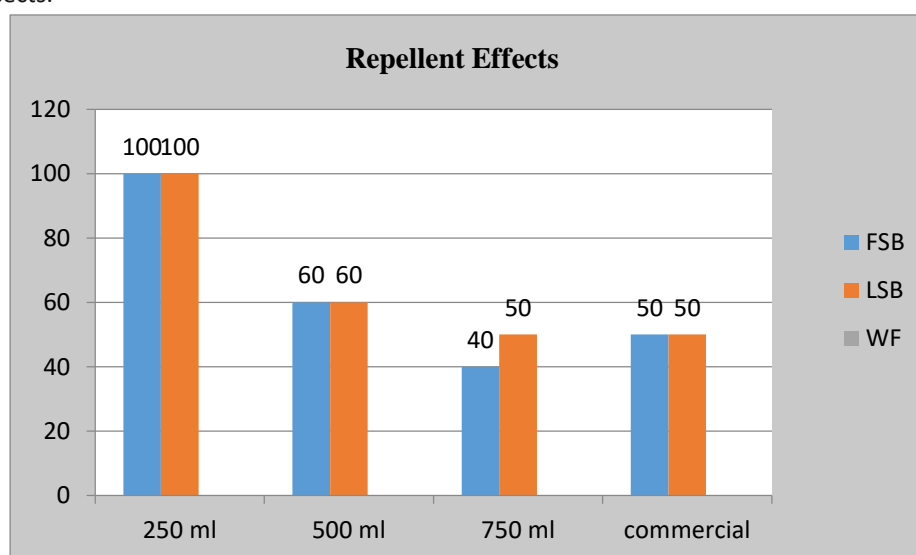


Fig. 4. Repellent effects of botanical leaf extracts on fruit and shoot borer (FSB), lady spotted beetle (LSD) and white flies (WF)

**Knockdown effects of botanical leaf extracts.** A highly significant knockdown effect was noted on Fruit and Shoot Borer, Lady Spotted Beetle, and White Flies among plants sprayed with varying levels of botanical extracts is presented in Figure 5. The lowest level of botanical extracts about 250 ml/16-liter water showed the least effective knockdown effect as compared to higher dosage. This means that the lower the concentration or levels of botanical leaf extract, the lower the chance of its knockdown

## Botanical Leaf Extracts and Mulching Materials in Organic Eggplant (*Solanum Melongena* L.) Off Season Production

effect. As the concentration of the botanical extract is increased to 750 ml/16 liters of water, its knockdown effect is even greater than the use of chemical pesticides. According to Ware (1983), Conventional pesticides are based on a single active ingredient, while plant-derived pesticides comprise an array of chemical compounds that are concerted on both behavioral and physiological processes. One plant like neem *Azadirachta indica* anti-feeding, anti-oviposition, repellent, and growth regulating, in contrast, the toxicity of conventional synthetic insecticide is mainly restricted to neuro-muscular function.

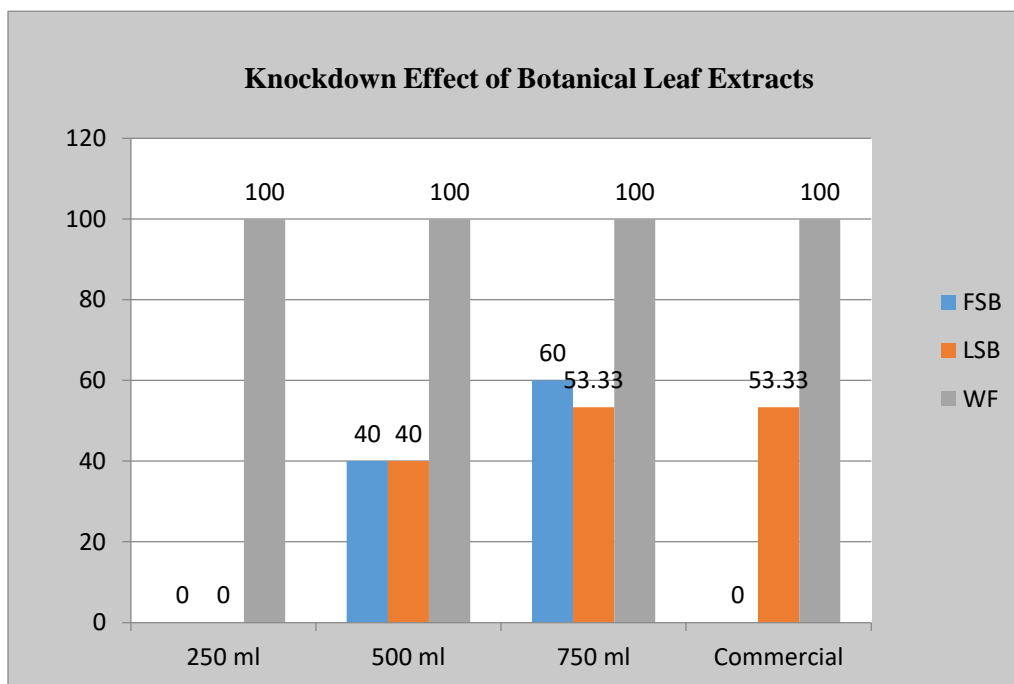


Fig. 5. Knockdown effects of botanical leaf extract on fruit and shoot borer FSB), lady spotted beetle (LSD) and white flies (WF).

## II. FIELD RESULTS

### Plant height at 35 days after sowing (DAS)

**Effects of botanical leaf extracts.** Plant height of test plants is presented in Table 1. There was no significant difference on the initial plant height. This implies uniformity among test plants that something minimized error to succeeding parameters. Homogeneity of test plants was also ensures equal condition of test plant or whatever condition under studied.

Table 1. Plant Height at 35 DAS as Affected by Varying Levels of Botanical Leaf Extracts

Treatments	Height (cm) at 35 DAS	
<b>Factor A – Levels of Botanical Leaf Extract</b>		
P0 – Control	24.76	
P1 – 250 ml/16liter water	23.61	
P2 – 500 ml/16liter water	23.54	
P3 – 750 ml/16liter water	23.26	
P4 – Commercial insecticide/16liter	25.17	
F-Test		ns
CV (%)	<b>8.28</b>	

ns – Not significant

**Effects of mulching materials.** The plant height of eggplant seedlings as affected by different mulching materials is shown in Table 1.a. Black plastic mulch, carbonized rice hulls and sawdust reveals comparative effects. This shows that different mulching materials used do not have any significant effects on the initial height of eggplant at 35 days after sowing.

**Table 1.a. Effects of Different Mulching Materials to the Plant Height of Eggplant at 35 DAS.**

Factor B - Mulch	Height (cm) at 35 DAS	
M1 – Black Plastic Mulch	24.13	
M2 – Carbonized Rice Hull	24.19	
M3 – Saw Dust	23.87	
F-Test		ns
CV (%)	5.34	

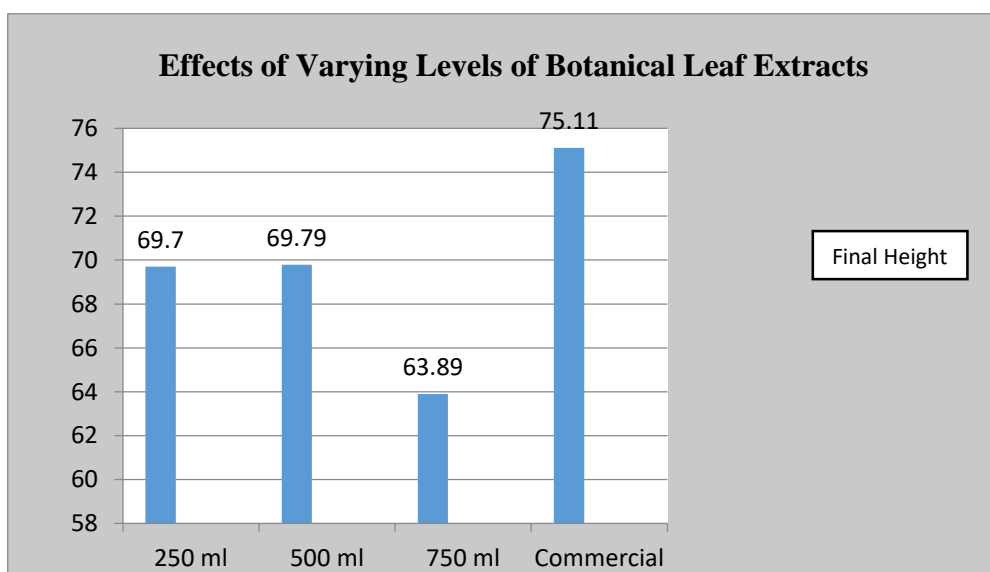
ns – Not Significant

**Interaction effect.** There was no significant interaction effect between mulching and botanical leaf extract application. Analysis of variance shows no significant differences among treatment means. This implies that regardless of botanical extracts and mulching materials used at an early stage of development of an eggplant do not affect its initial height. There were no marked interaction effects on the varying levels of botanical leaf extracts and mulching materials on plant height.

**Plant Height at 140 Days After Transplanting.**

**Plant Height at 140 Days After Transplanting.**

**Effects of botanical leaf extracts.** Plant height at 140 DAT is presented in Figure 6. Analysis of variance among treatments showed significant differences (Appendix Table 2. b). It could be noted that plants sprayed with commercial insecticide/16 lit water registered the tallest but were not significantly different from plants sprayed with a lower dosage of botanical leaf extract at 250 ml/16 lit water comparable with unsprayed plants. The higher dosage level of botanical leaf extract produced shorter plants as compared to those applied with commercial insecticide and plants not applied with any chemicals. The results imply that the substance present in the plant extract may have a depressing effect on plant height. This corroborates the study of M. A. K. Azad, M. N. Yesmin, and M. S. Islam, (2012) that botanical extract was found to have a profound effect on the physiology of plants. Neem leaf extracts were found to be phytotoxic and showed negative plant growth of brinjal.



**Fig. 6. Effects of Varying Levels of Botanical Leaf Extracts to the Final Height of Eggplant at 140 DAT**

**Effects of Mulch.** Table 2. a shows the height of plants at 140 DAS as affected by different mulching materials. Results showed that different mulching materials such as black plastic, CRH, and sawdust have comparable effects on plant height. Analysis of variance revealed no significant differences among treatment means. Plastic mulches retain soil moisture but raise soil temperature that maybe detrimental for plant growth. Organic mulches offer the same moisture retaining capacity, suppress weeds and fruiting advantages. Moreover, decomposing materials may add soil organic matter beneficial to plants (Sideman, 2017).



## Botanical Leaf Extracts and Mulching Materials in Organic Eggplant (*Solanum Melongena* L.) Off Season Production

**Table 2.a. Effects of Mulching Materials to the Height of Eggplant at 140 DAT.**

Factor B - Mulching Materials	Final Height (140 DAT)
M1 – Black Plastic Mulch	64.71
M2 – Carbonized Rice Hull	68.37
M3 – Saw Dust	71.96
F-Test	ns
CV (%)	15.30

ns – Not significant

**Interaction Effects.** Interaction effects of varying levels of botanical leaf extracts and different mulching materials produced uniform plants at maturity. Analysis of variance showed no significant differences (Appendix Table 2.a). This connotes that the eggplant Moringa F-1 variety reached its height potential with or without a complimentary reaction from botanical leaf extracts and mulching materials.

### Number of Leaves Developed per Plant

**Effects of botanical leaf extracts.** Application of botanical leaf extract solutions failed to influence the number of leaves as shown in Table 3. Statistical analysis showed no significant difference. This implies that number of leaves was not a function of botanical leaf extract solution. But it is believed that inherent to the variety of eggplant used or other factors such as fertilizer or any growth enhancer may alter this parameter.

**Table 3. Number of Leaves Developed per Plant as Affected by Varying Levels of Botanical Leaf Extracts.**

Treatments	Number of Leaves
<b>Factor A – Levels of Botanical Leaf Extract</b>	
P0 – Control ml/16liter water	37.26
P2 – 500 ml/16liter water 42.12	37.33
P4 – Commercial insecticide/16liter water	35.70
	ns
	13.83

ns – Not significant

**Effects of mulching.** Table 3.a presents the number of leaves as affected by different mulching materials. Carbonized rice hulls exhibited the highest number of leaves with a mean of 39.18 while saw dust gives the lowest mean of 36.30. Result showed no significant difference on the treatment means. However, carbonized rice hulls provide more benefits to plants.

**Table 3.a. Effects Mulching Materials to the Number of Leaves Developed per Plant.**

Treatments	Number of Leaves
<b>Factor B – Mulching Materials</b>	
M1 – Black Plastic Mulch	38.03
M2 – Carbonized Rice Hull	39.18
M3 – Saw Dust	36.30
F-Test	ns
CV (%)	20.44

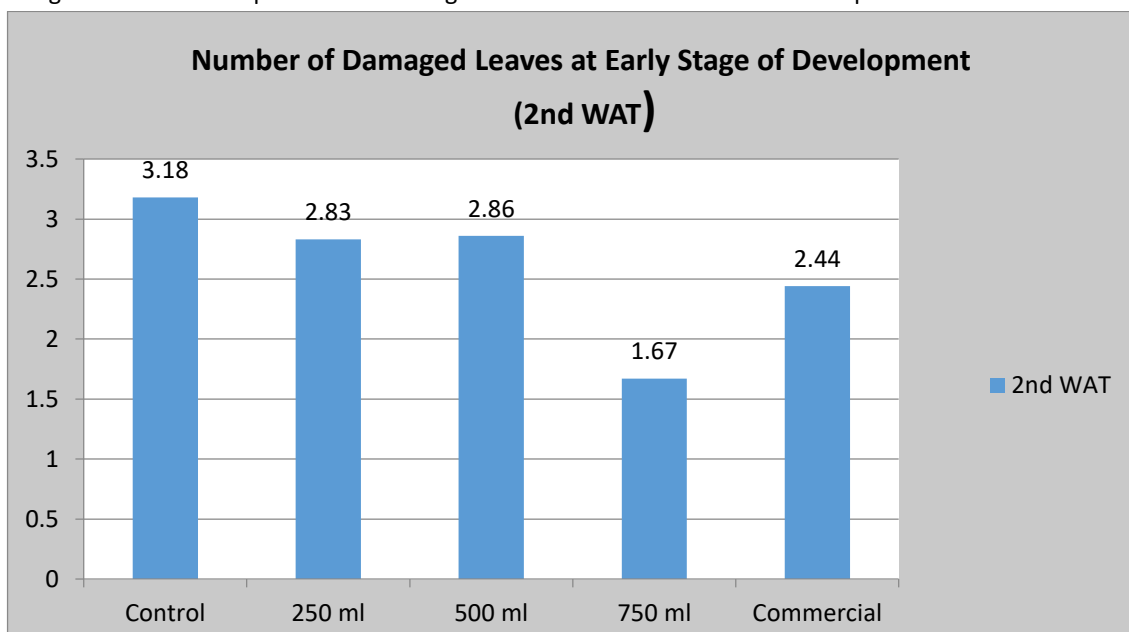
ns – Not significant

## Botanical Leaf Extracts and Mulching Materials in Organic Eggplant (*Solanum Melongena* L.) Off Season Production

**Interaction effects.** Appendix Table 3.a showed the interaction effects of varying levels of botanical leaf extracts and different mulching materials on the number of leaves developed per plants. Analysis of variance showed no significant difference on the parameters. This means that regardless of varying levels of botanical leaf extracts and different mulching materials it will not affect the number of leaves developed by plant.

### Number of Damaged Leaves at Early Stage of Development (2<sup>nd</sup> WAT)

**Effects of botanical leaf extract.** Two weeks after transplanting, effect of pest control treatment started to manifest as shown in Figure 7. Least damaged leaves was obtained from plants sprayed with botanical leaf extracts at 750ml/16 lit water over damaged plants applied with commercial insecticide. Result shows highly significant. This indicates that the treatments provided protection as early as two weeks after transplanting or at the early stage of development. Indeed the plant-based extracts especially the higher dose secured plants from damaged even better than the commercial pesticide.



**Fig. 7** Showed the Number of Damaged Leaves at Early Stage of Development as Affected by the Varying Levels of Botanical Leaf Extracts (2<sup>nd</sup> WAT).

**Effects of mulching materials and the interaction effect of the two factors.** Results showed no significant effect of mulching and even when combined with main plot treatments was detected as shown in Table 4.a and Appendix Table 5.a. This scenario, initial leaf damaged had a very slim range of 2.73 to 2.45 or approximately two (2) damaged leaf per plant. It implies that mulching materials do not affect insect or disease damaged on the leaves.

**Table 4.a. Effects of Mulching Materials to the Number of Damaged Leaves at Early Stage of Development (2<sup>nd</sup> WAT).**

Factor B – Mulch	Early Stage of Development (2 <sup>nd</sup> WAT)
M1 – Black Plastic Mulch	2.45
M2 – Carbonized Rice Hull	2.61
M3 – Saw Dust	2.73
F-Test	ns
CV (%)	17.59

ns – Not significant

### Number of Damaged Leaves at Vegetative Stage of Development (4<sup>th</sup> WAT)

**Effects of botanical leaf extracts.** Effects of varying levels of botanical leaf extracts to the number of damaged leaves at vegetative stage of development can be glance at Table 5. P3- 750ml botanical leaf extracts/16 li water gives the lowest mean number of damaged leaves with 1.38, while P4-Commercial insecticide gave a highest mean number of damaged leaves of 1.82. Analysis of variance shows no significant difference. This implies that there was an equally minimal number of damaged leaves at this stage indicative that foliage feeders might have been knocked down or driven away by the botanical leaf extracts applied. It

## Botanical Leaf Extracts and Mulching Materials in Organic Eggplant (*Solanum Melongena* L.) Off Season Production

can also be gleaned from the table that the leaf damage during the vegetative stage of the treatments had more or less with the same range of 1 to less than 2 damaged leaves.

**Table 5. Effects of Varying Levels of Botanical Leaf Extracts to Number of Damaged Leaves at Vegetative Stage of Development (4<sup>th</sup> WAT).**

Factor A – Levels of Botanical Leaf Extract	Vegetative Stage of Development (4 <sup>th</sup> WAT)
P0 - Control	1.67
P1 - 250 ml/16 lit. of water	1.64
P2 - 500 ml/16 lit. of water	1.72
P3 - 750 ml/ 16 lit. of water	1.38
P4 - Commercial insecticide/ 16 lit. of water	1.82
F-Test	ns
CV (%)	45.65

ns – Not significant

**Table 5.a Effects of Different Mulching Materials to the Number of Damaged Leaf at Vegetative Stage of Development (4<sup>th</sup> WAT).**

Factor B – Mulch	Vegetative Stage of Development (4 <sup>th</sup> WAT)
M1 – Black Plastic Mulch	1.33
M2 – Carbonized Rice Hull	1.99
M3 – Saw Dust	1.62
F-Test	ns
CV (%)	48.93

ns – Not significant

**Effects of mulching materials.** As shown in Table 5.a. the different mulching materials has a comparable effects on the number of damaged leaves at 4<sup>th</sup> week after transplanting or at vegetative stage of development. Statistical analysis showed no significant differences. According to the study of Liberato M.O. (2017) that mulch was efficient in conserving soil moisture favourable to plant growth and beneficial effects in suppressing pest.

**Interaction effects.** Appendix Table 6.a. shows the interaction effects of varying levels of botanical leaf extract and different mulching materials to the number of damaged leaves at vegetative stage of development (4<sup>th</sup> WAT). Results found to be insignificant. This implies that regardless of varying levels of botanical leaf extract and different mulching materials used, there will still be the same minimal effects on the plant.

### Number of Damaged Leaves at Reproductive Stage of Development (10<sup>th</sup> WAT).

**Effects of botanical leaf extracts.** The number of damaged leaves on the 10<sup>th</sup> week after transplanting or reproductive stage is shown in Figure 8. Results showed more evident effects of the varying concentrations of botanical leaf extracts. A more concentrated amount of botanical leaf extract at treatment P3 - 750ml/16 li of water showed most effective in minimizing leaf damaged. Evidently, the botanical leaf extract at 750ml/16 li of water is more effective in controlling leaf damage than commercial insecticide/16 li of water application. This supports the study of (Golob and Webly 1980) that botanical leaf extracts are broad spectrum materials used in pest control and they are safe to apply, unique in action and protect the plants from damage caused by insects. The main compounds of plant extracts are essential oils (mono-terpenoids). These botanical compounds offer promising alternatives to chemical insecticides. These compounds may act as effective insecticides against vegetables pests (Cork et al. 2005; Muyinza et al. 2010), contact insecticides (Kim et al. 2004; Tapondjou et al. 2005), repellents (Hori, 2003) and anti-feedants (Park et al. 2003).

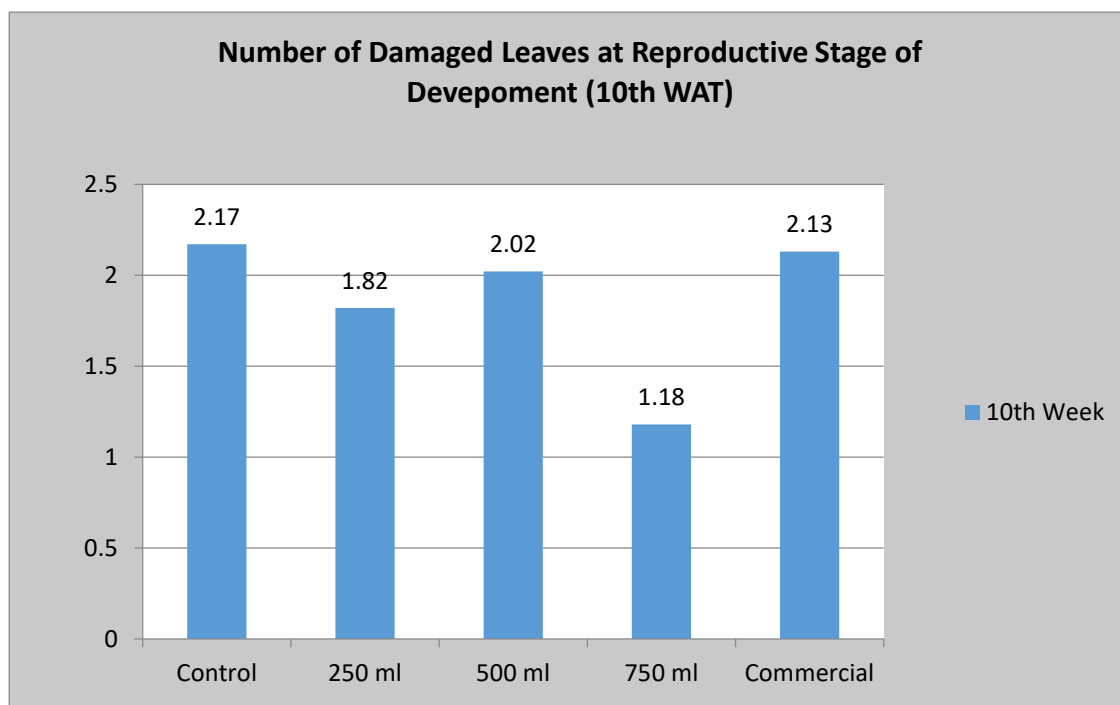


Fig. 8. Shows the Effect of Varying Levels of Botanical Leaf Extract to the Number of Damaged Leaves at Reproductive Stage of Development (10<sup>th</sup> WAT).

**Effects of mulching.** The effects of mulching materials failed to significantly influence the number of damage leaves at 10<sup>th</sup> week after planting (Table 6.a). This implies that all natural or organic mulches will improve the soil but like all things, they vary in quality and effectiveness. Good mulch lets air (oxygen) and water enter the soil and allows carbon dioxide to escape. Good mulch will readily decompose releasing the stored nutrients and will provide microorganisms and earthworms a good home for food source. According to Liberato M.O. (2017) mulch was efficient in conserving soil moisture favorable to plant growth and beneficial effects in suppressing pest.

Table 6.a Effects of Mulching Materials to the Number of Damaged Leaves at Reproductive Stage of Development (10<sup>th</sup> WAT)

Factor B – Mulch	Mean
M1 – Black Plastic Mulch	1.85
M2 – Carbonized Rice Hull	1.84
M3 – Saw Dust	1.90
F-Test	ns
CV (%)	35.91

ns - Not significant

**Interaction effects.** The botanical leaf extract at varying concentrations with different mulching materials revealed no significant interaction effects on the number of damaged leaves at reproductive stage of development (Appendix Table 7.a)

**Number of Days to Flower**

**Effects of botanical leaf extracts.** Presented in Table 7, the effects of botanical leaf extracts to the number of days to flower. Data showed comparable results. Statistical analysis shows no significant difference. This implies that days to flower may not be a function of botanical leaf extract mixtures, but rather on genetic make-up of the eggplant variety used.

Table 7. Number of Days to Flower as Affected by Varying Levels of Botanical Leaf Extracts.

Factor A – Botanical Leaf Extract	Mean
P0 - Control	46.11
P1 - 250 ml/16 liter of water	43.22
P2 - 500 ml/16 liter of water	42.44

## Botanical Leaf Extracts and Mulching Materials in Organic Eggplant (*Solanum Melongena* L.) Off Season Production

P3 - 750 ml/16 liter of water	45.44
P4 - Commercial insecticide	44.67
F-TEST	ns
CV (%)	6.86

ns – Not significant

**Table 7.a. Number of Days to Flower as Affected by Different Mulching Materials.**

Factor B – Mulch	Mean
M1 – Black Plastic Mulch	43.73
M2 – Carbonized Rice Hull	43.93
M3 – Saw Dust	45.47
F-Test	ns
CV (%)	<b>6.82</b>

ns – Not significant

**Effects of mulching.** Effects of different mulching materials to the number of days to flower is shown in Table 7.a. M1- Black Plastic Mulch and M2- Carbonized Rice hulls showed comparative result, while M3- Saw dust gave the highest mean of 45.47. Statistical analysis revealed no significant difference. Results imply that the different mulching materials either organic or plastic material are equally effective in their effect on the days to flower of eggplant ‘**Morena F1**’ based on the stated characteristics by East–West Seed Company that it can bear flower as early as 40 to 55 days after transplanting and harvesting at 60 to 75 days after transplanting.

**Interaction effects.** Shown in Appendix Table 4.a., there was no interaction effect of varying levels of botanical leaf extract application and different mulching materials.

### Number of Fruits

**Table 8. Number of Fruits per Plant as Affected by Varying Levels of Botanical Leaf Extracts**

Factor A – Botanical Leaf Extract	Mean
P0 - Control	18.00
P1 - 250ml/16 liters of water	18.67
P2 - 500ml/16 liters of water	21.33
P3 - 750ml/16 liters of water	21.67
P4 - Commercial insecticide	21.89
F-TEST	ns CV (%)
	<b>36.40</b>

ns – Not significant

**Effects of botanical leaf extracts.** Effects of varying levels of botanical leaf extracts to the number of fruits per plant is presented in Table 8. There was a comparable result with the other treatments means but no significant difference among the variables.

Birch et al. (2000) believed that eggplant growth conditions are the main determinant of the quality of its yield.

**Effects of mulching.** Table 8.a shows the effects of different mulching materials to the number of fruits per plants and it was found comparable. Analysis of variance shows no significant difference between treatment means. Mulching with crop residue is reported to be best for more yields in crops like groundnut and cassava (Chakraborty et al., 2008 and Ghosh et al., 2006). The plant characteristics like plant height, stem girth, fruit yield were increased efficiently by use of both organic as well as synthetic mulches. (Singh et al., 2006)

## Botanical Leaf Extracts and Mulching Materials in Organic Eggplant (*Solanum Melongena* L.) Off Season Production

**Table 8.a. Number of Fruit per Plant as Affected by the Different Mulching Materials**

Factor B – Mulch	Mean
M1 – Black Plastic Mulch	21.47
M2 – Carbonized Rice Hull	20.33
M3 – Saw Dust	19.13
F-Test	ns
CV (%)	26.69

ns – Not significant

**Interaction effect.** Appendix Table 8.a shows no significant interaction effects of varying levels of botanical leaf extracts and different mulching materials on the number of fruits per plant.

### Weight of harvested fruits

**Effects of botanical leaf extract.** Total weight of harvested fruits per plant in grams is shown in Tables 9, 9.a and Appendix Table 9.a. Plants sprayed with botanical leaf extract mixtures solution 750ml/16 li of water tend to produce a little more harvest in terms of weight in grams of fruit per plant with those sprayed with commercial pesticide. Statistical analysis shows no significant difference among treatments.

**Table 9. Weight of Harvested Fruit per Plant as Affected by Different Levels of Botanical Leaf Extracts**

Factor A – Botanical Leaf Extract	grams/plant
P0 - Control	1,793.89
P1 - 250ml/16 liters of water	1,831.11
P2 - 500ml/16 liters of water	2,133.89
P3 - 750ml/16 liters of water	2,288.89
P4 - Commercial insecticide	2,225.56
F-TEST	ns
CV (%)	38.77

ns – Not significant

**Table 9.a. Weight of Harvested Fruits per Plant as Affected by Different Mulching Materials.**

Factor B – Mulch	grams/plant
M1 – Black Plastic Mulch	2,156.00
M2 – Carbonized Rice Hull	2,067.67
M3 – Saw Dust	1,940.33
F-Test	ns
CV (%)	26.00

ns – Not significant

**Effects of mulching.** The mulching materials used in eggplant, 'Morena F1', did not exert significant effect on the weight of fruits per plant (Table 9.a). Results showed that plastic mulch is equally as effective as the use of CHR or sawdust as mulch in affecting the weight of marketable fruits per plant. Although, numerically, more weight of fruits per plant was obtained in plants mulched with Plastic and CRH mulch than those mulched with sawdust. Analysis of variance however, showed no significant differences. The results implies that the use of locally available and cheap materials could be used without adverse effect on yield with lesser input cost.

**Interaction Effects.** As shown in Appendix Table 9.a, there were no marked differences on the weight of fruits per plant. No significant interaction on the varying levels of botanical leaf extracts and different mulching materials to the weight of harvested fruits per plant.

### Weight of Marketable Fruit

**Effects of botanical leaf extract.** The weight of the marketable fruits of eggplants was not affected by the application of varying levels of botanical leaf extract

## Botanical Leaf Extracts and Mulching Materials in Organic Eggplant (*Solanum Melongena* L.) Off Season Production

**Table 10. Weight of Marketable Fruits per Plant as Affected by the Varying Levels of Botanical Leaf Extracts**

Factor A – Botanical Leaf	Weight of Marketable Fruits per Plant (grams)	Extract
P0 – Control	1,120.00	
P1 – 250ml/16 liters of water	1,229.44	
P2 – 500ml/16 liters of water	1,828.89	
P3 – 750ml/16 liters of water	2,101.67	
P4 - Commercial insecticide/16 liters of water	1,836.67	
F-TEST	ns	
CV (%)	47.50	

ns – Not significant

(Table 10). Plants sprayed with botanical leaf extracts of 750ml/16 li of water tended to have the heavier marketable fruit. Statistical analysis showed no significant difference among treatment means. This implies that due to promising pesticide properties of the botanical leaf extracts on reducing the number of fruit damaged thus making the plants able to produce more food because of more functional photosynthesizing leaves.

**Effect of mulching.** Table 10.a presents the weight of marketable fruit per plant as affected by different mulching materials. Results showed that plastic mulch is equally as effective as the use of CRH and Sawdust as mulch in affecting the weight of marketable fruits per plant. ANOVA revealed no significant difference among treatments. The results imply that the use of locally available and cheap materials could be used without adverse effect on yield with lesser input cost and improved the fertility and health of the soil. This supports the statement of (Dilip Kumar et al., 1990) that mulch facilitates more retention of soil moisture and helps in control of temperature fluctuations, improves physical, chemical and biological properties of soil, as it adds nutrients to the soil and ultimately enhances the growth and yield of crops.

**Table 10.a. Effects of Different Mulching Materials to the Weight of Marketable Fruits.**

Factor B – Mulch	Weight of marketable fruits per plant (grams)	
M1 – Black Plastic Mulch	1,671.00	
M2 – Carbonized Rice Hull	1,632.33	
M3 – Saw Dust	1,566.67	
F-Test	ns	
CV (%)	30.87	

ns – Not significant

**Interaction effects.** As shown in Appendix Table 10 there were no marked interaction effects on the weight of fruits per plant on the varying levels of botanical leaf extracts and different mulching materials used. Statistical analysis shows no significant differences among treatment means.

### Number of marketable fruits

**Effects of botanical leaf extract.** Effects of varying levels of botanical leaf extracts to the number of marketable fruits is presented in Table 11. Number of marketable fruits taken from plants sprayed with varying levels of botanical leaf extracts mixture solution ranges from 10.78-19.67. Where plant sprayed with botanical leaf extracts of P3-750ml/16 li water exhibited the highest mean number of marketable fruits, while P0- Control shows the lowest in terms of the number of marketable fruits. Analysis of variance shows no significant difference among treatment. This implies that, the higher the dosed of botanical leaf extracts sprayed to the plants, the higher number of marketable fruits will be harvested and marketed.

**Table 11. Effects of Varying Levels of Botanical Leaf Extracts to the Number of Marketable Fruits per Plant.**

Factor A – Botanical Leaf Extract	Number of Marketable Fruits per Plant
P0 - Control	10.78
P1 - 250ml/16 liters of water	12.22

## Botanical Leaf Extracts and Mulching Materials in Organic Eggplant (*Solanum Melongena* L.) Off Season Production

P2 - 500ml/16 liters of water	17.78
P3 - 750ml/16 liters of water	19.67
P4 - 40ml/16 liters of water	17.14
F-TEST	ns
CV (%)	45.06

ns – Not significant

**Effects of mulching.** Mulched eggplants produced number of marketable fruits ranging from 16.20 - 14.87 as shown in Table 11.a. Result shows no significant difference among treatment means. This corroborates the study of Sideman (2017) that black plastic mulch suppresses weeds, and also protects the fruit of un-staked plants from coming into contact with the soil, thus preventing it from fruit rotting and occurrence of diseases.

**Table 11.a. Effects of Different Mulching Materials to the Number of Marketable Fruits per Plant**

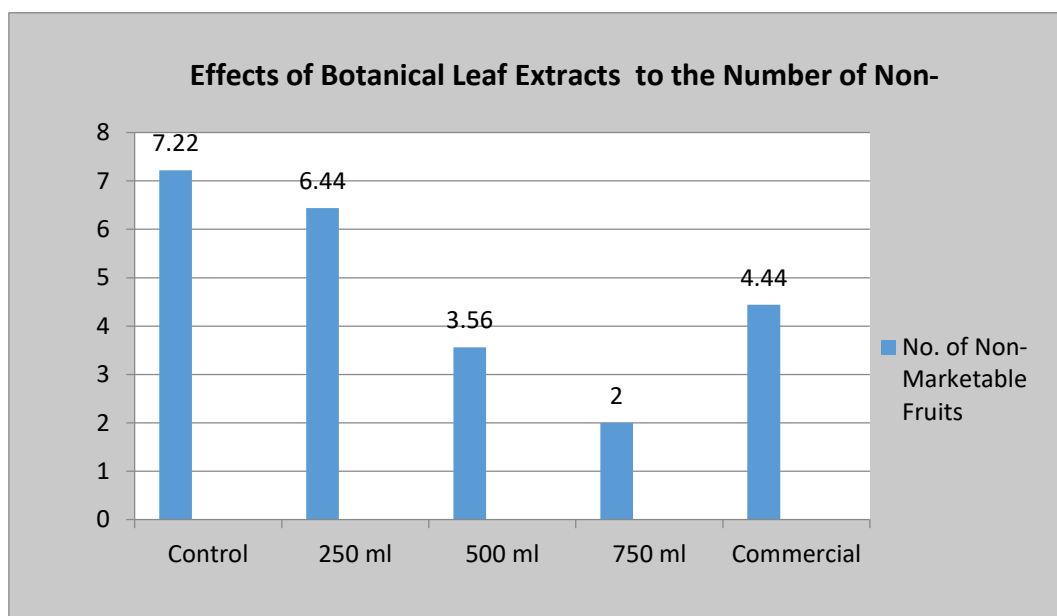
Factor B – Mulch	Number of Marketable Fruits per Plant
M1 – Black Plastic Mulch	16.20
M2 – Carbonized Rice Hull	15.67
M3 – Saw Dust	14.87
F-Test	ns
CV (%)	32.52

ns – Not significant

**Interaction effects.** Appendix Table 12.a, presented a very low number of marketable fruits per plant and was obviously observed from those unsprayed with sawdust as mulching material with only 7.00 fruit per plant and exceptionally high number of fruits per plant from those plants sprayed with 750 ml of botanical leaf extract solutions per 16 li of water + carbonized rice hull as mulch. Analysis of variance revealed no significant differences between the two variables.

### Number of non-marketable fruits

**Effects of botanical leaf extracts.** Figure 9 present the number of non-marketable fruit per plant. Plants sprayed with botanical leaf extract mixture solution of 750 ml/16 li water exhibited the lowest mean of 2.00. Statistical analysis showed significant result. This implies that botanical leaf extracts has the capacity to protect eggplants because it carried with some hazardous or toxic residues. Results supports the findings of Ahmed et al. (2009) Zehnder et al. (1996; 1997) implied that the availability of more undamaged foliage which through photosynthesis resulted in increased dry matter accumulation in the fruits.



**Fig. 9. Shows the effect of varying levels of botanical leaf extracts to the number of non- marketable fruits.**



## Botanical Leaf Extracts and Mulching Materials in Organic Eggplant (*Solanum Melongena* L.) Off Season Production

**Effects of mulching.** Effects of different mulching materials to the number of non- marketable fruits showed in Table 12.a.M3- Saw dust exhibited the lowest mean but comparable to the M2- Carbonized rice hull, while M1-Black Plastic gives the highest mean number of non- marketable fruits. Analysis of variance shows no significant difference among treatment means. This implies that there is something to benefit on the use of mulch that serves as control measures in reducing the number of non-marketable fruits.

**Table 12.a Effects of Different Mulching Materials to the Number of Non-marketable Fruit per Plant.**

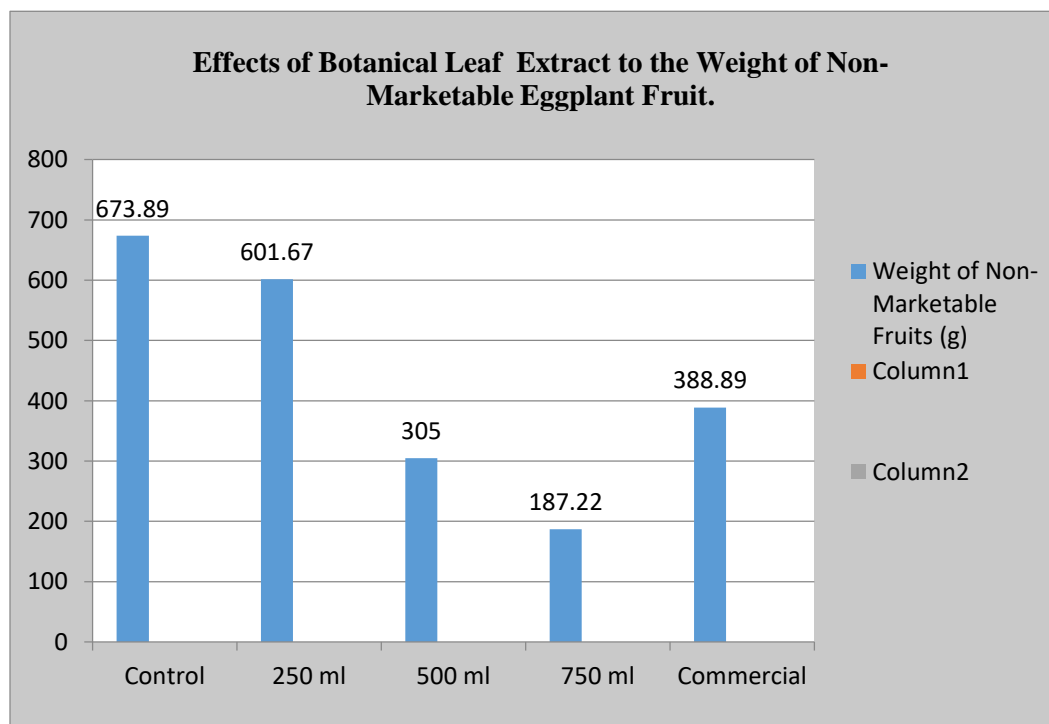
Factor B – Mulch	Number of Non-Marketable Fruits
M1 – Black Plastic Mulch	5.27
M2 – Carbonized Rice Hull	4.67
M3 – Saw Dust	4.27
F-Test	ns
CV (%)	33.99

ns – Not significant

**Interaction effects.** Appendix Table 13.a.revealed that plants sprayed with botanical leaf extracts solution even mulched with either plastic, CRH or sawdust produced almost similar number of non-marketable fruits per plant. ANOVA revealed no significant difference. This implies that varying levels of botanical leaf extracts and different mulching materials has the capacity to protect eggplant fruit be it organic or synthetic.

### Weight of Non-Marketable Eggplant Fruit

**Effects of botanical leaf extract.** Weight of non-marketable fruits is normal to any crop especially when no pesticide is applied. In this experiment, the application of higher dose of botanical leaf extracts 750ml/16 li water provided protection to eggplant that lowers unmarketable fruits produced (Figure 10) similar with the commercial pesticide. Analysis of variance showed highly significant difference. This implies that there is something to benefit on the use of pest control measures reducing the weight of unmarketable fruits.



**Fig. 10.** Presents the effects of varying levels of botanical leaf extracts to the weight of non-marketable fruits

**Effects of mulching.** Effects of different mulching materials to the number of non-marketable fruits did not differ significantly (Appendix Table 13.a)

## Botanical Leaf Extracts and Mulching Materials in Organic Eggplant (*Solanum Melongena* L.) Off Season Production

**Interaction effects.** There was no interaction effects on botanical leaf extracts and mulching to the weight of non-marketable fruit Appendix Table 13.b. Botanical leaf extracts at 750ml per 16 li water + sawdust with a mean of 161.67 grams exhibited the lowest in terms of non-marketable fruits. ANOVA revealed no significant differences among two variables.

### Length of Fruits

**Table 13. Effects of Varying Levels of Botanical Leaf Extracts to the Length of Fruits**

Factor A – Botanical Leaf Extract	Length of Fruits (cm)
P0 - Control	20.00
P1 – 250ml/16 liter of water	20.52
P2 – 500ml/16 liter of water	20.51
P3 – 750ml/16 liter of water	21.50
P4 - Commercial insecticide	20.19
F-TEST	ns
CV (%)	7.35

ns – Not significant

**Effects of botanical extracts.** Length of fruits as affected by varying levels of botanical leaf extracts is presented in Table 13., statistical analysis showed no significant differences observed. It is believed that the characteristics of the variety used in the experiment and other factors like fertilizer, water condition and other growth inducers greatly influenced the fruits to become bigger and longer but not the treatments used.

**Effects of mulching.** Mulching materials like, plastic, CRH and sawdust shows comparative result in terms of the length of fruits (Table 13.a), but do not differ significantly in terms of the treatment means. This implies that the variety used produced the same number of developed fruits, same length, and fruiting percentage regardless of the mulching materials used.

**Table 13.a. Length of Fruit as Affected by Different Mulching Materials.**

Factor B – Mulch	Length of fruits (cm)
M1 – Black Plastic Mulch	20.18
M2 – Carbonized Rice Hull	20.61
M3 – Saw Dust	20.85
F-Test	ns
CV (%)	6.17

ns – Not significant

**Interaction effects .** Botanical leaf extracts and mulching materials do not affect the length of eggplant fruits as shown in Appendix Table 14.a. ANOVA result no significant difference. This implies that varietal characteristics of 'Morena F1' of East West Seed Company has excellent quality result in terms of the length of fruits.

### Yield of plants per hectare

**Effects of botanical leaf extracts.** Yield per plant as affected by varying levels of botanical leaf extracts is presented in Table 14. Botanical extracts and commercial application tend to increase yield. Eggplant applied with botanical leaf extracts and with commercial insecticide tend to produce more yield from 32 tons to 56 tons per hectare. The reported average yield for eggplant was 30 - 40 tons/ha (BAS, 2008). However, analysis of variance showed insignificant result (Appendix Table 15.b). The production of 56 tons/ha for plants applied with botanical leaf extract at 750ml/16 li water can be attributed to the least number of damaged leaves and damaged or unmarketable fruits. Likewise the application of the right fertilizer and irrigation may have contributed to the high yield of eggplant.

## Botanical Leaf Extracts and Mulching Materials in Organic Eggplant (*Solanum Melongena* L.) Off Season Production

**Table 14. Effects of Varying Levels of Botanical Leaf Extracts to the Yield of Plants per Hectare (kg)**

Factor A – Botanical Leaf Extract	Yield of plants per hectare (kg)
P0 – Control	29,867.04
P1 – 250ml/16 liter of water	32,785.48
P2 – 500ml/16 liter of water	48,771.01
P3 – 750ml/16 liter of water	56,045.23
P4 - Commercial insecticide	48,978.48
F- Test	ns
CV %	47.50

ns – Not significant

**Effects of mulching.** Effect of different mulching materials to yield is presented in Table 14.a. When mulching is practiced, fruit yield can go as high as 44,560.56 kilograms per hectare or 44.56 tons per hectare as shown by the results of the ANOVA. This connotes the statement of (Nisnisan, 2014) as cited by Liberato M.O. (2017) that yield can be attributed to the ability of plastic mulch to maintain microclimatic factors in the soil as a result of efficient covers.

**Table 14.a. Yield of plants per hectare as affected by different mulching materials**

Factor B – Mulch	Yield of Plants per Hectare (kg)
M1 – Black Plastic Mulch	44,560.56
M2 – Carbonized Rice Hull	43,529.34
M3 – Saw Dust	41,778.39
F-Test	ns
CV%	30.87

ns – Not significant

**Interaction effects.** Interaction effects of different varying levels of botanical extracts and different mulching materials do not differ significantly. But it is interesting to note the very exceptional fruit harvest when eggplant was applied with 750ml/16 li of water of botanical leaf extract mixture solution and mulch with Carbonized Rice Hulls (Appendix Table 15.a). This implies that while statistics failed to detect significant differences but the high yield gap is worth considering especially when demand is great.

### Regression Analysis

The relationship on the mean number of damaged leaves in the 2<sup>nd</sup> week or at early stage of development to yield as affected by the different varying levels of botanical leaf extracts is shown in Figure 11. The regression equation model  $Y = 5153.2x + 37743$  with a coefficient of  $R^2 = 0.7129$ . This signifies that 71.29 percent of the correlation on the mean yield of eggplant was due to the correlation on the mean number of damaged leaves at 2<sup>nd</sup> week or at early stage of development of an eggplant.

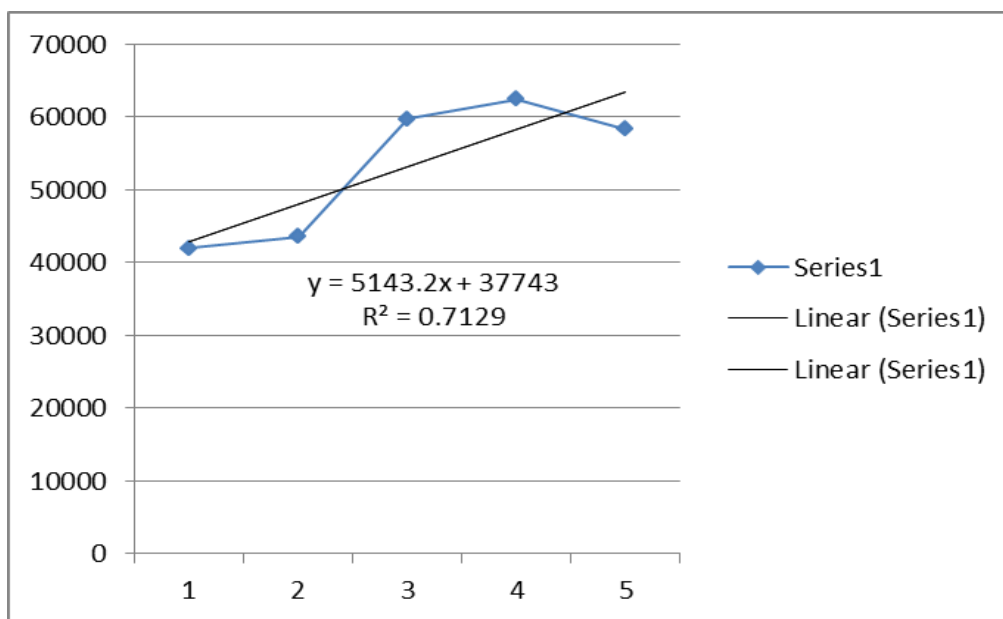


Fig. 11. Relationship between the mean number of damaged sleeves in the 2<sup>nd</sup> week or at early stage of development to the yield in kilogram of eggplant as affected by different varying levels of botanical leaf extracts.

Legend:

- 1- P0 – Control
- 2- P1 – 250 ml/ 16 liter of water
- 3- P2 – 500 ml/ 16 liter of water
- 4- P3 – 750 ml/ 16 liter of water
- 5- P4 - Commercial insecticide

Figure 12 shows the relationship on the mean number of damaged leaves on the 4<sup>th</sup> week or at the vegetative stage of development to yield as affected by the different varying levels of botanical leaf extracts. The regression equation model  $Y = 6293.1x + 84011$  with a coefficient of  $R^2 = 0.80339$ . This signifies that 80.33 percent of the correlation on the mean yield of eggplant was due to the correlation on the mean number of damaged leaves at 4<sup>th</sup> week or at vegetative stage of development of an eggplant.

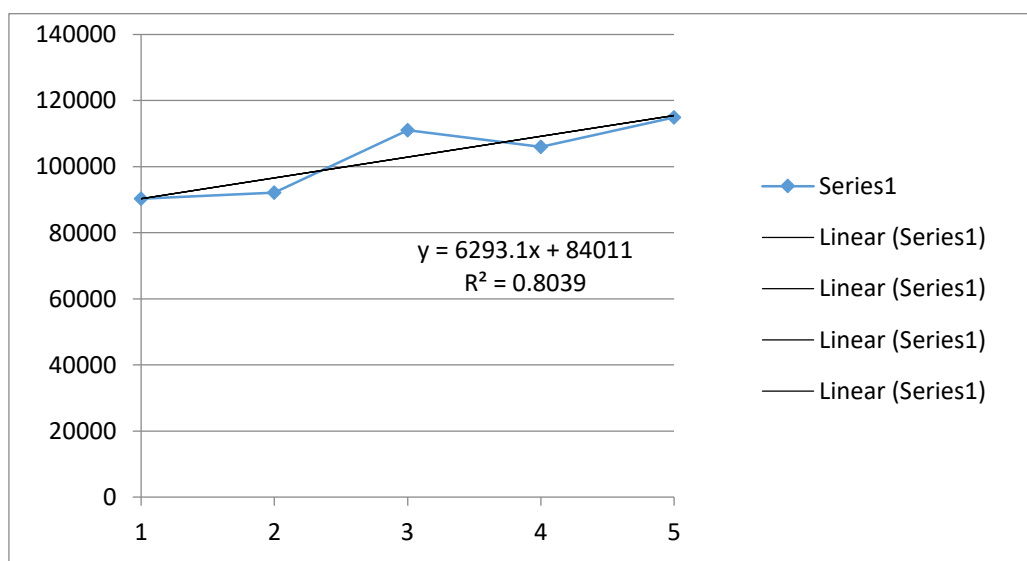


Fig. 12. Relationship on the mean number of damaged leaves on the 4<sup>th</sup> week or at vegetative stage of development to the yield in kilogram of eggplant as affected by different varying levels of botanical leaf extracts.

