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Application of Biomechanical Principles, Perceived Sports Performance Contribution, And Perceived Injury Prevention in Sports and Physical Activity

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ABSTRACT: This study examined the application of biomechanical principles, the perceived contribution of biomechanics to sports performance, and the perceived effectiveness of biomechanics in injury prevention among student-athletes of the University of Makati. An explanatory sequential mixed-methods design was used. In the quantitative phase, 110 student-athletes answered a researcher-made four-point questionnaire with excellent content validity (S-CVI/Ave = .99) and reliability (α = .97). The data were analyzed in SPSS using frequency, percentage, mean, and standard deviation, the Mann–Whitney U and Kruskal–Wallis H tests with Dunn's post hoc test, and Spearman's rank-order correlation. In the qualitative phase, twelve purposively selected participants were interviewed, and their accounts were analyzed through manual thematic coding. The application of biomechanical principles was high (M = 2.94), led by movement technique (M = 3.19), while the use of biomechanical technology was the only low area (M = 2.40). The perceived contribution of biomechanics to sports performance was high (M = 3.14), with overall athletic performance rated very high (M = 3.26), and its perceived effectiveness in injury prevention was high (M = 3.00), with the reduction of overuse injuries rated lowest (M = 2.96). Only prior exposure to biomechanics training produced significant differences, in application, $H(5) = 24.29$, $p < .001$, and in perceived performance contribution, $H(5) = 16.17$, $p = .006$, with athletes exposed to video or motion analysis scoring highest. All three variables were positively related, most strongly performance contribution and injury prevention ($\rho = .63$, $p < .001$). Six themes explained these results, describing an application that is technique-rich but science-light, a constrained training environment, a technology access divide, biomechanics as a visible performance advantage, reactive injury management that overlooks overuse, and athletes' call for an accessible, integrated program. The integrated findings showed that visible feedback links exposure to benefit and that the barriers are structural rather than attitudinal. The study proposes MOVE SMART, a guided biomechanics feedback and injury prevention program built on low-cost video feedback, load and recovery monitoring, coach capacity building, and a culture of good movement.

KEYWORDS: biomechanics, sports performance, injury prevention, video feedback, student-athletes, explanatory sequential mixed methods, joint display, MOVE SMART

I. INTRODUCTION

Sports and physical activity play an important role in promoting health, physical fitness, skill development, recreation, and overall well-being. Participation in sports also provides opportunities for individuals to develop physical abilities, technical skills, discipline, coordination, and competitive competence. As sports participation continues across recreational, school, amateur, and professional settings, the application of scientific principles has become increasingly important in improving performance and promoting safer participation.

One scientific discipline that contributes to the understanding of human movement is biomechanics. Biomechanics applies mechanical principles to the study of human movement and examines how forces, body segments, joint actions, and movement patterns interact during physical activity. In sports and physical activity, biomechanics provides a scientific basis for understanding how movements are performed and how they may be improved.

The application of biomechanical principles may be observed through movement technique, body mechanics, movement efficiency, training practices, and the use of biomechanical technology. Proper movement technique allows athletes and physically active individuals to perform skills with greater precision and consistency. Appropriate body mechanics promote effective coordination and alignment of body segments, while movement efficiency allows individuals to perform activities with less

unnecessary movement and mechanical stress. Biomechanical principles may also be incorporated into training practices to improve movement quality and performance.

Technological developments have further expanded the application of biomechanics in sports. Motion analysis, wearable sensors, force platforms, inertial measurement units, video analysis, and other technologies can provide information regarding movement patterns, force production, body positioning, and performance. These technologies may assist coaches, trainers, and athletes in evaluating movement and identifying areas for improvement. The development of technology has therefore strengthened the potential application of biomechanics in both performance assessment and sports training.

Biomechanics is also relevant to athletic performance. Sports performance involves several physical and technical components, including skill execution, speed, agility, balance, coordination, strength, power, and overall movement efficiency. Biomechanical principles can be applied to examine how these components are produced and coordinated during sport-specific activities.

Through biomechanical analysis, athletes and sports practitioners may identify inefficient movement patterns and technical deficiencies. Corrective feedback may help improve skill execution, body positioning, coordination, force application, and movement efficiency. In this sense, biomechanics may contribute to performance by providing a scientific basis for understanding and refining movement.