## Botanical Leaf Extracts and Mulching Materials in Organic Eggplant (*Solanum Melongena* L.) Off Season Production

### Legend:

- 1- P0 – Control
- 2- P1 – 250 ml/ 16 liter of water
- 3- P2 – 500 ml/ 16 liter of water
- 4- P3 – 750 ml/ 16 liter of water
- 5- P4 - Commercial insecticide

The relationship on the mean number of damaged leaves in the 10<sup>th</sup> week or at the reproductive stage of development to yield as affected by the different varying levels of botanical leaf extracts is presented in Figure 13. The regression equation model  $Y = 6073x + 27019$  with coefficient of  $R^2 = 0.7444$ . This signifies that 74.44 percent of the correlation on the mean yield of eggplant was due to the correlation on the mean number of damaged leaves at 10th week or at the reproductive stage of development. This means that there was a reversed negative relationship between the yield and the number of

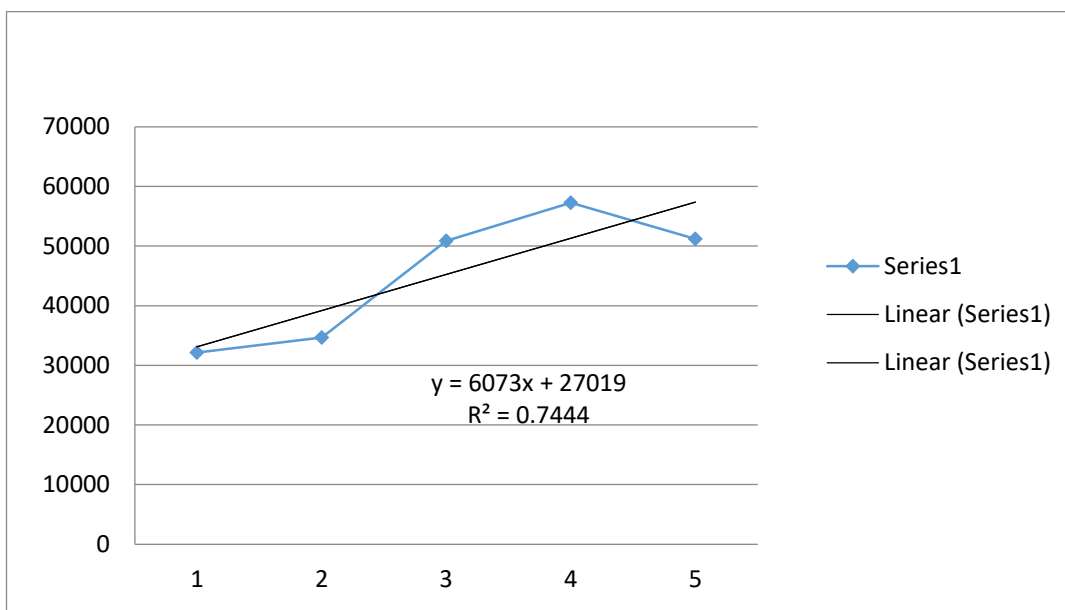


Fig.13. The relationship on the mean number of damaged leaves in the 10<sup>th</sup> week or at the reproductive stage of development to yield as affected by the different varying levels of botanical leaf extracts.

### Legend:

- 1- P0 – Control
- 2- P1 – 250 ml/ 16 liter of water
- 3- P2 – 500 ml/ 16 liter of water
- 4- P3 – 750 ml/ 16 liter of water
- 5- P4 - Commercial insecticide

damaged leaves. The higher the number of damaged leaves, the lower the harvested yield. Likewise, the lower the damaged leaves or infestation the higher the harvested yield.

### Cost and Return analysis of Eggplant

Table 15, 16 and 17 presents the gross sales, expenses, income and return on investment of eggplant as affected by varying levels of botanical leaf extracts. Results revealed that eggplant sprayed with botanical leaf extract at 750ml/16 li of water produced the highest net income Php 689,433.77, followed by eggplant sprayed with commercial with a net income of Php 581,432.52 and the least among was the unsprayed eggplant with Php. 336,362.27. Eggplant applied with black plastic mulch gave the highest net income of Php 517,118.25 followed by carbonized rice hull with Php 512,751.45 and Php 486,984.50 applied with sawdust showed the least among treatments. Eggplant sprayed with botanical leaf extract at 750ml/16 liter of water + carbonized rice hulls produced the highest net income of Php 797,635.15 followed by eggplant applied with botanical leaf extract at 750ml/16 liter of water + sawdust with Ph.P.745,467.75 net income, and the least among combined treatments was unsprayed eggplant + sawdust which give a result of Php 636,533.00. Market value of eggplant fruit at the time of harvest (December) was Php

## Botanical Leaf Extracts and Mulching Materials in Organic Eggplant (*Solanum Melongena* L.) Off Season Production

40/kilogram, but the farm gate price of Php 15/kg was used in the study. This implies that the management interventions vis a vis improved cultural practices offered additional benefits to eggplant production.

Return on investment of eggplant as affected by varying levels of botanical extracts and different mulching materials. Eggplant sprayed with botanical leaf extracts at 750ml/16 li of water revealed the highest ROI with 455.84, followed by eggplant sprayed with 500ml/16 liter of water with ROI 383.70 and the least among were eggplant sprayed with 250ml/16 liters of water with ROI of 225.16. Eggplant applied with Carbonized rice hulls exhibited the highest ROI of 365.75, followed by eggplant applied with sawdust with 348.61 ROI and the least were eggplant applied with black plastic mulch gave the least ROI with 341.80. Combination of two factors revealed that eggplant sprayed with botanical leaf extracts at 750ml/ 16 li of water + carbonized rice hulls tend to give the highest ROI of 540.00, followed by eggplant sprayed with botanical leaf extracts at 750 ml/16 li of water + sawdust with ROI of 504.68 and the least among was eggplant sprayed with botanical leaf extracts at 250 ml/16 li of water + carbonized rice hulls with a ROI of 148.23. Cost of inputs in eggplant production maybe high but with the considerably high market value and great demands, returns is good with a hundred fold of increase especially with the improved farming practices through the introduction of botanical leaf extracts solution and mulching materials. This implies that eggplant production is highly competitive to other high valued economic crops like tomato, onion, garlic and others.

**Table 15. Gross Sales, Expenses, Net Income and Return on Investment as Affected by Botanical Leaf Extracts.**

Extract	Gross sales	Expenses	Net income	ROI
P0 - Control	448,005.60	111643.33	336,362.27	301.28
P1 – 250ml/16 lit water	491,783.85	151243.33	340,540.52	225.16
P2 – 500ml/16 lit water	731,564.70	151243.33	580,321.37	383.70
P3 – 750ml/16 lit water	840,677.10	151243.33	689,433.77	455.84
P4 - Commercial	734,675.85	153243.33	581,432.52	379.40
F-Test	ns	ns	ns	ns
CV%	47.50	0	51.80	51.43

ns – Not significant

**Table 16. Gross Sales, Expenses, Net Income and Return on Investment as Affected by Different Mulching Materials**

Mulch	Gross sales	Expenses	Net income	ROI
M1- Plastic	668,408.25	151290.00	517,118.25	341.80
M2 - CRH	652,941.45	140190.00	512,751.45	365.75
M3 - Sawdust	626,674.50	139690.00	486984.50	348.61
F-Test	ns	ns	ns	ns
CV%	30.87	0	33.66	35.00

ns – Not significant

**Table 17. Gross Sales, Expenses, Net Income and Return on Investment as Affected by Botanical Leaf Extracts and Different Mulching Materials**

TREATMENT	Gross sales	Expenses	Net income	ROI
P0M1	508,018.50	119210.00	388,808.50	326.15
P0M2	525,339.90	108110.00	417,229.90	385.93
P0M3	310,670.00	107610.00	203,060.55	188.70
P1M1	651,341.25	158810.00	492,531.25	310.13
P1M2	366,671.25	147710.00	218,961.25	148.23
P1M3	457,309.05	147210.00	310,099.05	210.65
P2M1	701,342.10	158810.00	542,532.10	341.62
P2M2	701,342.10	147710.00	553,632.10	374.810
P2M3	782,009.70	147210.00	634,799.70	431.22
P3M1	684,007.50	158810.00	525,197.50	330.70
P3M2	945,345.15	147710.00	797,635.15	540.00

## Botanical Leaf Extracts and Mulching Materials in Organic Eggplant (*Solanum Melongena* L.) Off Season Production

P3M3	892,677.75	147210.00	745,467.75	504.68
P4M1	797,343.00	160810.00	636,533.00	395.82
P4M2	645,341.40	149710.00	495,631.40	331.06
P4M3	761,342.85	149210.00	612,132.85	410.24
F-Test	ns	ns	ns	ns
CV%	30.87	0	33.66	35.00

ns – Not significant

### Chemical Soils Laboratory Analysis and Nutrient Requirement of Eggplant

**Chemical properties of soil before the conduct of the experiment.** The chemical properties of the soil used in the experiment indicate the fertility of the soil. The mean data on Ph, EC (mS/cm) OM%, P (ppm) and K (ppm) and nutrient requirement of eggplant before planting is presented in Table, 19. Based on the result, the texture of the area was heavy, with 7.2 soil pH which is favourable for nutrient availability, 0.93% OM, 26.63 ppm P, 318.89 ppm K.

**Table 18. Mean Data on pH, EC (mS/cm) OM%, P (ppm) and K (ppm) of Soils Before Blanting and Nutrient Requirement of Eggplant.**

Soil	Lab.	EC				Nutrient			
Information_	No._	Texture_	_pH	(mS/cm)	OM%	P (ppm)	K(ppm)	Crop	Reqt.
Field ID	17-265	Heavy	7.2	0.93	0.89	26.63	318.89	Eggplant	90+0+0

### Chemical properties of soil after the conduct of the experiment

**Effect of botanical leaf extracts.** The mean data on soil pH as affected by the different varying levels of botanical extracts is presented in Table 19. The data result on soil pH dictates the fixation and or release of nutrients in the soil especially phosphorous which is believed to be essential for plant growth and development. High pH may allow the accumulation of Calcium and Manganese while low pH would trigger increase in aluminium. For most cases, should be maintained at 5.5 – 7.0 ph.

Before the conduct of the experiment, soil pH was observed to have gone up beyond the higher boarder (7.2) however, during the conduct and even after crop harvest, soil pH has returned/ restored to normal ranging from 5.98- to 6.59 which implies that the application of botanical leaf extracts mixture solutions and mulching reduced soil pH possibly due to the reactions of crop management.

**Table 19. Mean Data on Soil pH Level of the Soil as Affected by the Different Varying Levels of Botanical Leaf Extracts**

Treatment	Soil pH
P0 – Control	6.21
P1 – 250ml/16 liter of water	6.22
P2 – 500ml/16 liter of water	6.51
P3 – 750ml/16 liter of water	6.28
P4 - Commercial insecticide	6.06
F-Test	ns
CV%	5.32

ns – Not significant

**Effect of mulching.** Plastic mulch had the least pH mean result with 6.24. though it was comparable to other different mulching materials use (Table 29.a). It reveals no significant difference. This implies that using these three different mulching materials, a decreased in soil pH largely associated with the temperature condition, the water and fertilizer application situation. According to Russell AD (2002) eggplant mono-cropping may degrade soil quality and negatively affect soil physical processes. Higher species richness may be associated with nutrient cycling characteristics that often can regulate soil fertility.

## Botanical Leaf Extracts and Mulching Materials in Organic Eggplant (*Solanum Melongena* L.) Off Season Production

**Table 19.a. Mean Data on pH Level of the Soil as Affected by the Different Mulching Materials**

Factor B – Mulch	pH
M1 – Black Plastic Mulch	6.24
M2 – Carbonized Rice Hull	6.25
M3 – Saw Dust	6.28
F-Test	ns
CV%	5.20

ns – Not significant

**Interaction effects.** Before the conduct of the experiment, for soil pH was observed to have gone up beyond the higher border (7.2) However, during the conduct and even after crop harvest, soil pH has returned or restored to normal ranging pH from 5.98 – 6.59 which indicates that the application of botanical leaf extract mixture/solutions and different mulching materials contributed to the availability of soil nutrients for plant intake. Statistically found comparable. According to Lantican (2001) the pH level of the soil determines the availability of certain nutrients to plants. Slight acidity adversely affect phosphorous availability and to lesser extent that nitrogen, potassium, calcium and magnesium.

### Electrical Conductivity (EC, mS/cm)

**Effect of botanical leaf extracts.** Mean data on Electrical conductivity (mS/cm) level of the soil as affected by different varying levels of botanical extracts is presented in Table 20. The data showed comparable results on EC. Electrical conductivity (mS/cm) measures the total dissolved salts in a solutions recognized as one of the significant factor that influences plants availability to absorbed water, sometimes used as an indicator of water quality, salinity and others. Knowing the EC levels therefore, help and lead s to cost effective use of plant inputs and less shrinkage hence, higher crop production.

**Table 20. Mean Data on Electrical Conductivity (mS/cm) Level of the Soil as Affected by the Different Varying Levels of Botanical Leaf Extracts**

Treatment	EC (mS/cm)
P0 – Control	0.64
P1 – 250ml/16 liter of water	0.82
P2 – 500ml/16 liter of water	0.69
P3 – 750ml/16 liter of water	0.57
P4 - Commercial insecticide	0.64
F-Test	ns
CV%	27.68

ns – Not significant

**Effects of mulching.** The experimental area before the conduct of the study was noted to have an electrical conductivity of 0.93 (Table 20.a). This level was within the normal range for seedlings and salt sensitive plants. However, after the conduct of the study utilizing botanical varying levels of botanical leaf extracts and different mulching materials, electrical conductivity of most of the plots had been lowered to 0.75 which implies that prolong use of this cultural practice should not be advocated to eggplant growers if only to protect soil health unless there will be intervention to restore EC to normal level.

**Table 20.a. Mean Data on Electrical Conductivity (mS/cm) Level of the Soil as Affected by Different Mulching Materials**

Factor B – Mulch	EC (mS/cm)
M1 – Black Plastic Mulch	0.71
M2 – Carbonized Rice Hull	0.59
M3 – Saw Dust	0.71
F-Test	ns
CV%	31.82

ns – Not significant



## Botanical Leaf Extracts and Mulching Materials in Organic Eggplant (*Solanum Melongena* L.) Off Season Production

### Organic Matter (OM%)

**Effect of botanical leaf extracts.** Mean data on Organic matter as affected by the different varying levels of botanical leaf extracts is presented in Table 21. The organic matter expressed in percent is very essential especially during the early stages of growth for it serves as an initial supplier of nutrients for plant recovery and faster growth. Initial analysis shows that the area contain only 0.89% OM which implies the necessity of applying fertilizer following the recommended rate. After the conduct of the experiment however, applications of varying levels of botanical leaf extract and different mulching materials seemed to have increased the organic matter except POM1 (0.83) indicating that these cultural practices helped in enriching the soil organic matter. According to Acayen (2005-2006), mulching is very effective in conserving soil moisture for the plants, preventing growth of the weeds lessening the use of chemicals, and can also be used as organic fertilizer for plants.

**Table 21. Mean Data on Organic Matter of the Soil as Affected by Varying Levels of Botanical Leaf Extracts**

Treatment	OM %
P0 – Control	1.08
P1 – 250ml/16 liter of water	1.13
P2 – 500ml/16 liter of water	1.36
P3 – 750ml/16 liter of water	1.27
P4 - Commercial insecticide	1.03
F-Test	ns
CV%	33.02

ns – Not significant

**Table 21.a. Mean Data on Organic Matter of the Soil as Affected by the Different Mulching Materials**

Factor B – Mulch	OM%
M1 – Black Plastic Mulch	1.13
M2 – Carbonized Rice Hull	1.22
M3 – Saw Dust	1.18
F-Test	ns
CV%	27.49

ns – Not significant

**Effects of mulching.** Table 21.a. shows data on the organic matter of the soil as affected by the different mulching materials. Table 21.a presents comparable effect among treatment means but no significant difference among treatment means.

### Phosphorous (ppm)

**Effects of botanical leaf extracts.** Table 22 presents the mean data on Phosphorous level of the soil as affected by the different levels of botanical leaf extracts. Phosphorous is a component of the complex nucleic acid structure of plants which regulates protein synthesis. It plays a significant role in photosynthesis, respiration energy storage and transfer several processes in plants.

In the case of this research, inherent phosphorous content of the soil was found to be at 26.63 ppm. However, after the application of botanical leaf extract, P levels has increased to 30.99 to 43.54 ppm implying that the materials sprayed contain phosphorous not fully consumed by the plants instead stored into the soil.

**Table 22. Mean Data on Phosphorous Level of the Soil as Affected by the Different Varying Levels of Botanical Leaf Extracts**

Treatment	P (ppm)
P0 – Control	21.86
P1 – 250ml/16 liter of water	30.99
P2 – 500ml/16 liter of water	43.54
P3 – 750ml/16 liter of water	34.82
P4 - Commercial insecticide	21.51

## Botanical Leaf Extracts and Mulching Materials in Organic Eggplant (*Solanum Melongena* L.) Off Season Production

F-Test	ns
CV%	60.75

ns – Not significant

**Effects of mulching.** Table 23.a. shows the mean data on Phosphorous level of the soil as affected by different mulching materials. Similarly, mulching materials like carbonized rice hull, sawdust and plastic mulch either prevented the loss of phosphorous and even enriched the soil.

It is interesting to note the very high phosphorous levels lend on P2M2 (50.98ppm) after harvest and P2M3 (41.74ppm). This means that carbonized rice hull contain high phosphorous that when plants cannot fully utilized may remain into the soil for succeeding crop (Appendix Table 19). This corroborates the study of Sideman (2017) that while black plastic mulch suppresses weeds, and also protects the fruit of un-staked plants from coming into contact with the soil, organic mulches like carbonized rice hull offers more benefits. Organic mulch offer the same moisture retaining, weed suppressing and fruit protecting advantages as plastic, but the latter offers more benefits as it eventually decomposed, adding to the soil's supply of organic matter.

**Table 22.a. Mean Data on Phosphorous Level of the Soil as Affected by the Different Mulching Materials**

Factor B – Mulch	P (ppm)
M1 – Black Plastic Mulch	29.80
M2 – Carbonized Rice Hull	31.47
M3 – Saw Dust	30.36
F-Test	ns
CV%	29.25

ns – Not significant

### Potassium (ppm)

**Effects of botanical leaf extracts.** Potassium regulates the opening and closure of stomata's therefore regulates carbon dioxide uptake triggering the activation of the enzymes and essential for the production of ATP. Lack of potassium reduced plant growth, root development and seed and fruit development.

In eggplant production, this element is very necessary especially the economic saleable part is the fruit hence, optimum amount should be applied. Before planting, the soil found to contain 318.89 ppm of potassium. After the experiment with the use of varying levels of botanical leaf extracts and different mulching materials there was an increased in the Potassium levels especially in 500ml/16 liter of water (526.48 ppm), This is an indication that the materials applied to eggplant either botanicals or mulch might have left unutilized potassium. This implies that application of botanical leaf extracts and different mulching materials could have great factor in the result of high potassium level of the soil after harvesting.

**Table 23. Mean Data on Potassium Level of the Soil as Affected by the Varying Levels of Botanical Leaf Extracts**

Treatment	K (ppm)
P0 – Control	212.11
P1 – 250ml/16 liter of water	376.48
P2 – 500ml/16 liter of water	526.48
P3 – 750ml/16 liter of water	370.49
P4 - Commercial insecticide	325.03
F-Test	ns
CV%	66.72

ns – Not significant

**Effects of mulching.** Table 23.a showed the effects of different mulching materials which is comparable but sawdust (420.85 ppm) registered the highest potassium rate. Analysis of variance showed no significant effect among treatment means.

**Interaction effects.** Effects of botanical leaf extracts and different mulching materials showed comparable but no significant difference among treatment means.

## Botanical Leaf Extracts and Mulching Materials in Organic Eggplant (*Solanum Melongena* L.) Off Season Production

Table 23.a. Mean Data on Potassium Level of the Soil as Affected by the Different Mulching Materials

Factor B – Mulch	K (ppm)
M1 – Black Plastic Mulch	370.60
M2 – Carbonized Rice Hull	350.18
M3 – Saw Dust	420.85
F-Test	ns
CV%	43.03

ns – Not significant

### SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

#### Summary

Eggplant, dubbed as “king of vegetables” is commonly applied with chemical pesticides to control stem and fruit borer and other pests attacking eggplant. Botanical extracts contains compounds with insecticidal properties which can control pest and safe to consumers and the environment, because they are easily decomposed by a variety of microbes common in most soils. Hence, this study was conducted on the “Efficacy of Botanical Leaf Extracts and Mulching Materials in Organic Eggplant (*Solanum melongena* L.) Production” at Imus, Santiago, Ilocos Sur from August 2017 to January 2018.

Generally this study was conducted to determine the best level of botanical leaf extracts application and best mulching material to increase growth and yield of eggplant.

Specific objectives were the following: 1). To determine the best level of botanical leaf extract that has repellent and knockdown effects on major eggplant insect pest;

2). To determine the best level of botanical leaf extract that produce the highest yield; 3). To determine the best mulching materials for eggplant; 4). To determine the best combination effects of botanical leaf extract and mulching materials for eggplant production; 5). To determine the correlation of infestation to yield; 6). To determine the profitability of eggplant production using botanical leaf extracts and mulching materials combined; and 7). To evaluate the effect of botanical leaf extracts and mulching materials on soil chemical properties.

The treatments used were Mainplot: Different Levels of Botanical Leaf Extract Application (P0 – No Application, P1 –250 ml leaf extract (Neem + Madre de Cacao + Guava)/16 li water, P2 –500 ml leaf extract (Neem + Madre de Cacao + Guava):16 li water, P3 –750 ml leaf extract (Neem + Madre de Cacao + Guava)/16 li water, P4 – 40 ml Brodan /16 li water). Subplot: Mulch (M1 – Plastic Mulch (PM), M2 – Carbonize Rice Hulls (CRH) and M3 – Saw Dust (SD)).

A Split- plot Factorial Design was used in the study with three blocks. Each block was composed of 15 treatment combinations. All the data gathered were arranged, tabulated, presented and analysed using the Analysis of Variance (ANOVA). Comparison among treatment means was done using the Least Significant Difference. Regression analysis was also used in determining the relationship of some parameters using the Statistical Analysis for Agricultural Research (STAR) version 20.1. (2013).

Mass rearing of test insect pest was done in order to have uniform age and population of test insects per plot. Preliminary screening was likewise done through bioassay using the different levels of botanical extracts. The botanical extracts were prepared by shredding/crushing the leaves of neem, madre de cacao, and guava at 1:1:1 ratio and soaked in 7.5 li water for seven days.

The botanical leaf extracts regardless of rates are observed to have higher repellent to fruit and shoot borer. Application of 250 ml botanical leaf extract mixture/ 16 li of water showed higher repellent effect on lady spotted beetle but no repellent effect was noted on whiteflies.

A highly significant knockdown effect was noted on FSB, LSD and WF among plants sprayed with varying levels of botanical leaf extracts. Botanical leaf extracts at 500 – 750 ml/16 li water is as effective as the commercial insecticide application.

Result showed there was no significant difference on the plant height at 35 DAT of plants under black plastic mulch, carbonized rice hulls and sawdust, similarly comparative result were obtained from plants sprayed with varying levels of botanical leaf extracts. No interaction effects between mulching materials and botanical leaf extracts application was noted at 35 DAT on plants

Significant difference was obtained in the height of the plant at 140 DAT on plants sprayed with commercial insecticide registered the tallest but not significant to plants without application (Control) and application botanical leaf extracts of 250

## **Botanical Leaf Extracts and Mulching Materials in Organic Eggplant (*Solanum Melongena* L.) Off Season Production**

ml/16 li water. Plants sprayed with botanical leaf extracts of 500ml-750ml/ li water tend to inhibit the plant height. No significant difference on plant height was noted in terms of the kind of mulching materials used.

No interaction effects between mulching and botanical leaf extracts application was detected on the plant height at 140 DAT.

Application of varying levels of botanical leaf extract, mulching materials and even the combination of the two variables failed to influence the number of leaves.

Highly significant result was shown in terms of the number of damaged leaves at 2<sup>nd</sup> WAT and 10<sup>th</sup> WAT. Least damaged leaves was taken from plants sprayed with botanical leaf extracts at 750ml/16 li water, lesser than plants applied with commercial insecticides. Results showed no significant combined effect on botanical leaf extract application and different mulching used was detected.

Days to flower was not affected by botanical leaf extract mixtures, or by mulches used or their combined effects but rather on genetic make-up of the eggplant variety used.

The number of fruits per plants were comparable among treatments and treatment combinations.

There were no marked differences on the weight of the marketable fruits of eggplants affected by the application of varying levels of botanical leaf extract. However, plants applied with the highest dose 750ml/16 li of water tended to have the heavier marketable fruit.

The number of marketable fruits harvested from plants sprayed with varying levels of botanical leaf extracts ranges from 10.78-19.6 and mulching materials ranging from 14.87 -16.20. Result shows no significant differences among plants applied with varying levels of botanical leaf extracts as wells as by different mulching materials. No interaction effects was obtained but plants sprayed with 750 ml botanical leaf extracts per 16 li of water + carbonized rice hull combination tend to have more marketable fruits than plants among treatment combinations.

Result shows highly significant differences on the number of non-marketable fruits. Application of higher dose of botanical leaf extract mixtures/solutions of 500ml – 750ml/li water provided protection to eggplants that reduced unmarketable fruits produced similar with the commercial pesticide. Plants sprayed with higher dose botanical leaf extracts at 750 ml/16 li water with only 2.00 mean number of non-marketable fruit and application of botanical leaf extract at (500ml/16 li water) with 3.56 mean number of nonmarketable fruit.

Similarly, in terms on the weight of non-marketable fruit a highly significant differences was obtained. Interaction of two factors was noted significantly only on the combination of botanical extracts at 750ml/16 liter of water + sawdust with 161.67 grams exhibits the lowest in terms of non-marketable fruits.

Result showed no significant differences observed on the length of fruits.

Black plastic mulch, CRH and sawdust shows comparative results but shows no significant differences among treatment means.

Yield was comparable among plants applied with botanical extracts as well as with different mulching materials. No interaction effect was noted. Yield range from 29, 876 – 56,045 kg/ha.

Regression correlation analysis showed that number of damaged leaves to yield is highly correlated . A correlation coefficient of 71.29 % was obtained from 2<sup>nd</sup> week while 80.33% was obtained on the 4<sup>th</sup> week and 74.44% on the 10<sup>th</sup> week implying that as the number of damaged leaf is increases, yield decreases.

Results of the cost and return analysis showed no significant differences in terms of net profit and return on investment among plants applied with varying levels of botanical extracts as well as application of different mulching materials. No interaction effects between the two factors was detected. However, a net income of Php 689,433.77 sprayed with botanical extract at 750ml/16 li water while application of commercial insecticide achieved Php 581,432.52 net income per hectare.

Results showed no significant difference in terms of soil pH among treatments. Initial soil pH was 7.2 but after harvest soil pH was lowered to 6.06 to 6.51. Electrical conductivity was likewise changed from 0.93 to 0.57 – 0.82. Soil organic matter was increased from 0.89 before planting and raised to 1.03 – 1.22 after the conduct of experiment. Soil P content was increased from 26.63ppm to 21. 86 – 43.54 ppm, soil K was likewise changed from 318.89 ppm to 212 – 526.48 ppm. Similar trend was obtained on soil properties under mulching materials. No significant difference was obtained in all soil properties was detected. No significant interaction effect between botanical leaf extract and mulching materials application was noted.

## **CONCLUSIONS**

Based from the results of the study, the following conclusions were derived:

1. Application of botanical leaf extract at 750ml/16 li water have highly significant knockdown effect on FSB, LSB and WF while 250 ml of botanical leaf extracts showed significant repellent effect on FSB and lady spotted beetle (LSB).
2. Plants applied with the highest dose of botanical leaf extract of 750ml/16 li of water tended to increase marketable fruit yield.

## Botanical Leaf Extracts and Mulching Materials in Organic Eggplant (*Solanum Melongena* L.) Off Season Production

3. Application of black plastic mulch is comparable with the application of carbonized rice hulls and sawdust in all growth and yield parameters.
4. Combined application of botanical leaf extracts at 750 ml/16 li of water with Carbonized Rice Hulls as mulch exhibited the highest in terms of yield (63,023.01 kilograms), gross sales of (Php 945,345.15).
5. Regression correlation analysis revealed that there is a direct correlation between the numbers of damaged leaves to yield.
6. Highest net income (Php 797,635.15 and return on investment with 540 percent was obtained from plant applied with botanical leaf extracts of 750ml/16 li water and mulch with CRH.
7. Chemical properties of the soil after planting was enhanced except in the soil pH content of the soil.

### RECOMMENDATIONS

Based on the conclusions, the following recommendations were drawn:

1. Botanical leaf extracts at 750ml//16 li of water is recommended to reduce Fruit Shoot Borer, Lady Spotted Beetle, and White Flies damaged.
2. Black plastic, carbonized rice hulls (CRH) or sawdust can be used as mulch for organic eggplant production.
3. Combined application of botanical leaf extracts at 750 ml/16 li of water and carbonized rice hulls (CRH) can be used for high fruit yield.
4. A similar study should be conducted to further validate the efficacy of botanical leaf extracts and mulching materials on the other eggplant varieties and/or other vegetables.

### REFERENCES

- 1) Ahmed BI, Onu I, Mudi L (2009). Field bioefficacy of plant extracts for the control of post flowering insect pests of cowpea(*Vigna unguiculata* (L.) in Nigeria. J.
- 2) Acayen, M.T.C. (2005-2006). Dried Papaya Leaves as Organic Mulch for tomato Plants.
- 3) BAS. 2007c. Performance of Philippines agriculture January to December 2006. Bureau of Agricultural Statistics, Department of Agriculture, Philippines <http://www.bas.gov.ph/perflastyear.php>
- 4) Badgley, C., J. Moghtader, E. Quintero, E. Zakem, M. J. Chappell, K. Avilés-Vázquez, A. Samulon, and I. Perfecto. 2007. Organic agriculture and the global food supply. *Renewable Agriculture and Food Systems* 22:86-108.
- 5) Baloc, H. A. 1, Bulong M. P. 2; (2012). (Efficacy of Fermented Botanical Plant Extracts in the Management of White Flies and 28-Spotted Beetles in Tomato
- 6) Beleña M. J. G., C. P. Josue, A. J. M. Ondo and M. U. Peralta (March 2017) BOTANICAL LEAF EXTRACT AS BIO PESTICIDE IN EGGPLANT PRODUCTION (Unpublished Undergraduate Thesis)
- 7) Birch C. J., Rickert K.G., Wearing A.H., Tan D.K.Y., 2000. Broccoli yield and quality can be determined by cultivar and temperature but not photoperiod in south – east Queensland. *Aust. J. Exp. Agric.* 39: 901-909.
- 8) Bliss RM, Elstein D., (2004) Scientists get under eggplant's skin. *ARS Magazine*, 2004 January; 52 (1): <http://www.ars.usda.gov/is/AR/archive/jan04/skin0104.htm>. 2004.
- 9) Chakraborty, D., Nagarajan, S., Aggarwal, P., Gupta, V.K., Tomar, R.K., Garg, R.N., Sahoo, R.N., Chopra, U.K. and Kalra, N. 2008. Effect of mulching on soil and plant water status, and the growth and yield of wheat (*Triticum aestivum* L.) in a semiarid environment. *Agricultural Water Management*. 95(12): 1323-1334
- 10) Chen N.C., Li H.M., 1997. Cultivation and seed production of eggplant. Training workshop on vegetable cultivation and seed production technology. Shanhu, Tainan: AVRDC. J: 1-12.
- 11) Cork, A.; Iles, M.J.; Kamal, N.Q.; Choudhury, J.C.S.; Rahman, M.M. and Islam, M. 2005. An old pest, a new solution - Commercializing rice stem-borer pheromones in Bangladesh. *Outlook on Agriculture*, 34(3): 181-187.
- 12) Davis C. C., 1993. Environmental concerns about pesticide use in Philippine Agriculture: *Science of The Total Environment* Volume 134, Supplement 1, 1993, Pages 293-306)
- 13) Diaz Perez J.C., Gitaitis R., Mandal B., 2007. Effects of plastic mulches on root zone temperature and on the manifestation of tomato spotted wilt symptoms and yield of tomato. *Sci. Hort.* 114: 90-95.
- 14) Dilip Kumar, G. Sachin, S. S. and Rajesh Kumar. (1990). Importance of mulch in crop production. *Indian Journal of Soil Conservation*, 18: 20-26.
- 15) Dioquino, C.C. (2002). Report on pesticide poisoning in the Philippines. National Institute of Health and Sciences. 7th GINC meeting. Tokyo, Japan. Available at: <http://www.nihs.go.jp/GINC/meeting/7th/prof%20file.html>
- 16) Domingo, O. F., Science Research Specialist II, PCARRD ( Science and Technology & POST: Publication of the Department of Science and Technology Vol. XXV, 4<sup>th</sup> Quarter, October–December 2007) [pesticidescheaper.effectivepest-control.html](http://www.ars.usda.gov/is/AR/archive/jan04/skin0104.htm)

## Botanical Leaf Extracts and Mulching Materials in Organic Eggplant (*Solanum Melongena* L.) Off Season Production

- 17) DOST. (1998): Madre de cacao. Department of Science and Trade. Manila, Philippines.
- 18) FAO, (2009). The United Nation Food and Agriculture Organization.
- 19) Food for the family ,Health and Home, May-June 2007 p.39 ).
- 20) Francisco, SR. (2009). Costs and benefits of UPLB Bt Eggplant with Resistance to Fruit and Shoot Borer in the Philippines. In: Norton GW, Hautea DM, editors. *Projected Impacts of Agricultural Biotechnologies for Fruits and Vegetables in the Philippines and Indonesia. Ithaca, NY and Los Banos, Laguna*
- 21) Golob, P. and Webly, D. J. 1980. The use of plants and minerals as traditional protectants of stored products. *Insect Sci. Application.*12(1\2\3): 103-109.
- 22) Ghosh, P.K. Dayal, D. Bandyopadhyay, K.K. and Mohanty, M. 2006. Evaluation of straw and polythene mulch for enhancing productivity of irrigated summer groundnut. *Field Crops Research.* 99(2- 3): 76-86.
- 23) Haida KS, Baron A, Haida KS (2011) Phenolic compounds and antioxidant activity of two varieties of guava and rue. *Rev Bras Ciênc Saúde* 28: 11-19.
- 24) Health and Home (May-June2007). Food for the family p.39
- 25) H. M. Burkill, (1997). *The Useful Plants of West Tropical Africa*, 2nd edition, 1997
- 26) Hori, M. 2003. Repellency of essential oils against the cigarette beetle, *LasiodermaSerricornes* .
- 27) Immaraju JA (1998) The commercial use of azadirachtin and its inte-gration into viablepest control programmes. *Pestic Sci* 54:285–289
- 28) Katarzyna Adamczewska-Sowińska\*, Magdalena Krygier, Joanna Turczuk 2012. The Yield of Eggplant Depending on Climate Conditions and Mulching.
- 29) Khan, W., U. Rayirath, S. Subramanian, M. Jithesh, P. Rayorath, D. M. Hodges, A. Critchley, J. Craigie, J. Norrie and B. Prithiviraj, 2009. Seaweed extracts as biostimulants of plant growth and development. *Journal of Plant Growth Regulation*, 28(4): 386-399.
- 30) Kim, H. K.; Kim, J. R. and Ahn, Y. J. 2004. Acaricidal activity of cinnamaldehyde and its congeners against *Tyrophagus putrescentiae* (Acari: Acaridae). *Journal of Stored Product Research.* 40: 55-63.
- 31) Lantican, R. M. 2001. *The Science and Practice of Crop Production*. College of Los Baños, Laguna, Phils.: SEAMEO SEARCA and UPLB. 330p.
- 32) Liberato, M. O. 2017. Off season production of tomato (*Lycopersicom esculentum* L.) under different shading and mulching materials.
- 33) Mateljan,George 2017. World Healthiest Vegetables Foundation
- 34) Maughan, Tiffany and Dan Drost, January 2016. Use of plastic mulch for vegetable production, Horticulture Extension Utah State University Horticulture/Vegetables/2016-01
- 35) Memon, M.S., Jun, Z., Jun, G., Ullah, F., Hassan, M., Ara, S. and Changying, J. 2017. Comprehensive review for the effects of ridge furrow plastic mulching on crop yield and water use efficiency under different crops. *InternationalAgricultural Engineering Journal.* 26(2):GROWTH AND YIELD OF EGGPLANT (*Solanum melongena* L.) ON VARIOUS COMBINATIONS OF N-SOURCE AND NUMBER OF MAIN BRANCH
- 36) Moch. Dawam Maghfoer, Roedy Soelistyono and Ninuk Herlina, 2014. Growth and Yied of Egplant (*Solanum melongena* L.) on various combination of N- source and number of Main branch.
- 37) Moreno M. M., Moreno A., 2008. Effect of different biodegradable and polyethylenemulches on soil properties and production in a tomato crop. *Sci. Hort.* 116: 256-263.
- 38) M. A. K. Azad , M. N. Yesmin and M. S. Isl.am, (2012). Effect of Botanical Extract on Pest Control in Brinjal Field
- 39) Musa, A. K. and Olaniran, R. O. (2014) Insecticidal activity and phytochemical screening of guava, psidium guajava l. Leaf oil against khapra beetle, *trogoderma granarium everts* (coleoptera: dermestidae) on stored groundnut.
- 40) N.C. Chen, T. Kalb, N.S. Talekar, J.F. Wang and C.H. Ma, 2002. Asian Vegetable Research and Development Center; P.O. Box 42, Shanhua; Taiwan 741; ROC tel: (886-6) 583-7801 fax: (886-6) 583-0009 email: avrdcbox@netra.avrdc.org.tw www: <http://www.avrdc.org.tw>
- 41) N. S. Ncube, A. J. Afolayan, and A. I. Okoh, 2008 “Assessment techniques of antimicrobial properties of natural compounds of plant origin: current methods and future trends,” *African Journal of Biotechnology*, vol. 7, no. 12, pp. 1797–1806, 2008. View at Google Scholar · View at Scopus
- 42) New Zealand Digital Library. The University of Walkato Humanity Development Training and Development Soils, Crops and Fertilizer Use: Chapter 8: Using Fertilizers and Soil Conditioners).

## Botanical Leaf Extracts and Mulching Materials in Organic Eggplant (*Solanum Melongena L.*) Off Season Production

- 43) Panergayo, K.S., Magos,, R.C., Baletaryo, C.H., Panergayo, R.A. *et. al* (2008) 'Morena and 'Banate King' : New promising eggplant hybrids in the Philippines (2008) Source: University Library, University of the Philippines at Los Baños  
HOMEPAGE:<http://www.uplb.edu.ph>
- 44) Park, J. D.; Ahn, Y-J.; Park, I-K.; Lee, S-G. and Choi, DH. 2003. Insecticidal activities of constituents identified in the essential oil from leaves of *Chamaecyparis obtusa* against *Callosobruchus chinensis* (L.) and *Sitophilus oryzae* (L.). *Journal of Stored Product Research*. 39: 375-384.
- 45) Philippines Statistics Authority-Bureau of Agricultural Statistics. *CropStat for 2005–2014*.
  - a. Available: <http://countrystat.psa.gov.ph/>
- 46) Prashanth G.K1 , G.M. Krishnaiah2 (2014). Chemical composition of the leaves of *Azadirachta Indica* Linn (Neem) Department of Chemistry, Sir M. Visvesvaraya Institute of Technology, Hunasamaranahalli, Bangalore-562 157, India.
- 47) Pretty, J. N., J. I. L. Morison, and R. E. Hine. 2003. Reducing food poverty by increasing agricultural sustainability in developing countries. *Agriculture, Ecosystems & Environment* 95:217-234
- 48) Regnault-Roger C, Philogène BJR, Vincent C (eds) (2005) *Biopesticides of plant origin*. Lavoisier, Paris, p 313.
- 49) Rosenthal, G.A. and Janzen, D.H. (eds). 1979. *Hervibores: their interaction with secondary plant metabolites*. Academic Press, New York.
- 50) Russell AD (2002). Antibiotic and biocide resistance in bacteria: Introduction. *J Appl Microbiol* 92: 1S–3S. [PubMed]
- 51) Sarian, Sac V. (Nov. 2017 ) *AGRI MAGAZINE: East-West Seed's 35 Farmer Heroes Featured*.
- 52) Shweta, D. Mal, L. Singh, S. Gharde, P. Kaur and Datta, S. 2018. Effect of Mulching in Brinjal (*Solanum melongena L.*): A Review. *Int.J.Curr.Microbiol.App.Sci*. 7(06): 504-509. doi: <https://doi.org/10.20546/ijcmas.2018.706.056>
- 53) Sideman B. 2017. *Growing Vegetable Tomatoes*. UNH Cooperative Extension. University of New Hampshire. [https://extension.unh.edu/resources/files/resource000609\\_rep631.pdf](https://extension.unh.edu/resources/files/resource000609_rep631.pdf)
- 54) Singh, S., Awasthi O.P. and Meena, S.R. 2006. Influence of mulch on soil hydrothermal regimes, leaf and soil nutrient concentrations, growth and fruit yield of brinjal grown under arid ecosystem. *Agropedology*. 16 (2): 112-116.
- 55) Somasundaram, D.J., Rajadurai, S. (1995). War and suicide in Northern Sri Lanka. *Acta Psychiatr. Scand*. 91: 1-4
- 56) Stoll, G. (2000): *Natural protection in the tropics*. Margraf Verlag. Weikersheim. [www.bar.gov.ph](http://www.bar.gov.ph)
- 57) Tacio, Henrylito D. *Organic, Botanical Pesticides: Cheaper and Effective Pest Control* September 8, 2009).
- 58) UNDP. 2006. A logistical evaluation of the vegetables sub-sector. *Globalization and Corporate Citizenship (Project ID00014496) From Seed to Shelf, a Logistic Evaluation of the Vegetables Sub-Sector (Unpublished Report)*. United Nations
  - a. Development Programme.
- 59) United Nations Environmental Programme: *Chemicals* (1996). Philippine case study: a developing country's perspective on POPs. IFCS meeting on POPs. 17-19 June, 1996. Manila, The Philippines. Available at:
- 60) Vijaya.K.S, Dr.S.Seethalakshmi, 2011. Response of Eggplant (*Solanum melongena L.*) To Integrated Nutrient Management Amended Soil
- 61) Ware GW (1983). *Pesticide. Theory and application*. Freeman, San Francisco, p. 308
- 62) Waterer, D. R. (2000). Effect of soil mulches and herbicides on production economics of warm-season vegetable crops in a cool climate. *HortTechnology*, 10: 154-159.
- 63) <http://www.chem.unep.ch/pops/indxhtmls/mane xp7.html>
- 64) <http://www.gaiadiscovery.com/agriculture-industry/organic-botanical-pesticides-cheaper-effective-pest-control.html>
- 65) [https://archive.org/stream/useofsawdustform891alli/useofsawdustform891alli\\_djvu.txt](https://archive.org/stream/useofsawdustform891alli/useofsawdustform891alli_djvu.txt)
- 66) <http://slideshare.net/sekaran85/cfakepath pesticide-sekaran>
- 67) (<http://www.ijsr.net/archive/v4i7/SUB156514.pdf>)
- 68) [https://www.researchgate.net/publication/306080082\\_The\\_Vegetable\\_Industry\\_in\\_Tropical\\_Asia\\_The\\_Philippines](https://www.researchgate.net/publication/306080082_The_Vegetable_Industry_in_Tropical_Asia_The_Philippines)
- 69) [www.encyclopedia.org/wiki/how\\_to\\_used\\_neem\\_as\\_a\\_natural\\_pesticide](http://www.encyclopedia.org/wiki/how_to_used_neem_as_a_natural_pesticide)
- 70) [www.gaiadiscovery.com/agriculture-industry/organic-botanical-](http://www.gaiadiscovery.com/agriculture-industry/organic-botanical-)
- 71) [www.gramr.com/sites/default/files/issues-pdf/031\\_2pdf](http://www.gramr.com/sites/default/files/issues-pdf/031_2pdf)
- 72) [www.imok,ufl.edu/hlb/database/pdf/00002604.pdf](http://www.imok,ufl.edu/hlb/database/pdf/00002604.pdf)
- 73) ([https://archive.org/stream/useofsawdustform891alli/useofsawdustform891alli\\_djvu.txt](https://archive.org/stream/useofsawdustform891alli/useofsawdustform891alli_djvu.txt)).



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Food Management Control and Field Bureaucrats Policy Implementation in Kwara State, Nigeria National Agency for Food and Drugs Administration and Control



Dr.Yahuza Danjuma Izom<sup>1</sup>, Ibrahim Salihu Kombo<sup>2</sup>, Mustapha Babarani<sup>3</sup>

<sup>1,2,3</sup> Department of political science, IBB University Lapai, Niger state-Nigeria

**ABSTRACT:** This study titled food management control and field bureaucrats policy implementation in Kwara state Nigeria national agency for food and drugs administration and control. The aim of this study is to analyse the activities of field level bureaucrats to describe how they act to overcome barriers that affect policy implementations on food management control in Kwara state Nigeria. While most policies rely on field level bureaucrats for their implementation, there is still a lack of empirical studies maximally that provide an adequate understanding of how field bureaucrats can overcome the barriers, delays, and disincentives associated with implementing policies on food management control. For this reason the study decided to examine how field level bureaucrats are influenced by barriers and how the influences from the barriers affect their work – policy implementation on food management. Documentary research was used in this study, of which qualitative approach was used in sources of data. The study adopted elite theory. Data were analysed using documentary records. The findings of the study indicated that there were no significant relationships between food management control and field bureaucrats’ policy implementation in Kwara state, Nigeria national agency for food and drugs administration and control. Furthermore, rank effects of the results were barriers that provide most issues that influence the work of field bureaucrats in policy implementation of food management in Kwara state. The results of the research shows that field bureaucrats are more respond to barriers by adopting a flexible role, which means, simplification of the policy implementation process, and this were influenced by time pressure than other forms of barriers. The study thereby recommends that attention should be paid to the behaviour of field bureaucrats on duties, in such a way as to ensure that policy behaviour are well implemented for food management control care, so as to ensure more positive outcomes of its kind.

**KEYWORDS:** policy, Bureaucrats, food management, Barriers, Government

### INTRODUCTION

The effectiveness of governance depends on proper policy formulation and implementation which accounts for why government spends so much money to develop policies world wide. Over the years the Nigerian Government has invested huge funds, of about an average of N2trillion annually (Nwosu and Okafor, 2014) to develop public policies to address many public issues, such as, the need to have a safe supply of herbal medicine, and that processed foods are safe for public consumption, in the society. Generally, the expected outcome of the public policies formulated by Government is to, in the long-run, make positive changes to identified public problems. Such changes could either be to eliminate such problem, or to manage it or to restructure its appearance to a more desirable one. Foreexample, the Federal Government in 2005 created the Herbal Medicines and Related Product (Advertisement) Regulation, domiciled with the National Agency for Food and Drugs Administration and Control (NAFDAC) to bring to stop a situation of uncontrolled advertisement of herbal medicines, some of which are harmful for public consumption. Concerns remain, however, about how quickly and effective policies in Nigerian are transformed into their desired outcomes. This is because policy implementation is a vital aspect of the policy process. It is at this point that intended outcomes which a policy was created to achieve can either be achieved or not achieved. Basically, terms such as “complete failure”, “White Elephant project”, and “graveyard of policies” have been used to describe the situation of policy implementation in Nigeria (Makinde 2005, Egonmwan, 1984), which of course, expresses the concern about the efficacy of public policies implementation in Nigeria. However, studies in public policy implementation have indicated that policy implementation cannot occur without some form of disincentives or obstacles (Alesch and Petak, 2001, Olaoye, 2010, Sutton, 1999). These obstacles basically mean that some form of distortion to the policy intent may occur when implementing a policy or that the policy outcome may take longer time



## **Food Management Control and Field Bureaucrats Policy Implementation in Kwara State, Nigeria National Agency for Food and Drugs Administration and Control**

before they are achieved (Sutton, 1999). The nature of effect a challenge might have on a policy outcome, be it distortion or delay in outcome provision, depends on a number of complex factors such as the type and source of the challenges in question, the extent to which such a challenge is allowed to persist, and the method through which the policy is to be implemented (Alesch and Petak, 2001, Sutton, 1999).

The complexity of the policy implementation process has challenged researchers to develop theories or models that predict how and under what conditions policies are implemented (Sutton, 1999, Smith, Richards, Geddes, and Mathers, 2011). One of such models is the "Street Level Bureaucrats model" developed by Lipsky (1980), wherein he explains that actors who work in bureaucracies where work is done more on the field, have a role to play, they are not merely cogs in an automatic transfer of policy-making to outcome in practice. Due to constraints on their time, and bureaucratic procedures at the local level, Lipsky argues that workers may exercise considerable flexibility in implementing instructions. Winter (2002) provides technical insight into this approach, highlighting the agency of individual actors (their knowledge and power), which enables them to act autonomously and mould outcomes.

Bureaucracy according to Heywood (2017), is a giant mechanism operated by pygmies. It is the structure and set of regulations in place to control activity, usually in large organizations and government (Arowolo, 2018).

In Nigeria, this bureaucratic arrangement though present in letter and practice is largely unattainable due to the high enormity in the personalization of office and the non-adherence to the other bureaucratic values or ethos listed in the preceding sections in the system. This personalization makes many officials corrupt in the course of their duty as civil or public servants.

The discipline therefore needs to intensify its effort and salvage the country from the mess of misconceived values' influence on the heart and minds of many Nigerians. The teaching and learning of Social Studies needs to demonstrate its capability and readiness as societies only hope among the disciplines to cure its social ills by stemming the trend of misconceived values in Nigeria. The subject needs to take some decisive steps to tackle this malady that is spreading fast like cancer.

Therefore, to gain some level of understanding, the study analyses the activities of policy actors to describe how they act to overcome challenges that affect policy implementation, drawing experiences from the implementation of the Herbal Medicine and Related Product Advertisement Regulatory Policy and the Processed Food Regulatory Policy of NAFDAC in Kwara state, Nigeria.

### **AIM AND OBJECTIVES OF THE STUDY**

The main objective of this study is to analyse food management control and field bureaucrats' policy implementation in Kwara state Nigeria national agency for food and drugs administration and control.

#### **Specific objectives of this work are:**

To ascertain the influence of field bureaucrats on policy implementation for effective decision making

1. To identify the type of influence which bureaucrats have on policy implementation on food management control by NAFDAC in Kwara state.

2. To analyse the challenges faced by field bureaucrats in improving policy implementation on food management control in Kwara state.

### **CONCEPTUAL CLARIFICATIONS**

#### **Bureaucracy**

Bureaucracy as defined by customers and employees is an array of negative forces, attitudes or actions that are damaging to customer and employee satisfaction. Because bureaucracy is concerned with people in organization, it is damaging to organizational effectiveness. It weakens employee morale and commitment. It divides people within the organization against each other, and misdirects their energy into conflict or competition with each other instead of mission achievement. According to Max Weber cited in Johnston (2011) six major principles were noted about bureaucracy. These were as follows:

**A formal hierarchical structure:** In an organization, each level controls the level below and is controlled by the level above. A formal hierarchy is the basis of central planning and centralized decision making.

**Management by rules:** Controlling by rules allows decisions made at high levels to be executed consistently by all lower levels.

**Organization by functional specialty:** Work is to be done by specialists, and people are organized into units based on the type of work they do or skills they have.

**An "up-focused" or "in-focused" mission:** If the mission is described as "up-focused," then the organization's purpose is to serve the stockholders, the board, or whatever agency empowered it. If the mission is to serve the organization itself, and those within it, e.g., to produce high profits, to gain market share, or to produce a cash stream, then the mission is described as "in-focused."

## **Food Management Control and Field Bureaucrats Policy Implementation in Kwara State, Nigeria National Agency for Food and Drugs Administration and Control**

**Purposely impersonal:** The idea is to treat all employees equally and customers equally, and not be influenced by individual differences.

### **Policy**

Policy is typically described as a principle or rule to guide decisions and achieve rational outcome(s). Policy can be considered as a "Statement of Intent" or a "Commitment". Policy may also refer to the process of making important organizational decisions, including the identification of different alternatives such as programs or spending priorities, and choosing among them on the basis of the impact they will have. Policies can be understood as political, management, financial, and administrative mechanisms arranged. The term may apply to government, private sector organizations and groups, and individuals. According to a report by Torjman (2005), there are different ways to look at policy.

### **THEORETICAL FRAMEWORK**

This study adopted two major theories but considered one which is the elite theory for the study.

#### **Elite Theory**

The elite theory, succinctly put, states that every typical society is divided into two groups (i) the few who have power and occupy by virtue of their power, top positions in the society; and (ii) the many who have no social influence or power, hence are at the bottom of the social ladder. The former who have power, though few in number, rule the people in the latter group. Consequent upon the above, public policy formulation and implementation is seen "as representing preferences and values of the governing or political elites. Thus, the suggestion that public policy is a reflection of the demands of the people is said to be a myth rather than reality" (Okereke, 1998). This theory which was popularized by scholars like Vilfredo Pareto, Gaetano Mosca and Wright Mills assumes that the masses are apathetic and ill-informed about public policy, hence, cannot be relied upon to drive policy matters. The burden is now left squarely at the feet of the elites to initiate policies and "push it downwards" to the masses.

In the Nigerian context, the influence of the elite in the policy formulation and implementation process is irrefutable. Most times they (the elites) are the ones who determine what policies are to be enacted in the country and who is to benefit from such policies; and since they share consensus on certain social values, they ensure that policies made without their input or perceived to be against their class interest is sabotaged. A good example of this scenario is the anti-graft policy of government which has not been able to effectively checkmate corruption among the elites in the country.

### **REVIEW OF RELATED EMPIRICAL STUDIES**

Franklin (2011) in his research titled *Effects of Bureaucracy on Policy Implementation in the Public Sector „A Case Study of Ghana Audit Service, Ashanti Region* attempted to find out the bureaucratic effect of policy implementation within the Ghana Audit Service (GAS), Ashanti Region. In all, 76 structured questionnaires were administered to staff of different ranks in Ghana Audit Service, Kumasi Office. The results from the study show that there are various policies such as performance appraisal policy, Computer Assisted Audit Techniques and Risk based Audit approach policy etc. within the GAS. However, implementation is poor and affected by bureaucracy, dissemination of information and lack of logistical supports. Most of these policies are formulated from the GAS Headquarters in Accra and rolled to the regional and district offices. Though GAS has means of evaluating and monitoring policies, these structures are less effective resulting in poor implementation of policies. It is therefore recommended that there should be proper decentralization of policy issues to regional and district offices. Furthermore, frequent transfer of staff should also be reduced to enable staff fully benefit from policies implementation programmes rolled out to them. Training Programmes should also be adequately provided to help with appropriate orientation, skills and best practices of techniques to minimize bureaucratic tendencies. It is therefore recommended that further research on effectiveness of policy evaluation mechanism and how to remove bureaucratic bottlenecks within GAS should be carried out.

Ugwuanyi, and Emma (2013), carried out a study on the obstacles to effective policy implementation by the public bureaucracy in developing nations: the case of Nigeria. The study explored the importance of public policy in governance and public administration—generally, deeply discussed public bureaucracy and its role in policy implementation, critically examined and analyzed the key obstacles inhibiting the public bureaucracy in Nigeria from effectively implementing policies. In carrying out the study, the secondary sources of information or data gathering were mostly relied on and consequently, content analysis technique was adopted in the analysis. The basic finding is that there exists, indeed, some factors and circumstances that constitute serious obstacles to effective policy implementation by the public bureaucracy in Nigeria. These factors, among others, include the ineffective and corrupt political leadership under which the public bureaucracy in Nigeria thrives, the pervasive and deep rooted corruption within the public bureaucracy and the pressure and influence of primordial demands and values on the bureaucracy which negatively affect implementation activities and processes. Recommendations offered to overcome the obstacles and

## **Food Management Control and Field Bureaucrats Policy Implementation in Kwara State, Nigeria National Agency for Food and Drugs Administration and Control**

challenges and to reposition the Nigeria public bureaucracy for effective implementation of policies include, basically, that government should work towards ensuring the involvement of both purposeful and responsible political and bureaucratic leaderships as well as work towards further realization of politics and administration dichotomy in Nigeria in order to create room for the bureaucracy to operate and implement policies essentially on the basis of laid down ideal bureaucratic rules and principles. The bureaucrats need too to strongly de-emphasize primordial considerations and to resist primordial pressures and demands for special favours in policy implementation activities and processes while government also need to constantly develop appropriate programs for improving the working conditions, and other incentives for the public bureaucrats in order to build their morale and commitment to public service. This, too, could reasonably diminish the propensity among the bureaucrats to misappropriate funds allocated for implementing development policies.

Oghenechuko, (2015) investigated the effect of public policy implementation barriers on field level bureaucrats: a study of selected policies of the national agency for food and drug administration and control. The study analysed the activities of field level bureaucrats and how they act to overcome barriers that affect policy implementation. The research was conducted using a case study model, as such two policies – processed food regulatory policy and herbal medicine and related product advertisement regulatory policy of the National Agency for Food and Drug Administration and Control was studied. Both primary and secondary data was sourced for the research. Questionnaires containing both closed and open ended questions was distributed to selected field bureaucrats responsible for implementing the regulatory policies. The field bureaucrats were asked to identify how they would respond in behaviour, to selected types of barrier that have been identified to influence policy implementation negatively. Further, they were asked to rank the barriers that provide the most influence on their work. The results of the research show that field bureaucrats are more likely to respond to barriers by adopting a flexible role, which means, simplification of the policy implementation process, and further, are more influenced by time pressure than other forms of barriers. The author recommends that attention should be paid to the behaviour of field bureaucrats on duties, in such a way as to ensure that the behaviour they depict are those that will not compromise the policy in their care, so as to ensure more positive outcomes.

Goddey W, and Alafuro, E (2018) conducted a study titled public policy formulation and implementation in contemporary Nigeria. This study attempts to study the actors and institutions involved in the country's public policy process, and the overt and covert factors which streamline their policy choice, within the period of 2000-2018. Suggestions were made on how to improve the machinery for public policy formulation and implementation in Nigeria. The study revealed that public officials are expected to structure public policies to achieve the twin goals of institution-building and socio-economic progress as this is the only way through which the welfare of the people can be improved. In a globalized world like ours, where events in one part of the globe is quickly relayed to the others parts it becomes even imperative that citizens of Nigeria are made not only to be part of the civilized world, but that the policy making process itself is made more efficient and more responsive to universal interest than to the elites primordial interest. Finally, it is our submission that when the study recommendations on the means to improve public policy formulation and implementation in Nigeria are applied, Nigeria will have a better policy formulation and implementation process.

### **THE GAPS IN THE LITERATURE**

The literature reviews on policy implementation and bureaucrats influence on national agency for food drugs administration and control are based on areas of concern other than extend of bureaucratic interferences. Most scholars identified that policy implementation for control and management of drugs are relevant as it offered proper and practical of drugs hygiene skills, confidence of use and contribution to decision making which have impact directly on human consumption. On the other hands, literatures reviews on community perception towards public policy implementations by NAFDAC and revealed that the organisation (NAFDAC) can do better if the barriers such as traditional medicines are curtail, enhance the norms and culture of its policies implementations that has hinder its policy implementation. The NAFADAC policy implementation should be based on constant review within a given frame. Despite the fact that a lot of studies have been conducted to curb its policy implementation and bureaucrats influence of which has live unsolved over years. By this there were need to conduct study to know the degree of public policy implementation and bureaucrats influence on national agency for food administration and control in Nigeria.

### **METHODOLOGY**

This study adopted documentary research specifically to analyse this study. This study was carried out in NAFDAC offices in Kwara State. The state is in north central Nigeria. Sharing boundary with Benin Republic to the West.

**Effect of bureaucracy within an organization in relations to food management control and field bureaucrats' policy implementation in Kwara state Nigeria national agency for food and drugs administration and control.**

## **Food Management Control and Field Bureaucrats Policy Implementation in Kwara State, Nigeria National Agency for Food and Drugs Administration and Control**

In an organization, each department has its own agenda. Some departments do not cooperate to help other departments get the job done. This leads to delays in proceedings resulting in ineffective implementation of policies. In addition, heads of departments feels responsible first for protecting the department, its people and its budget, even before helping to achieve the organization's mission also another bureaucratic form (Johnston, 2011). Work environment also have a strong bureaucratic effect on organization's output. It includes large amounts of unhealthy stress on people which reduce their output. Internal communications to employees within the organization which is poor causing distortion to reflect what the organization would like to be, rather than what it really is. Furthermore, employee's mistakes and failures being denied and covered up or ignored have negative effect on the organization. Because of bureaucracy, responsibility for mistakes and failure tends to be denied, and where possible, blame is shifted to others (Johnston, 2011). Bureaucracy has effect on policies, practices and procedures within an organization. It tends to grow endlessly and to be followed more and more rigidly (Johnston, 2011). It retards policy implementation and hence growth of organizations. However, bureaucratic effects also arise from political influence. There is political in-fighting, with executives striving for personal advancement and power. Promotions are more likely to be made on the basis of politics, rather than actual achievements on the job. Thus have strong effect on organizations performance.

### **CHARACTERISTICS OF BUREAUCRATIC ORGANIZATIONS**

These are some of the major characteristics of what is called the bureaucratic forms in organization. According to Johnston (2011), they are:

1. Most employees blame their organizations bureaucracy on senior management. They assume that management must want it, or it wouldn't be tolerated.
2. Senior managers do not want or like bureaucracy any more than the rest of the employees. The detestable effects of bureaucracy victimize everyone, regardless of level. Senior managers have not known what to do to get rid of it. Executives have tried many things to eliminate bureaucracy, but the program-of-the-year approach generally has not worked, because they have been fighting symptoms, not the root cause.
3. The root cause of bureaucracy is the organizing model. The bureaucratic form is so pervasive that its destructive nature is seldom questioned.
4. Management people in the organization must learn and use new ways of managing people and affairs. They will need to learn what they have been doing that adds to the bureaucracy in the organization. They will need to learn new ways of doing their jobs that diminish the amount of bureaucracy within the organization. Most importantly, they will need to provide empowerment for those who work for them, and protection and coaching to those who accept and act upon the offered empowerment.

### **Some Benefits of Bureaucracy in Organizations**

A major benefit of bureaucracy in organizations is that top executives or management would have control over the entire organization. This enables clients of the organization to know who to hold responsible when they encounter problems. Therefore in an organization in which the senior people were educated and the workers were less, it seemed vital to concentrate on control. Organizations that are managed by rules and regulations there is control and consistency. Thus bureaucratic forms though hindering progress, allow management to exhibit full control on the organization. For instance, if the entire organization was managed by rules, then top management could be sure that the organization would be controlled by their decisions (Johnston, 2011). Most of the public sector offices are government agencies. Bureaucracy within these organizations theoretically results in people serving government but the head of agencies. In addition, because of specialization of different departments within the organization, bureaucratic forms promised accountability and expertise control of affairs in these departments

### **POLICY MONITORING AND EVALUATION.**

Policies are implemented to achieve specific aim. There are several reasons why monitoring and evaluation of policies are necessary and carried out. They include:

1. Monitoring and evaluation enables a comprehensive assessment of effectiveness and impacts of the policy by implementers'.
2. Monitoring and evaluation is not only an instrument to measure progress in attaining benefits but also should be considered an intrinsic part of this progress.
3. Monitoring and evaluation ensures that accountability is a critically important issue based on transparent procedures, oversight, and data-based reporting

## **Food Management Control and Field Bureaucrats Policy Implementation in Kwara State, Nigeria National Agency for Food and Drugs Administration and Control**

Monitoring and evaluation helps the entire organization or enterprise to become progressively more cost-effective by building on the lessons of both successes and failures early enough for them to make a difference. To accomplish this, monitoring and evaluation ensures that what is being learned is effectively disseminated. (GEF, 2002).

### **Monitoring and Evaluation Criteria of Policies**

In general, monitoring and evaluation practices explore five criteria for assessment of policies. These five specific monitoring and evaluation criteria are used in combination to provide the decision-maker with essential information in connection with present and future decisions concerning the policy.

**Impact:** Measure both the positive and negative, foreseen and unforeseen, changes to and effects on society caused by the policy (cies) under evaluation.

**Effectiveness:** Measures the extent to which the objective has been achieved or the likelihood that it will be achieved.

**Efficiency:** assesses the outputs in relation to inputs, looking at costs, implementing time and economic and financial results.

**Relevance:** gauges the degree to which the policy at a given time is justified within the organization's environment and development priorities.

**Sustainability:** measures the extent to which benefits are gained from the policies relative to the period without the policy (GEF, 2002).

### **Monitoring Program**

A monitoring system is an essential tool for improved performance, planning, and portfolio and project or program management. One of the elements of this monitoring program is the monitoring of a policy progress in implementation and in achieving its overall goals. In addition, and on the basis of a minimum common format, each policy will build into its design a monitoring and evaluation component. This would include a baseline assessment, at a level appropriate to each project, to establish the conditions existing prior to policy implementation and a monitoring program carried out during implementation which may include, where appropriate, participatory modes of monitoring and evaluation. An important outcome of the monitoring program at the project level is the annual portfolio performance reports, which provide an analysis of the aggregated results of individual project monitoring (GEF, 2002).

### **Evaluation Program**

The types of policy evaluations conducted by the various departments responsible for the policy implemented include mid-term reviews, implementation completion reports, performance audit reports, and independent terminal evaluations. These departments are responsible for the implementation of the policy evaluations together with the GAS. A distinction should be made between internal reviews performed by staff in the responsible operational division and evaluations carried out by persons who are independent of policy operations. The latter may be conducted by staff members of the evaluation departments or external evaluators on contract (GEF, 2002).

### **Strategic Management Capacities for Implementing Policy**

Strategic management capacities are important to enable policy implementers to deal with the challenges of policy reform. Strategic implementation management can be thought of in terms of a conceptual capacity to look outward, look inward, and look forward CDG, (2001).

**Looking outward;** the tendency of managers to concentrate on the pursuit of day-to-day bureaucratic routines to the exclusion of being proactive or attentive to performance is well recognized. Policy implementers need to build capacity to extend their focus beyond the boundaries of their individual organizations. This means becoming more aware of who and what respond is appropriately. In essence, this calls for capacity in strategic planning and management. It includes the ability to identify key stakeholders; create opportunities for participation; forge partnerships among public, private, and voluntary sectors; set feasible objectives; build constituencies for change; and resolve conflicts. CDG, (2001).

**Looking inward;** efficient internal structures, systems, and procedures are important for achieving results. Critical to this kind of capacity are efficient and effective ways to design and implement programs; to set up and manage organizations; to hire, train, and motivate personnel; and to allocate, monitor, and account for financial and other resources. Without achieving some minimal level of operational efficiency, it is difficult to think or act strategically.

**Looking forward;** the third capacity relates to bringing together strategy, structure, and resources to achieve policy goals. It includes attention to sustainability, which implies the capacity to be anticipatory and proactive, not just responsive and reactive. Dealing with what is critical today is not enough. Policy implementers must be capable of identifying and preparing for what will be critical tomorrow and the next day as well. This includes operational capacity in evaluation and monitoring; but extends beyond to those more intangible capabilities, such as leadership, agenda-setting, and visioning. CDG, (2001).

## **Food Management Control and Field Bureaucrats Policy Implementation in Kwara State, Nigeria National Agency for Food and Drugs Administration and Control**

### **Addressing Challenges of Policy Implementation**

The policymakers need to build genuine consensus among all stakeholders on the aims of policy implementation concerning a particular program. If all people are involved, then actual making of the progress of the policy would easily be attained. Roseveare, (2008). At the same time, all political players and stakeholders need to develop realistic expectations about the policy program being implemented. Stakeholders, especially grassroots staff who are the policy are concerned need to be fully involved in designing and formulating the policy changes. Policy makers are also sometimes tempted to transform indicators that can be measured into goals and targets for projects, because they can be used to show progress over time. However, this approach can crowd out other goals that may have important underlying merits and that society may consider important. Roeselare, (2008). Service Corporate Plan, 2003).

### **REVIEW OF RELATED EMPIRICAL STUDIES**

Franklin K. D, (2011) in his research titled Effects of Bureaucracy on Policy Implementation in the Public Sector „A Case Study of Ghana Audit Service, Ashanti Region attempted to find out the bureaucratic effect of policy implementation within the Ghana Audit Service (GAS), Ashanti Region. In all, 76 structured questionnaires were administered to staff of different ranks in Ghana Audit Service, Kumasi Office. The results from the study show that there are various policies such as performance appraisal policy, Computer Assisted Audit Techniques and Risk based Audit approach policy etc. within the GAS. However, implementation is poor and affected by bureaucracy, dissemination of information and lack of logistical supports. Most of these policies are formulated from the GAS Headquarters in Accra and rolled to the regional and district offices. Though GAS has means of evaluating and monitoring policies, these structures are less effective resulting in poor implementation of policies. It is therefore recommended that there should be proper decentralization of policy issues to regional and district offices. Furthermore, frequent transfer of staff should also be reduced to enable staff fully benefit from policies implementation programmes rolled out to them. Training Programmes should also be adequately provided to help with appropriate orientation, skills and best practices of techniques to minimize bureaucratic tendencies. It is therefore recommended that further research on effectiveness of policy evaluation mechanism and how to remove bureaucratic bottlenecks within GAS should be carried out.

Ugwuanyi, B, I and Emma E.O. C (2013), carried out a study on the obstacles to effective policy implementation by the public bureaucracy in developing nations: the case of Nigeria. The study explored the importance of public policy in governance and public administration-generally, deeply discussed public bureaucracy and its role in policy implementation, critically examined and analyzed the key obstacles inhibiting the public bureaucracy in Nigeria from effectively implementing policies. In carrying out the study, the secondary sources of information or data gathering were mostly relied on and consequently, content analysis technique was adopted in the analysis. The basic finding is that there exists, indeed, some factors and circumstances that constitute serious obstacles to effective policy implementation by the public bureaucracy in Nigeria. These factors, among others, include the ineffective and corrupt political leadership under which the public bureaucracy in Nigeria thrives, the pervasive and deep rooted corruption within the public bureaucracy and the pressure and influence of primordial demands and values on the bureaucracy which negatively affect implementation activities and processes. Recommendations offered to overcome the obstacles and challenges and to reposition the Nigeria public bureaucracy for effective implementation of policies include, basically, that government should work towards ensuring the involvement of both purposeful and responsible political and bureaucratic leaderships as well as work towards further realization of politics and administration dichotomy in Nigeria in order to create room for the bureaucracy to operate and implement policies essentially on the basis of laid down ideal bureaucratic rules and principles. The bureaucrats need too to strongly de-emphasize primordial considerations and to resist primordial pressures and demands for special favours in policy implementation activities and processes while government also need to constantly develop appropriate programs for improving the working conditions, and other incentives for the public bureaucrats in order to build their morale and commitment to public service. This, too, could reasonably diminish the propensity among the bureaucrats to misappropriate funds allocated for implementing development policies. Oghenechuko, O (2015) investigated the effect of public policy implementation barriers on field level bureaucrats: a study of selected policies of the national agency for food and drug administration and control. The study analysed the activities of field level bureaucrats and how they act to overcome barriers that affect policy implementation. The research was conducted using a case study model, as such two policies – processed food regulatory policy and herbal medicine and related product advertisement regulatory policy of the National Agency for Food and Drug Administration and Control was studied. Both primary and secondary data was sourced for the research. Questionnaires containing both closed and open ended questions was distributed to selected field bureaucrats responsible for implementing the regulatory policies. The field bureaucrats were asked to identify how they would respond in behaviour, to selected types of barrier that have been identified to influence policy implementation negatively. Further, they were asked to rank the barriers that provide

## **Food Management Control and Field Bureaucrats Policy Implementation in Kwara State, Nigeria National Agency for Food and Drugs Administration and Control**

the most influence on their work. The results of the research show that field bureaucrats are more likely to respond to barriers by adopting a flexible role, which means, simplification of the policy implementation process, and further, are more influenced by time pressure than other forms of barriers. The author recommends that attention should be paid to the behaviour of field bureaucrats on duties, in such a way as to ensure that the behaviour they depict are those that will not compromise the policy in their care, so as to ensure more positive outcomes. Goddey W, and Alafuro, E (2018) conducted a study titled public policy formulation and implementation in contemporary Nigeria. This study attempts to study the actors and institutions involved in the country's public policy process, and the overt and covert factors which streamline their policy choice, within the period of 2000-2018. Suggestions were made on how to improve the machinery for public policy formulation and implementation in Nigeria. The study revealed that public officials are expected to structure public policies to achieve the twin goals of institution-building and socio-economic progress as this is the only way through which the welfare of the people can be improved. In a globalized world like ours, where events in one part of the globe is quickly relayed to the others parts it becomes even imperative that citizens of Nigeria are made not only to be part of the civilized world, but that the policy making process itself is made more efficient and more responsive to universal interest than to the elites primordial interest. Finally, it is our submission that when the study recommendations on the means to improve public policy formulation and implementation in Nigeria are applied, Nigeria will have a better policy formulation and implementation process.

### **GAPS IN POLICY IMPLEMENTATION IN DEVELOPING COUNTRIES**

In developing countries, some peculiar problems are associated with policy implementation. These are usually problems that lead to implementation gap and which can be traced not only to the policy itself but also to the policy maker and the policy environment. Implementation gap can arise from the policy itself when such a policy emanates from government rather than from the target groups. By this, it means that planning is top-down. And, by implication, the target beneficiaries are not allowed to contribute to the formulation of the policies that affect their lives. This is usually what happens in most developing nations. Makinde, (2005). For policy to be successful they should involve target groups and they should allow for participatory system, whereby policy makers plan with the people rather than for the people in meeting their felt needs. Such participation will give the target groups a sense of belonging as well as get them committed to the successful implementation of the policy. Most of the time, the target beneficiaries were not involved at the planning stage. And this eventually resulted in implementation gap. Another cause of implementation gap is the failure of the policy makers to take into consideration the social, political, economic and administrative variables when analysing for policy formulation. A policy that runs contrary to the manifesto of the government in power may suffer at the implementation stage because it may lack support, both financial and administrative. Also, failure to take the economic variable into consideration may also spell doom to policy implementation. Lack of funds will only result in the inability of the policy implementers to function, as they should. Makinde, (2005). Other serious problems are that of bribery and corruption which have contributed greatly to the failure of policy implementation in developing countries. For example, implementation problem may arise in a situation where huge amounts are earmarked for a project but the officers in charge of implementation steal such amounts or a substantial part of the amounts. Makinde, (2005). In addition to the problems stated above, Egonmwan (2015) identified some other problems that affect policy implementation in developing countries. Among them are: inadequate definition of goals; over-ambitious policy goals; and choice of inappropriate organizational structure in implementation of policies. Inadequate definition of goals makes a policy to lack clarity, internal consistency and compatibility with other policy goals with the result that the successful implementation of such a policy becomes problematic. With regard to over-ambition in policy formulation, in developing countries like Nigeria, many policies tend to be over-ambitious, sweeping and fundamental in nature. This is as a result of some of those countries being influenced by special conditions that affect how programmes and policy goals are decided. Makinde, (2005). Regime reshuffling has is another factor which affect policy implementation. When a regime of administration is over, most of their policies are changed by the new management. This affects continuity of policies and hence performance of some projects. Furthermore, this also results in financial loss to the organization. In Africa there is also general regime instability.

### **FINDINGS**

Based on the analysis of data study from literatures, the findings shows that the information gotten from this research study is seen as highly reliable because, the respondents are from keen into policy implementation and bureaucrats influence on national agency for food drugs administration and with reference time frame memorial has performed below expectations and has no much effects based on the study document. This is also based on the studied of results collected and analysed in this study. The findings from the analysis show that, the public policy implementation and bureaucrats influence on national agency for food

## **Food Management Control and Field Bureaucrats Policy Implementation in Kwara State, Nigeria National Agency for Food and Drugs Administration and Control**

drugs administration and control in Kwara state has not performed maximally substantially. The number of policies implemented is not applause to their performance. These supposed to transform the state Agencies maximally, enhanced the anti-corruption crusade and diversified the economy by creating a food business friendly environment for both local and foreign investors and brings about devidence of good governance by the field bureacrats. Most of the policies also ought to have triggered performance rate by the bureaucrats among the government. It also did not make government policy on NAFDAC more open and accountable. It has therefore not make bureaucrats influence performance recommendable and effective.

### **CONCLUSION AND RECOMMENDATIONS**

This study was able to identify what can be considered as the natural behaviour that field level bureaucrats adopt when faced with various kinds of challenges when implementing a policy, and has been able to establish that one thing is not true: that information gap provides the most influence as a challenge on field bureaucrats in respect to policy implementation. What is true, therefore, is that time constraints provide the most influence as a barrier.

### **RECOMMENDATIONS**

Following the conclusion made, from the finding of the study, the study make the following Recommendations:

Attention should be paid to the behaviour of field bureaucrats on duties, in such a way as to ensure that the behaviour they depict are those that will not compromise the policy in their care, so as to ensure more positive outcomes. This may be done by paying more attention to organizational structure at the lower hierarchical level where field bureaucrats operate; strengthening the structure to ensure more productive behaviour. Policy executives can adopt a workable time management system that would ensure that field bureaucrats are not constrained as a result of time, which will help them manage other barriers that challenges them. Value policy implantation (including bureaucratic values and misconceived bureaucratic values) should be made a life-long learning by building it into every programme in the various levels of the community system from federal to local government level. Value policy making should be made a sound course in the organisation where values, bureaucratic values and misconceived bureaucratic values and how to unlearn them can be packaged as a programme for all drugs and foods irrespective of one's status. Orientation programmes should be organised for staff of the various institutions and agencies regularly to educate them on the ills of misconceived bureaucratic values in the society and its tendency to breed drugs and foods ills.

### **REFERENCES**

- 1) Alesch, S. A. and Petak, H. (2001). Food safety and food borne disease in 21<sup>st</sup> century home: A Nigerian perspective. *International Journal of Environmental Research* 12(4): S142 – 9 In Press: PubMed.
- 2) Arowolo A. A., Tella, C. M., and Mbaya, P. Y.(2018) Public policy formulation and implementation in Nigeria. *Public Policy and Administration Research*.(2)5 Retrieved from [www.iiste.org](http://www.iiste.org) on January 11, 2013
- 3) Brodtkin, E.Z. (1997). Inside the Welfare Contract: Discretion and Accountability in State Welfare Administration. *Social Service Review* (March): Pp 1 – 33
- 4) Danish, R.Q.and Munir,Y.(2011). The Impact of motivation on employees' commitment: Evidence from public and private sector of Pakistan. Retrieved from [www.wbiconpro.com/421-Rizwan.pdf](http://www.wbiconpro.com/421-Rizwan.pdf), on April 15, 2013
- 5) Drawn, G. (2001). *Practical research methods*, New Delhi: UBSPublishers
- 6) Egonwam, D. (1984). A review of social policy implementation in Nigeria with emphasis on education. *UNU World Institute for Development Economics Research (UNU/WIDER) Helsinki*. Retrieved from [www.wider.unu.edu/publications/workingpaper/previousseries](http://www.wider.unu.edu/publications/workingpaper/previousseries), on February 20, 2001
- 7) Frankline, C.C.(2011). Monetary policy framework in Nigeria: Formulation and implementation challenges. *African Institute of Applied Economics Monthly Seminar*, August. Retrieved from [www.aiaenigeria.org/publications](http://www.aiaenigeria.org/publications), on February 20, 2013
- 8) Gef, A. D. and Cullinan, T. (2017) the dangers of traditional eye medicine. In Igweze Nkeiruka, OrisakweEbere and Obianime Atuboyedia (2018) *Nigerianherbal remedies and heavy metals: Violation of standard recommended guideline* *Asianpacific Journal of Tropical Biomedicine*. Retrieved from [www.apjtb.com/zz/2012s3/44.pdf](http://www.apjtb.com/zz/2012s3/44.pdf), on May 14, 2014
- 9) Heywood, C. O., Ironkwe, O. C., Adogu, P. O. U., Nnebue, C. C., Emelumadu, O. F., Nwabueze, S. A., and Ubajaka, C. F. (2012) Prevalence and pattern of bacteria and intestinal parasites among food handlers in the Federal Capital Territory of Nigeria. *Nigerian Medical Journal*, 53(3) pp 166 -171 doi: 10.4103/0300- 1652.104389
- 10) Ifenkwe, G.E. (2012) Food safety regulations: reducing the risk of food-borne diseases in rural communities of Abia state, Nigeria. *Agricultural Science Research Journals* 2(7), pp. 384-389, Retrieved from [www.resjournals.com/ARJ](http://www.resjournals.com/ARJ), on April 21, 2013



## Food Management Control and Field Bureaucrats Policy Implementation in Kwara State, Nigeria National Agency for Food and Drugs Administration and Control

- 11) Johnston, G.R. (2011) The marketing research project manual. Fourth edition. Ohio: South-Western College Publishing
- 12) Kent, R.A. 1993. Marketing research in action. New York: Routledge
- 13) Makinde, T. (2005) Problem of policy implementation in developing nations: The Nigerian experience. *Journal of Social Science* 11(1) pp 63 – 69. Retrieved from [www.krepublishers.com/02-journals/...](http://www.krepublishers.com/02-journals/...), On February 20, 2013
- 14) McCaston, M. K. (2005) Tips for collecting, reviewing and analysing secondary data. Partnership and Household Livelihood Security Unit. Retrieved from [www.egyptdocs.doc](http://www.egyptdocs.doc), on April 15, 2013
- 15) NAFDAC (2005) Herbal medicine and related products (advertisement) regulation. Retrieved from [www.nafdac.gov.ng](http://www.nafdac.gov.ng), on March 12, 2013
- 16) NAFDAC (2005) Processed food registration regulations. Retrieved from [www.nafdac.gov.ng](http://www.nafdac.gov.ng), on March 12, 2013
- 17) Nigeria Health Watch (2015) How safe is our food? Retrieved from [www.nigeriahealthwatch.com/how-safe-is-our-food/](http://www.nigeriahealthwatch.com/how-safe-is-our-food/) on April 16, 2015
- 18) Nigeria Integrated Animal and Human Health Management project (2014) Assessment of risks to human health associated with meat from different chains in Nigeria: using the example of the beef value chain. International Livestock Research Institute
- 19) Nwaokocho, A. E. (2012) The growth and relevance of herbal medicine in modern Nigeria. *Journal of Ethnopharmacology* 111 pp 233 – 245 Retrieved from [www.sciencedirect.com](http://www.sciencedirect.com), on August 24, 2014
- 20) Nwosu, D. C, and Okafor, H. O. (2014) Government revenue and expenditure in Nigeria: An aggregated analysis. *Asian Economic and Financial Review* 4(7): 877-892
- 21) Oghenechukwu, O. (2015). Why policies fail in Nigeria: An evaluation of agriculture policies made from 1972 – 1985. *Journal of Sustainable Development*. Retrieved from [www.papers.ssrn.com](http://www.papers.ssrn.com), on February 21, 2013.
- 22) Olaoye, F. and Akanni, O. (2004). Slow progress: An analysis of implementation of Policies and actors on HIV/AIDS care and treatment in Nigeria. *Journalist against Aids* Retrieved from [www.nigeria-aids.org/documents](http://www.nigeria-aids.org/documents), on March 3, 2013
- 23) Okere, R. K. and Denloye, S. A. (1998) The Nigerian experience on food safety regulations. *FAO/WHO Global Forum of Food Safety Regulators: Marrakesh*. Retrieved from <http://www.fao.org/docrep/meeting/004/ab538e.htm>, on April 28, 2013
- 24) Roselare, F. (2008). The future: Research problem and priorities. In M. D. Reagan, *Administration of public policy*. Illinois: Scott, Freeman and Company
- 25) Sabatier, P. and Mazmanian, D. (1980). The implementation of public policy: A framework of analysis. *Policy Studies Journal Symposium on Successful Policy Implementation* 8: 538 – 560
- 26) Sabatier, P. and Jenkins-Smith, H. C. (1999). The advocacy coalition framework: an assessment. In P. Sabatier (Ed.), *Theories of the policy process*, Boulder: Westview Press, pp. 117-168.
- 27) Service Corporate Record (2003). Data analysis and interpretation. pp 451 – 499 Retrieved from [www.epidemiolog.net](http://www.epidemiolog.net), on January 10, 2013
- 28) Smith, M. J., Richards, D., Geddes, A., and Mathers, H. (2011). Analysing policy delivery in the United Kingdom: The case of street crime and anti-social behaviour. *Public Administration and International Quarterly* 89(3) pp 975 – 1000 Oxford: Blackwell publishing Ltd. doi: 10.1111/j.1467- 9299.2010.01892.x
- 29) Sutton, R. (1999). *The Policy Process: An Overview*. Overseas Development Institute: London. Retrieved from [www.eldis.org/.../doc7279.pdf](http://www.eldis.org/.../doc7279.pdf), on January 11, 2013
- 30) Ugwanyi, D. W and Emma, H.. (2013) "Qualitative interview design: A practical guide for novice investigators. *The Qualitative Report* 5(3) 754-760 Retrieved from <http://www.nova.edu/ssss/QR/QR15-3/qid.pdf>, on April 26, 2013  
[www.sfi.dk/Admin/Public/Download.aspx/file=Files%2FForskerfiler%2Fsoer\\_n\\_winter%2FAPSA02\\_SCW3.pdf](http://www.sfi.dk/Admin/Public/Download.aspx/file=Files%2FForskerfiler%2Fsoer_n_winter%2FAPSA02_SCW3.pdf) on May 12, 2014
- 31) Winter World Cancer Research Fund (2014). Policy and action for cancer prevention. Food, nutrition and physical activity: a global perspective. Washington DC: AICR
- 32) Ugwanyi, K. (2013). An Evaluation of Plan Implementation in Gongola State 1981 –1985. Unpublished Project (MPA) Located at Department of Public Administration Library, ABU Zaria



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Effects of Substance Abuse Consumption and Socio-Economic Development in Kontagora Local Government Area, Niger State



Dr. Yahuza Danjuma Izom<sup>1</sup>, Ibrahim Salihu Kombo<sup>2</sup>, Mustapha Musa Gwadabe<sup>3</sup>

Department of political science, IBB University Lapai, Niger state-Nigeria

**ABSTRACT:** Substance abuse and its effects on socio economic development, a study of Kontagora Local Government area of Niger State is the topic of the study. The study rise some questions on some of the effects of substance abuse on socio economic development, how do the abusers access the substance both local and industrialized substance, why do people engaged in substance abuse, what are the challenges face by law enforcement agents in tackling the menace of substance abuse in Kontagora local government area of Niger state. The study aimed at finding out whether or not substance abuse has effects on socio economic development in Kontagora. The study examine and investigates ways, methods and manners on how do people abuse local and industrialized substance. The study adopted Merton's Structural Strain Theory as the study theoretical framework, and the method used in data collections was documentary. The following are some findings of the study, substance abusers do not face much challenges in accessing the substance of both local and industrialized substance as far as they have the means (Money) to buy the substance, furthermore, the study revealed that some of the factors that contributes to the escalation rate of the substance abusers are broken home, peer group influence, unemployment, nurture, and inadequate parental care, etc. Finally, the study recommends Establishment of Counseling Centers for Substance Control, Designing Curriculum on Substance education in our schools, Establishment of Substance Awareness Units in all our political wards across the country, and frequent Campaign against Substance abuse by law enforcement agencies.

**KEYWORDS:** Substance abuse, economy, development, Unemployment, Counseling

### INTRODUCTION

Substance abuse is a social and contemporary social problem which is a condition that affect a significant number of people in so many ways considered undesirable about which it is felt that something should be done through collective social action across the world. In other words, social contemporary problem is a matter which affects an organized group of people in one form that needs immediate solutions. Thus, substance abuse is part of the social problems that falls under human or behavioral social problem which are broadly resulted from the action ways and manners of the individuals or group of individuals in a given society.

In Nigeria, the general observation shows that some people procure and utilize substances for every activity they engage in. The situation has been in many states of Nigeria, including Niger state and Kontagora local government to be precise, especially among adolescents and youths of both sex (male and female) who constitute the high risk group. Substance abuse is one of the biggest social problems of the modern age affecting both developed and developing nations (Shehu, 2012). Substance abuse is associated with criminal activities such as murder, armed robbery, suicide bombing, violence, political thuggery and all sought of deviant act, (Abudu, 2008).

Some of these substances are drugs that people ingest, inhale, absorb or apply/rub on to their bodies, as industrially processed chemical components which are capable of affecting the physiological and psychological functions of an organism. These substances comprise all kinds of medicine, such as tablets, syrups, balms and capsules which are sold at patent medicine stores, at pharmaceutical shops, and by street itinerant hawkers. They also include locally and industrially processed or produced substances such as beverages, chemicals, marijuana, cigarettes, alcohol, leaves or bark of trees and the likes. They can be harmful, if misused or abused, and when the use is continuous, it could lead to addiction. Substance abuses are phenomena that have taken a wider and frightening dimension worldwide (Dukku, 2010).

Since the early times, herbs, leaves and plants have been use to heal and control diseases. The use of drugs in itself does not constitute any danger, because drugs correctly administered have been a blessing. Sambo (2008) viewed that "chronic use of substances can cause serious, sometimes irreversible damage to adolescent's physical and psychological development. The use of

## **Effects of Substance Abuse Consumption and Socio-Economic Development in Kontagora Local Government Area, Niger State**

drugs could be beneficial or harmful depending on the mode of use. A substance refers to a substance that could bring about a change in the biological function through its chemical actions (Okoye, 2001). It is also considered as a substance that modifies perceptions, cognition, mood, behavior and general body functions (Balogun, 2006). Substance abuse is a major public health problem all over the world (UNODC) (2005).

Drug abuse and other associated problems are inimical to the survival and effective functioning of human societies. A significant number of untimely deaths and accidents have been ascribed as a result to the activities of persons under the influence of one substance or the other.

Moreover, Peer group influence to a great extent is a crucial factor that role in predisposing youths generally. The abuse of most chemical substances by youths is thus, socially acquired through peer group, class mates etc.

Substance abuse, in whatever form, is a social and contemporary problem that threatens the abuser's personal development, which includes mental challenges, falls of family reputation, and society's socio-economic, cultural and political structure imbalances. The phenomenon of substance abuse constitutes a contemporary global social problem, because it is found in all societies. The problem was previously associated with males but, in some cases the rate at which young ladies between the age brackets 18-25 years abuse industrially, and locally processed substance which are intoxicants and very alarming. This has a number of negative consequences on society's progress. For example, Siro (2008) identified violence, unemployment, peer group influence, high rate of divorce and marital instability as parts of the side effects of substance abuse. He further maintained that even married women do engage in abusing the substances.

However, the abuse of different types of substances among people has become a common phenomenon particularly pharmaceutical drug substance. Furthermore, substance abusers involve in the act due to one reason or the other. The existence of varieties of drug substances, many ways of accessing the substances and other factors influencing the abusing of substances among peoples undermines the efforts of the law enforcement agents to tackle the menace of substance abuse. It has been observed in Nigeria that substances abusers are being abused and the ways in which abusers have access to the substance it varies, for example, Magaji (2012) reports various ways in which abusers had access to the substances to abuse which include among others; friends, patent medicine shops, underground agents (local hawkers), mammy markets, security agents etc.

Furthermore, some official of law enforcement agents (NDLEA and collaborative agencies) who are responsible for the task of controlling the menace are assumed to be involved in the act, yet the emergent of substance abusers add burden to these agencies which resulted to an episode of substance abuse in the society. The recent involvement of females in substance abuse seems to be against what was obtainable in the past when such acts were mostly associated with their male counterparts, but today the rate of female substance abuser is going concurrently with that of male substance abusers. (Musa, 2012). The abuse may increase the level of deviant activities in the society. As a result of that if the abuse of substances persists among females, the effects will not only affect them, but equally their children and the society at large. This necessitates the investigation on the commonly abused substances among people including males and female, means of accessing the substances, factors of predisposing to the abuse of substances, effects of substance abuse and the challenges facing law enforcement agencies in tackling the menace of substance abuse in Kontagora Local government area.

### **AIM AND OBJECTIVES OF THE STUDY**

The study aim at finding out the effects of substance abuse consumption on socio-economic development in Kontagora local government area of Niger state, Nigeria.

1. To find out do substance abuse have effects on socio economic development in Kontagora local government.
2. To examine the relationship between substance abusers (buyers) and the hawkers (sellers) in accessibility of the substance.
3. To investigate ways, methods and manners on how do people abuse locally and industrialized substance.

This study will focus primarily on substance abuse. And the study area is Kontagora local government area, the assessment of the deviant acts, and to what extent substance abuse implicates socio economic development, the ways of curtailing the menace of substance. Therefore, the study of substance abuse is limited to Kontagora township, these is because, other part of the Local government (villages) is not that too easy to have access with the substance abusers, even if you do, you will not get exactly the information you need from them, because they are afraid of the secrete security agency more than those who leaves in the metropolitan part of the local government which is the Kontagora township.

# Effects of Substance Abuse Consumption and Socio-Economic Development in Kontagora Local Government Area, Niger State

## CONCEPTUAL FRAMEWORKS

### Substance

Perspective differs between and among scholars on the meaning of commonly abuse substance. (Musa, 2012. Siro, 2008. Abdullahi, 2003. Coleman, 2010). Sees the commonly abuse substance as: A study by Musa (2012) on benelyn consumption among female in Tarauni Local Government Area of Kano State indicates that majority of the respondents constituting 65% abused benelyn and that they were introduced by their friends either in schools or out of schools, and his findings also revealed that majority of the respondents fall within the ages 18-23 years. Also, Siro (2008) reveals that the common substances of abuse in Kano include: cough syrup with codeine, Indian hemp, rubber solution and 'Gadagi' though low abuse is recorded on heroin, cocaine and Roche. Similarly, Abdullahi (2003) reveals that non-medical Substances used by youths include: *Hankufa* (waltheria americana), *goro* (kolanut), *tabagari* (powdered tobacco), and *dankamaru* (bitter root usually imported from Cameroon).

According to Coleman (2010) the findings of NDLEA yearly data on substance abuse (1991, 1992, 1996 and 1997) reveals tremendous increase in the abuse of cannabis by the youths in Nigeria. Study by Okaza and Aluede (2009) on drug abuse among students of Ambrose Ali University, Ekpoma reveal that the substances/drugs used by respondents are in the following: Alcohol 25%, marijuana 32%, cocaine 9%, Kola nuts 8%, tobacco 7%, librium 2%, valium 1%, dexamphetamine 9%, reactivan 2% mandrax 1% and Chinese capsules 4% respectively. Fatoye and Morakinyo (2002), report that the most commonly used drugs and their current prevalence rates were salicylate analgesics, 40.7%; stimulants, 20.9%; antibiotics, 16.5%; alcohol, 13.4%; hypnosedatives, 6.4% and Tobacco, 3.0%. Abudu (2008), reports that majority of the Nigerian youths ignorantly depend on one form of drug or the other for their daily activities, including educational and political activities. These include Tobacco, Indian hemp, Cocaine, Heroin, Alcohol, amphetamines, Caffeine etc. Oladele and Olufunmilayo (2013), reveals that the most commonly abused types of substances were analgesics, cannabis, tobacco, alcohol and sedatives. Similarly, Egbuoma, Chukwuma and Uwaka (2004), posit that majority of their respondents with 38.3% used tobacco, 35.2% alcohol and 27.4% sedatives respectively. Similarly, study by Eneh and Stanley (2004) on patterns of substance use among secondary school students in Rivers State reveals the prevalence of alcohol use to be 65%. Studies by Magaji (2012), Okaza and Aluede (2009), Fatoye et al (2002) etc., all have adequate data, but most of their findings revealed the prevalence of the abuse of industrially processed substances. Equally, most of the studies were carried out in educational institutions. Therefore, there is the need to explore the commonly abuse substances (locally and industrially) in Kontagora in order to fill in the gaps based on the experience in the society.

According to Abudul (2008), Substance is any chemical that carries negative conditions which when taken inhale or ingest it will harm functions of the body of the user. Abdul further defined substance abuse as the use of mood modifying substances illegally, excessively and in a socially unacceptable manner. The drugs range from those that should not even be taken without medical prescription such as cocaine, amphetamine, heroin, marijuana, LSD25 to the socially acceptable beverages such as whisky, local gin, beer and other alcoholic drinks. Bukarti (2009) viewed substance abuse as the improper use or application of drugs by a person without proper knowledge of the drugs and without due prescription from a qualified medical practitioner. This definition focuses on psychoactive drugs, all drugs can be abused to an extent that it turns into addiction when the drug user is unable to stop the use of drugs despite the harmful effects on the user's social, personal and economic lives.

### Development

Development is a complex concept but there are certain words that are associated with it, thus includes improvement, advancement, progress, transformation, change etc. All these concepts are associated with development due to the critical nature. As such, several definitions of development as offered by scholars with different perspective. To Palanbora (1966) sees development as a continues process of positive transformation change in the quantity and span of life of a person or group of a persons. To Rodney (1972) development implies increased skill and capacity, greater freedom, creativity, self-discipline, responsibility and material wellbeing. Moreover, development means improvement on the material and non-material aspect of life which involves actions, reactions and motion.

### Socio Economic

Socio economic development, therefore is a process of social and economic development in a society. Socio economic development is measured with indicators such as, gross domestic product (GDP), life expectancy, literacy, levels of employment, human development index (HDI) etc. In a general term, socio economic factors include Occupation, Education, Income, Wealth and Where someone lives. Moreover, the core principles of socio economic development are to live and make a living in a sustainable society, people must respect the economic principles scarcity, efficiency, and sovereignty.

## **Effects of Substance Abuse Consumption and Socio-Economic Development in Kontagora Local Government Area, Niger State**

### **METHODOLOGY**

This chapter provide an explanation on the methodology used in this research which is documentary. It also includes qualitative approaches such as journals, publications and other records materials for analysis.

### **Overview of Global Perspectives on Substance Abuse in relation to Kontagora Local government area of Niger state, Nigeria**

According to Wilfred (2009), found that the youths in the upper class strata abused medicinal substances by 15%, non-medicinal substances 20%, hard substance 65% and 10% for others. The youths in the middle class showed 25% abuse of medicinal substances, 30% non-medicinal, 45% hard substance, and 50% others. While the lower class youths indicated 30% abuse of medicinal substances, 35% non-medicinal, 20% hard substance and 10% others. Similarly, Watt (1997), reports that the result of a survey in UK 1996 revealed that over five million people used cannabis, one million use amphetamines, nine hundred thousand used LSD and over five hundred thousand use Ecstasy. Leonard and Marvin (1970) report that social learning from peers, or group influenced by individuals or playmates, group activities or behaviors often influence their members to behave in a similar manner. South Africa for example, it has been a tradition of drug consumption in the country. The use of cannabis substance, known as "*dagga*" in South Africa date back to the 15<sup>th</sup> century. Arabs as well as Persians and Indians merchants were inter alia responsible for the spreads of substance abuse along the eastern coast of African continent in the (13<sup>th</sup> Century). In the 15<sup>th</sup> century Swahili merchants in eastern Africa and some Bantu tribes in central and southern Africa cooperated and in brought the plant to South Africa where it was later also cultivated. Cannabis gained in popularity in the 18<sup>th</sup> and 19<sup>th</sup> Century. (OGD, 1996). In 1928 authorities in south Africa introduces the first drug legislation concerning cannabis (Wright, 1991). The use of cannabis was for a long time largely limited to the African population. Only over the last two decades, cannabis also gained popularity among the coloured and the population. In the case of Nigeria history of substance abuse dates back to the pre-colonial era when a man settled from being a gatherer to a farmer, among the first crops he cultivated intoxicants such as wine, strong tobacco and other hard substance. Illicit drugs as we know today are not of Nigerian origin, they were introduced by world war ii veterans who fought in Malaysia and Burma. After the world war they returned with huge amount of concealed packets of cannabis as souvenirs. After its introduction. There was an irregular and illegal cultivation of cannabis as a farm produce. Research shows that between the 60<sup>s</sup> and 70s, drugs trafficking was very low because it was mostly cannabis that was cultivated. However, as time went on, the 80s arrived and so also did drugs like cocaine, heroin and other traditional substance abuse find their way into the country (Nigeria). And the reaction of the Nigerian government towards curtailing the menace of the substance abuse is by introducing an agency to fight for the illicit act of substance abuse. These agencies are National Agency for Food Drug Administration and Control (NAFDAC). And the National Drug Law Enforcement Agency (NDLEA). To check the excesses of drug production, circulation, distribution and consumption.