Another important application of biomechanics is injury prevention. Sports-related injuries may occur because of several factors, including inappropriate movement mechanics, faulty technique, repetitive loading, excessive mechanical stress, and inefficient movement patterns. Biomechanical assessment may help identify movement characteristics that are associated with injury risk.

The identification of injury risk factors is important because movement deficiencies may be addressed before they contribute to injury. Similarly, correction of faulty movement patterns may reduce unnecessary mechanical stress on specific body structures. Biomechanical principles may also contribute to the reduction of overuse injuries by promoting appropriate movement efficiency and training practices.

Existing literature has emphasized that biomechanical analysis can support both sports performance and injury prevention. Penichet-Tomas (2024) described biomechanics as a multidisciplinary field that contributes to performance enhancement, injury prevention, and movement analysis. Vancini et al. (2024) likewise highlighted the growing role of technology in biomechanical assessment and evidence-based sports training.

Rebelo et al. (2023) further emphasized the use of wearable technologies, force platforms, and biomechanical monitoring systems to assess movement quality, workload, fatigue, and injury-related factors. Such technologies provide sports practitioners with objective information that can support training and movement assessment.

Despite these developments, the application of biomechanics may vary according to the sport, level of participation, experience, resources, and accessibility of technology. There is also a need to understand how biomechanics is perceived and applied by individuals directly involved in sports and physical activity rather than relying only on laboratory-based measurements.

The existing literature also indicates a need for research involving different sports contexts and participant characteristics. Much of the available research has focused on specific sports, elite athletes, laboratory settings, or technological assessment. There remains a need to examine the perceptions of individuals involved in sports and physical activity regarding how biomechanical principles are applied, how they contribute to sports performance, and how they may contribute to injury prevention.

In the Philippine context, research on the practical application of biomechanics in sports and physical activity remains comparatively limited. The availability of specialized biomechanical equipment, training, and sports science resources may differ among institutions. Examining the perceptions and experiences of individuals involved in sports may therefore provide useful evidence regarding the practical application of biomechanics.

The present study addressed this need by examining the application of biomechanical principles, perceived sports performance contribution, and perceived injury prevention in sports and physical activity. It focused on the perceived application of biomechanics through movement technique, body mechanics, movement efficiency, training practices, and use of biomechanical technology. It also examined the perceived contribution of biomechanics to skill execution, speed and agility, balance and coordination, strength and power, and overall athletic performance.

In addition, the study examined the perceived effectiveness of biomechanics in injury prevention in terms of identification of injury risk factors, correction of faulty movement patterns, and reduction of overuse injuries. It further determined whether

perceptions differed according to the respondents' demographic and sports-related profiles, including their prior exposure to biomechanics training, and whether significant relationships existed among the major variables.

Because the study also sought to understand participants' experiences, perceptions, and challenges, an explanatory sequential mixed-methods design was employed. The quantitative phase first established measurable patterns and relationships, and the qualitative phase then explored the experiences and perceptions that explain them. The integration of the two phases provided the basis for the evidence-based program proposed in Chapter 6.

The study is supported by Philippine policies that recognize the importance of sports development, physical education, health, and scientific approaches to physical activity.

Republic Act No. 6847, or the Philippine Sports Commission Act of 1990, established the Philippine Sports Commission and provides a framework for the development and promotion of sports in the country. Its emphasis on sports development and scientific approaches to athlete development provides a policy context for studies examining biomechanics and sports performance.

Republic Act No. 10533, or the Enhanced Basic Education Act of 2013, recognizes Physical Education as an important component of basic education. The development of physical fitness, movement competence, and participation in physical activity provides a relevant educational context for the application of biomechanical principles.

The study is also consistent with Sustainable Development Goals 3 and 4, which promote health and well-being and inclusive, quality education, and with AmBisyon Natin 2040, the country's long-term vision of long and healthy lives for Filipinos. It also responds to the call of the Second Congressional Commission on Education (EDCOM II) for more responsive higher education curricula and to the National Integrated Basic Research Agenda of the Department of Science and Technology–National Research Council of the Philippines, which encourages locally grounded research on health and nation-building.