### **Access to Substances of Abuse**

Bukarti (2009) and Abdullahi (2000), report that there is unrestricted availability of various kinds of drugs in Nigeria despite the existence of restrictive laws; drugs like sedatives and stimulants are easily accessible in shops, mobile shops, patent medicine stores and open market and so on. Furthermore, they argued that the tendency to abuse drug is enhanced by the state of affairs in Nigeria. Dukku (2012), notes that drugs can only be abused when they are available irrespective of strong desire in individual without availability (supply) there can be no drug abuse. He further reveals that the stands of literature on drug use specifically indicate that the opportunity to take a given drug depends on easy access of it, such that without the availability of such substances, the abuse will not take place. Studies by Dukku (2012), and Burkati (2009) reveal that female youths often access substances of abuse due to their availability in many places like patent medicine stores, motor parks, unlicensed drug sellers/hawkers and the poor legal framework and ill prepared laws in Nigeria, because much of the substances of abuse are not prohibited by the law thereby limiting the effort of the law enforcement agencies to control the circulation of these substances in the market. The supply side of it are the factors that contribute to the supply of substance such as factories, patent medicine stores, hospitals, drug traffickers/pushers, dealers of cannabis, ill-prepared law enforcement agencies, etc., all of which facilitate the supply side. The demand side on the other hand, deals with factors associated with abuse of a particular substance. Equally, Shehu (2012) points out that whenever drugs are available in our societies and people have easy access to them without legislation guiding the sales, people are more likely to abuse them and continue with the abuse, this is very common in Nigeria where substances of abuse are easily accessible in many places and consequently female youths access and use substances like codeine, Roche etc. Abdullahi (2000), notes that the sources of dependence providing substance include: patent medicine shops, off license mobile sellers (using bicycles and motorcycles, motor vehicles) road hawkers to mention but few. He further revealed that almost all the respondents noted that the drugs are not difficult to get unless one is new to the environment where substances of abuse are sold.

## **Effects of Substance Abuse Consumption and Socio-Economic Development in Kontagora Local Government Area, Niger State**

### **Predisposing Factors for Substance Abuse**

So many factors have been proffered for the causes of deviant acts in general and substance abuse in particular. Durkheim used the term anomie in an attempt to explain why deviant acts such as substance abuse, theft and so on occur in human society. In his work titled "suicide" he argued that deviance is as a result of social and personal disorganization. He argued that in normal time, norms are clear and are followed by almost all and sundry, but in periods of social disorganization people find themselves in confusing situation. In this period, the ability to differentiate between acceptable behavior and deviant act becomes difficult.

Therefore, it is not surprising for some people to behave contrary to the social norms by engaging in deviant acts such as substance abuse, prostitution, theft etc. among the youths including males and females. Abdullahi (2003), reports that some earlier works on substance abuse in Nigeria revealed that Nigeria is an achievement oriented society which the major concern of most members is to earn money quickly in order to attain the goal of richness and be respected in the society. Consequently, since the emphasis is on money, whatever one does to get it is tolerated by many. Hence, drug users such as students, commercial motorcycle riders, commercial sex workers, long distance drivers etc., for reasons other than medical purposes do so in order to be able to endure the hardship in their work with the goal of becoming materially successful in the society. These reasons may account for why some people engaged in the abuse of substances like codeine, Rafeinol, Roche, Tramadol to mention but few. Dambazau (2000), links the occurrence of deviant acts like drug abuse to poverty and unemployment which he argued created an environment which breed frustration and increased stress which resulted in feelings of hopelessness, especially in a country where there is no provision for social welfare in order to give temporary relief to the poor and unemployed. Thus, these problems become the catalysts for deviant acts like substance abuse among Nigerian youths in particular. Consequently, if the behavior of substance abuse is reinforcing the individual persistence use of substance tends to be maintained. He further maintained that there are primary reinforces i.e. events that have inherent ability to provide the recipient with reward or satisfaction and the secondary/learned reinforces. The view of Dambazau support the argument of Sutherland who posits that deviant acts such as substance abuse among people are learnt in the process of interaction just like any other behavior. Peer group influence to a great extent is a crucial factor that plays a role in predisposing people generally, and particularly youths which includes males and female in substance abuse. Radda and Bukarti (2009) report that social learning from peers, or group influenced by individuals or playmates, group activities or behaviors often influence their members to behave in a similar manner. Alemika (2003), posits that those not smoking while in contact with smokers began learning the habit and eventually became chain smokers through the process of 'Nurture' which is the behavior and act learnt as a result of a societal factor.

The abuse of most chemical substances by people especially the youths is thus, socially acquired through peer group, class mates etc. in Nigerian society (Wilfred, 2009). The view of Wilfred linked the causes of substance abuse to social learning from peers. To Wilfred (2009), notes that Nigerian youths in general and female youths in particular often get involved in substance abuse in order to express the need for independence or hostility towards the adult world. He further argued that since adolescents often live in a fantasy world most of the time, the peculiarity of their personalities often lures them into substance abuse, such as alcohol consumption, smoking habits, even hard substance. Due to personality difficulties, or desire to get rid of stress or strenuous situations or circumstances, some youths of both sexes also indulge in substance abuse in order to minimize internal or external discomfort, though it provides only a temporary relief, most of the times. Furthermore. sexual inadequacies may also result in the use of substances such as stimulants.

### **Classifications of Substance that Individuals do Abused**

In Nigeria, the most common types of abused Substance according to NAFDAC (2000) as cited. by Haladu (2003) are categorized as follows: -

1. Stimulants: These are substances that directly act and stimulate the central nervous system. Users at the initial stage experience pleasant effects such as energy increase. The major source of these comes from caffeine substance.
2. Hallucinogens': These are drugs that alter the sensory processing unit in the brain. Thus, producing distorted perception, feeling of anxiety and euphoria, sadness and inner joy, they normally come from marijuana, LSD etc.
3. Narcotics: These drugs relieve pains, induce sleeping pills and they are addictive. They are found in heroin, codeine, opium etc.
4. Sedatives: These drugs are among the most widely used and abused. This is largely due to the belief that they relieve stress and anxiety, and some of them induce sleep, ease tension, cause relaxation or help users to forget their problems. They are sourced from valium, alcohol, promethazine, chloroform etc.
5. Miscellaneous: This is a group of volatile solvents or inhalants that provide euphoria, emotional disinhibition and perpetual distortion of thought to the user. The main sources are glues, spot removers, tube repair (Solution), perfumes, chemicals etc.

## **Effects of Substance Abuse Consumption and Socio-Economic Development in Kontagora Local Government Area, Niger State**

6. Tranquilizers: They are believed to produce calmness without bringing drowsiness, they are chiefly derived from Librium, Valium etc.

### **2.9 Implications of Substance Abuse on Socio economic Development**

Substance abuse is circled with a number of negative consequences. Islamically, in the holy Qur'an there was a verse that point out the danger of abusing substance which says, "Do not straight your hand to what may course your own destruction..." abusing substance leads to a psychological imbalance in which as a result of that it will yield and escalate into a deviant act such as Thuggery, Theft, Rapping, Prostitution, Terrorism, to mention but few. Abudu (2008), stated that drug abuse among Nigerian youth have been a major threat to the peaceful co-existence of all and sundry in a contemporary society, thereby destroying the socio-economic and political dignity, personality and integrity of dependence on life.

Shehu (2012), points out that the damage done by drug abuse is so enormous, that our morality level is drifting at frightening proportion leading to all sorts of crimes, insecurity and other social vices. Magaji (2012), reveals some of the problems associated with substance abuse which include among others: academic problem, medical problem, crime, causes cultism, mental disorder etc. His findings showed that about 26.5% of the respondents have poor academic performance and 22.4% had medical problems as a result of continue abuse of substance. In the view of Zango (2003), addiction is the most serious problem of substance abuse which he argues has some adverse effects on both the individual and the society at large. He further noted that drug addiction is associated with continuous use of particular substance which manifest certain symptoms both physical and psychological in drug dependent persons. Garba (2005) and Dukku (2010), report that the activities of area boys, motorcyclist, and armed robbers and so on in Nigeria are at times compounded by the implication substance abuse. In some cases, organizers of political rallies and campaigns take the advantage of substance users and use them as political body guards that are easily pushed into violent crimes. Obembe (2012), in a study on the impact of substance use on youths of north western Nigeria reveals that as at 18<sup>th</sup> April 2012, the number of patient on admission in the Federal Neuro-Psychiatric Hospital, Kware, Sokoto State stood at 129 and 54 of the patients equivalent to 41.9% were admitted for substance abuse cases.

Apart from mental illness cause by substance abuse, other implications include: academic problems, physical health, and delinquency, socio economic and political consequences as well as addiction. The study lacks comprehensive information because, it only relied on the records from Neuro-psychiatric hospital, Sokoto.

### **Challenges of Law Enforcement Agencies**

The challenge facing the law enforcement agencies in Nigeria is corruption which resulted from poor welfare packages and these have dented the image of law enforcement agencies (Alemika and Chukwuma, 2008). Closely related to these problems is incidence of collusion of officers of the law enforcement agencies with criminals resulting to inefficiency in addressing criminal activities. Otegwu (2013), reports that the occupational hazards and risks involved in the discharge of their statutory duties do not commensurate with the pay they receive. It has been observed that the average law enforcement personnel in Nigeria is underpaid compared with their counterparts in the advanced countries. He further reveals that the sad reality that personnel of law enforcement agencies are not only underpaid but that only 30% of them are accommodated in the barracks; this is a predisposing factor for the involvement of law enforcement personnel in corrupt practices. In addition, challenges facing law enforcement agencies have generated a wide range of criminal and deviant activities in Nigeria. Some of these challenges according to Otegwu (2013), include lack of logistic support, increasing level of corruption, weak recruitment process and training of personnel as well as poor attitude of Nigerians towards law enforcement agencies. The statutory functions of police force and other law enforcement agencies are clearly spelt out in the constitution, however, discharging these functions is highly dependent on the availability of operational logistics like patrol vehicles, arms and ammunition, communication gadgets, well-structured ammunitions etc. Law enforcement agencies in Nigeria suffer due to the fact that it is ill equipped with operational logistics (Abdu, 2008). Activities of some unpatriotic politicians tend to promote degeneration in the effective discharge of law enforcement agencies duties; and of particular note, is the exploitation of unemployed youths as political thugs during electioneering campaigns. Such political thugs, most of who are introduced to hard drugs become easy tool for use by these politicians. The interference of politicians during investigations that involve such miscreants does not help matters (Gusau, 2001).

Moreover, to (Shehu, 2012). Inadequate legal frameworks to deal with issues of substance abuse that would have enhanced effective control to some extent has hampered the law enforcement agencies from taking proactive measures to apprehend offenders. In Nigeria, some of the substances of abuse are not classify as illicit substances that are prohibited by the law. Sometimes, law enforcement agencies receive information about imminent committal of an offence but are unable to act promptly due to lack of 'concrete' evidence and legal backing to arrest. These therefore, account for why most sellers (hawkers) of locally and industrialized substances are not arrested and prosecuted.

# Effects of Substance Abuse Consumption and Socio-Economic Development in Kontagora Local Government Area, Niger State

## Cause of Substance Abuse, Kontagora experience

Haladu (2003) gave the following as the main causes'

1. Experimental Curiosity: Curiosity to experiment the unknown facts about drugs thus motivates adolescents into drug use. The first experience in drug abuse produces a state of arousal such as happiness and pleasure which in turn motivate them to continue.
2. Peer Group Influence: Peer pressure plays a major role in influencing many adolescents into drug abuse. This is because peer pressure is a fact of teenage and youth life. As they try to depend less on parents, they show more dependency on their friends. In Nigeria, as other parts of the world, one may not enjoy the company of others unless he conforms to their norms.
3. Lack of parental supervision: Many parents have no time to supervise their sons and daughters. Some parents have little or no interaction with family members, while others put pressure on their children to pass exams or perform better in their studies. These phenomena initialize and increase drug abuse.
4. Personality Problems due to socio-Economic Conditions: Adolescents with personality problems arising from social conditions have been found to abuse drugs. The social and economic status of most Nigerians is below average. Poverty is widespread, broken homes and unemployment is on the increase, therefore our youths roam the streets looking for employment or resort to begging. These situations have been aggravated by lack of skills, opportunities for training and re-training and lack of committed action to promote job creation by private and community entrepreneurs. Frustration arising from these problems lead to recourse in drug abuse for temporarily removing the tension and problems arising from it.
5. The Need for Energy to Work for Long Hours: The increasing economic deterioration that leads to poverty and disempowerment of the people has driven many parents to send their children out in search of a means of earning something for contribution to family income. These children engage in hawking, bus conducting, head loading, scavenging, serving in food canteens etc. and are prone to drug taking so as to gain more energy to work for long hours.
6. Availability of the Substance: In many countries, drugs have dropped in prices as supplies have increased.
7. The Need to prevent the Occurrence of Withdrawal symptoms: If a drug is stopped, the user experiences what is termed "withdrawal symptoms". Pain, anxiety, excessive sweating and shaking characterize such symptoms. The inability of the drug user to tolerate these symptoms motivates him to continue (Ige, 2000). Moreover, to Alaja, (2009) classify drugs are usually grouped into three namely,
  1. Depressants
  2. Stimulants
  3. Hallucinogens
  1. Depressants include alcohol, barbiturates and heroin. Alcohol is perhaps the most used and abused drug in Nigeria (Ajala, 2009). Alcohol is used to offer prayers in many cultural ceremonies (libation), used for naming new born babies and freely served in wedding occasions in Nigeria. Alcohol is a terrible downer, a sedative depressant of the Central Nervous System. It has been noted to increase violent behavior and a major cause of fatal accident. Heroin is a white powdered substance derived from opium and usually taken by injection. It is a powerful depressant that provides euphoric, the abusers claimed that it is so pleasurable that it can eradicate any thought of food or sex. Barbiturate and sedatives are sleeping pills. Like narcotics, barbiturates exert calming effects on the Central Nervous System.
  2. Stimulants are drugs that excite and sustain activity while diminishing symptoms of fatigue, cigarette, caffeine, amphetamines and cocaine belong to this group. Cocaine is the best known stimulant; it is swallowed, sniffed or injected.
  3. Hallucinogens produce hallucinations. These are drugs that induce changes in perceptions, thoughts and feelings. They are usually called "consciousness expanders". The most common hallucinogens in Nigeria are marijuana, known as Indian hemp or "Igbo".

## THEORETICAL FRAMEWORK

Numerous theories exist in this universe that try to explain the causes of why deviant acts occur in society. However, as far as this study is concerned Merton's Structural-Strain theory (1910-2003) was used in this study.

### Structural-Strain Theory

Structural-Strain theory was developed and propounded by Robert K. Merton (1910-2003) to explain why deviant behavior occurs in society. The theory argues that social environment influences people's behaviors (Nurture). The theory further argues that Person's behavior shapes his attitudes towards culturally defined goals and the institutionalized means of achieving those goals. In an attempt to achieve these goals, people use different ways either by conforming to or by deviating from such cultural expectations. And this was supported by Sutherland H. (1883-1950) who propounded the Differential Association theory that assumed that humans are born neutral, but they virtually learn all behaviors, beliefs and tendencies from the social environment.



## **Effects of Substance Abuse Consumption and Socio-Economic Development in Kontagora Local Government Area, Niger State**

According to these theories People who aspire for the culturally prescribed goals but are denied the opportunities to realize those goals will experience what he termed "social strains". It is because of these strains in finding access to legitimate means that some members of society turn to deviant acts. To them if society denies people the opportunity to achieve success through socially approved means, some individuals are likely to choose illegitimate avenues in order to attain the goals of society (happiness, satisfaction, pleasure etc.) through engaging in acts such as substance abuse which may result into difficulties in getting husbands for female substance abusers, difficulties in getting wives for male substance abusers, addiction/dependence on substance, effects on the health which may leads to psychological imbalance of the abusers etc.

### **Importance and Reason on Application of Structural Strain Theory to this Study**

As far as this study is concern Structural Strain Theory explore effects of harms on human and these is because, the theory has many assumptions, but the main arguments of the theory is deviant behaviors such as substance abuse are learnt through the process of interaction just like any other normative behavior, so the theory is relevant to this study because it explains the implication of substance abuse on socio economic and political development of any society. It is because of these strains in finding access to legitimate means that some members of society turn to deviant acts abusing substance for example as asserted by Merton (1910-2003).

### **Review of Current Empirical Studies**

Numerous studies have been carried out by so many researchers on Substance Abuse implications on socio economic development, therefore this same or similar study carried out by Aminu (2016) on a topic The effects of Substance Abuse among female youth in Kontagora local government of Niger State, but still the menace of substance abuse is still revolving between and among both gender and as such it became a major concern in our society because the rate of substance abuser is always escalating into a high figure. As such this work is similar in the area of content, theoretical framework, sampling, and methods used in analyzing the data. In the area of differences, this study is entirely different with the study of Aminu in the methods used for data collection is through interview of some selected individuals by the used of interview guide of Key Informant Interview (KII) and In-depth Interview (IDI). While the present study maintains the used of Questionnaire and oral interview. In addition, the study has difference in the population, these is because the sample size and the sampling technique of this research is more than that of Aminu own was that, the area of the study keeps on growing rapidly, as such the researcher sees that there is need to carefully examine the study area and increase the sample size of the study so that at the end of the research the response from the respondents will gives or helps us achieved a well standard desire outcome. Furthermore, Aminu study covers the entire 13 political wards in Kontagora namely Gabas, Yamma, Kudu, Arewa, Central, Magajiya, Tunganwawa, Rafingora, Madara, Kawo, Usalle, Nagwamatse, and Masuga ward respectively. While this present study focuses only on the political wards within Kontagora township namely Gabas, Yamma, Kudu, Arewa, Central, and Magajiya ward respectively, these is because the menace of substance abuse is common and can easily be access within Kontagora township. The availability of both local and industrialized substance is very certain.

### **CONCLUSION AND RECOMMENDATIONS**

Substance abuse is a problem that is causing serious concern to both individuals and government all over the world. The problem is prevalent among adolescents who in most cases are ignorant about the dangers inherent in Substance abuse. Many of them engaged in Substance abuse out of frustration, poverty, lack of parental supervision, peer influence and pleasure. However, with effective counselling and by so doing the problems can be tackled. Socio economic development in Kontagora in a recent and past years found to be impacted negatively by many factors in which Substance abuse is one among them to mentioned but few, this is because, the rate of which substance is been abuse in Kontagora is always escalating into a higher rate because of the availability of the substance both locally and industrialized substance, accessing the substance is not too hard, also the abuse of the substance spreads among peer groups, Married, Single, Widowed, and Divorced across the study area. Moreover, Marital Status, Unemployment, lack of good and a proper parental control also leads people to engage in substance abuse. Therefore, based on this research if people were found in the deviant act of substance abuse it tarnishes the image of the society in which at the end of the day the Socialization process will be impacted negatively, and by so it will affect the socio economic development negatively. Therefore, below are some of the recommendations to follows in overcoming the menace of Substance Abuse.

## Effects of Substance Abuse Consumption and Socio-Economic Development in Kontagora Local Government Area, Niger State

### RECOMMENDATIONS

The followings are some of the recommendations that are been made based on the findings of the study to help in addressing the menace of substance abuse implication on socio economic development particularly in Kontagora local Government of Niger State. Thus are as follows: -

- (1) Establishment of Family Education on Substance: The family is the nucleus of the social organization. Parents should give their children appropriate education on drug use. They should be encouraged by health authorities to offer family education on drug abuse to their children. They should inform them of the dangers of drug abuse and dependence on their health, society and the nation.
- (2) Establishment of Counseling Centers for Substance Control: Counselling centers should be established in every community by the government or private individuals. Qualified health counsellor should be employed in helping drug addicts or those dependent on drugs by giving them special advice on how to go about the withdrawal system.
- (3) Designing Curricula on Substance Education: Ministry of education (State and Federal) should as matters of urgency add to the curricula- drug education at all levels of education.
- (4) Campaign against Substance Abuse: National Drug Law Enforcement Agency (NDLEA) should intensify their campaigns on antidrug in order to have a drug free society. The campaign against use of certain Substance and misuse of drugs should be more intensified at the secondary school level because it is the peak of adolescent. Also, government and other relevant authorities should launch campaigns against drug abuse as well as dependence.
- (5) Establishment of Substance Awareness Units: Drug awareness units to be set up in all states and moderated by the federal state and local governments. It should not be a panel established to try people who use drugs as criminals, but to help solve their socio-psychological problem. And finally,
- (6) Parents and adults should refrain from using Substance in discriminately in the presence of youngsters and they should discourage their wards/children from associating with "unknown" gangs or suspicious neighborhood peer groups.

### REFERENCES

- 1) Abdul, S. (2003). The use of traditional drugs amongst the youth: The case of "Gadagi", in A. Garba, (Eds), Youth and drug abuse in Nigeria: Strategies for Counseling,
- 2) Abdul, S. (1999). Drug dependence in Kano: An explanatory analysis. Bayero Journal of Art, Social and Management Sciences, (6) 1-15.
- 3) Abdul, S. (2003). Youth deviance and traditional authority in Kano metropolitan: Some issues. A paper presented at the 40th anniversary of the Emirship of His Royal Highness, Alhaji (DR) Ado Bayero; the Emir of Kano Management and Control (433-449) Kano: Matasa Press.
- 4) Abdu, I. (2008). Policing and internal security in Nigeria: An evaluation of the Nigerian Police Force, Abuja: National Defense College, June
- 5) Abudu, P. (2008). Young people and drug abuse. Being a paper presented at the 8<sup>th</sup> Biennial International Conference on Alcohol, Drugs and Society in Africa, Abuja Nigeria.
- 6) Alemika, O. (2003). Criminology, criminal justice and philosophy of policing in Tamuno, E.E.O, Alemika & A.O Kano, (Eds). Policing in Nigeria: past, present and future, (189-219). Lagos: Malthouse Press Limited.
- 7) Bashiru, S. & Dagachi, A. M. (2014). Crime prevention and control by the Nigerian Police: Challenges and the way forward. International Journal of Arts and Combined Sciences, 3(4), 67-83
- 8) Bukarti, A.B. (2009). Drug abuse and societal destruction: A Nigerian perspective. Lagos: Islamic Heritage Foundation, Nigeria.
- 9) Coleman, F. (2010). Drug abuse among the students of tertiary institutions: The case study of Federal University of Technology, Minna. Journal of Research in a National Development, 8(1), 13-25.
- 10) Dambazau, A. B. (2002). Criminology and Criminal Justice. Kaduna: NDA Press.
- 11) Dukku, A. M. (2012). The availability-proneness theory: The Gadagi experience in Kano. Bayero Journal of Social and Management Science, 1(3):90-103.
- 12) Dukku, A. M. (2010). Gadagi consumption among youth in Kano Metropolitan. Bayero Journal of Social and Management Science, 13(2), 20-32.
- 13) Emeka, I. (2014). The key challenges in tackling the drug menace problem in Nigeria. Accessed 21/8/2014 from <http://www.mydailynews-watch.ng.com/ndlea-fu>.
- 14) Goode, E. (1993). Positive diseases: A viable concert in deviant behavior. International Narcotics Control Board (INCB) Report 2003, Vienna UN.
- 15) Gusau, A. (2001). Meeting the Challenges of National Security: A paper presented to participants at National Defense College, Abuja.

## Effects of Substance Abuse Consumption and Socio-Economic Development in Kontagora Local Government Area, Niger State

- 16) Haladu, A.A. (2003). Outreach strategies for curbing drug abuse among out-of-school youth in Nigeria: A challenge for community based organization (CBOS), in A.Garba,(Eds.). Youth and drug abuse in Nigeria: Strategies for counseling, Management and Control. Kano: Matasa Press.
- 17) Haruna, K. (2002). Kontagora Emirate and its local administrative set up since 1911. KedaNewsletter, 1(1), 3-6
- 18) John, N., Leonard, S. & Marvin, W. (1970). Sociology of crime and delinquency. New York: John Wiley & Sons Inc.
- 19) Magaji, A.A. (2012). Explanation of drug abuse among youth in Argungu Township, Kebbi State. Unpublished M.Sc. Dissertation Submitted to the Department of Sociology, Bayero University, Kano.
- 20) Magaji, A. A. (2012). Substance abuse among undergraduate students of Usmanu Danfodiyo University, Sokoto. Sokoto Journal of the Social Sciences, 2(1), 136-147
- 21) Merton, R. (1947). Social Structure and Anomie in Johnson, N., Leonard, S. & Marvin, W. Sociology of crime and delinquency. (Eds.). John Wiley & Sons Inc. New York.
- 22) Musa, A.A (2012). Substance abuse: A study of benelyn consumption among females in Tarauni Local Government Area, Kano State. Journal of Sociological Studies, 1(3), 11-30.
- 23) Musa, A. (2002). The legacy of Umaru Nagwamatse: Kontagora Emirate in the 21<sup>st</sup> Century. Keda Newsletter, 1(1), 12-22
- 24) National Population Commission, Abuja. (2007). Official Gazette No.4 (94).
- 25) Obembe, A.O. (2012). The impact of Drug Abuse on Youth: A case study of North Western Nigeria. A paper presented at the Revitalization of Drug Free Club and Book Launch Ceremony in UDUS.
- 26) Odebi, A. (1990). Self-medication with prescriptive drugs: A pattern of health behaviour amongst students in a Nigerian university. Journal Social and Administrative Pharmacy, 7(3), 120-136
- 27) Okaza, J. & Aluede, O. (2009). Drug abuse among students of Ambrose Ali University Ekpoma, Nigeria. European Journal of Social Science, 10(1), 72-8
- 28) Oladele, A. A. & Olufunmilayo, E.A. (2013). Pattern of substance abuse among senior secondary school students in a south western Nigerian city. International Review of Social Sciences and Humanities, 4 (2), 54 – 65.
- 29) Oshioko, A. (2006). Perception of Drug Abuse Amongst Nigerian undergraduates, in Abudu, P. (2008) Young people and drug abuse. A paper presented at the 8<sup>th</sup> Biennial International Conference on Alcohol, Drugs and Society in Africa, Abuja Nigeria.
- 30) Otegwu, I. O. (2013). Policing and national security in Nigeria: Issues and challenges. A paper presented at the 4<sup>th</sup> National Conference on the theme: Contemporary issues in Nigeria's National Development, organized by the Faculty of Social Sciences, UDUS, at the University Auditorium, between 15<sup>th</sup>-16<sup>th</sup> may, 2013.
- 31) Radda, S. I. (2006). Drug abuse and its consequences on the youth in, Essays on Local Government Administration: Fostering Better Service Delivery, Record Keeping Accounting and Empowerment at the Local Level. Shehu Dalhatu, (Eds) Benchmark publishers
- 32) Social Science Association of Nigeria (2002). Interdisciplinary methodologies in social science. Abuja. A publication by United Nations Educational and Cultural Organization.
- 33) Shehu, A. (2012). The youth and effects of drug abuse. Daylight Global Resources, Sokoto, Nigeria.
- 34) Siro, A. A. (2008). A study of drug abuse among the youth in metropolitan Kano. An unpublished M.Sc. Dissertation Submitted to Department of Sociology, Bayero University, Kano.
- 35) United Nations Population Fund (2014). Young People. Assessed on 4/08/2014 from [www.nigeria.unpf.org/young](http://www.nigeria.unpf.org/young)
- 36) Wilfred, S. (2009). Drug intake and pathogenesis: The case of the youths, counseling agents and care givers. Benue journal of sociology, 2(1), 11-28
- 37) Zango, M. (2003). Characteristics of youth with drug abuse problem. The Social Mirror. Publication of NSASA, BUK, Kano, 4(1), 15-16



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Contribution of Deformation Measurements on the Southern Flank of Nyiragongo Volcano by Inclinometry and Gps in the Monitoring and Prediction of Volcanic Eruptions



Ngangu B. Rugain<sup>1</sup>, Honore M. Ciraba<sup>1</sup>, Kamenyenzi M. Prospère<sup>4</sup>, Migezi M. Rodrigue<sup>3</sup>, Bazibuhe M. Salomon<sup>3</sup>, Kitumaini M Flavien<sup>1</sup>, Maombi Nz Sandra<sup>1</sup>, Kwetu S. Gloire<sup>1</sup>, Seza Bintu D<sup>1</sup>, Bahati R. Marcel<sup>2</sup>, Faustin S. Habari<sup>2</sup>

<sup>1</sup>Department of Geodesy and Deformation, Goma Volcano Observatory, Goma, DR Congo

<sup>2</sup>Department of Geochemistry and Environment, Goma Volcano Observatory, Goma, DR Congo

<sup>3</sup>Faculty of sciences: Agronomic and Environment at the university of the fiftieth anniversary of lwiwo, DR Congo

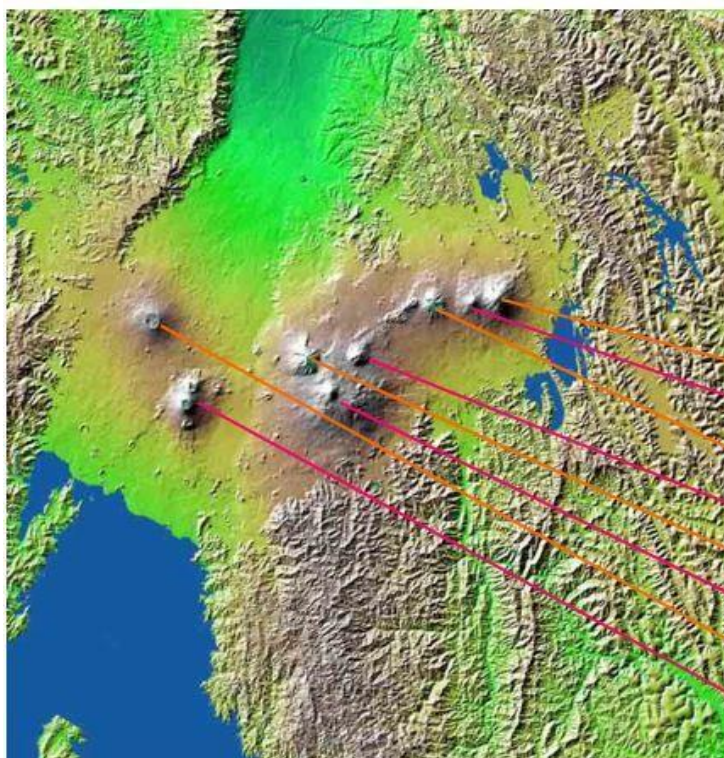
<sup>4</sup>Department of Techniques, Goma Volcano Observatory, Goma, DR Congo

### INTRODUCTION

Volcanic eruptions are a major risk especially the plans: regional, national and international (biotic and abiotic factors) during its passage. Although generally predictable, this phenomenon is nonetheless particularly dangerous and destructive.

One of the most impressive features of the western branch of the East African Rift is the volcanic complex located north of Lake Kivu. This volcanic complex consists of eight major volcanoes distributed in an east-west direction perpendicular to the rift axis: Muhabura, Gahinga, Sabinyo, Visoke, Karisimbi, Mikeno, Nyamulagira and Nyiragongo.

With the exception of a short-lived lava expulsion on the northern flank of the Visoke River, recent eruptions in the Virunga region have been confined to Nyiragongo and Nyamulagira volcanoes (Hamaguchi and Zana, 1993) (Brousse et al., 1979) (Kasahara et al., 1992) These two volcanoes are well known for their lava lake eruptions and their Hawaiian-type flows. Some authors suggest that they are representative of hotspot volcanism in the African tectonic plate (Hamaguchi and Zana 1993).



Au Nord du lac Kivu, une chaîne de 8 grands volcans est apparue au fond et sur le bord du rift. Deux volcans sont encore actifs.

Muhabura

Gahinga

Sabinyo

Visoke

Mikeno

Karisimbi

Nyamulagira (actif !)

Nyiragongo (actif !)

Am 22. Mai 2021 ereignete sich nach einer fast 19-jährigen Beruhigung eine weitere reißende Eruption des Nyiragongo. Der Vulkan

## Contribution of Deformation Measurements on the Southern Flank of Nyiragongo Volcano by Inclinometry and Gps in the Monitoring and Prediction of Volcanic Eruptions

hatte jedoch schon lange vorher starke Signale ausgesandt, insbesondere durch seinen intrakrateralen Ausbruch am 29. Februar 2016. Die Eruption ereignetesich in einer überschwänglichen Phase, wobei die Güsse in drei Richtungen ausfielen, die sich durch die Brüche geöffnet hatten: Nordostflanke (Kaneza-Achse), Nordwestflanke (Rusayo-Achse) und Nord-Südflanke (Munigi-Achse). Sie verursachte materielle und menschliche Schäden in den Randgebieten der Stadt, wobei die Gebäude und verschiedene Infrastrukturen viel stärker betroffen waren. Die Schäden waren jedoch geringer als beim Ausbruch von 2002.

Die starke seismische Aktivität nach dem Ausbruch hat einige alte Brüche reaktiviert und neue Brüche an der Südflanke geschaffen, die sich bis in die Stadt Goma erstreckten. Sie waren vor allem in den Vierteln Majengo, Katoyi, Mabanga, Vulkane und Bujovu zu sehen. Die intensive seismische und tektonische Aktivität in und um Goma hat zu einer Erkundungskampagne geführt, um die neuen offenen Brüche und die alten Brüche zu identifizieren, die nach dem Ausbruch vom Mai 2021 reaktiviert wurden. Es sei darauf hingewiesen, dass die Reaktivierung der Verwerfungen auch im Becken des Kivu-Sees nach größeren tektonischen Ereignissen wiederholt beobachtet wurde (Munyololo et al., 1999; Ciraba et al., 2012).

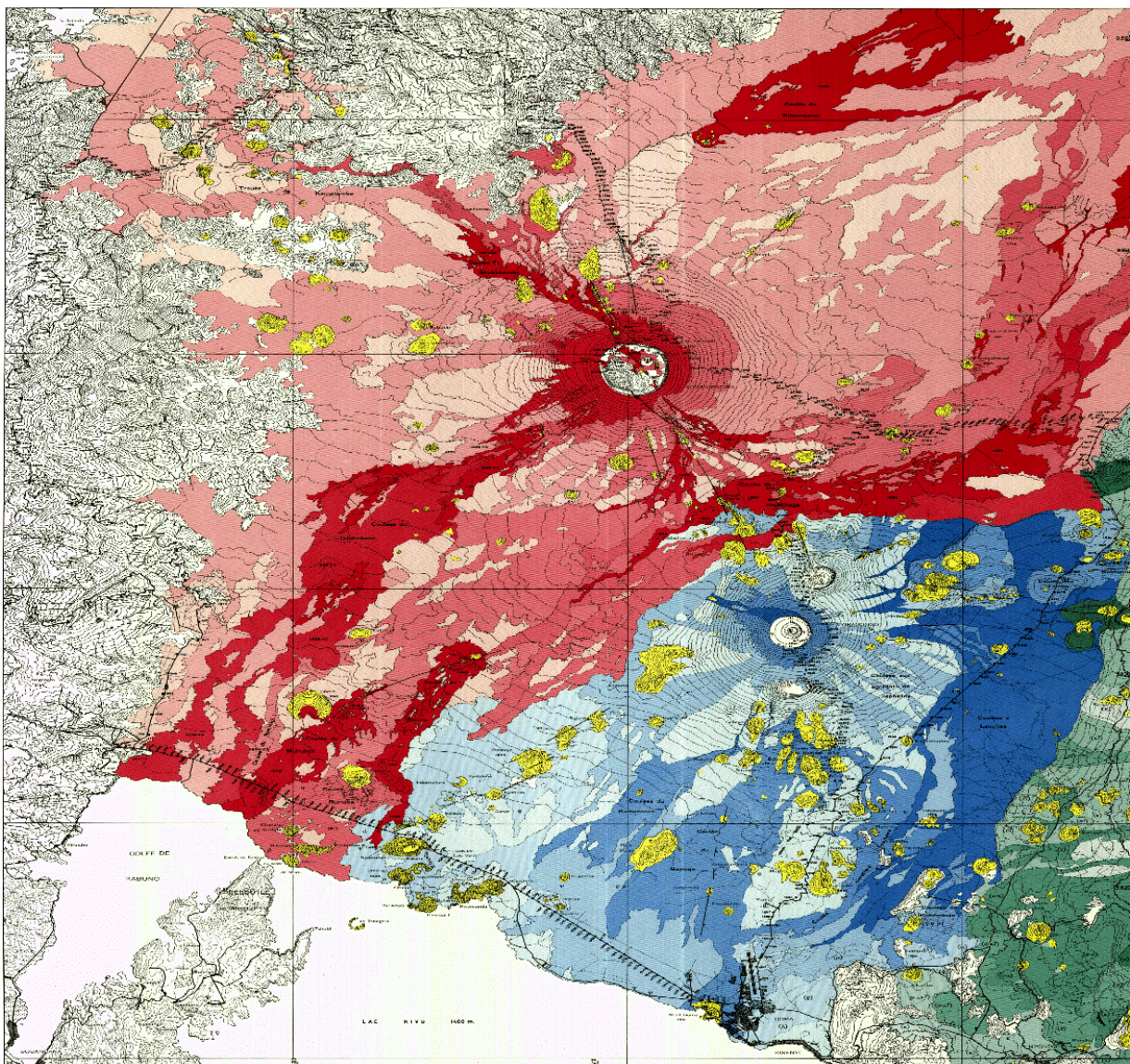
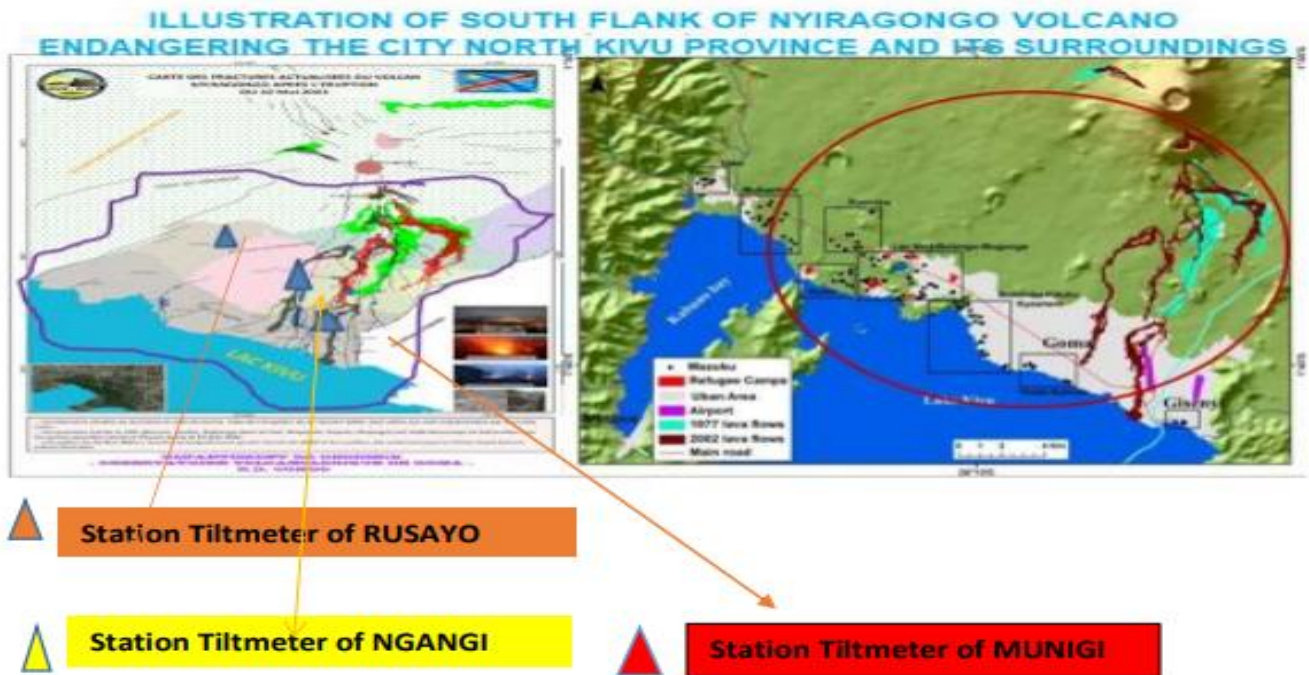


Fig. 2. Karte von Thonnard 1965

Volcanism is always the result of a rise of deep magma, but its surface manifestations may differ from eruption to eruption. The intrusion of magma within the volcanic edifice can lead to variations in pressure in the chamber and the magma conduit, temperature and fluid circulation, which are manifested by surface deformations, which can be detected with the help of various sensors: Inclinometer, Laser Distance Meter, GPS Network. During a magmatic intrusion, the rock fractures resulting in microseismicity (earthquakes of magnitude less than 2-3), followed regularly by seismometers placed around the volcanoes. Managing such a catastrophe is an enormous task; for it is not confined to a particular place, nor does it quickly disappear as soon

# Contribution of Deformation Measurements on the Southern Flank of Nyiragongo Volcano by Inclinometry and Gps in the Monitoring and Prediction of Volcanic Eruptions

as it appears.



The main aim of this study is to develop a system of instrument networks composed of different types of sensors: GPS, tiltmeters (Tiltmeter) to better understand different deformations related to volcanic activities on the surface, finally to monitor them properly and predict volcanic eruptions, but also the management of an exposed entity has such risks.

The methodology for this study will focus much more on the use of deformation sensors: the inclinometer and GPS receivers for monitoring and prediction of a future eruption and will be accompanied by the dialectical method that will help us to compare the documentation that we will exploit and the realities that we will find on the ground. It will help us to establish the relationship between concepts and materials in field research.

From these measurements, different interpretations can follow depending on the volcanic nature (e.g. magma rise) or either tectonic or even seismic nature.

## 1. Contribution to the study of deformations

Unlike other methods of geodetic point measurements in space (such as GPS or distance measurement), inclinometry can detect very low amplitude deformations because it basically measures a spatial derivative of the displacement at a point. Detection levels of the order of  $10^{-9}$  can thus be achieved, i.e. two orders of magnitude below the magnitude of land-based tidal waves. Typically, pressure variations associated with deep magma movement, as detected at the earliest point in other volcanoes, result in surface deformations of the order of  $10^{-7}$  to  $10^{-8}$  [Kamo & Ishihara, 1989; Linde et al., 2005]. Inclinometry is also distinguished by its ease of implementation in real time since it is a punctual measurement in space, absolute and immediate (it does not require a reference frame or data processing to provide a physical measurement). These two features make inclinometry a particularly suitable technique for real-time monitoring. This high sensitivity leads to the absolute need for a perfect coupling of the instrument with the ground, and the search for sites where external disturbances (thermomechanical effects and fluid circulation) will be as low as possible.

The sensitivity levels achieved by inclinometry allow better constraint of deep source models [Kamo & Ishihara, 1989; Beauducel & Cornet, 1999; Linde et al., 2005] and shallow source models [Toutain et al., 1992; Voight et al., 1998; Peltier et al., 2007], provided that a network of sensors is well distributed over the building and/or used as a complement in an integrated model of the strain field. Another important constraint in the interpretation of inclination measurements is the integration of topography into models; even for deep sources, variations in surface inclination are strongly affected by the free surface effect [Beauducel & Cornet, 1999].

## 2. Sensor/ground coupling and perturbations

The techniques commonly used on volcanoes can be grouped into five types, the advantages and disadvantages of which are briefly discussed (modified from [Beauducel 1998]).

## Contribution of Deformation Measurements on the Southern Flank of Nyiragongo Volcano by Inclinometry and Gps in the Monitoring and Prediction of Volcanic Eruptions

(a) **Surface installation:** inclinometers are mounted on a massive lava flow and protected locally by an insulating housing. The instruments are good at measuring the deformations of the building, but the sunlight on the surface causes strong temperature gradients in the rock; the

“thermal” deformations are therefore significant (up to 100  $\mu\text{rad}/\text{day}$ , for example, at the Rusayostation) and difficult to correct a posteriori because they are highly non-linear and dependent on local fracturing and sunlight [Beauducel, 1992; 1998]. On the other hand, because the rock is not porous, disturbances from rain will be limited to the effects of loading and temperature changes in the rock.

(b) **Installation of wells in deposits:** the inclinometer is buried a few metres deep at the bottom of a well dug in a layer of deposits. The temperature variations are then extremely small (at a depth of one metre, diurnal variations are already practically zero), but the temperature gradients remain present in this non-conductive medium, generating thermo-mechanical deformations nevertheless important. In addition, the measurement is strongly disturbed by rainfall and groundwater movement in this porous medium; the latter effects are strongly non-linear and practically impossible to correct [Wolfe et al., 1981; Evans & Wyatt, 1984].

(c) **Installation in natural cavity:** the use of caves, lava tunnels or deep fractures greatly reduces thermal effects and weather disturbances. These are generally excellent sites, but cavity effects are predominant and depend entirely on the three-dimensional shape of the cavity [Harrison 1976; Pinettes 1997]. Strain modelling based on these signals will then be more complex (as for strain measurements) because the precise geometry of the site, which is usually unknown, would have to be introduced into the model.

(d) **Drilling or tunneling installation in massive rock:** inclinometers are installed deep into a massive lava flow. This system offers a perfect coupling with the rock and is free of all types of noise [Yoshikawa, 1962; Eto, 1965; 1966; Kamo & Ishihara, 1989], but the cost of its construction is prohibitive, unless you take advantage of a pre-existing tunnel. As this geometry is generally simple and known, cavity effects are attenuated, and can be taken into account more easily in a numerical model.

### DESCRIPTION OF EQUIPMENT (INCLINOMETER)



1. Inclinator/Tiltmeter /Sensor

2.a. Datalogger: On-site -CR1000X

b. Electric Power Supply System: Battery, Voltage Regulator

c. Data transmission system (real time): Modem

N.B. The data is stored in the Server Software (LoggerNet)

(e) **“Merapi” type installation:** inclinometers are placed on a massive lava flow, but this is covered by a thin layer of deposits (a few metres) which forms a natural insulation over a large area around the instruments. As a result, the temperature gradients are low, and neither sunlight nor water circulation has a significant effect on the measurements [Beauducel & Cornet, 1999]. The effects of rainfall are limited, as for type (a), to the effects of loading on the lava flow and to a lesser extent to changes in temperature.

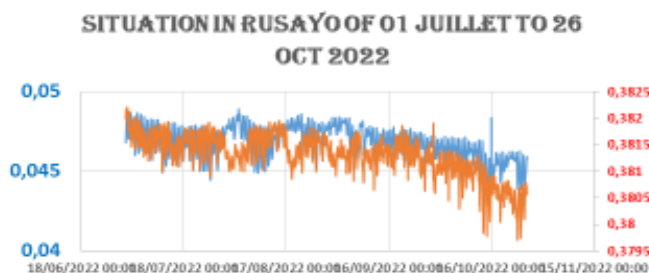
In this study, we will look for sites corresponding to the characteristics of tunneling facilities in massive rock and natural cavity. The search for sites results from a delicate compromise between the quality of the site, accessibility (especially for the drill), and the radio link (few or no relays).

### TREATMENTS/RESULTS

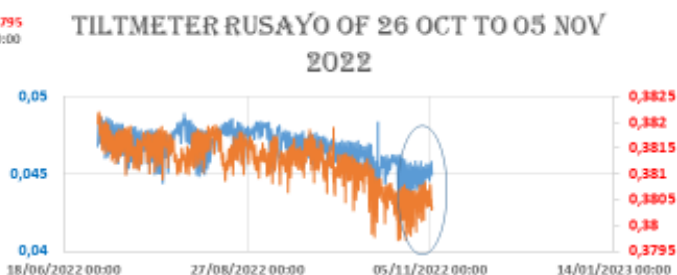
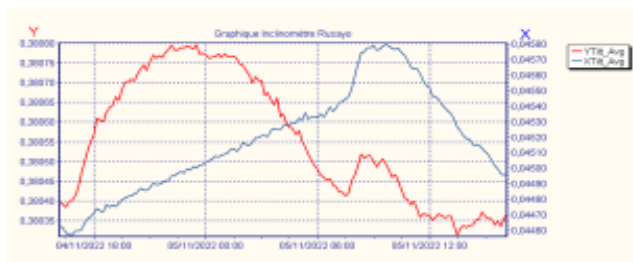
The data processing here of our Tiltmeter network is done with the RTMC free software, which leads us to make the representation

# Contribution of Deformation Measurements on the Southern Flank of Nyiragongo Volcano by Inclinometry and Gps in the Monitoring and Prediction of Volcanic Eruptions

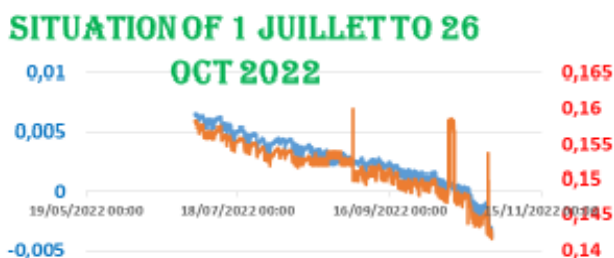
of the graphs with Excel due to the lack of the RTMC Pro (RealTime Monitoring Control) software.



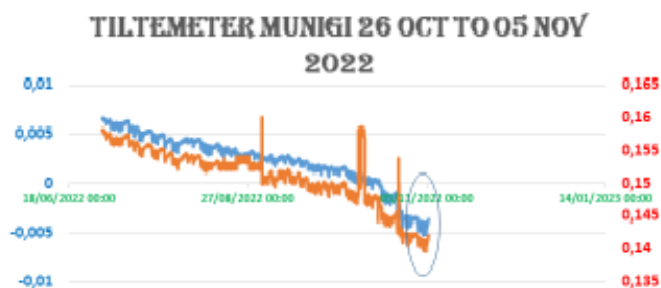
During this period from 08 to 26/10/2022, despite the many fluctuations, there was a small inflation on the X-Axis of the order of 0.000 38167 degrees ( 6.661 398 156 0868 Microradian [ $\mu$ rad]) to the east of the Y-Axis where there was a small deflation of 0.0002285 degrees ( 3.988 077 340 807 Microradian [ $\mu$ rad]) to the north.



Despite the multiple fluctuations, there was a small inflation on the X-axis of the order of 0.000 74183 degrees (12.947 375 990 07 Microradian [ $\mu$ rad]) to the east of the Y-axis where there was a deflation of 0.0001923 degrees or 3.356 268 151 585 1 Microradian [ $\mu$ rad] to the north.



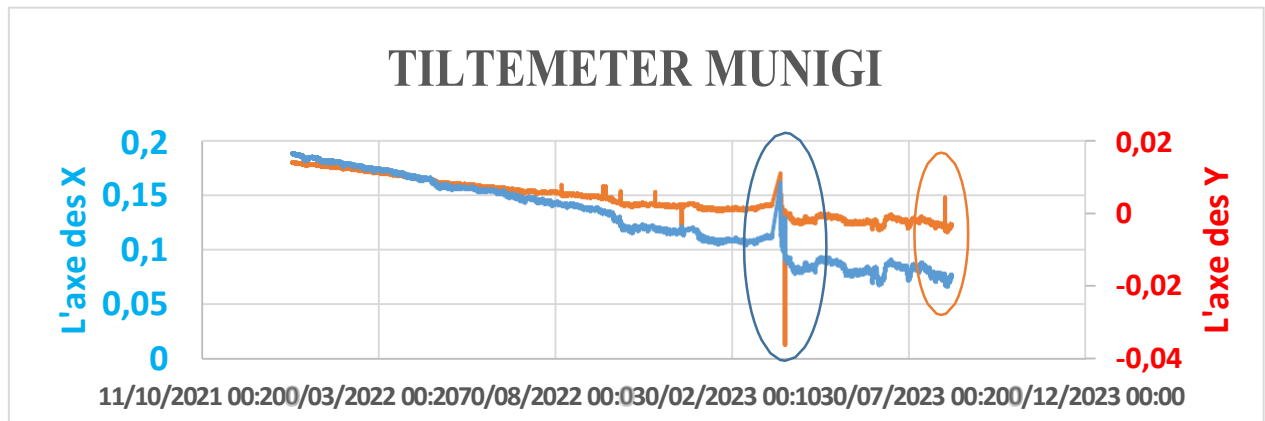
From 08 to 26/10/2022, we recorded an Inflation on 09 to 11 of 0.008999 degrees ( 157.062 179 386 97 Microradian [ $\mu$ rad] ) and of 0.0116086 degrees or 202.608 291 547 01 Microradian [ $\mu$ rad] on 24, but despite these anomalies a Sinking (deflation) oriented towards the South – West of the station was observed on both Axis (Y and X ) or 0.0052195 degrees ( 91.097 460 30 844 Microradian [ $\mu$ rad]) to the South and - 0.00403083 Degree (-70.351 255 088 163 Microradian [ $\mu$ rad]) on the x-axis (west).



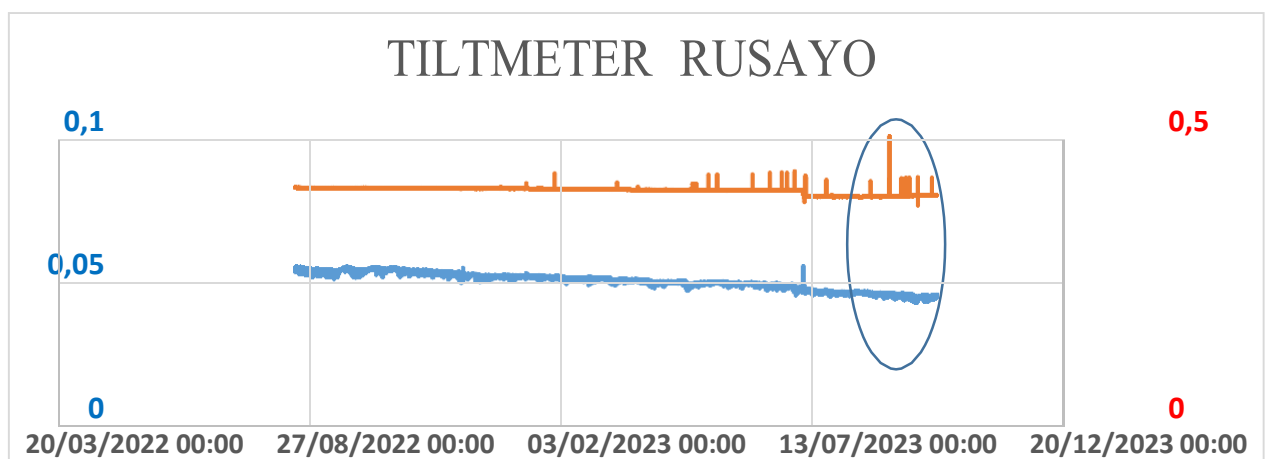
During this period, we recorded a small Inflation of 0.0004005 degrees (6.990 043 654 237 3 Microradian [ $\mu$ rad]) oriented to the south-west direction of the station and -0.001145 degrees (-0.199 840 199 353 35 Microradian [ $\mu$ rad]) on the x-axis (west).



**Contribution of Deformation Measurements on the Southern Flank of Nyiragongo Volcano by Incliniometry and Gps in the Monitoring and Prediction of Volcanic Eruptions**



During this period from 13 to 20 August 2023, despite the multiple fluctuations and the Inflation observed on the Y axis on 14/08/ at 3h30; Both axes recorded slight inflation from last week, of 20.449 [ $\mu$ rad] (X) direction EW and 7.429 [ $\mu$ rad] (Y) direction (NS).



Despite the multiple fluctuations and the high inflation anomaly observed on 08 August 2023 at 8:10 am on the Y axis, both axes recorded a slight inflation, of 31.942 492 371 225 [ $\mu$ rad] on the X axis compared to last week, which was 15.004 071 980 62 [ $\mu$ rad] and 85.957 465 660 721 [ $\mu$ rad] instead of 52.550 118 448 297 [ $\mu$ rad] on the Y axis, a difference of 407 [ $\mu$ rad] on the Y axis north-south and 16.938420390605 [ $\mu$ rad] on the X axis i.e. in the east-west direction.

**CONCLUSION**

Since November 2021, the date of the installation of these strain sensors on the southern flank of the Nyiragongo volcano, including in Ngangi, Munigi and Rusayo; the Zone has experienced several anomalies of denunciation and inflation, which has turned into sawtooths and the most observed anomalies are located almost at the same time of intense activity in the crater of the Nyiragongo volcano. The curve has a tendency to deflate after the eruption of May 2021 and with peaks that are cyclical following the perihelion period during which the earth is close to the sun. Thus, the activity of the lava lake is due not only to the activity in the magma chamber deep inside the volcano, but also to the attraction of the moon and sun on the lava in the volcano's crater.

Thus, Tiltmetric measurement continues on the southern flank of Nyiragongo Volcano and in the fractures; is one of the elements of volcano monitoring.

**REFERENCES**

- 1) Brousse R. J., Cocheme J., Pottier Y. J. et Vellutini P. J. (1979). Eruption et nature de la lave du Nyiragongo de 1977) au Kivu (Zaire). C.R. Acad. Sci. Paris, n° 289, pp. 808-812.
- 2) Hamaguchi H. et Zana N. (1993). Introduction to volcanoes Nyiragongo and Nyamulagira. In: H. Hamaguchi (éd.), volcanoes Nyiragongo and Nyamulagira: Geophysical aspects. , pp. 35-46.

## Contribution of Deformation Measurements on the Southern Flank of Nyiragongo Volcano by Incliniometry and Gps in the Monitoring and Prediction of Volcanic Eruptions

- 3) Kasahara M., Tanaka S. et Zana N. (1992). A flank eruption of volcano Nyamulagirain 1991, Mikombe, Preliminary Report. In: H. Hamaguchi (éd.), Geophysical Study on the HotspotVolcanoes in the African Continent. Tohoku Univ., pp. 116-136.
- 4) Beauducel, F., and F.H. Cornet, Collection and three-dimensional modeling of GPS and tilt data atMerapi volcano, Java, J. Geophys. Res., 104, B1, 725-736, 1999.
- 5) Beauducel, F., Modélisation d'une crise intrusive au Piton de la Fournaise. Atténuation des perturbations thermomécaniques sur les mesures de déformations, Rapports de stages DEA, IPGP,1, 47–81, 1992.
- 6) Eto, T., Volcanic crustal deformation (I) : Relation between the recent vertical deformations and volcanic activity at volcano Sakurajima, Annuals of Disaster Prevention Research Institute, KyotoUniversity (en Japonais), 8, 71–81, 1965.
- 7) Eto, T., Volcanic crustal deformation (II) : On the anomalous tilting movements accompanied withthe explosions of volcano Sakurajima, Annuals of Disaster Prevention Research Institute, Kyoto University (en Japonais), 9, 83–97, 1966.
- 8) Evans, K. and F. Wyatt, Water table effects on the measurements of Earth strain, Tectonophysics,108, 323–337, 1984.
- 9) Harrison, J.C., Cavity and topographic effects in tilt and strain measurement, J. Geophys. Res., 81,B2, 319-328, 1976.
- 10) Kamo, K. and K. Ishihara, A Preliminary experiment on automated judgement of the stages of eruptive activity using tiltmeter records at Sakurajima, Japan, IAVCEI Proceedings in Volcanology, 1, 585–598, 1989.
- 11) Linde A.T., S. Sacks, D. Hidayat, B. Voight, P. Malin, E. Shalev, G.S. Mattioli, S.R. Young, D. Elsworth, The Explosion of March 2004 at Montserrat : Constraints From Borehole Strain Data, paper presented at AGU Fall Meeting, 2005.
- 12) Pinettes, P., Précurseurs géophysiques des séismes : Approches expérimentales et modélisations, Thèse de Doctorat Univ. Paris 7, 221 pp, 1997.
- 13) Wolfe, J.E., E. Berg and G.H. Sutton, The change in strain comes mainly from the rain : Kipapa, Oahu, Bul. of Seism. Soc. of Am., 71, 1625–1635, 1981.
- 14) Yoshikawa, K., On the crustal movement accompanying with the recent activity of the volcano Sakurajima (Part 2), Bulletins of Disaster Prevention Research Institute, Kyoto University, 50, 2–23, 1962.
- 15) Peltier, A., Staudacher, T., Bachèlery, P., 2007, Constraints on magma transfers and structures involved in the 2003 activity at Piton de La Fournaise from displacement data, J. Geophys. Res., 112, B03207, doi :10.1029/2006JB00437.
- 16) Toutain, J.-P., P. Bachèlery, P.-A. Blum, J.-L. Cheminée, H. Delorme, L. Fontaine, P. Kowalski,P. Taochy, Real time monitoring of vertical ground deformations during eruptions at Piton de la Fournaise, Geophys. Res. Lett., 19, 553–556, 1992.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Preparing Some Nano Composites Decorated with Some Pharmaceutical Compounds and Evaluating their Biological Effectiveness



Athir Ihsan Shakir

Directorate of Salahaddin Education - Ministry of Education – Iraq

**ABSTRACT:** The aim of this study was to use electrochemical methods to synthesise and characterise several derivatives of graphene oxide or nanosheets of reduced graphene oxides (A3) and (A4). Melting-point analysis was performed on the produced compounds. SEM, XRD, TEM, and AFM. It's not environmentally friendly, but it's quick and doesn't cost a lot of money. All of the separated chemicals can be stored safely at room temperature. Bacteria have performed biological research on compounds created using the nanotechnology approach. And assess the produced compounds' capacity to limit bacterial growth and their biological efficacy against Gram-positive and Gram-negative bacteria.

**KEYWORDS:** Graphene, Reduced Graphene Oxide, Triazole, Gram bacteria

### 1. INTRODUCTION

Nanomaterials are considered advanced chemical materials that can be produced with dimensions ranging from 1 nm to 100 nm. The small sizes and scales of these materials have led them to behave differently from traditional large-sized materials whose dimensions exceed 100 nm, and to have strong qualities and properties. Excellence cannot be found together in traditional materials, and the smaller the scale of nanomaterials, the greater the effectiveness. <sup>(1)</sup>

Nano size is described with many examples, such as being the same width as deoxyribonucleic acid or the size of ten hydrogen atoms,<sup>(2)</sup> and nanotechnology is the application of scientific concepts and methods in the process of development at the nanoscale level, although nanotechnology is relatively new, as it is considered a revolution. Industrial fields in the electronic, industrial, military, medical and other vital fields that greatly affect our lives.<sup>(3)</sup>

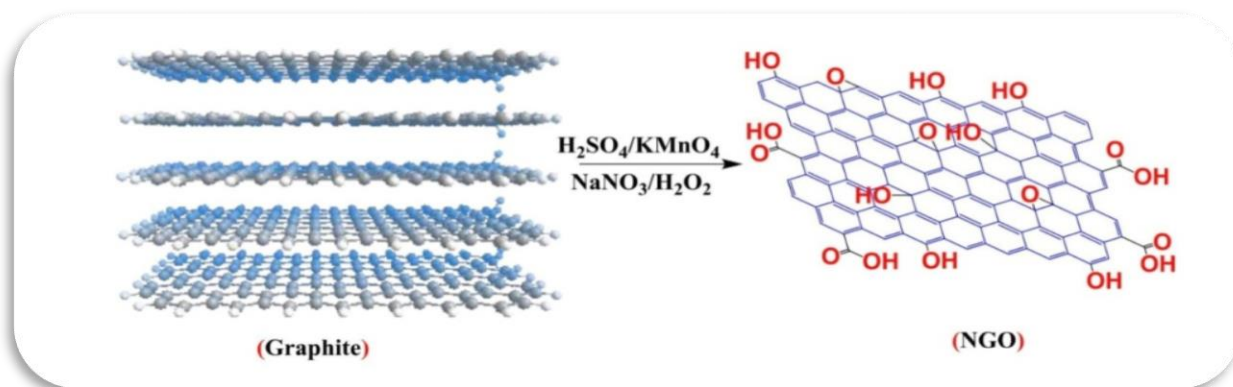
The emergence of new applications for nanotechnology has enabled researchers to control cell behavior and repair and develop human tissues, and it has also provided services in the field of energy and water purification.<sup>(4)</sup> Nanotechnology has also been used to study the structure of cancer cells and treat them.<sup>(5)</sup>

### 2. MATERIAL AND METHODS

#### 2.1 Synthesis Graphene Oxide (GO)

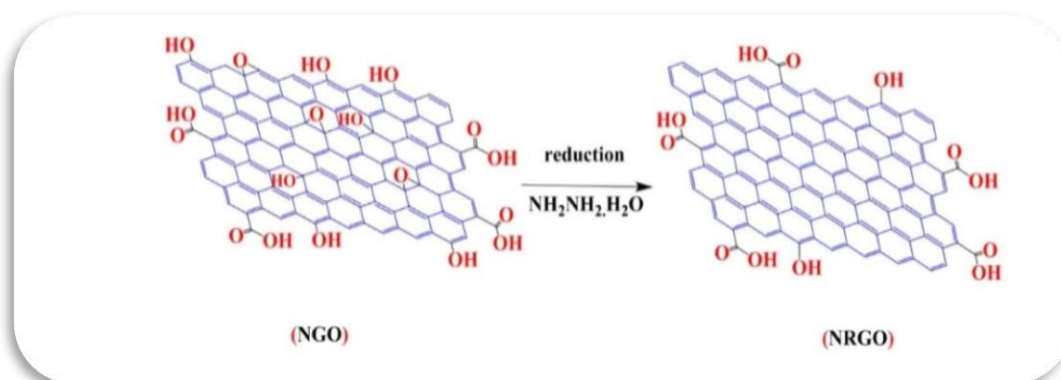
In a snow bath, 46 mL of concentrated sulfuric acid ( $H_2SO_4$ ) was introduced to a 600 ml beaker while magnetic stirring was maintained. After 15 minutes of stirring at 0 C°, 1 g of graphite was added progressively over the course of 10 minutes. Then, over the course of 10 minutes, while keeping the temperature below 10 C° for two hours, add 6 g of potassium permanganate while stirring slowly and carefully. Finally, remove the mixture from the ice bath and add 46 ml of distilled water while stirring slowly and carefully for 15 minutes. The temperature is 98 C°, and then 140 ml of distilled water is added to bring it down to a comfortable but still warm 50 C°. Ten minutes later, add 15 ml of 30% hydrogen peroxide  $H_2O_2$  and mix for another 30 minutes. The next step is to add 150 ml of distilled water to each half of the mixture. Finally, after 24 hours, drain the mixture and wash it once with 10% (HCl) to remove any remaining precipitate. The acidic function (pH=7) was attained after drying at 60–70 degrees Celsius and five washes with anionic water. <sup>(6)</sup>

## Preparing Some Nano Composites Decorated with Some Pharmaceutical Compounds and Evaluating their Biological Effectiveness



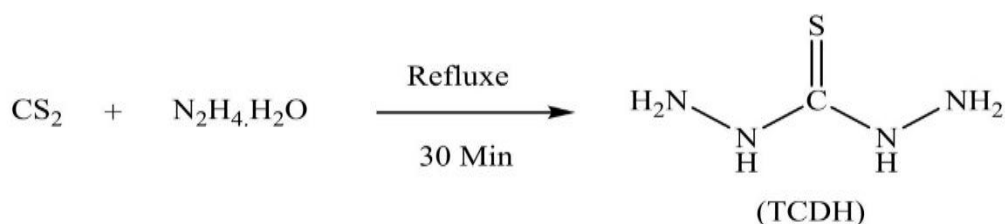
### 2.2 Synthesis reduced graphene oxide

In a heat-resistant circular flask of 50 ml, place 0.1 g of graphene oxide prepared in the Hummer method and add 1 ml of hydrochloric acid and keep it on constant stirring until it becomes a clear solution without plankton until homogenization, add 1 ml of hydrazine hydrate 80% was heated at 100 C° for 2 hours in the presence of an inverter condenser, collected NRGO by filtration, and washed with deionized water three times to get rid of excess hydrazine, where it was dried in an oven at 100 C° for 12 hours. <sup>(7)</sup>



### 2.3 Synthesis Thiocodamide Carbonylhydrazide TDCH

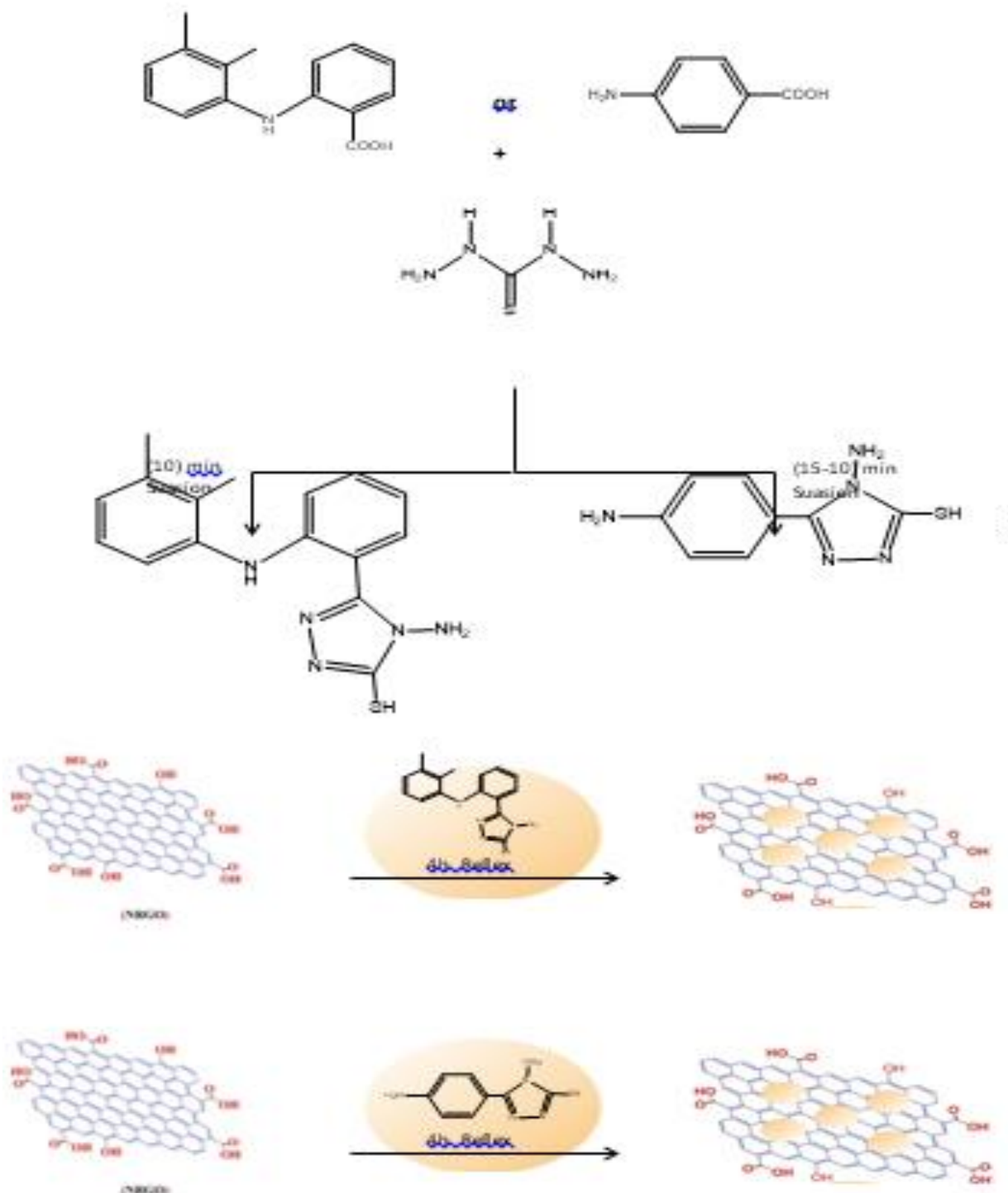
A 100 ml round flask was placed in an ice bath, 20 ml of 80% hydrazine was added, and 5 ml of carbon disulfide was added gradually over the course of 10 minutes with magnetic stirring. After 30 minutes, a yellow precipitate formed, and the mixture was cooled back down to room temperature. It was dried at 50 C° after being recrystallized with distilled water. The melting point was measured at (172 - 170) C° <sup>(8)</sup>, which agrees with the published data. 66% of the total product. <sup>(9)</sup>



### 2.4 Synthesis 4-Amino-5-Phenyl-4H-1, 2, 4-Triazole-3-Thiol

0.01 mole of pyridine-6,2-dicarboxylic acid was mixed with 0.02 mole of TDCH (or 0.01 mole of benzene-5,3,1-tricarboxylic acid with 0.03 mole of TDCH) in a heat-resistant flask and heated in an oil bath with Stir for a period of (10-15) minutes at the melting point. The product was cooled to room temperature until the consistency and color of the melt changed. Then it was treated with a 10% sodium bicarbonate solution. The product was collected by filtration and washed with ethanol several times until the acidity of the filtrate disappeared and it was dried in a temperature oven 60 C°. <sup>(10)</sup>

## Preparing Some Nano Composites Decorated with Some Pharmaceutical Compounds and Evaluating their Biological Effectiveness



### 2.5 Synthesis of reduced graphene oxide nanocomposites

Ultrasound at 50 Hz for 30 minutes is applied to 0.2 mole of the prepared nano-reduced graphene oxide (A2) in 10 ml of distilled water, then, 0.2 mole of one of the selected aromatic amines is added; the mixture is heated for 4 hours at 100 °C, finally, the product is collected, it is washed three times with 10 ml of deionized water; and it is dried in the oven at 80 °C until the weight is constant. <sup>(11)(12)</sup>

### 2.6 Biological application of graphene methyl dopa compounds

#### 2.6.1 Synthesis an antibacterial medical mask based on graphene pharmaceutical compounds <sup>(13)</sup>

Synthesis of colloidal solution of methyl dopa [A3,A4] at different concentrations (50, 100, 150) ppm From the solution of methyl dopa, a commercially purchased face mask was soaked in 50 ppm and 100 ppm solution and 150 ppm.

#### 2.6.2 Synthesis of colloidal solution using Methylcellulose

## Preparing Some Nano Composites Decorated with Some Pharmaceutical Compounds and Evaluating their Biological Effectiveness

A beaker containing 150 ml of deionized water at 90 C°, sprinkle 0.8042 g of methylcellulose (dynamic viscosity of a 2% solution 4000 cI) on it and stir vigorously to ensure that the substance is dispersed in the solvent, then cool the solution in an ice bath with constant stirring until it forms A clear colloidal solution. 0.02 grams of the nanomaterial was dispersed in a beaker containing 50 ml of deionized water for 60 minutes. Then, methylcellulose was added to the colloidal material after cooling. The reaction mixture was kept for (15-20) minutes at room temperature, then added to Mix 3-5 drops of diluted hydrazine solution (1 mL in 100 ml of DI water), stir the solution for 30 minutes at room temperature, and finally the formation of a silver colloidal solution of methyl-dopa nanopharmaceutical compounds can be observed.<sup>(14)</sup>

### 2.6.3 Synthesis the colloidal solution using Xanthan gum

A beaker containing 150 ml of DI water at laboratory temperature, sprinkle 0.8042 g of Xanthan gum (dynamic viscosity of a 2% solution 4000 cI) on it and stir vigorously to ensure that the material is dispersed in the solvent, and a clear colloidal solution is formed, and 0.02 g of the nanomaterial is dispersed In a beaker containing 50 ml of deionized water for 60 minutes, then add the colloidal substance of DI water and stir the solution for 30 minutes at room temperature, and finally the formation of a silver colloidal solution of methyl-dopa pharmaceutical nanocomposites can be observed.<sup>(15)</sup>

### 2.6.4 Synthesis a medical mask containing the nanocolloidal solution

From the concentrated solution of methyl-dopa nanocompounds, three different concentrations (100, 50, and 150) ppm were prepared. In the previously prepared solutions, small previously prepared pieces of masks measuring (55) cm in size began to be soaked for a period of (5-7) hours. At room temperature, then the pieces of masks were dried in room air for 30 minutes. Face masks treated with a colloidal methyl-dopa nanopharmaceutical solution will be further used in antimicrobial studies against Gram-positive and Gram-negative bacteria, as a mask treated with a 50 ppm solution is described as A50. While a mask treated with a 100 ppm solution is labeled A100, and a mask treated with a 150 ppm solution is labeled A150.<sup>(16)</sup>

## 2.7 Bacterial biological activity

### 2.7.1 Bacterial isolates

In this study, two types of Gram-positive bacteria and two types of Gram-negative bacteria were used. They were obtained and diagnosed from the Department of Biological Effectiveness at the General Company for Pharmaceutical Industry in Samarra. They were directly activated before use. The Gram-positive bacteria are Staphylococcus aureus. Gram-negative bacteria are Bacillus and Salmonella.

### 2.7.2 Synthesis of Bacterial inoculation

The bacterial suspension was prepared from a 24-hour-old colony, which was done by taking a smear of the isolated bacteria using a lube, and according to the type of bacteria to be worked on, it was placed in the prepared solution, Normal saline solution, in an amount of 10 ml, and incubated for 24 hours.<sup>(17) (18)</sup>

### 2.7.3 Synthesis bacterial plates to test the biological activity of the prepared compounds

The biological effectiveness of the prepared compounds was estimated according to the method (United States Pharmacopeia USP) under the antibiotics-microbial assays section, and the work was done using the cylinder plate method. Which is summed up by preparing a nutrient medium consisting of nutritional compounds for bacteria.<sup>(19) (20)</sup>

It was prepared and sterilized in an autoclave, and it consists of:

The acidity level (pH) after sterilization was  $(0.1 \pm 6.6)$ , after which the medium was cooled to a temperature of (37-40) C°, and the bacterial suspension prepared a day before was added, which was done by taking a swab of the bacteria isolated with a loop, and according to the type of bacteria to be worked on, and it was placed In a liquid nutrient medium prepared in advance in an amount of 10 ml and incubated for 24 hours, then an amount of (1-2) ml of the suspension is added to the basic nutrient medium, which usually has a volume of 100 ml. After placing the bacteria, the medium is poured into Petri dishes in an amount of 20 ml for each dish, then It cools and then makes discs of masks with a diameter of 6 mm, which were prepared in advance as mentioned in paragraph 4.6.2, and which were immersed in three concentrations of the prepared compounds (50, 100, 150) ppm, in addition to using a standard antibiotic for comparison purposes. The inhibitory effect is Gentamicin sulfate at the same concentrations above. It is an antibiotic effective against both Gram-positive and Gram-negative bacteria. It has many medical uses and is a standard substance approved in the quality control laboratories of the General Company for Pharmaceutical Manufacturing in Samarra, where it was grown on culture media in a manner (Antibiotic Disc) The dishes were incubated in an incubator at 37 C° for 24 hours, then the diameter of inhibition was read with a measuring device (zone reader), and then the diameter of the inhibition zone was taken in mm to determine the extent of antibacterial effectiveness.

# Preparing Some Nano Composites Decorated with Some Pharmaceutical Compounds and Evaluating their Biological Effectiveness

## 3. RESULT AND DISCUSSION

### 3.1 Synthesis and characterization of graphene oxide nanosheets

X-ray diffraction of graphene oxide, GO (A1), showed an angle value of  $2\theta=11.82^\circ$  and a distance between the layers of  $d=0.74$ . Increasing the distance between the layers indicates oxidation, and then the grain size is calculated, which is equal to 5.43. <sup>(21)</sup>

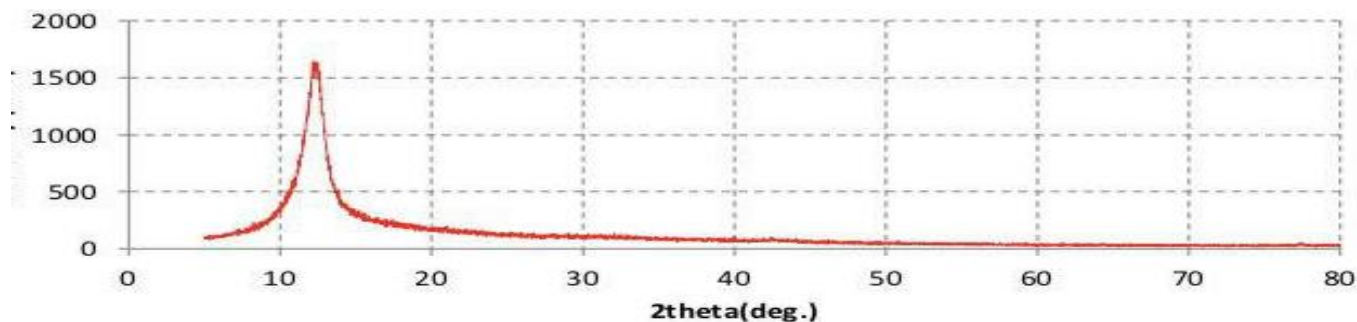


Figure (3-1) shows the XRD spectrum of compound (A1)

The SEM morphological images of compound (A1) show a peeling process resulting from oxidation and separation between the layers. Oxidation also appears on the edges and surfaces, with greater clarity of the rings on the plates.

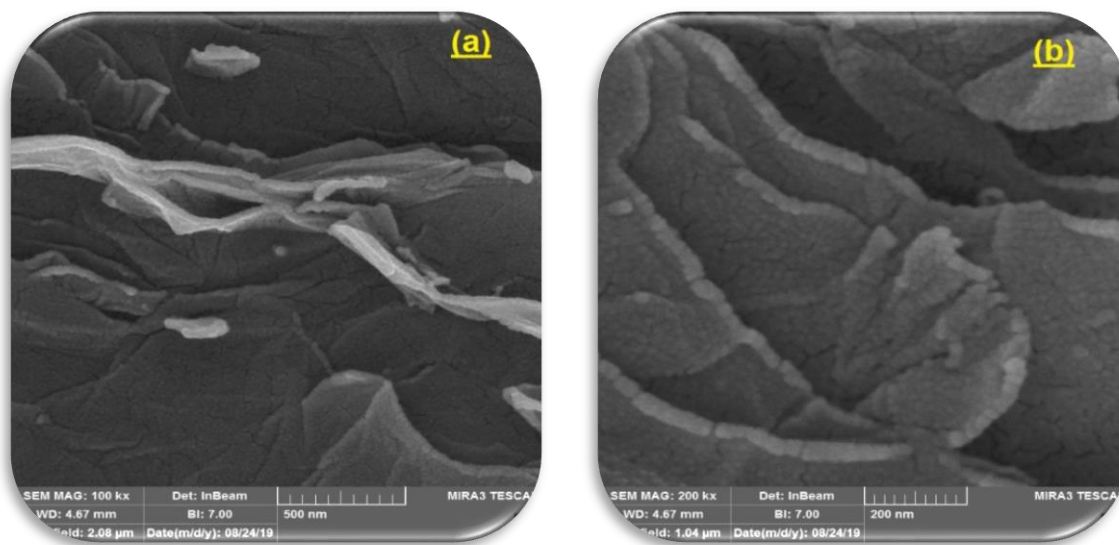


Figure (3-2) shows SEM images of the compound (A1)

AFM images of compound (A1) show a large sheet area (a) with the peeling process evident from observing the height of the sheet edges (b)

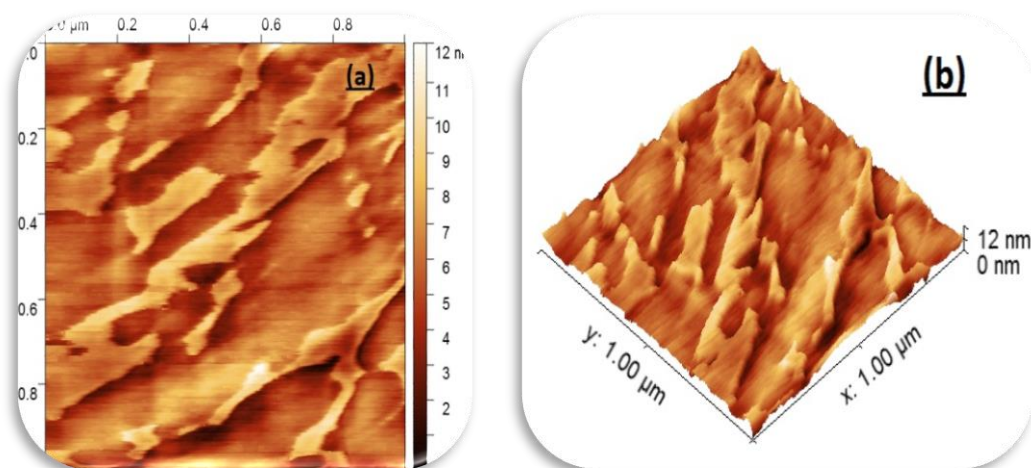


Figure (3-3) shows AFM images of the compound (A1)

## Preparing Some Nano Composites Decorated with Some Pharmaceutical Compounds and Evaluating their Biological Effectiveness

TEM images clearly showed the presence of high peeling (a), where supporting materials were collected on the surface of the sheets and their edges (b), with excellent transparency commensurate with the clear peeling of the layers, which sometimes reached a single shot (c).

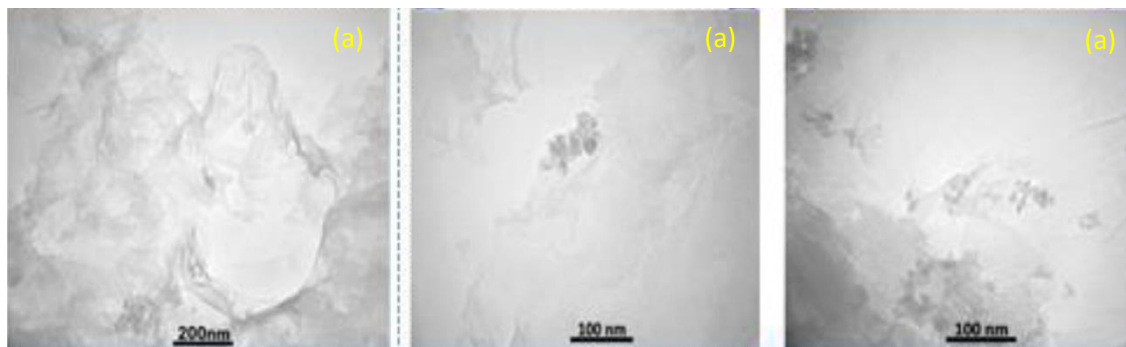


Figure (3-4) shows TEM images of the compound (A1)

### 3.2 Synthesis and characterization of reduced graphene oxide

The X-ray diffraction of RGO (A2) shows an angular value at  $2\theta=32.26^\circ$ , indicating the arrangement of the sheets along the stacking direction. This confirms that the sample is made of a few layers of RGO, with an interlayer distance of 0.74, which is smaller than GO due to the removal of most of the functional groups. <sup>(22)</sup>

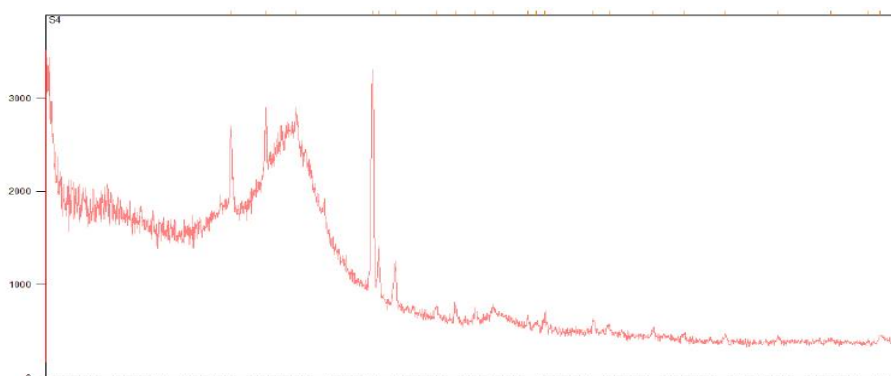


Figure (3-5) shows the XRD spectrum of the compound (A2)

SEM images of compound (A2) showed a decrease in the thickness of the sheets to 27.07 nm (a), with clear wrinkles on the sheets, while the oxidation state remained at the edges and some areas (b).

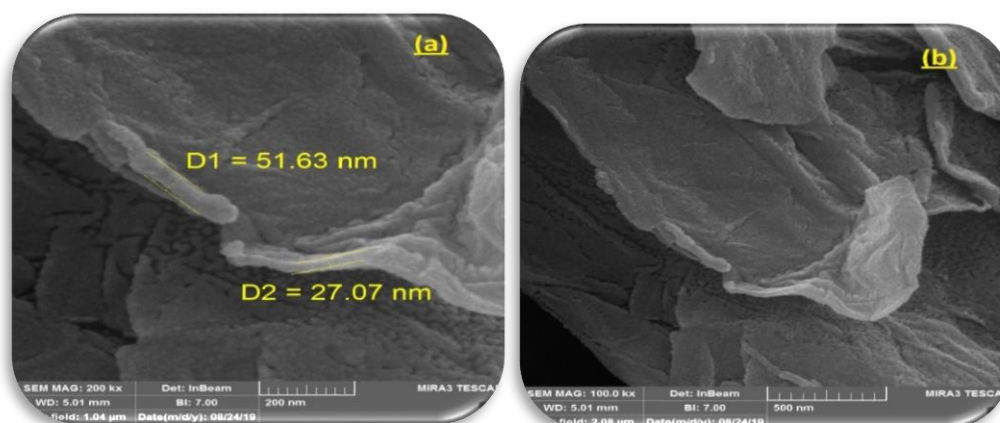


Figure (3-6) shows SEM images of the compound (A2)

As for the AFM images, they showed that the RGO (A2) in some areas on the surface still retained the oxygen groups (a) (b).



## Preparing Some Nano Composites Decorated with Some Pharmaceutical Compounds and Evaluating their Biological Effectiveness

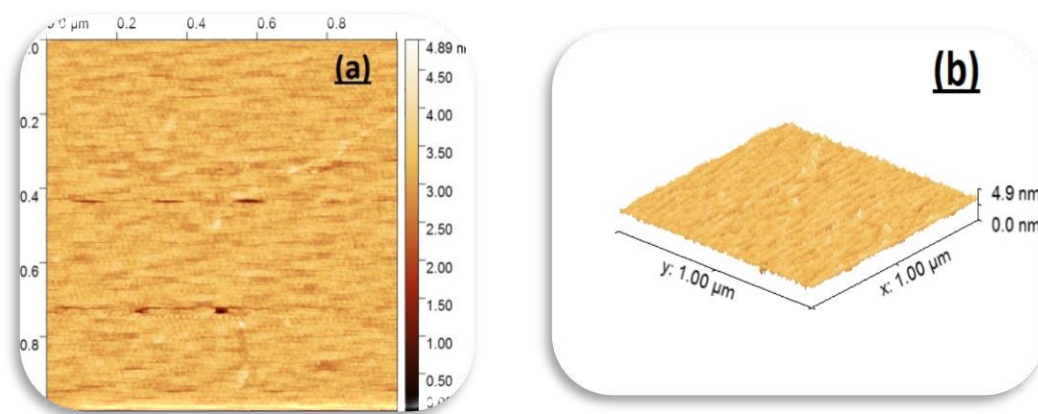


Figure (3-7) shows AFM images of the compound (A2)

TEM images revealed high peeling with high transparency (a), with obvious peeling layers (b) and reduced sheet cracks (c).

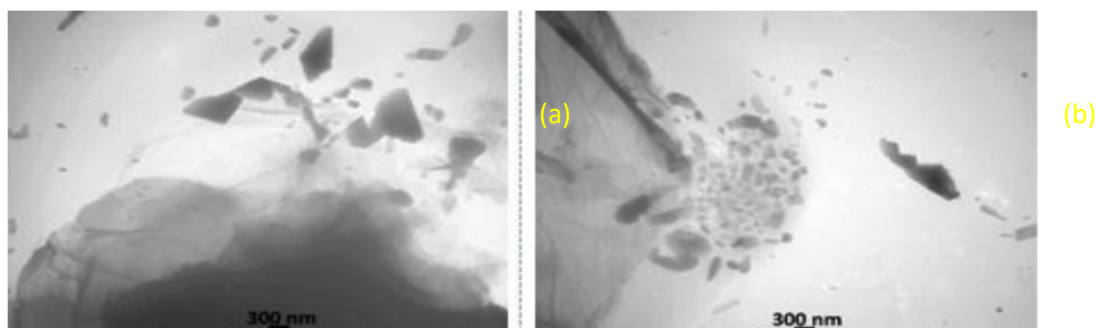


Figure (3-8) shows TEM images of the compound (A2)

### 3.3 Synthesis and characterization of reduced graphene oxide

With greater penetration and exfoliation, the X-ray spectra of compound (A3) showed an angle value of  $2\theta=27.16^\circ$ , indicating a decrease in both the interlayer distances ( $D = 3.1804 \text{ \AA}$ ) and the grain size ( $D = 1.7569 \text{ nm}$ ).

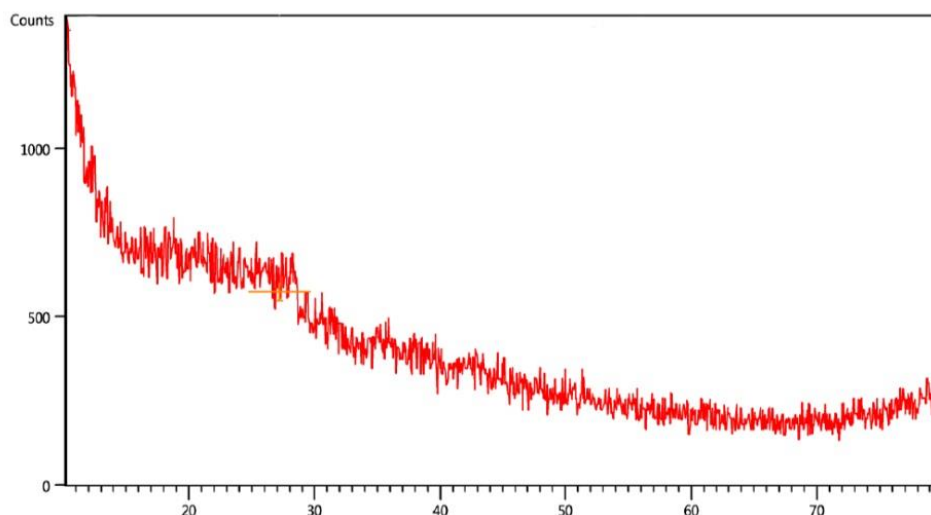


Figure (3-9) shows the XRD spectrum of the compound (A3)

The SEM images showed a roughness of up to 280 nm, and this corresponds to an increase in the surface area of  $26.7418 \text{ nm}^2$  with an increase in the thickening of the plate edges of 35.1540 nm with an increase in cracks.

## Preparing Some Nano Composites Decorated with Some Pharmaceutical Compounds and Evaluating their Biological Effectiveness

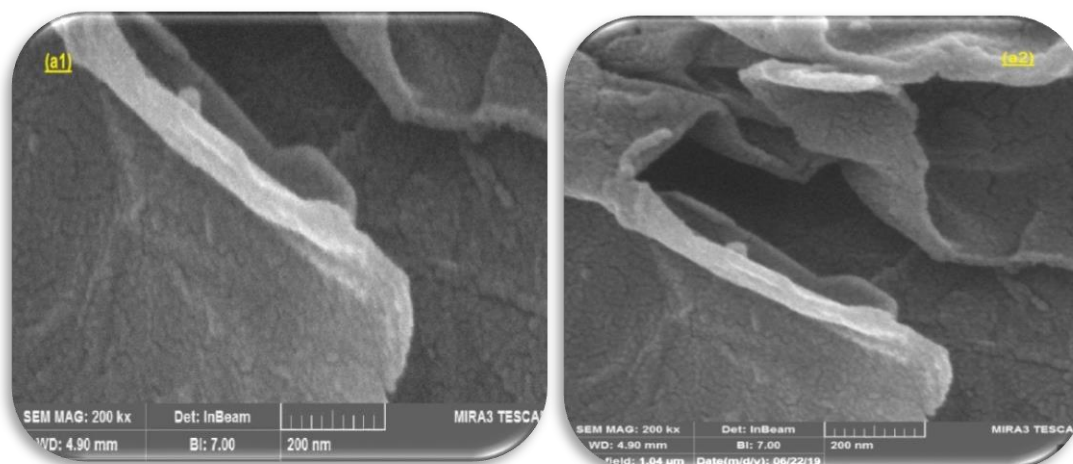


Figure (3-10) shows the SEM of the compound (A3)

The AFM images showed that the material to be overlaid with reduced graphene oxide spread well (a), in addition to maintaining the large area of the sheets and the distances between them (b).

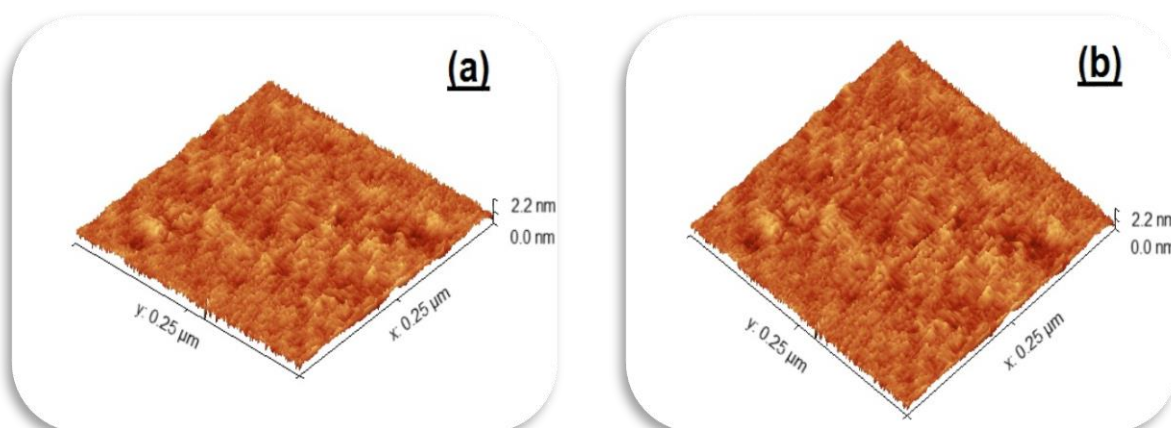


Figure (3-11) shows the AFM of the compound (A3)

TEM images clearly showed high peeling (a) as the support material collected on the edges (b) with a transparency commensurate with the clear peeling of the layers.

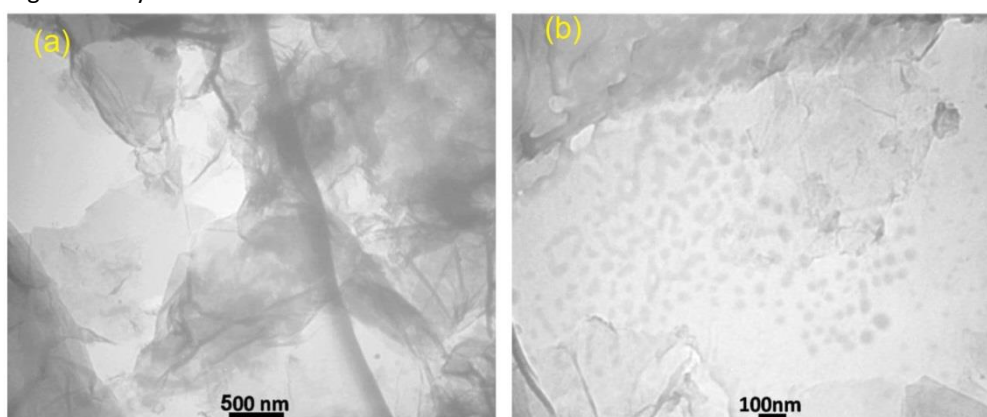


Figure (3-12) shows the TEM of the compound (A3)

The X-ray spectrum of compound A4 showed an angle value of  $2\theta = 26.4522$ , with the presence of d layers equal to  $3.3694 A_0$ , the grain size D equal to 19.5540, and the number of layers n equal to 5.8034. We notice a convergence between the distances for compounds A3 and A4, and we notice that the grain size of compound A4 is equal to compound A1.

## Preparing Some Nano Composites Decorated with Some Pharmaceutical Compounds and Evaluating their Biological Effectiveness

### 3.4 Synthesis and characterization of reduced graphene oxide

The X-ray spectrum of compound (A4) showed an angle value of  $2\theta = 26.4522^\circ$ , with the presence of d layers equal to  $3.3694 \text{ \AA}$ , the grain size D equal to  $19.5540$ , and the number of layers n equal to  $5.8034$ . We notice a convergence between the distances for compounds (A3) and (A4).

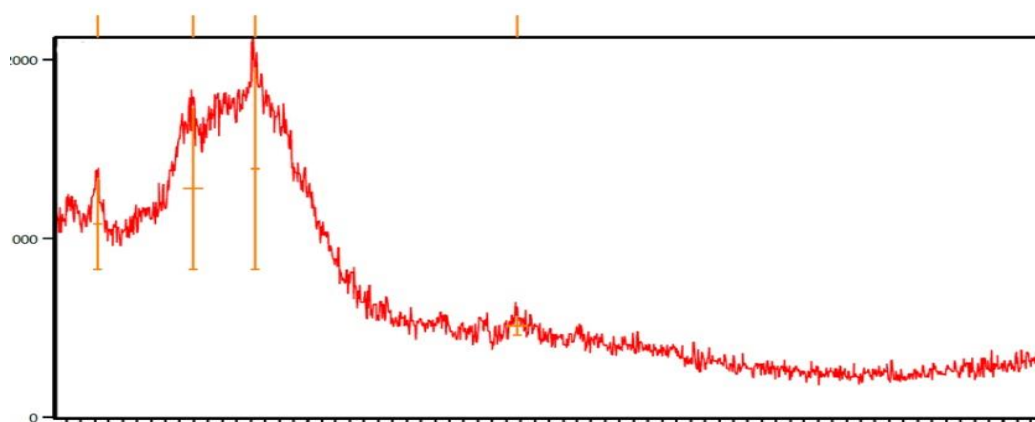


Figure (3-13) shows the XRD spectrum of the compound (A4)

From the SEM images of compound (A4), we notice the presence of high roughness, reaching  $230 \text{ nm}$ , and this is proportional to an increase in the surface area and an increase in thickening at the edges of the plate, and this explains the presence of cracks. <sup>(23)</sup>

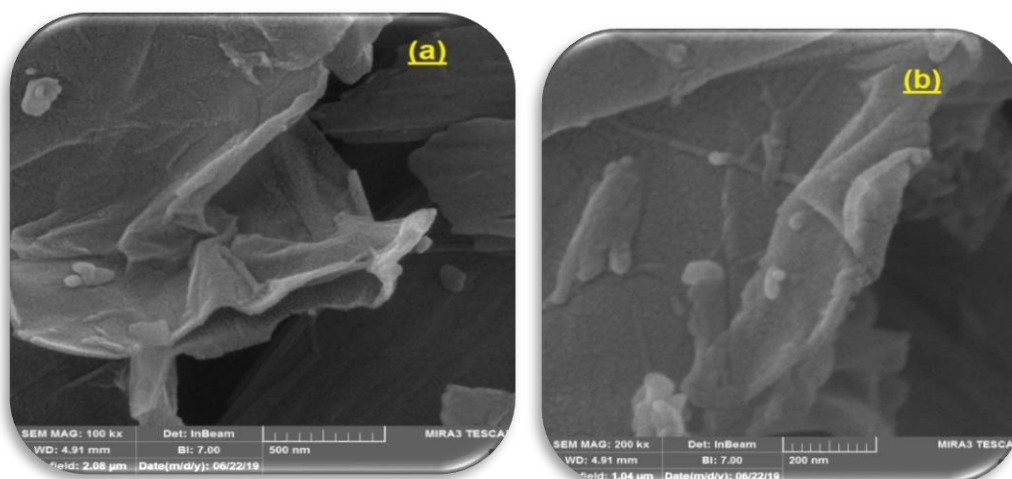


Figure (3-14) shows the SEM of the compound (A4)

The AFM images showed the spread of the superimposed materials on the surface of graphene oxide in an almost homogeneous manner (a), and the thickness of the sample was  $1.9 \text{ nm}$ . This indicates the nanosized, which supports the SEM and XRD images. It also indicates a decrease in the peak thickness of the sample (b).

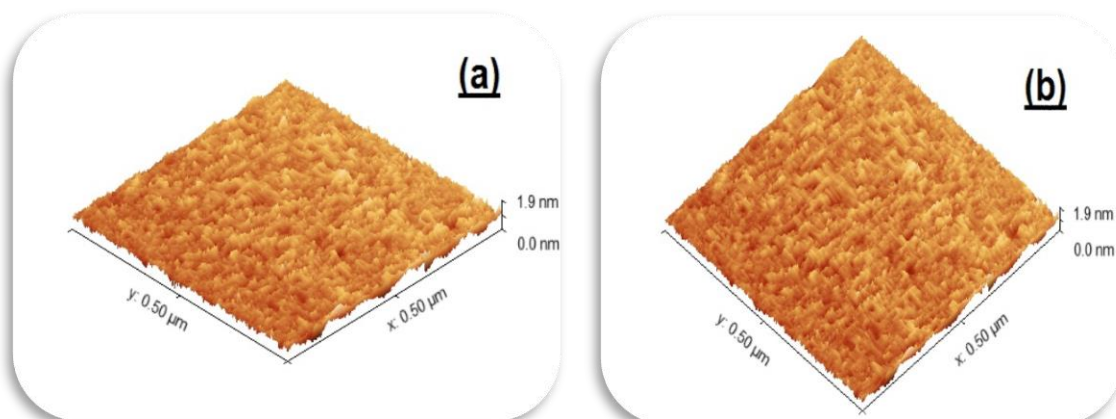


Figure (3-15) shows the AFM of the compound (A4)

## Preparing Some Nano Composites Decorated with Some Pharmaceutical Compounds and Evaluating their Biological Effectiveness

The TEM images of compound (A4) clearly showed the presence of layers of material with cracks (a) and the supporting material is connected in a circular manner and far from the edges of the cracks (b).

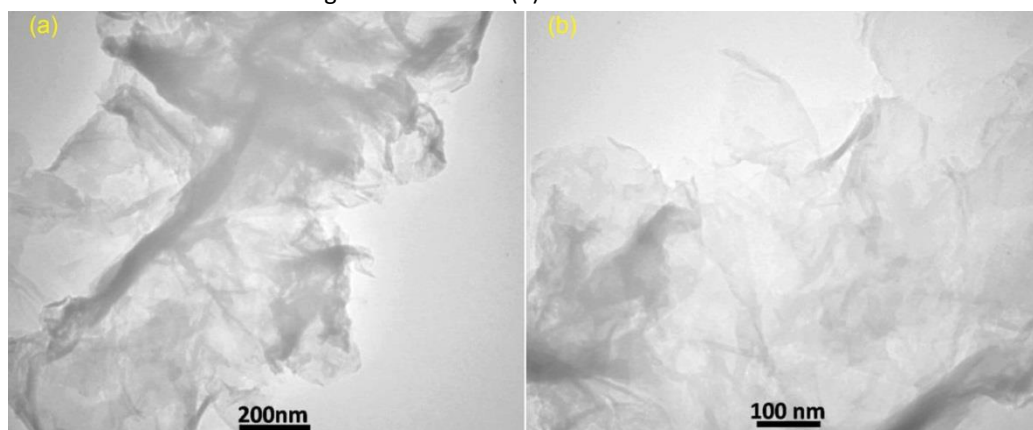


Figure (3-16) shows the TEM of the compound (A4)

### 3.5 Evaluation of the bacterial biological activity of some prepared compounds

Nanocomposites and heterocyclic compounds have different biological effectiveness against Gram-positive and Gram-negative bacteria. Two types of bacteria were used, and the effectiveness was evaluated by etching method, where three types of bacteria were used: Staphylococcus aureus, Bacillus bacteria, and Salmonella. These germs were chosen due to their medical importance. It causes many diseases, as well as its resistance to antibiotics. <sup>(24)</sup>

The results also indicate that the prepared compounds (A3) and (A4) have the ability to inhibit the growth of bacteria, both positive and negative, as the higher the concentration, the greater the inhibition. Concentrations of (50, 100, 150) p.p.m. were used, where the highest inhibition is when (150) p.p.m and the lowest at (50) p.p.m. The standard antibiotic used for comparison purposes in the effectiveness of inhibition is gentamycin.

When studying the inhibition using methylcellulose of gram-positive Staphylococcus aureus bacteria, it was found that the compound (A3) at a concentration of 150 p.p.m gave the highest inhibition of (A4) by 19.2 percent.

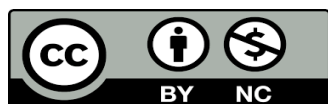
When studying the gram-positive bacillus bacteria, it was found that the compound (A4) gave the highest inhibition at a concentration of (150) p.p.m by 19.9, while when studying the gram-negative salmonella bacteria, it was found that the compound (A4) gave the highest inhibition at (150) p.p.m by 19.5. From this we conclude that the compound (A4) gave the highest rate of inhibition, and some concentrations showed a higher rate of inhibition than the antibiotic that was used in the study of gentamycin, and this is attributed to the large surface area that characterizes the compound (A4).

### REFERENCES

- 1) M. sherif EL- Eskandarany, Journal of Nanoparticles, Vol.2, pp.(13-22) (2009)
- 2) Moniri, M., Boroumand Moghaddam, A., Azizi, S., Abdul Rahim, R., Bin Ariff, A., Zuhainis Saad, W., & Mohamad, R. "Production and status of bacterial cellulose in biomedical engineering. Nanomaterials" , 7(9), 257. (2017).
- 3) Anwar, S., Raja, M. Y. A., Qazi, S., & Ilyas, M. "Nanotechnology for telecommunications". Crc Press. (2017)
- 4) Yusra A. Mohammed, G. H. A.-S., and Ali . H. Samir. "Synthesis Of Carboxylic Acid Functionalized Reduced Graphene Oxide (RGO) With Enhanced Heavy Metals Adsorption Capability." Research Journal of Pharmaceutical, Biological and Chemical Sciences. (2019).
- 5) Basu, S., & Bhattacharyya, P. "Recent developments on graphene and graphene oxide based solid state gas sensors. Sensors and Actuators B: Chemical", 173, 1-21. (2012).
- 6) L. Shahriary and A. A. Athawale, "Graphene oxide synthesized by using modified hummers approach," Int J Renew Energy Environ Eng, vol. 2, pp. 58-63. (2014)
- 7) L. Tang, Z. Yang, F. Duan, and M. Chen, "Fabrication of graphene sheets/polyaniline nanofibers composite for enhanced supercapacitor properties," Colloids and Surfaces A: Physicochemical and Engineering Aspects, vol. 520, pp. 184-192. (2017)
- 8) R. Nalawade, A. Nalawade, R. Shjendra, M. Anuse, International Journal of Engineering Science Invention. Vol.6.PP.46-49. (2017)

## Preparing Some Nano Composites Decorated with Some Pharmaceutical Compounds and Evaluating their Biological Effectiveness

- 9) M. Namvari and H. Namazi, "Sweet graphene I: toward hydrophilic graphene nanosheets via click grafting alkyne-saccharides onto azide-functionalized graphene oxide," *Carbohydrate research*, vol. 396, pp. 1-8, (2014)
- 10) H. N. Moorthy, U. B. Vittal, C. Karthikeyan, V. Thangapandian, A. Venkadachallam, and P. Trivedi, "Synthesis, antifungal evaluation and in silico study of novel Schiff bases derived from 4-amino-5 (3, 5-dimethoxy-phenyl)-4H-1, 2, 4-triazol-3-thiol," *Arabian Journal of Chemistry*, vol. 10, pp. S3239-S3244, (2017).
- 11) Rashad, S. F., Al-Somaidaie, Gh. H. "Synthesis and characterization derivatives 1,2,4- triazole and carbon silica with graphene oxide and study of anti-corrosion efficacy of some them". (2019).
- 12) Manousi, N., Rosenberg, E., Deliyanni, E. A., & Zachariadis, G. A. "Sample preparation using graphene-oxide-derived nanomaterials for the extraction of metals". *Molecules*, 25(10), 2411. (2020).
- 13) Rajabi, H., Jafari, S. M., Feizy, J., Ghorbani, M., & Mohajeri, S. A. "Preparation and characterization of 3D graphene oxide nanostructures embedded with nanocomplexes of chitosan-gum Arabic biopolymers. *International Journal of Biological Macromolecules*" 162, 163-174. (2020)
- 14) Hiragond, C. B., Kshirsagar, A. S., Dhapte, V. V., Khanna, T., Joshi, P., & More, P. V. "Enhanced anti-microbial response of commercial face mask using colloidal silver nanoparticles". *Vacuum*, 156, 475-482. (2018).
- 15) El-Sheikh, M. A., Al-Enezy, A., El-Enezy, F., Ashammri, D& , Alrowili, W. "A novel method for the preparation of conductive methyl cellulose silver nanoparticles-polyanilinenanocomposite". *Egyptian Journal of Chemistry*, 63(9), 8-9. (2020).
- 16) Shirmohammadli, F., Nikzad, M., Ghoreyshi, A. A., Mohammadi, M. & Poureini, F. "Preparation and Characterization of Zein/Sodium Caseinate/Xanthan Gum Complex for Encapsulation of Piperine and its In Vitro Release Study". *Food Biophysics*, 16(2), 254-269. (2021).
- 17) Wibisono, Y., Fadila, C. R., Saiful, S., & Bilad, M. R. "Facile approaches of polymeric face masks reuse and reinforcements for micro-aerosol droplets and viruses filtration": A review. *Polymers*, 12(11), 2516. (2020).
- 18) Aftan, M. M., Talloh, A. A., Dalaf, A. H., & Salih, H. K. "Impact para position on rho value and rate constant and study of liquid crystalline behavior of azo compounds. *Materials Today: Proceedings*. (2021)
- 19) Aftan, M. M., Toma, M. A., Dalaf, A. H., Abdullah, E. Q., & Salih, H. K. "Synthesis and Characterization of New Azo Dyes Based on Thiazole and Assess the Biological and Laser Efficacy for Them and Study their Dyeing Application. *Egyptian Journal of Chemistry*, 64(6), 2903-2911. (2021)
- 20) Khalaf, S. D., Ahmed, N. A. A. S., & Dalaf, A. H. "Synthesis, characterization and biological evaluation (antifungal and antibacterial) of new derivatives of indole, benzotriazole and thioacetyl chloride". *Materials Today: Proceedings*. 47(17), 6201-6210. (2021).
- 21) Firas. S. Abdulazeez, M.Sc. Thesis, College of sciences – University of Tikrit (2018).
- 22) Ahmed M. Jubair, G. H. A. "Synthesis and characterization of some new imine graphene derivatives." Department of Chemistry, College of Education for pure Sciences, Tikrit University. (2019).
- 23) Martínez-García, G., et al. "Multiplexed electrochemical immunosensor for obesity-related hormones using grafted graphene-modified electrodes as platforms for antibodies immobilization." 27: 187-189. (2017)
- 24) Ghasemi, P., Yarie, M., Zolfigol, M. A., Taherpour, A. A., & Torabi, M. "Ionically tagged magnetic nanoparticles with urea linkers: Application for preparation of 2-aryl-quinoline-4-carboxylic acids via an anomeric-based oxidation mechanism". *ACS omega*, 5(7), 3207- 3217. (2020).



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Legal Policy on Environmentally Friendly Waste Management



Wahyu Kurniawan Aji<sup>1</sup>, Monica Setyo Kinanthi<sup>2</sup>, Theresia Anita Christiani<sup>3</sup>, Hyronimus Rhiti<sup>4</sup>

<sup>1,2</sup> Student of Postgraduate of Law, Universitas Atma Jaya Yogyakarta, Indonesia

<sup>3</sup> Lecturer Faculty of Law, Universitas Atma Jaya Yogyakarta, Indonesia

<sup>4</sup> Lecturer Faculty of Law, Universitas Atma Jaya Yogyakarta, Indonesia

**ABSTRACT:** A healthy environment requires maintenance from the community. Society in every activity always produces residue called waste. The waste produced causes various problems in disposal and management. Overcoming the problems of the government is expected to provide policies and solutions for environmentally friendly waste management. This research was conducted with normative collected from primary normative sourced from the law. The results showed that the Provincial Government must be firm in making regulations related to landfills that are not one door for three districts and household waste processing can be used as feed for magot cultivation.

**KEYWORDS:** Environment, Policy, Society, Waste

### I. INTRODUCTION

Humans in their lives need a decent and conducive living environment in order to create a healthy society. A healthy society requires a healthy environment as well. A good and healthy environment is a human right. This is stated in Article 65 paragraph (1) of Law No. 32/2009 on Environmental Protection and Management (UUPPLH). Similarly, it is stated in Article 28H paragraph (1) of the 1945 Constitution of the Republic of Indonesia, which states "Every person has the right to live in physical and spiritual prosperity, to have a place to live, and to have a good and healthy environment, and to receive health services."

A healthy environment is the dream of every human being. Indonesian society is always increasing in terms of population every year, causing many changes that occur in the environment, changes that occur are positive and negative changes. Environmental changes that occur today are more in a negative context, for example the problem of waste generated from various community activities.

Humans with their activities cannot be separated from waste or always leave residue from activities, especially waste. Waste is a material or material that is no longer wanted or used by humans. Waste is one of the problems that cannot be resolved completely. Waste has been regulated in Law No. 18 of 2008 concerning Waste Management. This law has mandated that the government and local governments carry out waste management and provide public services in waste management.

The current reality of waste handling and waste management by local governments in various regions of Indonesia does not have a significant impact. Data shows that 302 districts/cities throughout Indonesia in 2022 with a percentage of 62.62% managed waste and 37.38% unmanageable waste.<sup>1</sup> People still think that burning waste is part of waste management, but burning waste can cause pollution to the environment and disturb health, especially for breathing.

Burning waste on a large scale can cause air pollution and cause health problems, especially respiratory problems, so destroying waste in this way is not recommended. Similarly, indiscriminate disposal of waste, for example, into rivers, rice fields, vacant land or in places that are not landfills will cause new problems to the environment, especially if it is done in urban or densely populated areas. This is because the volume of waste not only increases, but also non-organic waste is difficult to decompose. Many environmental problems will arise as a result of this, such as blockage of river flow, causing water pollution (including groundwater) and also air pollution.

To overcome this problem, the government has regulated an environmentally friendly waste reduction policy in order to create a clean and healthy environment that is free from non-degradable waste. This can be seen in the Law of the Republic of Indonesia Number 18 of 2008 concerning Waste Management, especially Chapter VI concerning the Implementation of Waste Management.

<sup>1</sup> <https://www.kemenkopmk.go.id/72-juta-ton-sampah-di-indonesia-belum-terkelola-dengan-baik> accessed on October 26, 2023, at 22.09 WIB.

## Legal Policy on Environmentally Friendly Waste Management

Environmentally friendly waste management as regulated in article 22 paragraph (1) of Law Number 18 of 2008 concerning Waste Management. One of the principles contained in the Act is the principle of continuity, which means that waste management is carried out in a more modern way that does not cause negative impacts and is environmentally friendly so that it does not affect negatively on public health now or for future generations.

Based on these problems, it can be said that waste management in the community has not been carried out optimally or the management is not fully environmentally friendly so that it can have a negative impact on humans and the environment. The government has provided a policy on environmentally friendly waste management, but it is less detailed about how to manage it and existing practices in the community have not been able to be carried out properly as expected by all parties.

One problem that has not been solved until now is the management of waste at the Piyungan landfill which always accumulates every time. The waste that accumulates in Piyungan landfill cannot be decomposed because there is already too much waste so that only neglect is carried out without sustainable waste processing. The role of the Provincial Government of the Special Region of Yogyakarta is needed to take the right steps so that it is immediately resolved so that it does not become a protracted problem and always repeats itself every time. Therefore, research needs to be carried out with the title "Legal Policy on Environmentally Friendly Waste Management". The problems as described in the background create a formulation of problems related to how the proposed concept of waste management policy at the Piyungan Final Disposal Site is a good solution with the right policy so that there is no accumulation. The next problem formulation is about how the government's solution is related to environmentally friendly waste management so that waste that can be decomposed or recycled can be implemented so that not all waste must be disposed of in landfills.

## II. METHODS

The research method used is normative legal research method, by collecting library data. The results written in this study are the result of primary normative data collection obtained from Law Number 32 of 2009 concerning Environmental Protection and Management and Law No. 18 of 2008 concerning Waste Management. In addition, it also comes from regulations regarding waste that apply in DIY. Secondary normative materials are obtained from library materials regarding the theory of waste and environmentally friendly management, legal principles applicable in Indonesia regarding waste management, results of previous studies, expert opinions on a healthy environment and environmentally friendly waste obtained from related book journals.

## III. RESULT AND DISCUSSION

Article 28H paragraph (1) of the 1945 Constitution of the Republic of Indonesia states that "Every person has the right to live in physical and spiritual prosperity, to have a place to live, and to have a good and healthy environment and to receive health services." Law No. 39 of 1999 on Human Rights Article 9 paragraph (3) affirms that "Everyone has the right to a good and healthy environment". Law of the Republic of Indonesia No. 32 of 2009 on Environmental Protection and Management Article 65 paragraph (1) affirms that "Everyone has the right to a good and healthy environment as part of human rights." Everyone is obliged to maintain the preservation of environmental functions and prevent and overcome environmental pollution and destruction, in accordance with Article 6 Paragraph 1 UUPH.

A clean and healthy environment is one that has many positive impacts on human life and the ecosystem as a whole. The importance of a clean environment means that people can contribute to keeping their natural surroundings clean and sustainable. Environmental cleanliness involves responsible behavior towards waste, wise use of natural resources and participation in conservation efforts. Enforcement of environmental pollution laws is important to protect ecosystems, human health and the sustainability of human natural resources. Environmental law enforcement is an important element in maintaining environmental sustainability and protecting people's rights to live in a healthy environment. Strengthening the legal system, increasing sanctions and public awareness can help prevent and crack down on environmental crimes.

Waste is the residue of a business or activity that contains hazardous or toxic materials which, due to their nature, concentration, and amount, either directly or indirectly, can endanger the environment, health, human survival and other living things. Waste is divided into three parts, namely liquid waste, solid waste and gas waste.<sup>2</sup>

Solid waste is waste that has a solid form that is dry and cannot move. The majority of this solid waste does not produce a pungent odor but makes the scope of the full.<sup>3</sup> This solid waste is generated from food scraps, pieces of wood or dregs from industry. The classification of solid waste in each country varies depending on the type, form and composition of the waste. The general classification in each country is said to be almost the same.

---

<sup>2</sup> R. Srihadi Darmo Wihardjo dan Henita Rahmayanti, Pendidikan Lingkungan Hidup (Pekalongan: NEM, 2021), hal. 101.

<sup>3</sup> Ibid. hal 103

## Legal Policy on Environmentally Friendly Waste Management

Organic waste as semi-perishable solid waste because it is decomposed by microorganisms produced from leftover processed food, vegetable and fruit waste.<sup>4</sup> Organic waste that does not decompose is organic solid waste which is said to be very difficult to decompose by microorganisms, this waste is mostly produced from glass or plastic businesses. Ash waste is solid waste in the form of grayish ash produced from burning garbage and is easily carried by the wind and can become air pollution.<sup>5</sup> This waste is not easily decomposed. Star carcass waste is a solid waste that is also said to be easily decomposed by microorganisms but takes longer than organic waste. This animal carcass waste can be a problem in the event of a natural disaster because it easily decomposes and causes a very strong odor and sometimes becomes a source of disease. Sweep waste is solid waste from street sweeping that contains various scattered garbage from the streets. This street sweep waste is generated more in developing countries. Industrial waste is solid waste generated from industrial discharges, this waste depends on the type of industry. The more industries there are, the more waste is generated. This industrial waste has the highest potential to pollute the environment.

Liquid waste is waste that has a liquid form and is always soluble in water, easily moving places. Liquid waste is a mixture of water with various pollutants carried by water in a dissolved or suspended state from domestic sources, industrial sources and at certain times mixed with groundwater, surface water and rainwater.<sup>6</sup> This liquid waste is generally divided into liquid waste derived from human excreta (feces and urine), sewage (wastewater) and industrial waste (waste material from industrial residues).

Gas waste is waste in the form of gas seen in the form of smoke and is always in motion so that its spread is very wide and fast. The majority of this gas waste is controlled by the combustion of motorized vehicles and the disposal of smoke from industrial products.<sup>7</sup> Air is the most easily polluted medium for this waste gas.

It is important to reduce this waste through efforts to control, reduce emissions, and protect the environment. Unfavorable pollution has significant impacts on human health, biodiversity, and environmental sustainability. Therefore, pollution reduction measures, prudent waste management, and environmental protection policies are essential to maintain the quality of life and the earth's ecosystem.

The principles contained in Article 3 of Law of the Republic of Indonesia Number 18 of 2008 concerning Waste Management are organized based on the principle of responsibility, the principle of sustainability, the principle of benefits, the principle of justice, the principle of awareness, the principle of togetherness, the principle of safety, the principle of security, and the principle of economic value. Meanwhile, Article 4 of Law of the Republic of Indonesia Number 18 of 2008 concerning waste management aims to improve public health and environmental quality and make waste a resource. The actual accountability of the government is also part of the waste management in Article 5 The Central Government and Regional Governments are tasked with ensuring the implementation of good and environmentally sound waste management in accordance with the objectives as referred to in this Law.

Article 6 Law number 18 of 2008 The duties of the Central Government and Regional Government as referred to in Article 5 consist of:

- a. develop and increase public awareness in waste management;
- b. conducting research, development of waste reduction and handling technology;
- c. facilitating, developing, and implementing efforts to reduce, handle, and utilize waste;
- d. implementing waste management and facilitating the provision of waste management infrastructure and facilities;
- e. encouraging and facilitating the development of the benefits of waste processing results;
- f. facilitating the application of local specific technologies that develop in local communities to reduce and handle waste; and
- g. coordinating between government institutions, the community, and the business world so that there is integration in waste management.

Legal theory is a term that is often used as in legal science to explain the basic concepts of what is studied in legal science in the form of ideas and ideas theoretically in order to support legal dogmatics that are arranged to make law a fundamental thing in the running of human life in various times and eras. Legal theory etymologically comes from the word "Legal Theory" which comes from English and "Rechtstheorie" in Dutch, along with the development of legal science in various times, legal experts began to use several terms, namely some called it Legal Philosophy, Jurisprudence and legal theory. Legal scholars use these terms to define legal theory although there are some differences in these terms.

---

<sup>4</sup> Ibid. hal 103

<sup>5</sup> Ibid. hal 104.

<sup>6</sup> R. Srihadi Darmo Wihardjo dan Henita Rahmayanti, Pendidikan Lingkungan Hidup (Pekalongan: NEM, 2021), hal. 106.

<sup>7</sup> Ibid. hal 109.



## Legal Policy on Environmentally Friendly Waste Management

Legal Theory becomes the foundation for positive law in solving certain legal problems in accordance with the needs of the community where the law is jurisdictionally applicable. Legal theory is something that is value-free abstract and not normative in contrast to legal dogmatics which are concrete practical and contain perspective and normative values, in line with this, legal theory is also methodically different from legal science where legal theory analyzes by parsing, separating, peeling and discussing different and seeking the truth with what distinguishes the law from other rules. Legal theory if you see this explanation, it can be said that basically legal theory is a theory or theoretical ideas and ideas from legal science and it can be said that the object of legal theory is legal science where legal theory includes everything about the law not limited to the law that applies in a certain area and time.<sup>8</sup>

The requirements that must be completed in order to be called a legal theory are:

1. Contains the problem being studied;
2. Contains a certain method;
3. Contains a consistent set of statements<sup>9</sup>

Legal theory is a science characterized as an interdisciplinary science, which sees law from other disciplines. Legal theory has 3 roles, namely:

1. Rechtsleer is analyzing various kinds of understanding related to juridical law;
2. The relationship between logic and law;
3. Methodology in theoretical aspects and practical aspects.<sup>10</sup>

Benevolence is always related to the theory of utilitarianism popularized by Jeremy Bentham. Benevolence in the theory initiated is classified as an ethical theory that places behavior and actions that can be said to be good are actions that are useful, provide benefits and provide benefits, while actions that are not good will only provide distress and suffering.<sup>11</sup> Utilitarianism theory is to base every action taken by humans on actions or actions that direct and lead to the greatest possible happiness and avoid and reduce suffering.

Basic policies between society and government as an effort to regulate ethically good actions and provide benefits that are considered good for the wider community. So that the theory initiated by Jeremy Bentham is in line with the creation of a new concept of waste management policy in the Piyungan landfill area so that waste decomposition occurs properly and does not harm the community around the Piyungan landfill area.

Piyungan landfill facilitates waste disposal from Sleman Regency, Bantul Regency, and Yogyakarta City while the location of Piyungan landfill itself is in Bantul Regency. Sleman Regency has a Strategic Environmental Assessment as stipulated in UUPPLH No. 32 of 2009 (Article 15, paragraph 3) KLHS is implemented with a mechanism:

1. Assessment of the influence of Policies, Plans, and or Programs (KRP) on environmental conditions in an area.
2. Formulation of alternative improvements to Policies, Plans, and or Programs (KRP)
3. Recommendation of improvements for KRP decision making that integrates the principles of sustainable development.

In fact, the three mechanisms above need to be supported by a process, namely the Strategic Environmental Assessment process needs to be designed, so that during the process and the results can be truly effective and efficient in accordance with the objectives. Government policy in Strategic Environmental Assessment must involve the interests of the community both in the preparation and evaluation of Policies, Plans, and or Programs in realizing a more strategic environment.<sup>12</sup>

The Bantul Regency Government in waste management has the principle of reducing, utilizing, and recycling waste. Policies in reducing and handling household and similar waste are contained in Bantul Regent Regulation Number 156 of 2018 concerning Regional Policies and Strategies (JAKSTRADA), which has the following objectives:

1. Improving the performance of household and similar waste reduction by implementing norms and procedures, strengthening coordination and cooperation between the Central Government, Regional Governments, and Village Governments, and strengthening the commitment of business actors through the application of producer obligations in reducing household waste.
2. Improving the performance of household waste management by strengthening the commitment of the executive and legislative bodies of Bantul regency in preparing the budget for waste management.<sup>13</sup>

---

<sup>8</sup> Isharyanto, 2016, "Teori Hukum Suatu Pengantar dengan Pendekatan Tematik" (Jakarta..WR Penerbit) hal. 13

<sup>9</sup> Hasanah Uswatun dan Eny Suastuti. 2020. "Buku Ajar Teori Hukum". (Surabaya. Scopindo Media Pustaka) hal. 3

<sup>10</sup> Hasanah Uswatun dan Eny Suastuti. 2020. "Buku Ajar Teori Hukum". (Surabaya. Scopindo Media Pustaka) hal. 3

<sup>11</sup> Pratiwi, Endang, Theo Negoro, dan Hassanain Haykal. 2022. "Teori Utilitarianisme Jeremy Bentham: Tujuan Hukum atau Metode Pengujian Produk Hukum". Jurnal Ilmiah Hukum 2, No. 3. hal 274.

<sup>12</sup> Laporan Akhir Kajian Lingkungan Hidup Strategis Rencana Pembangunan Jangka Menengah Kabupaten Sleman Tahun 2021-2024

<sup>13</sup> Laporan Akhir Kajian Lingkungan Hidup Strategis Rencana Pembangunan Jangka Menengah Kabupaten Bantul Tahun 2021-2024.

## Legal Policy on Environmentally Friendly Waste Management

The Yogyakarta City Government in waste management is managed by the Environmental Agency, which explains that it has policies in reducing and handling household waste in strategic plans and designs with waste reduction, providing facilities and infrastructure for waste reduction and handling from waste sources to landfills, development plans and utilization of environmentally friendly technology in meeting the needs of reusing, recycling, and final handling.

Poor waste management practices can have a negative impact on the environment. A lot of waste management carried out by the government or the community is not optimal or environmentally friendly, thus disturbing the state of a healthy environment. Cases that occur today related to poor waste management such as littering and waste management can cause a number of environmental and public health problems. In addition to damaging the environment, pollution due to poorly managed waste can have a negative impact on human health with the onset of various diseases.

Dumping waste into rivers, for example, can have a number of detrimental effects both for the river environment itself and for the people who rely on the river, especially during the rainy season. Garbage that is dumped in the river can be carried from the river to the ocean and create a buildup in the sea and even a buildup on the beach. Garbage that accumulates in the river can block the flow of the river and cause flooding. In addition to the river, garbage disposal that is not in its place can spoil the scenery around, cause unpleasant odors, and can cause flooding because of the accumulation of garbage, garbage can also bring various diseases and pollute the environment.

Littering can cause ecological damage and spread disease. Waste management that is burned can have an impact on air pollution and cause health problems, especially for respiratory health. Burning waste will still leave traces of the combustion results, especially from plastic waste, so burning waste will not solve the problem of waste management or destruction.

Waste disposal that is currently always done by the government is to facilitate landfills as the end of the waste management chain. The final waste disposal system is on a large scale every day but cannot break down the waste properly, only the collection and accumulation of waste, this system uses an urug system that will always increase in the future. Waste management systems like this will cause many major environmental problems for local residents, namely being disturbed by diseases caused by garbage, smelling strong odors and can disturb the quality of groundwater which becomes discolored and smelly.

Some cases of poor waste management practices can be concluded that poor waste management can have a negative impact on the environment and human health. Therefore, an appropriate legal policy is needed in environmentally friendly waste management to maintain the sustainability of the environment. Waste management in the Piyungan landfill has shortcomings if the gas produced from the waste collected in that place is not managed properly so that it can pollute the air. Piyungan landfill in managing leachate water is not maximized so that the resulting water quality standards can exceed the water quality standards. Leachate is water that seeps or drips through waste in landfills or waste disposal sites (TPS). This water is often impure or contaminated by substances present in the waste, and can contain compounds that are harmful to the environment and human health. Poor compost processing can cause a number of problems, both in terms of the quality of compost output, process efficiency, and environmental impact.

Addressing these issues, it is important to implement optimal compost processing practices. Thus, the resulting compost can be a high-quality and sustainable organic fertilizer. Cows in landfills are not given enough attention, which is a form of disrespect for other living things.

The Special Region of Yogyakarta is one of the provinces that is still experiencing waste management or waste disposal due to limited landfills. This problem certainly affects activities in Yogyakarta Province itself, especially in terms of cleanliness, namely because of the difficulty of managing waste and the lack of landfills. Waste management aims to move waste from the place to the Final Processing Site (TPA) so that it does not endanger the environment. According to Law No. 18 of 2008, each local government has the task of carrying out waste management and facilitating the provision of waste management infrastructure and facilities. Waste management in the city of Yogyakarta and its surroundings is handled by each district/city. Piyungan Landfill is located in Bantul, Yogyakarta. As a final disposal site, Piyungan Landfill is responsible for accommodating and managing waste originating from Yogyakarta and surrounding areas.

Piyungan landfill has a very vital role because Piyungan landfill is not only the final disposal for the Bantul area, but the Yogyakarta City and Sleman Regency areas also dispose of waste in the same place. Therefore, Piyungan Landfill has a very heavy burden and often found various problems that until now have not found a solution strategy.

Waste disposal that is always problematic at any time that occurs in the DIY area should be of more concern to the Provincial Government as regulated in the Yogyakarta Special Region Regional Regulation Number 3 of 2013 concerning Management of Household Waste and Waste Similar to Household Waste. The technical management of Piyungan Landfill should only be able to operate for 10 years, this is as explained in Article 36 paragraph (2) of the Minister of Public Works Regulation Number 3/PRT/M/2013 concerning the Implementation of Waste Infrastructure and Facilities in Handling Household Waste and Waste Similar to Household Waste which states that "The technical life of the landfill is at least 10 (ten) years". It is calculated that the

## Legal Policy on Environmentally Friendly Waste Management

Piyungan Landfill in 2016 should no longer be operated. The current landfill is no longer able to accommodate the large amount of waste that arrives every day and is increasing in volume.

The phenomenon of increasing waste not accompanied by the addition of landfills has a bad effect on residents around the landfill who have complained about the smell and pollution of their air and groundwater. The government should provide appropriate legal assertiveness about legal policies related to waste management so that there is no accumulation of too large a volume.

### IV. CONCLUSION

Based on the data above, the following conclusions can be drawn:

The condition of waste management in Piyungan landfill should be taken over by Bantul Regency, then Yogyakarta City and Sleman Regency can find a place in their respective areas and provide direction to the community to be able to manage household waste independently by being given training by the government by cooperating with competent parties in their fields.

The government policies of Sleman, Bantul and Yogyakarta City in waste management each have Strategic Environmental Studies in strategies in household waste management but in the final stage all household waste continues to accumulate at the Piyungan landfill without independent management in each household.

Meanwhile, the recommendations that can be given are as follows, the provision of new land for two districts outside the bantul district so that there is no accumulation of waste in Piyungan which is in the bantul district. The Yogyakarta City Government, which is said to be a very densely populated area and there is no vacant area to make a final landfill, can be recommended to cooperate with Sleman Regency to find a final landfill, besides that, residents of Sleman Regency and Yogyakarta City are educated to process their own organic and non-organic household waste.

The processing of organic waste that can be done is by collecting leftover foodstuffs or food waste in one place to be used as maggot feed so that it decomposes. Non-organic waste processing can be recycled such as pots, bags or plastic flowers as decoration.

### ACKNOWLEDGMENT

Thank you to the founders and co-founders of the Faculty of Law, Atma Jaya University Yogyakarta. Mrs. Theresia Anita Chsritiani, Mrs. Sundari and Mr. Hyronimus Rheti as lecturers of the Faculty of Law, Atma Jaya University Yogyakarta who have helped the process of writing this scientific work.

### REFERENCES

- 1) Agung Suprihatin, 2013, "Pengantar Pendidikan Lingkungan Hidup", Cetakan I, Gava Media. Yogyakarta
- 2) Asti M. S. Dan Sulistyawati. (2014). Keberadaan TPS Legal dan TPS Illegal di Kecamatan Godean Kabupaten Sleman. *Jurnal Kesehatan Masyarakat*
- 3) Cecep, Dani Sucipto. 2012. *Teknologi Pengolahan Daur Ulang Sampah*. Semarang: Gosyen Publishing
- 4) Hasanah Uswatun dan Eny Suastuti. 2020. "Buku Ajar Teori Hukum". (Surabaya. Scopindo Media Pustaka)
- 5) Isharyanto, 2016, "Teori Hukum Suatu Pengantar dengan Pendekatan Tematik" (Jakarta..WR Penerbit)
- 6) Kusminah, Imah Luluk. *Penyuluhan 4R (Reduce, Reuse, Recycle, Replace) Dan Kegunaan Bank Sampah Sebagai Langkah Menciptakan Lingkungan Yang Bersih Dan Ekonomis Di Desa Mojowuku Kabupaten Gresik*. *Jurnal Pengabdian Masyarakat LPPM Untag Surabaya*
- 7) Laode m Syarif, dan andri g wibisana, 2014, *hukum lingkungan teori, legislasi, dan studi kasus*, ISBN, Jakarta Selatan
- 8) Masrudi Muchtar , Abdul Khair, dan Noraida, 2016, "Hukum Kesehatan Lingkungan", Pustaka Baru Press. Yogyakarta
- 9) Mulasari A., Heru H. A., & Muhadjir N. (2016) *Analisis Situasi Permasalahan Sampah Kota Yogyakarta dan Kebijakan Penanggulangannya*. *Jurnal Kesehatan Masyarakat*
- 10) Pratiwi, Endang, Theo Negoro, dan Hassanain Haykal. 2022. "Teori Utilitarianisme Jeremy Bentham: Tujuan Hukum atau Metode Pengujian Produk Hukum". *Jurnal Ilmiah Hukum* 2, No. 3
- 11) Srihadi Darmo Wihardjo dan Henita Rahmayanti, *Pendidikan Lingkungan Hidup (Pekalongan: NEM, 2021)*
- 12) Safira Firda Ariyani, Hijrah Purnama Putra, Kasam "EVALUASI PENGELOLAAN SAMPAH DI TPA PIYUNGAN, KABUPATEN BANTUL" 2008
- 13) Undang-Undang Dasar Negara Republik Indonesia Tahun 1945
- 14) Undang-Undang Republik Indonesia Nomor 32 Tahun 2009 Tentang Perlindungan Dan Pengelolaan Lingkungan Hidup
- 15) Undang-Undang No. 18 Tahun 2008 tentang Pengelolaan Sampah

## Legal Policy on Environmentally Friendly Waste Management

- 16) Peraturan Menteri Pekerjaan Umum Nomor 3/PRT/M/2013 tentang Penyelenggaraan Prasarana dan Sarana Persampahan dalam Penanganan Sampah Rumah Tangga dan Sampah Sejenis Sampah Rumah Tangga
- 17) Peraturan Daerah Daerah Istimewa Yogyakarta Nomor 3 Tahun 2013 Tentang Pengelolaan Sampah Rumah Tangga dan Sampah Sejenis Sampah Rumah Tangga
- 18) Peraturan Gubernur Daerah Istimewa Yogyakarta No 16 Tahun 2021 Tentang Kebijakan dan Strategi DIY dalam Pengelolaan Sampah Rumah Tangga dan Sampah Sejenis Rumah Tangga
- 19) Laurensius Arliman S, "Eksistensi Hukum Lingkungan Dalam Membangun Lingkungan Sehat Di Indonesia", *Lex Librum: Jurnal Ilmu Hukum* 5, no. 1 (2018): 761-770.
- 20) M.Yasir Said & Yati Nurhayati, "Paradigma Filsafat Etika Lingkungan Dalam Menentukan Arah Politik Hukum Lingkungan", *Al'Adl* 12, no. 1 (2020): 39-60.
- 21) Laporan Akhir Kajian Lingkungan Hidup Strategis Rencana Pembangunan Jangka Menengah Kabupaten Sleman Tahun 2021-2024.
- 22) Laporan Akhir Kajian Lingkungan Hidup Strategis Rencana Pembangunan Jangka Menengah Kabupaten Bantul Tahun 2021-2024.
- 23) Republik Indonesia, Undang-Undang No 10 Tahun 2012 tentang Pengelolaan Sampah Pasal 13.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## Childfree, an Existentialist Feminist Perspective: A Critical Discourse Analysis of Youtube Cretivox Content '*Mending Punya Anak Atau Tidak Punya Anak???*'



Nurul Khoiriyah<sup>1</sup>, Diana Anggraeni<sup>2</sup>, Muhamad Rosit<sup>3</sup>, Mashadi Said<sup>4</sup>

<sup>1,2,3,4</sup> Faculty of Communication, Universitas Pancasila

**ABSTRACT:** This research explores the phenomenon of Childfree as a life choice, particularly within the context of the 21st century. Despite the increasing number of women opting to live without children voluntarily, society often perceives this choice as a deviation from women's inherent nature. The objective of this research is to examine how the childfree discourse is portrayed in Cretivox's YouTube content titled "*Mending Punya Anak Atau Tidak Punya Anak???*" (Is it better to have children or not to have children???) from an existentialist feminist perspective. To achieve this goal, the research employs Norman Fairclough's critical discourse analysis model within a qualitative descriptive approach. The findings of the research reveal that Cretivox frames the childfree issue as an individual's life choice deserving respect within the private sphere, free from judgment. The producer, Cretivox, advocates for childfree content as a means to counteract the social stigma associated with choosing not to have children. This aligns with the existentialist feminist viewpoint of Simone de Beauvoir, emphasizing that women's destinies should not be dictated by biological factors, and they should maintain control over their bodies.

**KEYWORDS:** childfree, critical discourse analysis, existentialist feminism

### INTRODUCTION

The term "childfree" originated in Western countries during the 1970s. However, the phenomenon itself dates back to the 1930s in the United States, emerging as a response to the challenges posed by the Great Depression or malaise crisis, resulting in widespread economic devastation (Chrastil, 2020, p. 85). The economic hardships of the time had a profound impact on family life in the United States, compelling couples to delay marriage and causing a significant decline in birth rates—marking a notable historical occurrence (Pells & Romer, 2023). This period of economic depression not only influenced family planning decisions but also contributed to the birth of the childfree phenomenon. Interestingly, the childfree discourse bears resemblance to the trajectory of feminism, which advocates for gender equality and women's freedom rights (Smith & Robinson, 2022, p. 9). In essence, the childfree movement can be seen as aligning with the broader pursuit of equality and individual autonomy characteristic of feminist ideals.

The childfree phenomenon in Indonesia gained prominence as a topic of discussion following a notable statement by influencer Gita Savitri Devi in 2018. The conversation resurfaced on February 7, 2022, when she asserted on Instagram that choosing to live without children was a key to eternal youth (Raizza, 2023). This declaration stirred diverse reactions among netizens, sparking both support and dissent.

Numerous studies have delved into the childfree trend in Indonesia. For instance, Rizka et al. (2021) revealed that couples' decisions to embrace a childfree lifestyle stem from various factors such as a lack of motivation for parenthood, financial considerations, pursuit of professional goals, physical health concerns, and personal beliefs aligning with concerns about overpopulation. Cornellia et al. (2022) approached childfree from the perspective of Jean-Paul Sartre's utilitarianism and existentialism, arguing that it is a legitimate choice as it pertains to individual rights and interests. Meanwhile, Jenuri et al. (2022) explored the generational divide, finding that 58.7% of Generation Z held a contra stance. They believe that the childfree choice contradicts the essence of womanhood, disrupts generational continuity, and is inconsistent with religious norms, viewing children as a divine gift. Furthermore, except for health-related considerations, they perceive childfree decisions as selfish.

Moreover, research conducted by Nugroho et al. (2022) underscores the significant impact of the feminist movement on the lives of Japanese women. The waning influence of patriarchal culture has paved the way for the acceptance of a childfree

## **Childfree, an Existentialist Feminist Perspective: A Critical Discourse Analysis of Youtube Cretivox Content 'Mending Punya Anak Atau Tidak Punya Anak???'**

and unmarried lifestyle, positioned as a practical response to the high cost of living and the challenges faced by couples in meeting their basic needs.

In a parallel vein, Huda's (2022) study highlights that indicators of the childfree movement have manifested through campaigns, signaling a resistance to constraining women's biological or natural freedom. Cornellia et al. (2022), examining the issue from the perspectives of utilitarianism and existentialism, argue that choosing a childfree lifestyle is permissible as it aligns with women's freedom and broader human rights.

Furthermore, Mingkase & Rohmaniyah's (2022) research delves into the gender construction inherent in the childfree discourse, still considered taboo within the public sphere. Utilizing virtual ethnography, the study reveals that while the concept of childfree living is relatively recent in Indonesia, it has been discreetly practiced by some individuals in private. Due to societal norms, childfree couples often refrain from openly discussing their choice, as it is perceived as deviating from cultural expectations.

The preceding research findings primarily elucidate the reasons behind couples choosing not to have children. However, the current study places a specific emphasis on the childfree discourse within the framework of existential feminism as portrayed in Cretivox's YouTube content, "*Mending Punya Anak Atau Tidak Punya Anak???*" (Is It Better to Have Children or Not Have Children??"). The central inquiry guiding this research is: How is the childfree discourse articulated through the lens of existentialist feminism in Cretivox's YouTube content?

This research aims to contribute valuable insights to the ongoing public discourse on the concept of childfree living, particularly as it unfolds in the dynamic landscape of social media. Additionally, the study aspires to foster awareness among the public regarding the diverse choices and perspectives surrounding the decision to be childfree, emphasizing the deeply personal nature of this choice. The ultimate goal is to promote understanding and respect for individual freedoms and choices in the realm of family planning.

### **THEORETICAL BACKGROUND**

The theoretical framework underpinning this research comprises two integral components: Simone de Beauvoir's existentialist feminism and the childfree phenomenon. Simone de Beauvoir's existentialist feminist perspective serves as a guiding lens, providing a philosophical foundation to analyze and interpret the content. This approach emphasizes the autonomy and agency of women, asserting that their destinies are not predetermined by biological factors. Concurrently, the study delves into the childfree phenomenon, exploring the motivations and implications associated with choosing a lifestyle that consciously eschews parenthood. By combining these theoretical strands, the research seeks to unravel the nuances of the childfree discourse within the existentialist feminist framework as portrayed in Cretivox's YouTube content, "*Mending Punya Anak Atau Tidak Punya Anak???*" (Is It Better to Have Children or Not Have Children??").

#### **Simone de Beauvoir's Existentialist Feminism**

Existentialist feminism, originating from the seminal work of French writer and feminist Simone de Beauvoir in 1949, is articulated in her groundbreaking book "The Second Sex." In this work, de Beauvoir contends that societal norms traditionally assign marriage as the destined path for women. She identifies two primary reasons for this imposition: first, women are expected to provide offspring for society, and second, they are deemed essential for fulfilling men's sexual needs and managing household responsibilities in return (Mahon, 1997, pp. 130-131).

The portrayal of marriage has been markedly different for men and women. Despite their interdependence, this relationship lacks reciprocity, with women never achieving an equal footing with men (Beauvoir, 2011, p. 453). According to tradition, children are seen as conferring concrete autonomy to a wife, freeing her to pursue other aspirations. The narrative suggests that if a woman is not regarded as a complete individual in the role of a wife, becoming a mother becomes a justifiable rationale. De Beauvoir posits that women attain sexual and social self-realization through the presence of children, imbuing the institution of marriage with meaning and purpose (Beauvoir, 2011, p. 573).

Mahon (1997, p. 132) encapsulates Simone de Beauvoir's viewpoint, emphasizing that de Beauvoir observed the simultaneous occurrence of sexual and reproductive functions in men, ensuring pleasure in the execution of these roles. In contrast, women experience the challenge of pregnancy following sexual union, adding a layer of complexity to their reproductive processes.

De Beauvoir (2011, p. 57) underscores the significance of the biological aspect, acknowledging the role of the body as a crucial medium through which individuals interact with the world. However, she rejects the notion that biological data alone dictate

## **Childfree, an Existentialist Feminist Perspective: A Critical Discourse Analysis of Youtube Cretivox Content 'Mending Punya Anak Atau Tidak Punya Anak???'**

a fixed destiny for women. De Beauvoir argues that such data are insufficient to establish a sexual hierarchy, explain the perpetual relegation of women to the status of "Other," or justify their subjugation.

Examining the psychoanalytic perspective, de Beauvoir challenges the idea that women are envious of the penis as a symbolic representation of male power. Instead, she contends that women desire the material and psychological privileges associated with being male. According to de Beauvoir (Mahon, 1997, p. 118), women's identities cannot be solely defined by their consciousness of femininity; this consciousness is shaped within the societal context they inhabit. Psychoanalysis, according to de Beauvoir (2011, p. 72), falls short in explaining why women are perpetually labeled as the "other." For de Beauvoir (2011, p. 74), women should be understood as individuals seeking value in a world intricately connected to economic and social structures.

The historical materialist perspective, rooted in pre-historical and ethnographic research, sheds light on the historical oppression of women, establishing a gender hierarchy (Mahon, 1997, p. 121). This perspective is exemplified in Bebel's work on "Women and the Proletariat," highlighting the interconnected fate of women and socialism. The challenges women face, often centered around their ability to work, draw parallels between the oppression based on gender differences and that arising from class inequality. Simone de Beauvoir emphasizes that there is no biological justification for class distinctions, and the proletarian goal is the elimination of class (Beauvoir, 2011, p. 79).

De Beauvoir (Mahon, 1997, p. 141) contends that a woman may have personal reasons for desiring a child, but she cannot have a reason for the child's existence. Two prevalent prejudices challenge de Beauvoir's thinking. Firstly, the notion that motherhood inherently provides complete happiness for women is refuted by de Beauvoir, who observes that many mothers are unhappy and dissatisfied. Secondly, the belief that children must be happy in their mothers' arms is debunked, as de Beauvoir notes the complex and challenging nature of the parent-child relationship (Mahon, 1997, p. 147).

Forced motherhood, according to de Beauvoir (2011, p. 539), results in the birth of neglected and unhappy children or those who become victims of community assistance. She offers practical advice for mothers, suggesting that it would be beneficial for the child if the mother is a complete individual in society, finding identity in work and self-realization rather than seeking control through descendants. Additionally, de Beauvoir recommends entrusting the child to its parents (Mahon, 1997, p. 148).

### **Childfree**

According to Merriam-Webster's online dictionary, the term "childfree" first appeared before 1901. It's crucial to distinguish "childfree" from "childless." "Childfree" denotes the voluntary choice to live without children as a lifestyle, while "childlessness" refers to a couple wanting children but facing reproductive challenges due to illness, physical disorders, or other factors (Tunggono, 2021, pp. 17-18).

Tunggono (2021, pp. 21-39) categorizes the reasons for choosing a childfree lifestyle into five groups, as articulated by Corinne Maier:

- a. **Personal (emotional and inner realm):** Arising from past experiences, such as witnessing issues within one's family (mental or physical conditions).
- b. **Psychological and medical:** Psychological reasons are linked to the subconscious mind, including trauma, while medical reasons are associated with physical limitations.
- c. **Economic:** The most pragmatic factor, considering the substantial costs involved in childbirth and child-rearing.
- d. **Philosophical:** Related to an individual's perspective on their own life or life in general.
- e. **Environmental:** Rooted in the living environment, practitioners of childfree living believe that the Earth's human population is already substantial, and further growth could have devastating consequences.

According to Defago, the childfree lifestyle exists amidst what he terms as "parental propaganda." The perceived selfishness in choosing not to have children, as described by Defago, lies not in living as one wishes but in expecting others to conform to one's lifestyle choices. Defago outlines ten assumptions often made about individuals who choose to live childfree (2005, pp. 36-43):

- a. It would be selfish not to have children: Defago argues against this assumption, contending that parents have children for personal fulfillment rather than for the greater good of society.
- b. People who do not have children are considered abnormal: The notion that women who choose not to have children are abnormal due to societal expectations about women and motherhood is challenged.
- c. There will be no one to take care of you when you get old: Childfree individuals often reject the idea of having children as a form of insurance against old age, viewing it as a selfish and flawed reason.
- d. Choosing a career over children: Childfree couples are sometimes stigmatized for prioritizing careers, but their choice often leads to success and a better quality of life.

## Childfree, an Existentialist Feminist Perspective: A Critical Discourse Analysis of Youtube Cretivox Content 'Mending Punya Anak Atau Tidak Punya Anak???'

- e. Childless women are considered cold and unnurturing: The assumption that childfree women are not ready for or capable of assuming motherly roles is challenged.
- f. Childfree decisions will change when you get older: Childfree individuals may choose to adopt or remain childfree as they approach menopause, countering the assumption that decisions are bound to change.
- g. Childfree people are perfectionists who 'can't handle' children: The perception that childfree individuals are perfectionists who avoid children to maintain a perfect life is addressed.
- h. Life doesn't need to change when you have children: The assumption that couples can maintain the same lifestyle after having children is discussed, challenging the notion that life remains unchanged.
- i. Having your own child will feel different: The assumption that having biological children is fundamentally different from other loving relationships is contested.
- j. Life without children would be empty and unfulfilling: The belief that children are necessary for a fulfilling family life is questioned by those who find fulfillment without having children.

### METHOD

This research adopts a critical paradigm, emphasizing value-based activism for human empowerment and addressing distortions at both fundamental and surface levels (Neuman, 2016, p. 123). Employing this paradigm, the study aims to uncover the reality of the childfree phenomenon through the lens of Simone de Beauvoir's existentialist feminism. The research utilizes a descriptive qualitative approach to comprehensively interpret the childfree discourse within Cretivox's YouTube content, titled "*Mending Punya Anak Atau Tidak Punya Anak???*" (Is It Better to Have Children or Not Have Children???). Data collection involves observation and the extraction of relevant text segments from the videos. In-depth interviews with Cretivox Producers and a female activist from Konde.co supplement the data gathered. Additionally, a literature study gathers information from diverse sources, including literature, newspapers, and previous research. For rigorous data analysis, the research employs Norman Fairclough's critical discourse analysis model. This model, divided into three dimensions—text (representation, relationships, identity), discourse practice, and sociocultural practice (situational, institutional, social)—provides a comprehensive analytical framework for exploring the childfree discourse presented in the YouTube content.

LEVEL	METHOD
Text (Representation, Relationship, Identity)	Critical linguistics: The researchers analyzed the construction of the childfree issue in Cretivox's YouTube content " <i>Mending Punya Anak Atau Tidak Punya Anak???</i> " focusing on language use, the relationship dynamics between Cretivox, sources (participants), and the audience, as well as the construction of identities for Cretivox and the sources within the content.
Discourse Practice (Production)	In-depth interview: The researchers conducted in-depth interviews with Adinda, the content producer at Cretivox, responsible for the entire production process. These interviews aimed to uncover patterns and routines related to media work, exploring the process and background of content creation shaping the discourse on childfree.
Sociocultural Practice (Situational, Institutional, Social)	Literature study, historical search, and interviews: The researchers examined discourse texts on the childfree issue, considering situational aspects in Indonesia during content creation. They explored the influence of organizational institutions, both internal and external to Cretivox, in determining the content production process. The study also observed how the childfree discourse in Cretivox was shaped by broader social contexts and societal changes.

Norman Fairclough aims to bridge micro-level text analysis with a larger social context, specifically emphasizing sociocultural practice. At the discourse practice level, in-depth interviews with the editorial team become essential, as highlighted by Eriyanto (2001, p. 326). Fairclough's model underscores the complexity of media discourse, positing that what appears in the text is the culmination of a multifaceted process. This intricate process unfolds on two fronts: within the editorial room or media institution and within the broader societal structure (Eriyanto, 2001, pp. 327-238).

### Text Dimension

In terms of text dimensions, the research concentrates on three key aspects: representation, relationships, and identity.

- a. **Representation:** The analysis delves into the issue of childfree as portrayed in Cretivox's YouTube content show "*Mending Punya Anak Atau Tidak Punya Anak???*" This involves a scrutiny of language use, encompassing expressions, grammar, and



## Childfree, an Existentialist Feminist Perspective: A Critical Discourse Analysis of Youtube Cretivox Content 'Mending Punya Anak Atau Tidak Punya Anak???'

metaphors related to the presence of children in marriage, as well as a woman's autonomy over her body as the bearer of the womb.

- b. **Relationships:** At the realization stage, the research explores the dynamics between the Cretivox team, the audience, and the four sources within the content. The focus of this relationship analysis is on patterns between the actors involved, observed directly from the text.
- c. **Identity:** In the identity stage, the researchers investigate the identities of Cretivox, sources, and audiences as depicted and constructed in the content. These identities play a pivotal role in shaping how the text is created, the nature of questions posed by Cretivox to the sources, and the manner in which the sources respond to these inquiries.

### Dimensions of Discourse Practice

The discourse practice dimension centers on the production and consumption of texts, emphasizing three crucial areas in the analysis.

- a. **Text Creator's Perspective:** This aspect considers the background, political stance, economic factors, values, and beliefs of the text creator (Fairclough, 1995, p. 48). Understanding these initial considerations provides insights into the shaping of the discourse on childfree issues.
- b. **Interaction with Media Organizational Structures:** Researchers delve into the dynamics between Cretivox content producers and other production teams within the media organizational structure. This exploration aims to uncover the influence and control exerted by these structures on content production.
- c. **Media Patterns and Routines in Content Creation:** The process of text production involves numerous stages and individuals, including considerations for newsworthiness (Eriyanto, 2001, p. 319). This dimension scrutinizes the patterns and routines employed by Cretivox in creating content. An in-depth interview with Cretivox content producers was conducted to illuminate their work patterns and routines, offering insights into the process and background of content creation that shapes the discourse on childfree issues.

### DIMENSIONS OF SOCIOCULTURAL PRACTICE

The analysis of sociocultural practices operates on the premise that the broader social context outside the media significantly shapes the delivery of news. This dimension elucidates how prevailing ideologies are comprehended and communicated to the larger community within the societal forces at play (Fairclough, 1995, p. 50). While not directly tied to text production, sociocultural practice determines how texts are both produced and interpreted.

In data analysis, three levels of scrutiny are applied: situational, institutional, and social.

- a. **Situational or Social Context:** This level explores how elements of a social situation influence text creation. Researchers observed discourse texts regarding the childfree issue, considering situational aspects in Indonesia at the time of content creation.
- b. **Institutional Level:** This delves into how organizational institutions, whether from the media itself or external entities seen as institutions, influence the discourse in the produced text. Researchers observe the impact of organizational institutions, both internal to Cretivox and external factors, determining the content production process.
- c. **Social Level:** The discourse in the media is influenced by situations and changes in the broader social environment. This level concentrates on the political, economic, and cultural systems of society, along with the prevailing ideals. The researchers noted that the emergence of childfree discourse in Cretivox was shaped by the social context and societal changes.

### Validation of Findings

To ensure the validity of the findings, the researchers implemented source triangulation. This involved comparing the results derived from various sources of data collection, aligning with the three techniques employed in this research: documentation, interviews, and literature studies. The researchers meticulously cross-referenced the data obtained through text analysis, verifying its consistency across multiple sources to enhance the credibility and reliability of the research findings.

### RESULTS AND DISCUSSION

The Cretivox YouTube content titled "*Mending Punya Anak Atau Tidak Punya Anak???*" serves as a vehicle for communicating a specific message to its audience, employing language as a strategic tool. Utilizing Norman Fairclough's critical discourse analysis method, this research delves into three distinct dimensions: text, discourse practice, and sociocultural practice. The analysis of these dimensions aims to uncover the underlying meaning encoded within the text.

## Childfree, an Existentialist Feminist Perspective: A Critical Discourse Analysis of Youtube Cretivox Content 'Mending Punya Anak Atau Tidak Punya Anak???'

### Dimensions of Childfree Issue Construction

#### a. Element of Representation

Cretivox initiates the exploration of the childfree issue by posing a fundamental question to the four sources: whether they agree with the proverbial statement "*banyak anak, banyak rezeki*" (more children, more fortune). This adage suggests that each child brings its own blessings, implying that a greater number of children leads to increased prosperity. The first source, Ahmad Fauzi, aligns with this principle. However, his wife, Audy, expresses a differing perspective, emphasizing her agreement with the concept of family planning. The contrast in their statements sets the stage for the nuanced representation of diverse viewpoints on the childfree issue.

(AF: Ahmad Fauzi, AU: Audy)

AF: *Ee... banyak anak banyak rejeki setuju-setuju aja sih karena ketika kita memiliki anak, motivasi kita untuk mencari rejeki, mencari uang, itu akan lebih...semangat karena yaa itu tadi kita ada suatu motivasi yang harus kita penuhi tanggung jawabnya. Jadi, mau gak mau akhirnya ketika kita mencari lebih mencari lebih dan akhirnya yaa alhamdulillah.*

AU: *Kalau anaknya banyak?*

AF: *Eheheh motivasi lagi karena ada anak yang harus kita penuhin gitu.*

AU: *Prinsip KB itu dua anak cukup itu bener ehehe.*

(AF: Ahmad Fauzi, AU: Audy)

#### Translation:

AF: Well... many children, many blessings. I agree with that because when we have children, our motivation to seek fortune, to earn money, becomes stronger. That's because, as I mentioned earlier, we have a motivation that we need to fulfill our responsibilities. So, inevitably, when we search, we search more, and eventually, well, thank God.

AU: What if you have many children?

AF: *hehehe*, It's another motivation because there are children that we need to provide for.

AU: The family planning principle is that two children are enough, right?

Referring to the dialogue, the representation in the clause at the expression level centers around the word "motivasi" (motivation)," emphasized three times by Ahmad Fauzi. This term encapsulates his conscious drive to work diligently, driven by the motivation to provide for his children. It serves as a representation of his alignment with the notion of "many children, much fortune," viewing children as a source of motivation for hard work.

The expression "*mau ngga mau* (like it or not)" introduces a homonym with the same spelling and pronunciation but a different meaning. In this context, the phrase implies a sense of obligation and inevitability. Ahmad Fauzi subtly conveys that having children imposes a duty to strive for greater earnings, ultimately leading to sustenance.

In continuation of the discussion on whether they agree with the saying "*banyak anak banyak rezeki* (more children, more fortune)," the third and fourth speakers, Kei and Lilia, present contrasting views. As a childfree couple, they express disagreement with the adage, deeming it irrelevant in current conditions. For them, having many children is perceived as a financial burden, contradicting the traditional belief in increased blessings with more offspring. This stance is elucidated in the ensuing dialogue:

(KE: Kei, LI: Lilia, AF: Ahmad Fauzi, AU: Audy)

KE: *Itu mah zaman dahulu ya karena kan Indonesia negara agraris, jadi banyak yang bertani, jadi kalau punya anak banyak itu anaknya langsung di sawah.*

AF: *Langsung di sawah ya?*

KE: *Tenaga kerja gratisan gitu, jadi rame-rame tapi kalau jaman sekarang kita udah gak kaya gitu udah gak relevan si sebenarnya prinsipnya.*

LI: *Banyak anak malah banyak pengeluaran kali ya?*

AU: *Betul heheheheh.*

LI: *Iya ya?*

AU: *Betul sekali.*

#### Translation:

KE: That was in the past because Indonesia was an agrarian country, so many people were farmers. Having many children meant having extra hands to work in the fields.

AF: Directly in the fields?

KE: It was like free labor, so it was bustling, but nowadays, it's not like that anymore. It's not really relevant anymore, actually, the principle.

## Childfree, an Existentialist Feminist Perspective: A Critical Discourse Analysis of Youtube Cretivox Content 'Mending Punya Anak Atau Tidak Punya Anak???'

LI: Having many children means more expenses, right?

AU: Absolutely hehehe. LI: Is that so? AU: Absolutely right

The representation in the clause leads to the expression "*zaman dahulu* (in the past)," voiced by Kei. This phrase amalgamates "*zaman* (era)," denoting a lengthy period marking a significant historical context, and "*dahulu*," signifying a time long ago. The combination conveys the denotational meaning that the principle "*banyak anak banyak rezeki* (more children, more fortune)" is outdated and no longer applicable in the current era. Kei's rejection of this principle emphasizes the disparity between traditional beliefs and the conditions of modern times.

The representation in a combination of clauses leads to the coherence within the statement "*karena kan Indonesia negara agraris, jadi banyak yang bertani, jadi kalau punya anak banyak itu anaknya langsung di sawah* (because Indonesia is an agricultural country, so many people farm, so if you have a lot of children, the children go straight to the fields)." This sentence elucidates that the origin of the saying "many children, much fortune" is rooted in Indonesia's historical status as an agricultural country, where children were integral to labor in the fields. It provides insight into the historical context shaping traditional beliefs about the correlation between offspring and prosperity.

Lilia's expression "*banyak pengeluaran* (a lot of expenses)" combines "*banyak* (a lot)," denoting a substantial quantity, with "*pengeluaran* (expenses)," referring to everything objectified as costs. In essence, Lilia communicates that having many children results in increased expenses, rejecting the principle "*banyak anak banyak rezeki* (more children, more fortune)."

The second question posed by Cretivox pertains to the interviewees' opinions on the importance of having children. Audy and Ahmad Fauzi, as a couple with children, affirm the significance of having children, providing reasons behind their viewpoint. However, Audy prefaces her response by stating that having children is a personal life choice. This sentiment is captured in the ensuing dialogue:

(AF: Ahmad Fauzi, AU: Audy)

AF: Mommy dulu yang jawab.

AU: Ya itu tergantung pilihan masing-masing sih ya (sambil melihat ke arah Lilia).

AU: Kalau menurut aku penting, kalau buat aku ya karena aku suka anak-anak hehe.

### Translation:

AF: Mommy answered that before.

AU: Well, it depends on each person's choice (while looking at Lilia).

AU: In my opinion, it's important. For me, because I love children hehe.

The representation in the clause leads to the expression "*tergantung pilihan masing-masing* (it depends on each individual's choice)," conveying Audy's perspective that the decision to have children or not is a personal choice made by each individual. In articulating her argument, Audy directs her gaze at Lilia, demonstrating an effort to express her opinion without causing offense to Lilia as a childfree individual. The representation in the combination of subordinate clauses leads to the coherence encapsulated in the statement "*karena saya suka anak hehe* (because I like children hehe)." This sentence encapsulates the reality that Audy finds the importance of having children in domestic life rooted in her genuine affection for children.

AF: Sama buat aku juga penting, setidaknya apa ilmu yang pernah kita dapet bisa diteruskan untuk anak-anak kita.

KE: Antara penting dan enggak sih sebenarnya, memang kan kita pengen punya legacy gitu kan tapi kalau dipikir juga manusianya juga udah banyak, zaman sekarang gitu loh terus juga tanggung jawabnya besar dan segala macam. Jadi, bukan dibilang punya keturunan itu tidak penting, cuma mungkin orang bisa memilih gak punya anak lah, bukan berarti itu gak penting yah. Cuma buat kita kayanya lebih baik gak usah punya anak aja.

### Translation:

AF: For me, it's important too. At least, whatever knowledge we've gained can be passed on to our children.

KE: It's actually between being important and not. We do want to have a legacy, but considering there are already so many people, and in this era, the responsibilities are significant and all. So, it's not like having descendants is not important; it's just that people can choose not to have children, and it doesn't mean it's not important. For us, it seems better not to have children.

The representation in the grammatical level clause is evident in the form of a process that generates action in the sentence "*setidaknya ada ilmu yang pernah kita dapet bisa diteruskan untuk anak-anak kita* (at least what knowledge we have gained can be passed on to our children)." This sentence signifies that Ahmad Fauzi deems children important because through them, the knowledge possessed by parents can be taught and passed on to the next generation. This perspective is rooted in religious factors, as Ahmad Fauzi, a follower of Islam, emphasizes knowledge as a form of intangible inheritance for his children. In Islam, there is a hadith stating that when a person dies, their practices end, unless one of them is beneficial knowledge.

## Childfree, an Existentialist Feminist Perspective: A Critical Discourse Analysis of Youtube Cretivox Content 'Mending Punya Anak Atau Tidak Punya Anak???'

The phrase "*antara penting dan nggak* (between important and not)" uttered by Kei indicates his hesitation in determining the importance of having children. His use of the term "legacy" reflects the concept of heritage. Additionally, Kei's statement "*manusianya juga udah banyak* (there are already a lot of people)" suggests that environmental factors influenced their decision to be childfree. The decision not to reproduce is seen as a way to mitigate the impact of overpopulation on Earth. The phrase "*tanggung jawab besar* (the responsibility is great)" implies the immense responsibility associated with bearing and raising children. From Kei's statement, it can be inferred that personal factors, such as their unpreparedness for the responsibilities of parenthood, influenced their choice to be childfree. Kei emphasizes that choosing not to have children is a valid life choice, acknowledging that people can make this decision without diminishing the importance of having children for others.

The third question posed by Cretivox focuses on the belief that having children "*memiliki anak akan menjamin di masa tua* (have a child guarantees life in old age)." Ahmad Fauzi and Audy, as parents, express that they do not expect their children to reciprocate their kindness in old age. Instead, their priority is to provide the best upbringing and support for their children.

(AU: Audy, AF: Ahmad Fauzi)

AU: *Kita jangan bergantung aja si sama anak, kalau menjamin si kalau anak itu pasti dia punya kehidupan masing-masing ya nantinya cuman kalau kita ngedidiknya bener, aku liat contoh suami ku ya dia tuh lebih perhatian ke ibunya tapi dia juga terus fokus sama keluarganya gitu, jadi tergantung cara didik kita juga nanti ke anak-anak gimana kita udah full kasih dia kasih sayang yang bener atau belum.*

AF: *Kalau aku si lebih ke kita memberikan yang terbaik aja untuk anak kita enggak berharap untuk anak itu harus melakukan yang terbaik juga buat kita, enggak seperti itu. Tapi, kita sebisa mungkin kita memberikan suatu hal yang terbaik buat anak-anak. Kalau pun pasti nanti akan berbakti kepada kita kepada orang tua itu bonus. Bonus kita udah memelihara anak dengan baik. Bonusnya ya itu yang kita dapetin nantinya.*

### Translation:

AU: Let's not rely solely on our children. While having children ensures they'll have their own lives, it depends on how we educate them. I see my husband as an example; he's attentive to his mother but also consistently focuses on our family. So, it depends on how we raise our children, whether we've given them the right amount of love and care.

AF: For me, it's more about giving our best to our children without expecting them to do the same for us. It's not like that. But, as much as possible, we provide the best for our children. If they do end up being grateful and showing respect to us as parents, that's a bonus. The real bonus is that we've raised them well. That's what we'll get in the end.

Referring to the dialogue, the representation in the subordinate clause at the expression level is evident in the sentence "*Kita jangan bergantung aja si sama anak, kalau menjamin si kalau anak itu pasti dia punya kehidupan masing-masing ya* (We should not just depend on the child, if we guarantee that the child will definitely have their own life, OK)?" This represents Audy's perspective that parents should not solely rely on their children for support in old age because children will have their own lives once they reach adulthood.

Representations in the grammatical level clauses are depicted in the form of processes that result in actions. The sentence "*kita udah full kasih dia kasih sayang yang bener atau belum* (We have fully given him or her true affection or not)" conveys Audy's belief that the child's future is closely tied to the amount of genuine love parents provide. Ahmad Fauzi's statement, "*kita memberikan yang terbaik aja untuk anak kita enggak berharap untuk anak itu harus melakukan yang terbaik juga buat kita, enggak seperti itu* (we only give the best to our children, we don't expect the child to do the best for us too, nothing like that)," indicates that as a parent, he does not anticipate his child repaying him for the care and support provided.

### b. Relation Element

The relationship element is the next element analyzed in Norman Fairclough's text dimensions. The analysis of the relationship element in this research reveals that the Cretivox team played the role of behind-the-scenes interviewers who had assembled four individuals as resource persons to discuss the decision to have a child in marriage. The relationship pattern observed is between Cretivox as the behind-the-scenes interviewer, representing the community, and the four sources, namely Ahmad Fauzi, Audy, Kei, and Lilia. The four sources were tasked with responding to questions posed by Cretivox based on their individual perspectives. Ahmad Fauzi and Audy are a couple with two children, while Kei and Lilia are a childfree couple.

Despite having differing views, the relationship between these partners is not antagonistic but supportive. This was evident when, in response to the question of whether having children was important, a discussion ensued between Kei, a childfree individual, and Ahmad Fauzi and Audy, who shared their experiences of caring for infants. This exchange involved the sharing of personal stories, illustrating a collaborative process, as depicted in the following dialogue:

(KE: Kei, AU: Audy, AF: Ahmad Fauzi)

## **Childfree, an Existentialist Feminist Perspective: A Critical Discourse Analysis of Youtube Cretivox Content 'Mending Punya Anak Atau Tidak Punya Anak???'**

*KE: Kemarin gimana tuh handle-nya? Waktu masih bayi masih bikin stress katanya gak tidur.*

*AU: Sebenarnya seruh, ribetnya pasti ada tapi ya seru aja bangun malem-malem harus nyusuin gantiin popok segala macam tidur terganggu 6153a hiy tapi yang namanya kalau anak sendiri ya senang aja ngejalaninnya gitu*

*KE: Mmmmm*

*AU: Walaupun ya pasti ada lah yang stresnya yang nangisnya itu 6153a hiya pasti.*

*AF: Karena itu tadi kita balik lagi, mental kita harus dipersiapkan kan menjelang pernikahan kita, kemudian menjelang nanti ada anak pun kita harus persiapkan itu tadi bener-bener perjuangan yang udah kita persiapin gitu aja sih.*

### **Translation:**

KE: How was it yesterday? When they're still babies, it's said to be stressful, especially with the lack of sleep.

AU: Honestly, it's challenging. It's definitely complicated, but it's fun waking up in the middle of the night, breastfeeding, changing diapers, and all that. Sleep gets disrupted, but when it's your own child, it's just enjoyable to go through.

KE: Mmmmm.

AU: Although, of course, there are moments of stress, especially with the crying and all.

AF: That's why, as I mentioned earlier, we have to prepare ourselves mentally. Before getting married, and then when planning to have children, we need to prepare. It's a struggle that we've prepared for.

In this dialogue, Kei's inquiry prompts Ahmad Fauzi and Audy to share their feelings and experiences regarding the birth of their child. The conversation reflects a collaborative exchange where individuals with different perspectives engage in open and respectful dialogue.

*(AF: Ahmad Fauzi, KE: Kei, LI: Lilia)*

*AF: Pernah gak sih ngerasa kayak boring gitu misalkan berdua aja jalan di jalan gitu kan*

*LI: Boring gak ada kerjaan...ngapain...gitu kan hehehe boringnya beda. Boringnya jadi kaya nyari-nyari kerjaan justru nyari kegiatan boringnya gak boring stress boringnya kaya gue udh begini ya gitu loh gue musti ngapain lagi ya? Boringnya gitu justru jadi kaya punya banyak waktu untuk mengeksplor apa yang harus dilakukan sih.*

*KE: Bukan boring berdua sih tapi boring karena rutinitas lah iya monoton mungkin ada.*

### **Translation:**

AF: Have you ever felt like it's boring when, for example, you're just two of you walking on the street?

LI: Boring like there's nothing to do... what to do... like that hehe. It's a different kind of boredom. It's the kind of boredom where you're actually looking for things to do. Boredom isn't boring; it's stressful. My boredom is like, "I'm already like this, what else should I do?" So, it's like having a lot of time to explore what needs to be done.

KE: It's not boring when it's just the two of you, but it's boring because of the routine, right? It might be monotonous.

The dialogue illustrates the relationship between the two couples, with Audy sharing her challenges as a mother in caring for her infant. This portrayal highlights a woman's struggles in motherhood, encompassing the efforts involved in conceiving, giving birth, and breastfeeding her child. The exchange sheds light on the multifaceted experiences and responsibilities tied to parenthood, offering a nuanced perspective on the complexities involved in raising children.

### **c. Identity Element**

The identity element examines the identity of Cretivox and the sources displayed and constructed in the content. This identity determines how questions are asked by Cretivox to the source and how the source answers these questions. This identification will also determine the discourse you want to present to the audience. In the YouTube content "*Mending Punya Anak Atau Tidak Punya Anak*," it is clear how the issue surrounding childfree is packaged.

Cretivox positions itself as a passive interviewer without refuting or criticizing the interviewee's answers. The debates or discussions that took place were carried out in a systematic and directed manner by the four speakers to discuss issues surrounding children and household relationships. Cretivox positions itself as a media that is interested in childfree issues and is in a marginal position between the pros and cons of society. In asking questions about the sources' opinions regarding the interest in having children, for example, Cretivox used questions that sparked the information and handed it over to the four sources for discussion. Meanwhile, the character of Kei and Lilia as a childfree couple is that they are open-minded and adopt liberal ideas (freedom) for each individual. When giving advice to audiences who want to be childfree, Kei provides wise advice without attacking certain groups. He is even a man who understands women's rights to bodily autonomy when discussing women's rights regarding pregnancy and childbirth. Similar to her husband, Lilia also expressed wise advice regarding a woman's decision to have children. Their two statements are illustrated in the following dialogue:

*(KE: Kei, LI: Lilia)*

## **Childfree, an Existentialist Feminist Perspective: A Critical Discourse Analysis of Youtube Cretivox Content 'Mending Punya Anak Atau Tidak Punya Anak???'**

*KE: Jadi temen-temen yang pengen childfree mikir childfree ya beneran harus siap, beneran harus sesuai dari keinginan sendiri gitu dan cari pasangan juga yang sevisi terutama buat perempuan yang cewek yak arena masalah punya anak itu kan ya rahim cewek jadi cewek aja nih yang ngomong lebih berhak dia ngomong (sembari menunjuk ke arah Lilia).*

*LI: Iya kalau menurut aku seorang wanita harus tau dulu apa yang dia mau dari diri dia harus dewasa mental gitu secara mentalnya sebelum memutuskan punya anak, yang kata tadi saya bilang ketika gue punya anak, gue udah akan mendedikasikan hidup gue untuk anak ini. Jadi kaya sadar kalau misalnya gue harus happy, gue harus waras, gitu kan ketika gue membutuhkan bantuan gue harus meminta bantuan gitu.*

### **Translation:**

KE: So, friends who want to go childfree need to really be ready. It should genuinely align with your own desires, and finding a partner who shares the same vision, especially for women since having children involves a woman's womb, so she has more say in it (pointing towards Lilia).

LI: Yes, in my opinion, a woman should first know what she wants. She needs to be mentally mature before deciding to have children. Like I mentioned earlier, when I have a child, I'll dedicate my life to this child. So, it's like being aware that if I need to be happy, I need to be mentally stable. When I need help, I have to ask for it.

Referring to this dialogue, Kei is a gender-sensitive male figure where he respects Lilia as a woman who has a uterus and has more right to express the issue of conceiving a child. Kei's statement, which emphasizes that women have the right to talk about childfree because it concerns the issue of pregnancy and childbirth, indicates that he is someone who understands women's right to bodily autonomy as the owner of the womb. Lilia's identity in positioning herself on the side of women is part of her perspective as a woman who is childfree and understands the big role and responsibilities of a mother.

In answering Cretivox's question, the identities of informants Kei and Lilia were constructed conventionally as two people who had experience in adopting the concept of childfree in their marriage. The answers given were not intervened by Cretivox as media and are purely based on their point of view and experience as childfree couples.

### **Discourse Practice Dimensions of Childfree Issue Construction**

#### **a. Text creation background**

Adinda's perspective, as revealed through the in-depth interviews, provides valuable insights into the discourse practice dimensions of Cretivox's content creation process. The analysis focuses on three crucial factors outlined by Fairclough: the individual side of the content creator, the relationship between text creators and media organizational structures, and the work methods used to create content.

Individual side of the content creator (Adinda): Adinda's role as the producer reflects her agency in shaping the content and the direction of the discourse. Her acknowledgment of the increasing debate on social media surrounding childfree issues indicates a proactive approach to address and compare perspectives on this trending topic. Adinda's intention to reduce the defensive side regarding childfree suggests a conscious effort to create content that fosters understanding and open dialogue.

Relationship Between Text Creators and Media Organizational Structures: Adinda's role as the producer places her within the media organizational structure. The decision to explore the childfree discourse aligns with Cretivox's goal of addressing societal debates and presenting diverse perspectives. The media's role is to provide a platform for discussions and comparisons between different viewpoints, contributing to a more nuanced understanding of the topic.

Work methods used to create content: The content creation process involves several stages, including conceptualization, scriptwriting, shooting, editing, and publishing. Adinda's description of the process highlights the deliberate approach taken by Cretivox in formulating questions that stimulate discussions and capture diverse opinions. The routine practice of staying updated on current issues and actively engaging with the audience reflects a dynamic and responsive content creation strategy.

*"...disini kita lebih memilih ingin membandingkan perspektif antara orang yang sudah menikah dan mempunyai anak sama orang yang sudah menikah lama tapi memilih untuk tidak punya anak. Di sini kita tidak ingin menilai siapa yang lebih benar dan siapa yang salah, tapi kita ingin mereka saling sharing opininya terutama kemaren juga lagi marak banget dimana di sosial media di mana dia ya (Gita) tone-nya lebih terlalu defensif bisa dibilang, disini kita ingin menurunkan sisi defensifnya dari mereka sharing opini juga kenapa akhirnya memutuskan itu tanpa adanya sisi defensif" (Adinda, 31 Mei 2023).*

### **Transition:**

"...here, we prefer to compare perspectives between those who are married and have children and those who have been married for a long time but choose not to have children. We don't want to judge who is right or wrong, but we want them to share their opinions, especially considering the recent trend on social media where someone like Gita was overly defensive in her tone. Here,

## **Childfree, an Existentialist Feminist Perspective: A Critical Discourse Analysis of Youtube Cretivox Content 'Mending Punya Anak Atau Tidak Punya Anak???'**

we aim to lower the defensive stance and have them share their opinions on why they ultimately decided, without a defensive stance." (Adinda, May 31, 2023).

From the interview excerpt, it can be observed that the genesis of Cretivox's YouTube content titled "*Mending Punya Anak Atau Tidak Punya Anak???*" itself emerged in response to the growing discussions among netizens on social media, debating the merits and drawbacks of the childfree lifestyle. Adinda, the producer, notes that the discourse unfolding on social media tends to be defensive and at times accusatory towards specific groups. Delving deeper, the inception of the widely debated childfree issue on social media traces back to the controversial statement made by Gita Savitri, an influencer, suggesting a connection between the childfree choice and the condition of youth, particularly if a woman decides not to have children.

Gita Savitri's provocative statement appears to have influenced public opinion by framing motherhood as a challenging responsibility. Adinda seems to perceive Gita Savitri's stance on being childfree as excessively offensive or as a form of criticism targeted at one group, namely women who are mothers. In the aftermath of this controversy, the emergence of childfree content establishes Cretivox's stance, as articulated by the producer. Cretivox positions itself as an independent digital media outlet that refrains from taking sides and avoids passing judgment on which party is right or wrong. Instead, it aims to provide a platform for sharing diverse perspectives.

*"...Kalau buat konten yang ini ya sebenarnya kita lebih mikirin latar belakang sih soalnya kalo personal masih bisa kita pancing lah buat 'ayo dong gitu' jadi untuk konten ini bener bener kita cari talent yang udah nikah tapi mungkin baru bentar udah punya anak, sama talent yang udah nikah lama tapi milih buat childfree, itu sih paling utama klasifikasi dari situ dulu baru kita langsung dari personalnya gimana"* (Adinda, 31 Mei 2023).

### **Translation:**

"...For this content, we're actually more focused on the background because if it's personal, we can still encourage them with a 'come on, please' kind of approach. So, for this content, we're really looking for talent who are married, maybe recently with a child, and talent who have been married for a long time but choose to be childfree. That's the primary classification. From there, we can then approach them personally." (Adinda, May 31, 2023).

Adinda's response suggests that, when selecting specific sources for the childfree-themed content, she and her team took into account the background and personal aspects of the individuals involved. Kei and Lilia, chosen as speakers, are a married couple who have spent 6 years together and have opted to lead a childfree life.

For non-childfree couples, Adinda and her team sought sources classified based on their recent marriage age but who were already parents. Ahmad Fauzi and Audy, a couple married for only 3 years, have two children.

Analyzing the values and beliefs of professionals is crucial in the discourse practice dimension. In this context, understanding Adinda's values and perspectives regarding childfree is essential. Adinda perceives childfree as an individual decision, particularly concerning women's positions. Her viewpoint is closely tied to her age, falling within the Generation Z category, characterized by its open-mindedness.

*"Aku tahun ini 23, aku pribadi bisa sih, dalam artian gini childfree atau tidak itu kan pilihan ya kalau misalkan emang perempuan tersebut memilih untuk tidak memiliki keturunan balik lagi ke tubuh dia juga"* (Adinda, 31 Mei 2023).

### **Translation:**

"I'm 23 this year. Personally, I think, in the sense that being childfree or not is a choice. If a woman chooses not to have offspring, it ultimately goes back to her body." (Adinda, May 31, 2023).

Adinda's statement indicates her understanding that the decision to be childfree or not is a personal life choice for each individual, and it also involves the issue of women's bodily autonomy. Implicitly, this understanding suggests that Adinda supports women's rights to autonomy over their bodies. She believes that women should independently comprehend their human rights regarding their bodies, including their readiness to decide on conceiving and giving birth to a child, as the choice ultimately lies with the woman.

### **b. Content production**

What's interesting is that Cretivox intentionally used a provocative video title, employing all capital letters in each word for a specific purpose. The use of the bold title "*MENDING PUNYA ANAK ATAU TIDAK PUNYA ANAK???*" is intended to captivate the audience's attention and encourage them to watch the content. According to Adinda, the choice of title itself does not carry a specific meaning but is deliberately crafted to draw the audience's attention. This approach aligns with the characteristics of Cretivox's audience, primarily consisting of individuals from Generation Z and millennials.

## **Childfree, an Existentialist Feminist Perspective: A Critical Discourse Analysis of Youtube Cretivox Content 'Mending Punya Anak Atau Tidak Punya Anak???'**

*"Sebenarnya kenapa dibilang targetnya gen Z karena mungkin salah satu faktornya orang-orang yang ada di Cretivox masih gen Z di mana 70% orang-orangnya itu gen Z dan salah satu CEO kita punya visi dan misi kalau gen Z itu generasi yang adaptif kita generasi yang ingin tahu akan sesuatu dan kalau bisa dibilang lumayan kritis akan banyak hal. Makanya, mungkin kita sebagai sebuah media ke trigger untuk why not kita menyuarakan suara gen Z? karena seperti yang kita lihat juga gen Z itu kan tipikal yang apa-apa diomongin di sosial media, kalau untuk masalah-masalah gitu paling gercep lah. Jadi, mungkin trigger awalnya dari situ"* (Adinda, 31 Mei 2023).

### **Translation:**

"Actually, why is the target considered to be Gen Z? Perhaps one of the factors is that people at Cretivox are mostly Gen Z, where 70% of the individuals are from Gen Z. Additionally, one of our CEOs has a vision and mission that Gen Z is an adaptive generation, a generation that is curious about things, and can be quite critical about many things. That's why maybe we, as a media platform, are triggered to ask, 'Why not raise the voice of Gen Z?' because, as we can see, Gen Z is the type that talks about everything on social media and tends to be quick in addressing issues. So, maybe the initial trigger comes from there." (Adinda, May 31, 2023).

The statement above indicates that the work environment, where the majority of Cretivox employees are 70% Generation Z, influences the factors that determine the target audience. The power dynamics within the company, with the CEO being the highest leader, are evident, and stakeholders have a significant influence on determining the vision, mission, and target audience of Cretivox.

Analyzing Adinda's response, it can be inferred that the success of the producer in presenting childfree-themed content is shaped by an awareness of the values related to the media's responsibility to amplify the voices of minorities and counteract negative childfree narratives on social media. The values held by the producers may not exert a profound impact on the content; however, Cretivox emphasizes the perspective that childfree is an individual life choice deserving respect, aligning with Adinda's viewpoint. The power dynamics involving the CEO as a stakeholder and the media work environment also play a crucial role in determining the target audience and the intended purpose of the content.

## **Sociocultural Practice Dimensions of Childfree Issue Construction**

### **a. Situational Elements**

In the analysis of the situational element within Fairclough's sociocultural practice dimension, the situational aspect considers how discourse is produced by taking into account various contextual elements. Fairclough argues that if language is perceived as an action, then the action is an attempt to respond to a specific situation. Each dialogue is shaped by the particulars of its situational environment, encompassing particular emotions and nuances.

Within this situational aspect, the concept of childfree is presented as a solution to address the issue of excessive human population on Earth, as articulated by Anita Dhewy, a women's activist and journalist from *Konde.co* who specializes in gender studies related to childfree.

*"Sebenarnya alasan seseorang untuk memilih childfree itu bisa beragam ya dari terkait masalah kondisi biologis, kedua pasangan ataupun itu kondisi psikologis dari aspek dikoloni aspek lingkungan, kalau kita bicara soal populasi segala macam ada banyak sekali alasan-alasan yang bisa jadi seseorang atau pasangan bisa punya alasan yang beragam atas keputusannya gitu"* (Anita Dhewy, 3 Juni 2023).

### **Translation:**

"Actually, the reasons for someone choosing to be childfree can vary. It could be related to biological conditions, the relationship between partners, or psychological conditions from colonization aspects to environmental aspects. When we talk about population and various other factors, there are many reasons that individuals or couples may have diverse reasons for their decisions." (Anita Dhewy, June 3, 2023).

Based on the interviews conducted by researchers with Anita Dhewy, it is apparent that an individual's choice to be childfree varies significantly, encompassing biological, psychological, and environmental considerations. The environmental aspects are particularly linked to the present issue of an excessive human population on Earth. Consequently, the concept of childfree emerges as a response to the challenge of human population problems. Despite being viewed within feminism as a personal choice, childfree decisions often transcend into the realm of public discourse.

*"...Lebih pada feminisme melihat itu bahwa kembali lagi adalah pilihan personal. Jadi, apapun keputusan itu ya itu jadi keputusan personal gitu, itu kan ada di wilayah privat gitu yang enggak mengganggu kepentingan publik istilahnya seperti itu ya tetapi perlu dilihat bahwa itu bukan hanya urusan urusan individu saja tetapi perlu dilihat bahwa itu bukan hanya urusan urusan individu saja tetapi, bahwa setiap orang seharusnya bebas untuk mengambil keputusan untuk punya anak atau tidak dan yang perlu dilihat juga itu kalo kita bicarannya dalam konteks kehidupan bernegara"* (Anita Dhewy, 3 Juni 2023).



## Childfree, an Existentialist Feminist Perspective: A Critical Discourse Analysis of Youtube Cretivox Content 'Mending Punya Anak Atau Tidak Punya Anak???'

### Translation:

"...More towards feminism, seeing it as a return to personal choice. So, whatever decision it is, it becomes a personal decision, which is in the private domain and does not interfere with public interests, so to speak. However, it should be noted that it is not just an individual matter. Every person should be free to decide whether to have children or not. It also needs to be seen in the context of nation-building." (Anita Dhewy, June 3, 2023).

Feminism regards childfree as a decision empowering women to lead lives in the private sphere without impinging on public interests. However, within the public domain, as articulated by Anita Dhewy, childfree is also intricately connected to the context of societal life. In the societal context, choosing to be childfree becomes a decision fostering individual life freedom, fundamentally linked to the provision of public services such as healthcare and caregiving. Anita Dhewy emphasizes that individuals of color opting for a childfree lifestyle should be assured care in their old age, aligning with their fundamental rights to public services as citizens. Beyond the environmental situational context, discussions on childfree choices thrive in the media, where there is a lack of awareness in giving a voice to minority groups.

*"Kalau terkait persoalan seperti ini mestinya media bisa gini dalam konteks masyarakat yang patriarkis posisinya itu kan ada ketimpangan, ini yang mesti dipahami oleh jadi mesti paham bahwa ada ketidakadilan gender ada ketimpangan di masyarakat. Jadi, ketika kita bicara soal isu-isu perempuan atau mengangkat isu perempuan itu juga mesti paham dengan situasi ini sehingga semestinya suara perempuan itu juga diberi ruang yang lebih banyak karna kan di masyarakat patriarkis itu seorang laki-laki yang lebih banyak didengar, kalau dari riset itu kan narasumber perempuan yang dikutip dari media masi sedikit tetapi ada study-nya dan itu masih minim"* (Anita Dhewy, 3 Juni 2023).

### Translation:

"When it comes to issues like this, the media should be like this in the context of a patriarchal society where there is inequality. This must be understood, so it must be understood that there is gender injustice and inequality in society. So, when we talk about women's issues or address women's issues, we must understand this situation. Women's voices should be given more space because in a patriarchal society, a man's voice is heard more. In research, female sources quoted in the media are still few, but there is a study on it, and it's still minimal." (Anita Dhewy, June 3, 2023).

The media holds the power to amplify the voices of minority groups that may otherwise remain unheard. Anita Dhewy criticizes the media for not fulfilling its role in representing minority groups, such as the childfree community, and providing them with a platform. She highlights the issue of media often quoting irrelevant sources or figures who lack relevance to the childfree discourse, especially when it is intricately related to women's bodies. For instance, quoting male religious figures, who have different physical conditions and do not undergo the same experiences as women, is considered inappropriate in addressing the nuances of the childfree conversation.

### b. Institutional elements

In the analysis of institutional elements, the impact of institutional components on how discourse develops in media production is considered. Institutions that influence the production of media texts can originate from within the media itself or be imposed by external influences. External factors, such as advertisers, play a significant role in influencing Cretivox to create content that can attract a broad audience, thus appealing to advertisers and encouraging financial support. The involvement of external entities often shapes the content creation process, emphasizing the need for media to cater to the interests and preferences of both the audience and external stakeholders.

*"Untuk urusan budgeting produksi terus untuk urusan brand di Cretivox kita juga produksi untuk tap in barengan sama brand misalnya kalau brand mau taro produknya di konten Cretivox itu gue yang ngurus juga biasanya. Jadi, untuk tek-tokan antara marketing dan juga production bisanya lewat dari gue dulu"* (Adinda, 31 Mei 2023).

*"...Biasanya kan orang ngiklan to the point ya, kalau di Cretivox biasanya kita implementasikan dengan teknis native ads yaitu gimana caranya kita bisa selling tapi gak kelihatan kalau kita selling gitu. Jadi, biasanya kita taro lah sedikit informasi tentang produk dari brand tersebut yang ingin tap in lewat percakapan-percakapan yang keluar dari talent Cretivox. Jadi, gak kelihatan lah kalau ini tuh iklan karena orang taunya kita cuma konten aja sebenarnya padahal disitu sebenarnya ada iklannya"* (Adinda, 31 Mei 2023).

### Translation:

"Regarding production budgeting and brand matters at Cretivox, we also collaborate with brands for tapping in, for example, if a brand wants to place its product in Cretivox content, I usually handle that. So, for the coordination between marketing and production, it usually goes through me first." (Adinda, May 31, 2023).

## Childfree, an Existentialist Feminist Perspective: A Critical Discourse Analysis of Youtube Cretivox Content 'Mending Punya Anak Atau Tidak Punya Anak???'

"...Usually, people advertise to the point, right? In Cretivox, we usually implement it with native ads, meaning how we can sell without it looking like we're selling. So, we typically include a bit of information about the product from the brand that wants to tap in through the conversations that come from Cretivox talents. So, it doesn't look like an ad because people think it's just our content, but there's actually an advertisement embedded in it." (Adinda, May 31, 2023).

In terms of media economics, Cretivox relies on advertisers for its survival. To promote brands, Cretivox employs native ads or a soft-selling method, seamlessly integrating brand displays into its content. The products of the advertised brand are also featured through conversations with Cretivox talent. Consequently, the statements made by Cretivox talent may contain varying degrees of influence from advertisers. To ensure the content is engaging for the audience, theme selection is informed by audience preferences, as indicated by analytical data from Cretivox's social media accounts. This approach aims to align content creation with audience interests while also meeting the needs of advertisers.

"...Tapi terlepas dari situ kita juga ada tim sosmed khusus YouTube yang menganalisis nih kira-kira dari viewers itu sukanya apasih, jadi kalo misalkan kalian comment itu kita bacain satu-satu, kita analilis juga kira-kira dari opini viewers kita itu mereka ingin konten yang gimana gitu. Terus yang kedua biasanya kita nyari topik yang emang mungkin sering dibahas di sosial media gitu misalnya dari tim analilis kita ngeceknnya dari Twitter, Instagram, YouTube Cretivox sendiri community juga" (Adinda, 31 Mei 2023).

### Translation:

"...But aside from that, we also have a dedicated social media team for YouTube that analyzes what viewers like. So, if you comment, we read them one by one. We also analyze from the opinions of our viewers what kind of content they want. Second, we usually look for topics that are often discussed on social media. For example, our analytical team checks Twitter, Instagram, and the Cretivox community on YouTube itself." (Adinda, May 31, 2023).

### c. Social context

Cretivox takes into account the audience's needs and desires when determining the themes or topics addressed in its content. On the other hand, the analysis of social context elements within the sociocultural practice dimension underscores that social factors significantly influence emerging discourses. Macro components of this social context, such as the political system, economy, or culture of society as a whole, are the focal points of Norman Fairclough's research.

Examining the childfree phenomenon through the lens of the Indonesian societal context, characterized by robust adherence to conventional cultural and religious values, reveals a significant contrast. In interviews with Anita Dhewy, who has also delved into gender studies related to childfree, she noted that the childfree phenomenon contradicts the understanding prevalent in Indonesian society due to the strong influence of cultural and religious values. These values reinforce the notion that the fundamental purpose of marriage is to have children.

"...Sebenarnya sih itu ada di small budaya kalau pada dasarnya punya keturunan itu pandangannya dianggap bahwa menikah punya pasangan punya anak ya pasti itu jadi bagian dari tujuan mereka, ini kan ada nilai-nilai agama dan budaya yang menguatkan pandangan tersebut, tapi pada dasarnya sebenarnya punya anak atau tidak itu kan pilihan personal gitu ya, karena masing-masing individu terutama perempuan ini terkait dengan tubuh perempuan gitu jadi ya sebenarnya pilihan personal, cuma masalahnya di mana masyarakat itu kemudian ada nilai-nilai budaya yang itu ikut melanggengkan pandangan bahwa ya punya anak itu jadi kaya sebuah keharusan seperti itu." (Anita Dhewy, 3 Juni 2023).

### Translation:

"...Actually, it's ingrained in a small culture where fundamentally having offspring is viewed as part of their goals when getting married and having a partner. There are religious and cultural values that reinforce this perspective. However, fundamentally, whether to have children or not is a personal choice because each individual, especially women, is related to their own body. So, it's really a personal choice. The issue is where society incorporates cultural values that perpetuate the view that having children is almost a necessity." (Anita Dhewy, June 3, 2023).

In Anita Dhewy's explanation above, it becomes evident that the childfree phenomenon is perceived as contradictory within the context of Indonesian society, closely tied to the profound influence of cultural and religious values. The religious and cultural values highlighted by Anita Dhewy establish a deeply ingrained perspective, asserting that the primary purpose of marriage is to bear children, and life is considered complete when children are present. Consequently, deviating from this cultural and religious norm by choosing not to have children, or being childfree, contradicts societal expectations and often results in the negative stigmatization of women.

As Anita Dhewy elucidates, the decision to be childfree is linked to individual life choices, particularly for women who are regarded as the bearers of the womb. The prevailing cultural belief, as expressed in the Javanese proverb "*banyak anak, banyak rezeki* (more children, more fortunes)," has been ingrained in Indonesian society for an extended period. This proverb implies that

## **Childfree, an Existentialist Feminist Perspective: A Critical Discourse Analysis of Youtube Cretivox Content 'Mending Punya Anak Atau Tidak Punya Anak???'**

having many children is synonymous with prosperity. The emergence of the childfree concept is fundamentally connected to women's growing awareness of bodily autonomy and serves as a form of resistance against patriarchal culture. Anita Dhewy contends that the decision to have or not have children should ultimately be a woman's prerogative, considering her bodily autonomy. However, patriarchal cultural norms, which prioritize men's contributions and uphold the societal expectation that women should bear children to carry on the family lineage, limit women's agency and choice. Consequently, women may find themselves devoid of the power to make autonomous decisions regarding their reproductive lives.

*"...Kaya akan semacam keharusan ketika perempuan menikah menjadi ibu terus punya anak padahal ya selama ini itu urusan tubuh itu bukan perempuan yang menentukan sendiri, di masyarakat kita yang cenderung patriarki, feminisme hadir untuk persoalan otoritas tubuh ya mengembalikan otoritas ibu itu pada diri perempuan karena perempuan yang menjalani proses untuk mengandung, melahirkan itu kan proses yang gak mudah, dalam arti maksudnya secara psikologis dan biologis itu juga butuh persyaratan atau kondisi yang mendukung seperti itu"* (Anita Dhewy, 3 Juni 2023).

### **Translation:**

"...It's like it becomes a kind of obligation when a woman gets married and becomes a mother, to have children. However, in reality, matters related to the body are not solely determined by women themselves. In our patriarchal society, feminism emerges to address issues of body autonomy, returning the authority over a mother's body to the woman because undergoing the process of pregnancy and childbirth is not an easy one. Psychologically and biologically, it requires supportive conditions and prerequisites." (Anita Dhewy, June 3, 2023). The patriarchal culture perpetuates a stereotype that women, upon marriage, are expected to transition into the role of mothers or bear children. In the context of media discourse practice, as elucidated in the discourse practice dimension, Adinda, the producer, demonstrates sensitivity to women's autonomy over their bodies, particularly in the decision-making process regarding their roles as mothers. This perspective aligns with Anita Dhewy's notion that women inherently experience the processes of conception and childbirth. Consequently, the decision to have children or not should consider the biological and psychological preparedness of the woman involved. Recognizing and respecting a woman's agency in deciding whether to become a mother is crucial, challenging the traditional expectations imposed by patriarchal norms.

### **CONCLUSIONS AND SUGGESTION**

Through the analysis of Norman Fairclough's critical discourse, which consists of three dimensions, and a study of Simone de Beauvoir's existentialist feminism, researchers reveal the discourse on childfree constructed in Cretivox's YouTube content entitled *"Mending Punya Anak Atau Tidak Punya Anak???"*. In the textual dimension, there are three elements that must be analyzed: representation, relationships, and identity. The representation of the construction of the childfree issue in this content highlights three points. Firstly, Cretivox presents the issue of childfree as a life choice for each individual in the private sphere that must be respected and should not be judged. This life decision involves a couple's unpreparedness to have children due to environmental and economic factors, particularly emphasizing a woman's right to autonomy over her body. Secondly, the relationship between Cretivox, sources, and the audience in constructing the issue of the presence of descendants has three points. The relationship between Cretivox as a media entity and sources as participants is that Cretivox acts as a behind-the-scenes interviewer, asking questions related to ancestry to the sources who are participants present in the content. Cretivox does not intervene in each source's answers but rather encourages discussion and debate among them. The pattern of relationships between sources does not involve judgment, even though they have different backgrounds and perspectives. Meanwhile, the relationship between Cretivox and its audience is as a medium seeking to present a new, neutral perspective to the audience. Thirdly, the identity of Cretivox and the sources in constructing the issue of the presence of offspring has two points. Cretivox positions itself as a media entity with an interest and concern for the childfree issue and is in a marginal position between the pros and cons. In constructing the issue of having children, childfree couples display an open-minded identity where the decision to have children or not is an individual's freedom. In the discourse practice dimension, related to the producer's background, namely producer Adinda, she promotes childfree content as an effort to counter social stigma against those who choose childfree. Cretivox, as an independent digital media outlet, aims to provide a fresh perspective that is non-judgmental, neutral, and pure from the responses of the sources; the producer's values and beliefs do not have a significant influence on the child-free discourse that the public wants to present. In the sociocultural practice dimension, the idea of childfree is presented as a solution to the high number of human populations on earth today. This is an environmental aspect that is one of the factors influencing someone's choice not to have children. Advertising factors from outside the media impact Cretivox's ability to produce material that attracts wide audiences and sponsors. For advertisers, Cretivox uses soft-selling techniques that appear in the content. The limitation of the present research is that it only used an existentialist feminist perspective. Therefore, it is suggested that future research can analyze childfree from a

## Childfree, an Existentialist Feminist Perspective: A Critical Discourse Analysis of Youtube Cretivox Content 'Mending Punya Anak Atau Tidak Punya Anak???'

different perspective, such as in terms of audience reception, where the meaning of messages related to childfree can be revealed more deeply.

### REFERENCES

- 1) Beauvoir, S. de. (2011). *The Second Sex* (J. Thurman (ed.)). Vintage Books A Division of Random House, Inc.
- 2) Child-free Definition & Meaning - Merriam-Webster
- 3) Chrastil, R. (2020). *How to Be Childless: A History and Philosophy of Life Without Children*. Oxford University Press.
- 4) Cornellia, V., Sugianto, N., Natallia, G., & Theresia, M. (2022). Fenomena Childfree Dalam Perspektif Utilitarianisme dan Eksistensialisme. *Jurnal Filsafat Terapan*, 1(1), 1–16. <https://doi.org/10.11111/moderasi.xxxxxx>.
- 5) Creswell, J. W. (2015). *Penelitian Kualitatif & Desain Riset: Memilih di antara Lima Pendekatan* (Edisi ke-3). Pustaka Pelajar.
- 6) Defago, N. (2005). *Childfree and Loving It!* Fusion Press.
- 7) Denada, V. S., Fikri, A., & Sokarina, A. (2022). Makna Investasi Pada Anak Dalam Mitos “Banyak Anak Banyak Rezeki”: Studi Fenomenologi. *Jurnal Ilmiah Akuntansi Peradaban*, 7(1), 84–99. <https://doi.org/https://doi.org/10.24252/jiap.v8i1.28939>.
- 8) Eriyanto. (2001). *Analisis Wacana: Pengantar Analisis Teks Media*. LKiS Yogyakarta.
- 9) Fairclough, N. (1995). *Media Discourse*. Edward Arnold.
- 10) Fairclough, N. (2003). *Analysing Discourse: Textual Analysis for Social Research*. Routledge Taylor & Francis Group.
- 11) Fairclough, N. (2013). *Critical Discourse Analysis The Critical Study of Language* (Second Ed). Routledge.
- 12) Huda, M. K. (2022). *Childfree: Studi Terhadap Perempuan Menolak Hamil di Media Sosial Perspektif Feminisme Radikal Andrea Dworkin*. Universitas Islam Negeri Sunan Ampel Surabaya.
- 13) Jenuri, Islamy, M. R. F., Komariah, K. S., Suwarma, D. M., & Fitria, A. H. N. (2022). Fenomena Childfree di Era Modern: Studi Fenomenologis Generasi Gen Z Serta Pandangan Islam Terhadap Childfree di Indonesia. *Jurnal Sosial Budaya*, 19(2), 81–89. <https://doi.org/10.24014/sb.v19i2.16602>
- 14) Mahon, J. (1997). *Existentialism, Feminism, and Simone de Beauvoir*. St. Martin's Press. Inc.
- 15) Mingkase, N., & Rohmaniyah, I. (2022). Konstruksi Gender Dalam Problematika Childfree di Sosial Media Twitter. *Yinyang: Jurnal Studi Islam Gender Dan Anak*, 17(2), 201–222. <https://doi.org/10.24090/yinyang.v17i2.6486>.
- 16) Neuman, W. L. (2016). *Metodologi Penelitian Sosial: Pendekatan Kualitatif dan Kuantitatif* (Seventh Ed). PT Indeks.
- 17) Ningsih, P. S. (2022). Wacana Otonomi Seksualitas Perempuan: Sisilism Menolak Standar Ganda. *Calathu: Jurnal Ilmu Komunikasi*, 4(2), 93–108. <https://doi.org/10.37715/calathu.v4i2.3316>.
- 18) Nugroho, D. A., Alfarisy, F., Kurniawan, A. N., & Sarita, E. R. (2022). Tren Childfree dan Unmarried di Kalangan Masyarakat Jepang. *COMSERVA: Jurnal Penelitian Dan Pengabdian Masyarakat*, 1(11), 1023–1030. <https://doi.org/10.36418/comserva.v1i11.153>.
- 19) Pells, R. H., & Romer, C. D. (2023). *Great Depression*. Britannica.Com. <https://www.britannica.com/event/Great-Depression>, diakses 25 Maret 2023.
- 20) Rahayu, L. S. (2023). Ma'ruf Amin Tak Sepakat Childfree: Nikah Itu untuk Berkembang Biak. *Detik.Com*. <https://www.google.com/amp/s/news.detik.com/berita/d-6563984/maruf-amin-tak-sepakat-childfree-nikah-itu-untuk-berkembang-biak/amp>, diakses 20 Juni 2023.
- 21) Raizza. (2023). *5 Pernyataan Gita Savitri Soal Childfree yang Kontroversial, Bikin Banyak Publik Figur Ikut Speak Up*. Intipseleb.Com. <https://www.intipseleb.com/lokal/59257-5-pernyataan-gita-savitri-soal-childfree-yang-kontroversial-bikin-banyak-publik-figur-ikut-speak-up>, diakses 25 Maret 2023
- 22) Rizka, S. M., Yeniningsih, T. K., Mutmainnah, & Yuhariati. (2021). Childfree Phenomenon in Indonesia. *Proceedings of AICS-Social Sciences*, 11(1), 336–341.
- 23) Smith, B. G., & Robinson, N. (2022). *The Routledge Global History of Feminism*. Routledge.
- 24) Tunggono, V. (2021). *Childfree & Happy*. Buku Mojok Group.
- 25) *Worldometer*. (2023). *Current World Population*. <https://www.worldometers.info/world-population/>, diakses 24 Juni 2023.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

## The Influence of the Pencak Silat Extracurricular Development Program and Practice Motivation on the Pencak Silat Abilities of Students of Sdit Insan Utama



Ari Marini<sup>1</sup>, Sumarjo<sup>1</sup>, Zaza Afnindar Fakhrurozi<sup>2</sup>

<sup>1</sup>Department of Sports Science, Faculty of Sports and Health Science, Universitas Negeri Yogyakarta, Indonesia Yogyakarta, DIY, 55281, Indonesia

<sup>2</sup>Department of Primary School Physical Education, Faculty of Sports and Health Science, Universitas Negeri Yogyakarta, Indonesia. DIY, 55281, Indonesia

**ABSTRACT:** This research aims to determine: (1) the influence of students' pencak silat abilities after participating in the pencak silat extracurricular training program at SDIT Insan Utama, (2) the influence of students' motivation to practice on pencak silat abilities, and (3) the influence of the training program and students' motivation to practice on simultaneous martial arts abilities. This research method uses quasi experimental design. The population of this study were participants of the pencak silat extracurricular at SDIT Insan Utama Yogyakarta. The sample for this research was 60 students from extracurricular pencak silat participants. This research variable consists of three variables: (1) extracurricular pencak silat training program, (2) motivation to practice extracurricular pencak silat participants, and (3) pencak silat ability. All data for this research were obtained through questionnaires and tests. The motivation instrument was measured using a practice motivation questionnaire and pencak silat ability was measured using a pencak silat ability test. The data analysis technique used is the paired sample t-test at a significant level of  $\alpha = 0.05$ , and the regression test uses  $R^2$  (squared). The results of this research show that: (1) there is development of students' abilities in mastering several pencak silat techniques, which were obtained through paired sample t-test analysis. Based on the results of the analysis, it can be concluded that there is an influence on students' pencak silat abilities after participating in the pencak silat extracurricular training program at SDIT Insan Utama. (2) there is an influence between students' motivation to practice and their pencak silat abilities through paired sample t-test analysis which is shown by the students' motivation scores in learning pencak silat. Assessment of student motivation before treatment and after treatment shows that students can develop the basic pencak silat skills that have been taught by the trainer so that they become more proficient in practice. (3) The training program and students' motivation to practice can simultaneously influence students' pencak silat abilities, which is shown through the results of regression test analysis using the  $R^2$  (squared) value which reaches 15.3%.

**KEYWORDS:** Extracurricular Development Program, Motivation to Practice Students, Pencak Silat Ability

### I. INTRODUCTION

A school is an educational institution that is used as a place for students to receive training so that these students have intelligence, skills and expertise [1]. When educational activities take place, training is required in a structured and coordinated manner [2]. Apart from receiving education and teaching that includes subjects, students receive development through extracurricular programs [3]. Extracurricular programs organized by the school have the function of optimal training and development of students' talents and interests. It is hoped that students' learning achievements can be achieved optimally, which will then enable the goals of education to be achieved [4].

Physical education in educational institutions is a concrete manifestation of sustainable sports development, which is carried out over a long period of time so that quality results can be achieved covering several areas such as: educational sports, recreation, and proportional achievement [5]. These activities can give rise to synergistic interactions that run systematically, in stages and sustainably by using the stages of cultivation, massing, breeding and development of an achievement which can later be at the highest level of achievement thereby creating a system of training and improving national sports which is expected by National

## **The Influence of the Pencak Silat Extracurricular Development Program and Practice Motivation on the Pencak Silat Abilities of Students of Sdit Insan Utama**

Sports System Law Number 3 of 2005 [6]. Apart from that, physical activity can be a factor in improving health and achieving academic goals in children and adolescents [7].

Extracurricular activities in the scope of education are the answer to the demands of students' needs to enhance the learning environment and stimulate students to be more creative [8]. Extracurricular activities are mandatory as stated in Minister of Education and Culture Regulation No. 62 of 2014 takes the form of scouting education, while optional extracurriculars consist of training your talents and practicing your desired interests [9]. Extracurricular sports is one of the extracurricular activities found in the school environment [10]. Extracurricular sports are not only an extension of physical education, but also the goal of sports [11].

The benefits obtained from extracurricular development for the school are as a means of promoting the school to the surrounding community [12]. Schools that achieve achievements can increase the level of the school in the opinion of the community. Activities carried out in extracurricular activities are based on the objectives contained in the school curriculum. The existence of various types of extracurricular activities increases the talents, skills and interests of students [13]. Pencak silat is an aspect of Indonesian culture whose development began centuries ago. Various ethnological and geographical situations and developments over time have been felt by the Indonesian people [14]. Historically, pencak silat is a martial skill that has a function according to the needs of the martial artist in dealing with a challenge, especially a challenge from nature, humans or animals [15].

The sport of pencak silat is included in the martial arts sport and to popularize it within universities or clubs, a place is needed to channel the talent of pencak silat itself [16]. This is done through various processes, such as holding a pencak silat competition championship at regional level [17].

In its development, pencak silat abilities contain 4 supporting elements in the form of sports, martial arts, arts and spirituality [18]. Pencak silat implemented in children is certainly not the same as pencak silat used by adults, the difference is that it focuses on developmental adaptations in children which are packaged for training and the movements used are simple [19].

The coaching program is an effort to develop the potential of students. What can be obtained from extracurricular pencak silat is that it can obtain a positive value on one's own personality and efforts to introduce and preserve authentic Indonesian culture to students [20]. The pencak silat development program for students which is carried out in extracurricular activities can be carried out by creating a training program which can later be used during training [21]. There is an advantage of extracurricular pencak silat activities for children, in the form of creating a strong physique in children as well as creating a strong mental state, where this can make them mentally strong and prepared to face life's obstacles in the future [22].

The extracurricular pencak silat development program also provides a contribution to the ongoing activities of forming the quality of the Indonesian nation. This is in line with the objectives of national education in the form of creating and improving skills and civilizational character in order to create a nation with dignity, in an effort to make the nation intelligent [23]. Apart from that, it also has the aim of seeking and developing the potential within students so that these students become firm in their faith and devotion to God Almighty [24].

Forming and improving students' abilities in practicing extracurricular pencak silat, something that is no less important to pay attention to is the students' motivation [25]. There are several factors that can influence the development of a person's talents, including the level of education received, the surrounding environment, neural and motor structures, motivation, interests, emotions [26].

Motivation is an abstract psychological energy, its form can only be observed in the form of behavioral manifestations it displays [27]. Motivation influences human performance and energizes human behavior and determines its direction. The greater the opportunity to achieve the goal, the greater the motivational power [28]. Meanwhile, according to the Big Indonesian Dictionary (KBBI), motivation is the urge that arises within a person to do or think with a certain purpose, whether consciously or unconsciously [29].

This drive comes from within a person who carries out an activity that is in harmony with his own drive, called talent or external encouragement, a kind of desire to achieve an achievement that will later receive praise from his friends [30]. Coaches can lead and motivate their students and their assistants. Apart from that, it is hoped that they will be able to socialize with many people, understand the hearts of their students, so that they can express their opinions and views honestly and openly [26]. The supportive behavior of teachers and trainers during activities will have a positive impact on student motivation [31].

The motivation aspect has a very important role in the human psyche, because motivation is a determining aspect in driving human behavior, with the presence of motivation a person has can provide encouragement to practice more actively and achieve a desired result [32]. The existence of motivation can give someone encouragement to practice, work together and last longer in participating in an exercise or activity [33].

## **The Influence of the Pencak Silat Extracurricular Development Program and Practice Motivation on the Pencak Silat Abilities of Students of Sdit Insan Utama**

SDIT Insan Utama organizes extracurricular sports, one of which is pencak silat, which is a branch of martial arts. The presentation of extracurricular pencak silat must be aligned with the development experienced by the child, physically and spiritually as well as the child's way of interpreting things, feeling, thinking and expressing them. [34] Extracurricular Pencak Silat can be a fun activity for students to support their talents and interests. Pencak silat is an educational and recreational sport and its peak is to become an achievement sport when there is a good and targeted coaching program [35].

The pencak silat extracurricular development program at SDIT Insan Utama involves various parties, including the school as an educational institution with the principal who has a role in being responsible for activities, deputy head of student affairs, physical education teaching staff, coaches, parents and students [36].

To find out about the ongoing development of extracurricular pencak silat at SDIT Insan Utama, the researcher made a visit before continuing the research process precisely on May 27 2023. Based on the researcher's experience, it was found that the extracurricular development of pencak silat was not taking place optimally, requiring further development to be able to achieve the goals. coaching. A development activity can obtain significant results and achieve achievements if the coaching program can be carried out well. However, the facts in the field show things that are not appropriate, so it is important for schools to overcome these problems, such as providing good facilities and infrastructure [37] [38].

These extracurricular sports activities should be managed well, in a pattern and systematically so that they can achieve the desired goals such as developing the potential of students with the hope of achieving a sporting achievement [37]. Coaching programs in extracurricular sports can be successful if there is cooperation between coaches who have knowledge and students, the school and the role of parents [39]. Pencak silat extracurricular development and motivation for student practice as a basis for improving students' martial arts skills requires serious management into a coaching system that is connected and has levels as a form of sustainable extracurricular pencak silat development [40].

Several problems in these initial observations indicate that the lack of a good coaching program and motivation to practice for students who participate in extracurricular pencak silat activities will affect students' pencak silat abilities. Therefore, researchers are interested in researching pencak silat abilities because they consider the importance of extracurricular pencak silat development programs. Researchers also believe that other incentives such as motivation to practice can help improve students' pencak silat abilities.

## **II. METHOD**

### **Experimental Research Design**

Quasi experimental design (quasi experiment) is the research method used in this research. Because the researcher could not completely control the variables which could later have an influence on the students' pencak silat abilities, a quasi-experiment was used [41]. The aim of this experimental method is to observe the existence of an influence caused by the actions and instruments contained in this research using questionnaires and tests [42]. To see the students' initial abilities, each student is given a pretest, then given treatment and a posttest will be carried out which aims to observe the results of the treatment. The independent variables in this research are the extracurricular pencak silat coaching program and motivation to practice. Meanwhile, the dependent variable is the students' pencak silat abilities.

In experimental research, treatment is given by measuring students' martial arts abilities. This study used 1 experimental group and 1 control group using a model that was used every day. The experimental group will be given guidance in the form of a systematic and structured training program over a certain period of time with the guidance of a professional trainer. It is hoped that the training program that has been prepared and the professional trainers and infrastructure that support training can encourage students to be more enthusiastic about practicing so that the hope is to increase students' pencak silat abilities significantly.

### **Place and time of research**

Researchers carried out research at SDIT Insan Utama which is located at Jl. Brawijaya Gatak, Tamantirto, Kasihan, Bantul Special Region of Yogyakarta. Research time 30 September – 1 November 2023.

### **Research Population and Sample**

Population is an important aspect in research, population is very necessary in answering a problem. Population is a collection of objects that will be studied so that the desired data is obtained [43]. The population in this study was all SDIT Insan Utama students who took part in pencak silat extracurricular activities totaling 60 people.

The total sampling technique is used to determine the sample that will later be used in the research. The description of total sampling is a sampling that is equal to the available population [42]. The sample size can be adjusted to the total number of SDIT

## **The Influence of the Pencak Silat Extracurricular Development Program and Practice Motivation on the Pencak Silat Abilities of Students of Sdit Insan Utama**

Insan Utama students who take part in pencak silat extracurricular activities totaling 60 people. This research sample was divided into two classes, consisting of 30 students for the control class and 30 students for the experimental class.

The sample selection in this study used a totally sampling technique, namely a sampling technique using all members of the population [44]. Another definition of totally sampling is a sampling technique where the number of samples is the same as the population in the study [45]. So, the number of samples used in the research was 60 students divided into experimental class and control class, who took part in pencak silat extracurricular activities.

The determination of the control and experimental groups is determined based on the motivation possessed by students, which includes internal and external factors. Internal factors include physical, interests, talents and motives, while external factors include the environment, family, facilities & infrastructure, and teacher trainers. Students who have high motivation scores are grouped in the control group, while students who have low motivation scores are grouped in the experimental group. **Data**

### **Collection Methods and Instruments**

#### 1. Method of collecting data

In this research, data was collected using questionnaires and tests.

#### 2. Data Collection Instruments Questionnaire Sheet

The function of the questionnaire sheet is to measure students' motivation to practice. Motivation is described in 8 indicators, each item represents each indicator. Motivation is measured using a Likert scale with answers from 1 to 5.

#### Test

The tests carried out by students take the form of variable indicator points for students' silat abilities referring to pencak silat techniques, tactics and rules based on basic pencak silat ability instruments [46].

### **Instrument Validity and Reliability**

#### 1. Instrument Validity Test

This research uses content validity, which can be obtained by consulting an instrument with experts (expert judgment), namely lecturers who are experts in their field to determine and check systematically whether the instrument items represent what will be measured. The validation lecturer in this research is Mr. Prof. Dr. Erwin Setyo Kriswanto, M. Kes. From the results of the expert judgment, the validator stated that the instrument was ready to be used, but required several additions. This aims to ensure that the instruments used are more optimal.

The results of the validity tests that have been carried out are in the form of analysis of the results on the motivation variables of SDN 1 Padokan students with a total of 30 students participating in the pencak silat extracurricular. Items that do not meet the requirements must be eliminated and cannot be used as research instruments. In this research, the practice motivation instrument consisted of 39 question items. After carrying out a validity test, it was found that 2 items were invalid, thus the total questionnaire that would be used for research was 37 items.

#### 2. Instrument Reliability Test

Reliability tests are carried out to test how much the measurement results agree if the same symptom is measured twice or more with the same instrument. Reliability testing is a tool for measuring a questionnaire which is an indicator of a variable or structure. A questionnaire is said to be reliable or credible if a person's response to a statement is consistent or stable over time [44].

The reliability test is carried out using a reliable instrument, namely the alpha formula or Cronbach's Alpa. The trial of this instrument was carried out at SDN 1 Padokan with 30 students participating in the pencak silat extracurricular. Based on the results of the reliability test, it was found that all statement items were reliable. **Data analysis technique**

#### 1. Normality Test

The purpose of carrying out a normality test is to test the research sample whether the sample is normally distributed or not normally distributed [47]. If it is normally distributed then the probability is  $> 0.05$ , but if it is not normally distributed then the probability is  $< 0.05$ . If it is not normally distributed, the Wilcoxon Signed Ranks difference test is then carried out which aims to validate the normality of the data. The Wilcoxon Signed Ranks difference test is used, namely as an alternative to the Paired Sample T-Test if the data used as a sample for this study is not normally distributed according to the results of the Asymp value normality test. Sig. (2-tailed)  $< 0.05$ . The purpose of using the Wilcoxon Sign Ranks difference test is to evaluate certain treatments, namely observations before treatment and after treatment [47]. There are two test qualifications in this test with a significance level of  $\alpha = 5\%$  with the description below:

There is a difference in value between before and after treatment with a p-value  $< 0.05$ , in other words  $H_0$  is rejected and  $H_a$  is accepted.



## The Influence of the Pencak Silat Extracurricular Development Program and Practice Motivation on the Pencak Silat Abilities of Students of Sdit Insan Utama

There is no difference in value between before and after treatment with a p-value > 0.05, in other words  $H_0$  is accepted and  $H_a$  is rejected.

### 2. Homogeneity Test

The function of the homogeneity test is to determine whether or not the homogeneity characteristic is fulfilled in the variance between the experimental group and the control group [44].

The two variance classes are the same (homogeneous) if the sig value is > 0.05 or  $F_{count} < F_{table}$ . The two variance classes are different (not homogeneous) if the sig value is < 0.05

### 3. Hypothesis Testing

Hypothesis testing is used if research data has been analyzed and meets normality and homogeneity tests. If it is distributed normally and homogeneously in the two classes, then a t test is carried out. The criteria for acceptance and rejection use a significance level of 5.  $H_0$  will be rejected if  $p < 0.05$  or the alternative hypothesis ( $H_a$ ) is accepted. The following explains the research analysis:

The first and second hypotheses of this research are to use the paired sample T-test.

The third hypothesis of this research is to use the R2 formula to determine students' pencak silat abilities.

## III. RESEARCH RESULT

**Table 1. Normality Test Results for Control Class Pencak Silat Ability Assessment**

No	Pencak Silat abilities	Sig value. Shapiro-Wilk		Sig value. Wilcoxon		Information
		Pretest	Posttest	Pretest	Posttest	
1	Performance of Pencak Silat Skills	0,000	0,009	0,000	0,000	Normal
2	Kick Speed	0,094	0,055	-	-	Normal
3	Scythe Kick Agility	0,015	0,033	0,000	0,000	Normal
4	Side Kick Agility	0,021	0,048	0,000	0,000	Normal
5	Coordination of Kicks and Punches	0,653	0,929	-	-	Normal

Source: processed data (2023)

The assessment of pencak silat abilities in the control and experimental classes, both pretest and posttest, was normally distributed. Normally distributed results lie in the assessment of kick speed and coordination of kicks and punches. In accordance with the statement of the normality hypothesis formulation, it is accepted if the Sig value is 0.05.

Meanwhile, the other three, namely: assessment of pencak silat skills, sickle kick agility, and side kick agility, showed that the results of the normality test were initially not normally distributed, because the significance value was < 0.05. Therefore, the Wilcoxon Signed Ranks difference test can be carried out to find the normality of the data.

Based on the results of the Wilcoxon signed ranks normality test, the assessment of pencak silat skills, sickle kick agility and side kick agility in the control class had a significance value of 0.000. This shows that the p-value (Asymp. Sig. (2-tailed)) < 0.05, then  $H_0$  is rejected and  $H_a$  is accepted, which shows that the data is normal.

**Table 2. Hasil Uji Normalitas Penilaian Kemampuan Pencak Silat Kelas Eksperimen**

No	Pencak Silat abilities	Sig value. Shapiro-Wilk		Sig value. Wilcoxon		Information
		Pretest	Posttest	Pretest	Posttest	
1	Performance of Pencak Silat Skills	0,000	0,094	0,000	-	Normal
2	Kick Speed	0,539	0,273	-	-	Normal
3	Scythe Kick Agility	0,773	0,263	-	-	Normal
4	Side Kick Agility	0,612	0,091	-	-	Normal
5	Coordination of Kicks and Punches	0,957	0,003	-	0,000	Normal

Source: processed data (2023)

Most of the assessments of pencak silat abilities in the pretest and posttest experimental classes were normally distributed. Normally distributed results lie in the assessment of kick speed, crescent kick agility and side kick agility. In accordance with the statement of the normality hypothesis formulation, it is accepted if the Sig value is 0.05.

## The Influence of the Pencak Silat Extracurricular Development Program and Practice Motivation on the Pencak Silat Abilities of Students of Sdit Insan Utama

Meanwhile, a small number of others, namely: assessment of pencak silat skills, and coordination of kicks and punches, showed that the results of the normality test were initially not normally distributed, because the significance value was less than 0.05. Therefore, the Wilcoxon Signed Ranks difference test can be carried out to find the normality value of the data.

Based on the results of the Wilcoxon signed ranks normality test, the assessment of pencak silat skills and coordination of kicks and punches in the experimental class has a significance value of 0.000. This shows that the p-value (Asymp. Sig. (2-tailed)) < 0.05, then  $H_0$  is rejected and  $H_a$  is accepted, which shows that the data is normal.

**Table 3. Homogeneity Test Results for Pencak Silat Ability Assessment**

No	Pencak Silat abilities	Sig value. Levene Statistics		Information
		Pretest	Posttest	
1	Performance of Pencak Silat Skills	0,111	0,557	Homogen
2	Kick Speed	0,627	0,817	Homogen
3	Scythe Kick Agility	0,969	0,085	Homogen
4	Side Kick Agility	0,426	0,431	Homogen
5	Coordination of Kicks and Punches	0,969	0,078	Homogen

Source: processed data (2023)

Based on the results of the homogeneity test for assessing pencak silat abilities in the pretest and posttest, overall it can be declared homogeneous. This is due to the sig value > 0.05, so that it is in accordance with the hypothesis formulation statement, which is accepted if the Sig value is 0.05 or the data variance in the data tested is homogeneous.

**Table 4. Test Results of Paired sample t-test Development Program on Students' Pencak Silat Ability**

No	Pencak Silat abilities	Sig value. (2-tailed)	Information
1	Performance of Pencak Silat Skills	0,000	Signifikan
2	Kick Speed	0,000	Signifikan
3	Scythe Kick Agility	0,000	Signifikan
4	Side Kick Agility	0,000	Signifikan
5	Coordination of Kicks and Punches	0,000	Signifikan

Source: processed data (2023)

In accordance with the description of the data from the results of the pretest and posttest of the students' pencak silat abilities in the control class, overall there was an increase in the results of the pretest scores and the results of the posttest scores. This explains the development of students' skills in mastering several pencak silat techniques. Then it can be concluded that there is an influence on students' pencak silat abilities after participating in the SDIT Insan Utama extracurricular pencak silat coaching program.

**Table 5. Test Results Paired sample t-test Student Motivation on Students' Pencak Silat Ability**

No	Student Motivation	Sig value. (2-tailed)	Information
1	Performance of Pencak Silat Skills	0,000	Signifikan
2	Kick Speed	0,000	Signifikan
3	Scythe Kick Agility	0,000	Signifikan
4	Side Kick Agility	0,000	Signifikan
5	Coordination of Kicks and Punches	0,000	Signifikan

Source: processed data (2023)

## The Influence of the Pencak Silat Extracurricular Development Program and Practice Motivation on the Pencak Silat Abilities of Students of Sdit Insan Utama

In this case, student motivation can influence each type of assessment of students' pencak silat abilities. Student motivation which influences students' pencak silat skills obtained a significance value of 0.000. By obtaining a Sig value  $< 0.05$ ,  $H_0$  is rejected and  $H_a$  is accepted, so there is an influence between student motivation and pencak silat abilities.

**Table 6. R2 (squared) Test Results of Student Motivation towards Pencak Silat Ability**

No	Student Development and Motivation Program	R2 Value (Squared)	Percentage
1	Performance of Pencak Silat Skills	0,011	11%
2	Kick Speed	0,024	2,4%
3	Scythe Kick Agility	0,010	1%
4	Side Kick Agility	0,004	0,4%
5	Coordination of Kicks and Punches	0,005	0,5%
<b>Total R<sup>2</sup></b>		<b>0,153</b>	<b>15,3%</b>

Source: processed data (2023)

Overall, from the results presented above, the student coaching and motivation program variables can contribute 15.3%, which is obtained from the results of the total R2 (squared) percentage value above. Therefore, student coaching and motivation programs can simultaneously or jointly influence students' pencak silat abilities. The remaining 84.7% in the research could have been influenced by variables outside the research.

#### IV. DISCUSSION

##### 1. The influence of the coaching program on SDIT Insan Utama's pencak silat abilities

The research that has been carried out explains that the overall pencak silat abilities of students who took part in the extracurricular pencak silat coaching program have experienced a significant increase in scores after the treatment. Apart from that, students' ability to master several pencak silat techniques has also increased. Then it can be concluded that there is an influence on students' pencak silat abilities after participating in the extracurricular pencak silat coaching program at SDIT Insan Utama.

This research has similarities with research by Amrullah & Hanif (2019) which explains that there are significant differences in techniques and assessments in the pencak silat sport that have been studied previously. Analysis of the research results can be explained regarding students' pencak silat abilities, namely the increase in scores on each assessment and the differences in results in treatment or treatment regarding the extracurricular pencak silat development program [48]. Research by Satria et al., (2022), with the title "The Effect of Training Methods and Motivation on The Mastering of Pencak Silat Single Category" also has similarities with this research, where the results of the research show a relationship between training methods and motivation on the ability of single category pencak silat [49].

The increase in scores that occurred after the treatment or treatment of the pencak silat extracurricular coaching program was because the planned coaching program had been implemented and the delivery of the material could be understood by the students who took part in the pencak silat extracurricular. This can be seen from the basic pencak silat abilities of students who initially did not or did not understand the basic techniques of pencak silat, after coaching they become more understanding and even proficient in practicing the techniques in pencak silat.

Based on the results and supporting relevant research, it can be stated that the hypothesis regarding "the influence of students' pencak silat abilities after participating in the extracurricular pencak silat coaching program at SDIT Insan Utama" is proven to be in accordance with the results of the analysis obtained in this research.

##### 2. The influence of motivation to practice on pencak silat abilities at SDIT Insan Utama

In discussing the influence of students' motivation to practice on pencak silat abilities, researchers used a paired sample t-test to determine and analyze the influence of these two variables. In this case, student motivation can influence each type of assessment of students' pencak silat abilities so that this is directly proportional to the increase in students' pencak silat abilities. The results of this research are similar to research by Kotarska et al., (2022), namely regarding "Self-Assessment of Physical Fitness and Health versus Motivational Value of Physical Activity Goals in People Practicing Fitness, Football, Martial Arts and Wheelchair Rugby". The results of this study indicate that there is a need to strengthen self-esteem and motivation for physical activity, increase

## **The Influence of the Pencak Silat Extracurricular Development Program and Practice Motivation on the Pencak Silat Abilities of Students of Sdit Insan Utama**

perseverance, the ability to focus on the implementation of one's goals and prioritize goals among people who practice various sports disciplines [28].

Research conducted by Kovacs et al., (2022), namely regarding Sport Motivation From The Perspective of Health, Institutional Embeddedness And Academic Persistence Among Higher Educational Students also supports the discussion of this hypothesis. The results of this study show that the influence of socio-demographic variables is significant on gender, country, and mother's employment, especially in terms of intrinsic, introjected, and extrinsic motivation. The role of coping was particularly prominent for the health consciousness factor, with positive effects on intrinsic motivation and negative effects on other types. The impact of education quality and support is usually negative, while the positive effect of satisfaction with infrastructure is noteworthy. The effect of persistence in sports on intrinsic and introjected motivation is positive. Exercise frequency increases intrinsic motivation, while practical exercise instills extrinsic motivation [50].

Motivation is a strong encouragement for students who take part in pencak silat extracurricular activities to be more active in practicing seriously and with discipline in order to excel in the field of pencak silat. Students can also develop basic pencak silat skills that have been taught by the trainer. Thus, the difference in students' motivation assessments before treatment and after treatment shows that there are significant differences between students.

Based on the results and supporting relevant research, it can be stated that the hypothesis regarding "the influence of training motivation on students' pencak silat abilities at SDIT Insan Utama" is proven to be in accordance with the results of the analysis obtained in this research.

### **3. The influence of the coaching program and student training motivation on students' simultaneous pencak silat abilities at SDIT Insan Utama**

The analysis of the two research variables, namely the coaching program and students' motivation to practice on students' pencak silat abilities, can simultaneously be explained by analysis of the regression test by examining the percentage value of R<sup>2</sup> (squared), which was found in this research. Overall, the results show that the coaching program variables and student motivation can contribute 15.3% in influencing students' pencak silat abilities.

These results are in accordance with research conducted by Hardiansyah & Sutapa (2021), with the title "SMA Muhammadiyah 2 Yogyakarta Students Have Sufficient Motivation towards Extracurricular Activities Pencak Silat." The results of this research conclude that, based on extrinsic and intrinsic factors consisting of attention indicators, interest indicators, activity indicators, trainer indicators, facility indicators, school regulation indicators, and environmental indicators, it is stated that students at SMA Muhammadiyah 2 Yogyakarta have sufficient motivation for activities. pencak silat extracurricular [51].

Apart from that, research conducted by Ihsan et al., (2022), was regarding "The Effect of Limb Muscle Explosive Power, Flexibility, and Achievement Motivation on Sickle Kick Performance in Pencak Silat Learning". The results of this research are: 1) there is an influence of leg muscle explosive power on sickle kick performance of 21.59%; (2) there is an influence of flexibility on sickle kick performance of 6.94%; (3) there is an influence of achievement motivation on sickle kick performance of 9.74%; (4) there is an influence of leg muscle explosive through achievement motivation on sickle kick performance of 38.14%; (5) there is an influence of flexibility through achievement motivation on sickle kick performance of 13.51%; and (6) there is an influence of flexibility through achievement motivation on sickle kick performance of (6) there is a simultaneous influence of these variables of 51.41% [52].

Apart from that, in terms of motivation, there is low motivation and high motivation. Low motivation is a person's level of motivation that decreases due to internal and external influences, resulting in a decrease in attitudes and actions to achieve something desired [37]. Meanwhile, high motivation is a person's level of motivation that increases due to various factors in achieving something desired [38].

The hypothesis in this research is that the coaching program and the level of student motivation for pencak silat abilities are at a low level of motivation. Based on the results and supporting relevant research, it can be stated that the hypothesis regarding "the influence of the coaching program and student training motivation on students' simultaneous pencak silat abilities at SDIT Insan Utama" is proven to be in accordance with the analysis results obtained in this research.

## **V. CONCLUSION**

The influence of students' pencak silat abilities after participating in the SDIT Insan Utama extracurricular pencak silat coaching program showed significant results. This was obtained from the results of the analysis of the pretest and posttest of the pencak silat abilities of control and experimental class students. Overall, the score results from the pretest and posttest increased. So there is an influence on students' pencak silat abilities after participating in the SDIT Insan Utama extracurricular pencak silat coaching program.

## The Influence of the Pencak Silat Extracurricular Development Program and Practice Motivation on the Pencak Silat Abilities of Students of Sdit Insan Utama

The influence of students' motivation to practice on their pencak silat abilities was analyzed using a paired sample t-test, the student motivation variable can have a positive and significant effect on the students' pencak silat ability variable. In this case, student motivation can influence each type of assessment of students' pencak silat abilities. Student motivation influences students' pencak silat abilities with sig values.  $0.000 < 0.05$ .

The influence of the coaching program and student motivation on students' simultaneous pencak silat abilities at SDIT Insan Utama showed positive and significant results. The R<sup>2</sup> (squared) regression analysis carried out contributed 15.3%. Therefore, the coaching program and student motivation can jointly influence students' pencak silat abilities simultaneously, even with a small value. Apart from that, the remaining 84.7% in the study could have been influenced by other variables outside this study.

### REFERENCES

- 1) Rubandiyah, Hidayatul Issri; Nugroho, Efa. Pembentukan kader jumatik sebagai upaya peningkatan pengetahuan siswa di sekolah dasar. *HIGEIA (Journal of Public Health Research and Development)*, 2018, 2.2: 216-226.
- 2) Al Hakim, Irfan. Manajemen Kegiatan Ekstrakurikuler Di Madrasah. *AL-HIKMAH (Jurnal Pendidikan dan Pendidikan Agama Islam)*, 2020, 2.2: 149-153.
- 3) Agung, Febri. Efektivitas Kegiatan Ekstrakurikuler Keagamaan (Rohis) Dalam Meningkatkan Hasil Belajar Pai Pada Siswa Di Smp Wiyatama Bandar Lampung. *BMC Public Health*, 2017, 5.1.: 1–8.
- 4) Nuryanto, Slamet. Manajemen Kegiatan Ekstrakurikuler di SD Al Irsyad 01 Purwokerto. *Jurnal kependidikan*, 2017, 5.1: 115-129.
- 5) Anugrah, Audi, et al. Tipologi Manajemen Tradisional dan Modern dan Klasifikasinya dalam Manajemen Pendidikan Islam. *Journal of Islamic Education: The Teacher of Civilization*, 2022, 3.1.
- 6) Sudarmono, Martin. Sistem pembinaan ekstrakurikuler sepakbola di Kabupaten Banyumas. *Jurnal Penjakora*, 2018, 5.1: 64-75.
- 7) Jägerbrink, Veronica; Glaser, Joakim; Östenberg, Anna Hafsteinsson. Extracurricular Pulse Activities in School: Students' Attitudes and Experiences. *International Journal of Environmental Research and Public Health*, 2022, 19.22: 15051.
- 8) Mobonggi, Arten; Buhungo, Ruwiah A.; Bonde, Fradita. Meningkatkan Kemandirian Belajar Melalui Kegiatan Ekstrakurikuler. *Educator: Directory Of Elementary Education Journal*, 2021, 2.1: 23-42.
- 9) Kemendikbud. 2014. Peraturan Menteri Pendidikan dan Kebudayaan Republik Indonesia Nomor 62 Tahun 2014 tentang Kegiatan Ekstrakurikuler pada Pendidikan Dasar dan Pendidikan Menengah. Berita Negara Republik Indonesia Tahun 2014 Nomor 958. Sekretariat Kemendikbud. Jakarta.
- 10) Wibowo, Y. A., & Andriyani, F. D. 2015. Pengembangan Ekstrakurikuler Olahraga Sekolah. UNY Press.
- 11) Hao, Xiaoliang; Yang, Yunyun. Healthy physical education curriculum model and students' extracurricular sports participation—test based on the trans-contextual model of motivation. *BMC Public Health*, 2022, 22.1: 1-12.
- 12) Yunus, Yunus. Prospek Pengembangan Pondok Pesantren Kecamatan Malangke Kabupaten Luwu. *Jurnal Ilmiah Iqra'*, 2018, 12.2: 88-105.
- 13) Saleh, Khairul; Malik, Lina Revilla. Strategi Peningkatan Mutu Pendidikan Sekolah Dasar Islam Terpadu (SDIT) di Provinsi Kalimantan Timur (Studi kasus SDIT Cordova Samarinda dan SDIT YABIS Bontang). *FENOMENA*, 2019, 11.2: 143-154.
- 14) Widagda, Sidiq Pramana, et al. Atraksi Pencak silat Merpati Putih Sebagai Daya Tarik Wisata Dalam Upaya Melestarikan Warisan Budaya Indonesia. *Media Wisata*, 2022, 20.1: 136-147.
- 15) Ediyono, Suryo; Widodo, Sahid Teguh. Memahami makna seni dalam pencak silat. *Panggung*, 2019, 29.3.
- 16) Adeyansyah, Rizka; Bachtiar, Bachtiar; Saleh, Muhammad. Pengaruh Metode Latihan Side Step Terhadap Kelincahan Tendangan Sabit Pada Atlet Perguruan Silat Nasional Perisai Putih Tahun 2020. *Riyadhoh: Jurnal Pendidikan Olahraga*, 2022, 4.2: 148-155.
- 17) Wardoyo, Hendro; Fitranto, Nur. Kemampuan Teknik Guntingan Kategori Tanding Atlet Pencak Silat DKI Jakarta Pada Kualifikasi Pra PON 2020. *Jurnal Ilmiah Sport Coaching And Education*, 2021, 5.1: 55-62.
- 18) Suidiana, I Ketut. & Sepyanawati, N. L. P. 2017. Keterampilan Pencak Silat. Rajawali Press.
- 19) Fadilah, Nuki; Setyowati, Sri. Kontribusi Kegiatan Ekstrakurikuler Pencak Silat Terhadap Kemampuan Motorik Kasar Pada Anak Kelompok A Di Tk Aisyiyah Bustanul Athfal 05 Surabaya. *Jurnal Paud Teratai*, 2017, 6.03.
- 20) Widodo, H. 2021. Evaluasi Pendidikan. UAD Press.
- 21) Usra, Meirizal. Upaya Peningkatan Pembelajaran Beladiri Pencak Silat Melalui Pendekatan Kerja Kelompok. *Altius: Jurnal Ilmu Olahraga Dan Kesehatan*, 2019, 7.2.

## The Influence of the Pencak Silat Extracurricular Development Program and Practice Motivation on the Pencak Silat Abilities of Students of Sdit Insan Utama

- 22) Jannah, Miftachul; Pujiyanto, Pujiyanto; Arizal, Fariza Wahyu. Perancangan Webcomic Jiwa Kesatria Bertema Aksi dalam Dua Bahasa untuk Memperkenalkan Pencak Silat. *JoLLA: Journal of Language, Literature, and Arts*, 2022, 2.5: 724-745.
- 23) Hendriana, E. C., & Jacobus, A. Implementasi pendidikan karakter di sekolah melalui keteladanan dan pembiasaan. *JPDI (Jurnal Pendidikan Dasar Indonesia)*, 2017, 1.2: 25–29
- 24) Fadilah, Nuki; Setyowati, Sri. Kontribusi Kegiatan Ekstrakurikuler Pencak Silat Terhadap Kemampuan Motorik Kasar Pada Anak Kelompok A di TK Aisyiyah Bustanul Athfal 05 Surabaya. *Jurnal Paud Teratai*, 2017, 6.03.
- 25) Putra, I. Dewa Gede Rat Dwiwana. Peran kepuasan belajar dalam mengukur mutu pembelajaran dan hasil belajar. *Jurnal Penjaminan Mutu*, 2019, 5.1: 22-31.
- 26) Bangun, Sabaruddin Yunis. Peran Pelatih Olahraga Ekstrakurikuler Dalam Mengembangkan Bakat Dan Minat Olahraga Pada Peserta Didik. *Jurnal Prestasi*, 2019, 2.4: 29-37.
- 27) Husdarta, H. J. S. 2018. *Psikologi Olahraga*. Alfabeta.
- 28) Kotarska, Katarzyna, et al. Self-Assessment of Physical Fitness and Health versus Motivational Value of Physical Activity Goals in People Practicing Fitness, Football, Martial Arts and Wheelchair Rugby. *International Journal of Environmental Research and Public Health*, 2022, 19.17: 11004.
- 29) Alifia, Isye Fera, et al. Pengaruh Motivasi Berwirausaha Dan Lingkungan Sosial Terhadap Minat Berwirausaha (Studi Kasus Pada Dusun Beton Desa Tritunggal Kecamatan Babat Kabupaten Lamongan). *Jurnal Bisnis Indonesia*, 2019, 10.02.
- 30) Oktiani, Ifni. Kreativitas guru dalam meningkatkan motivasi belajar peserta didik. *Jurnal kependidikan*, 2017, 5.2: 216-232.
- 31) Hao, Xiaoliang; YANG, Yunyun. Healthy physical education curriculum model and students' extracurricular sports participation—test based on the trans-contextual model of motivation. *BMC Public Health*, 2022, 22.1: 1-12.
- 32) Laia, Bestari. Kontribusi Motivasi Dan Minat Belajar Terhadap Kemampuan Berbicara Bahasa Inggris Mahasiswa Program Studi Bimbingan Konseling Stkip Nias Selatan. *Jurnal Education and Development*, 2018, 6.1: 70-70.
- 33) Alnedral, Alnedral, et al. Motivasi Siswa dalam Mengikuti Ekstrakurikuler Pencak Silat. *Jurnal Patriot*, 1.3: 896-909.
- 34) Damayanti, A. 2020. Pendidikan Anak di Era Milenial (Issue 112). PT Raja Grafindo Persada.
- 35) Muhtar, T. 2020. Pencak Silat. UPI Sumedang Press.
- 36) Lestari, Ria Yuni. Peran kegiatan ekstrakurikuler dalam mengembangkan watak kewarganegaraan peserta didik. *Untirta Civic Education Journal*, 2016, 1.2.
- 37) Fikry, Ilham Aulia Qur'anil; Indika, Pudia M. Upaya Meningkatkan Motivasi Siswa Sekolah Menengah Pertama Dalam Mengikuti Kegiatan Ekstrakurikuler Olahraga. *Jurnal Stamina*, 2020, 3.6: 527-543.
- 38) Romadhon, Etika Surya; Listyorini, A. Erlina. Faktor Keterlaksanaan Ekstrakurikuler Olahraga Tahun Ajaran 2017/2018 Di Sekolah Dasar Negeri SeKecamatan Ngaglik Kabupaten Sleman Yogyakarta. *PGSD Penjaskes*, 2018, 7.4.
- 39) Sudarmono, Martin. Sistem pembinaan ekstrakurikuler sepakbola di Kabupaten Banyumas. *Jurnal Penjakora*, 2018, 5.1: 64-75.
- 40) Zulfah, Zulfah. Pengaruh Penerapan Model Pembelajaran Kooperatif Tipe Think Pair Share Dengan Pendekatan Heuristik Terhadap Kemampuan Pemecahan Masalah Matematis Siswa Mts Negeri Naumbai Kecamatan Kampar. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, 2017, 1.2: 1-12.
- 41) Wardani, Intan Kusuma. Pengaruh Model Pembelajaran Take and Give Untuk Meningkatkan Hasil Belajar Siswa. *JISIP (Jurnal Ilmu Sosial dan Pendidikan)*, 2018, 2.3.
- 42) Arikunto. 2006. Prosedur Penelitian Suatu Pendekatan Praktek. PT Rineka Cipta.
- 43) Cooper, Donald R.; Schindler, Pamela S. Metode Penelitian Bisnis Edisi 12 Buku 2. 2017. 44) Sugiyono. (2022). *Metode Penelitian Kuantitatif, Kualitatif dan R&D*. Alfabeta CV.
- 44) Putri, Amalla Rizki; Maison, Maison; Darmaji, Darmaji. Kerjasama dan kekompakan siswa dalam pembelajaran Fisika di kelas XI MIPA SMA Negeri 3 Kota Jambi. *EduFisika: Jurnal Pendidikan Fisika*, 2018, 3.02: 32-40
- 45) Johansyah, L., & Hendro, W. 2016. Pencak Silat Edisi Ketiga. PT RajaGrafindo Persada.
- 46) Ghozali, I. 2018. Aplikasi Analisis Multivariate Dengan Program IBM SPSS 26 Edisi 10. Badan Penerbit Universitas Diponegoro.
- 47) Amrullah, Ramdani, et al. Effect of Plyometrics Training and Achievement Motivation on the Ability of Crescent Kicks in the Pencak Silat Sport. *JIPESJournal Of Indonesian Physical Education And Sport*, 2019, 5.1: 49-62.
- 48) Satria, Galih Satria; Subarjah, Herman; Safari, Indra. The effect of training methods and motivation on the mastering of pencak silat single category. *Gladi: Jurnal Ilmu Keolahragaan*, 2022, 13.1: 88-97.

## The Influence of the Pencak Silat Extracurricular Development Program and Practice Motivation on the Pencak Silat Abilities of Students of Sdit Insan Utama

- 49) Kovács, Karolina Eszter, et al. Sport motivation from the perspective of health, institutional embeddedness and academic persistence among higher educational students. *International Journal of Environmental Research and Public Health*, 2022, 19.12: 7423.
- 50) Hardiansyah, Reza; Sutapa, Panggung. SMA Muhammadiyah 2 Yogyakarta Students Have Sufficient Motivation towards Extracurricular Activities Pencak Silat. *International Journal of Multicultural and Multireligious Understanding*, 2021, 8.3: 12-18.
- 51) Ihsan, Nurul, et al. The Effect of Limb Muscle Explosive Power, Flexibility, and Achievement Motivation on Sickle Kick Performance in Pencak Silat Learning. *Physical Education Theory and Methodology*, 2022, 22.3: 393-400.
- 52) Lomu, Lidia; Widodo, Sri Adi. Pengaruh motivasi belajar dan disiplin belajar terhadap prestasi belajar matematika siswa. 2018.
- 53) Muhammad, Maryam. Pengaruh motivasi dalam pembelajaran. *Lantanida Journal*, 2017, 4.2: 87-97.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.

ISSN[ONLINE] : 2643-9875    ISSN[PRINT] : 2643-9840

---

WHY PUBLISH WITH IJMRA ?

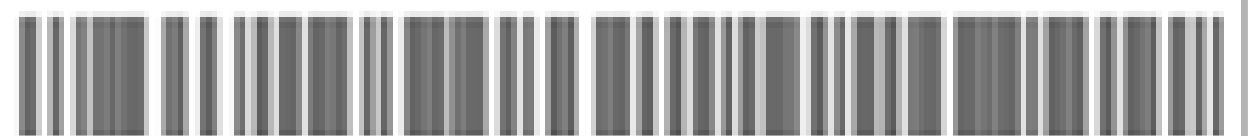
- 1) WE PROVIDE FULL OPEN ACCESS.
  - 2) DOI OF EACH PUBLISHED ARTICLE.
  - 3) THE ARTICLE WILL BE UPLOADED AFTER PUBLICATION IN THE FOLLOWING INDEXING SERVICES: GOOGLE SCHOLAR, INDEX COPERNICUS, DRJI, CITE FACTOR, ISI, EURO PUB, ACADEMIA, ZENODO, SCRIBD ETC. (MANY MORE)
  - 4) FAST RESPONSE, PEER REVIEW, AND FAST PUBLICATION.
  - 5) GLOBAL INTERNATIONAL KNOWLEDGE SHARING.
  - 6) A DIGITALLY SIGNED E-CERTIFICATE WILL BE PROVIDED TO THE AUTHOR FOR A PUBLISHED ARTICLE.
  - 7) YEARLY SUBSCRIPTION.
  - 8) YOU CAN ALSO DOWNLOAD FULL MONTH ISSUE.
- 



International Category Code (ICC):  
ICC-1402



International Journal Address (IJA):  
IJA.ZONE/264370649875



Country

UNITED STATES