Within the University of Makati, the study supports institutional efforts related to education, sports, wellness, research, and evidence-based practice. The findings may provide local evidence that can support the improvement of sports and physical activity programs.

Research Question

This study examined the application of biomechanical principles, the perceived contribution of biomechanics to sports performance, and the perceived effectiveness of biomechanics in injury prevention among individuals engaged in sports and physical activity.

Specifically, it sought to answer the following questions:

What is the demographic profile of the respondents in terms of:

1.1 age;

1.2 sex;

1.3 type of sport or physical activity;

1.4 years of participation in sports or physical activity; and

1.5 level of competition (recreational, school, amateur, or professional); and

1.6 prior exposure to biomechanics training?

2. What is the level of application of biomechanical principles in sports and physical activity as perceived by the respondents in terms of:

2.1 movement technique;

2.2 body mechanics;

2.3 movement efficiency;

2.4 training practices; and

2.5 use of biomechanical technology?

3. What is the perceived level of contribution of biomechanics to sports performance in terms of:

3.1 skill execution;

3.2 speed and agility;

3.3 balance and coordination;

3.4 strength and power; and

3.5 overall athletic performance?

4. What is the perceived effectiveness of biomechanics in injury prevention in terms of:

4.1 identification of injury risk factors;

4.2 correction of faulty movement patterns;

4.3 reduction of overuse injuries;

5. Is there a significant difference on the level of application of biomechanical principles in sports and physical activity as perceived by the respondents when grouped according to profile?

6. Is there a significant difference on the perceived level of contribution of biomechanics to sports performance when grouped according to profile?

7. Is there a significant difference on the perceived effectiveness of biomechanics in injury prevention when grouped according to profile?

8. Is there a significant relationship between the level of application of biomechanical principles in sports and physical activity, perceived level of contribution of biomechanics to sports performance and perceived effectiveness of biomechanics in injury prevention?

9. What experiences, perceptions, and challenges do athletes describe regarding the application of biomechanics in training, competition, injury prevention?

10. Based on the integration of the quantitative and qualitative findings, what evidence-based program may be proposed to strengthen the application of biomechanics in sports and physical activity programs?

The following null hypotheses were tested at the .05 level of significance:

Ho1. There is no significant difference in the level of application of biomechanical principles when the respondents are grouped according to profile.

Ho2. There is no significant difference in the perceived contribution of biomechanics to sports performance when the respondents are grouped according to profile.

Ho3. There is no significant difference in the perceived effectiveness of biomechanics in injury prevention when the respondents are grouped according to profile.

Ho4. There is no significant relationship among the level of application of biomechanical principles, the perceived contribution of biomechanics to sports performance, and the perceived effectiveness of biomechanics in injury prevention.

II. SCOPE AND LIMITATION OF THE STUDY

This study focused on the application of biomechanical principles, perceived contribution of biomechanics to sports performance, and perceived effectiveness of biomechanics in injury prevention among student-athletes engaged in sports and physical activity at the University of Makati.

The quantitative component involved 110 student-athletes and was limited to the profile variables identified in the Statement of the Problem: age, sex, type of sport or physical activity, years of participation, level of competition, and prior exposure to biomechanics training. Perceptions were measured on a four-point scale.

The application of biomechanical principles is limited to movement technique, body mechanics, movement efficiency, training practices, and use of biomechanical technology. The perceived contribution of biomechanics to sports performance is limited to skill execution, speed and agility, balance and coordination, strength and power, and overall athletic performance. Perceived injury prevention is limited to identification of injury risk factors, correction of faulty movement patterns, and reduction of overuse injuries.

The qualitative component was limited to in-depth interviews with twelve student-athletes purposively selected from the survey respondents, who described their experiences, perceptions, and challenges regarding the application of biomechanics in training, competition, and injury prevention.

The study was conducted at the University of Makati during the approved data-collection period. It relied on self-reported survey responses and interview accounts and did not include laboratory-based biomechanical testing such as motion capture, force-plate testing, or electromyography.

Because the study was conducted within a single institution, the findings may not be generalized to all sports participants or organizations. Nevertheless, the results provide useful evidence for improving sports and physical activity programs within the study setting and in similar school-based contexts.

FRAMEWORK

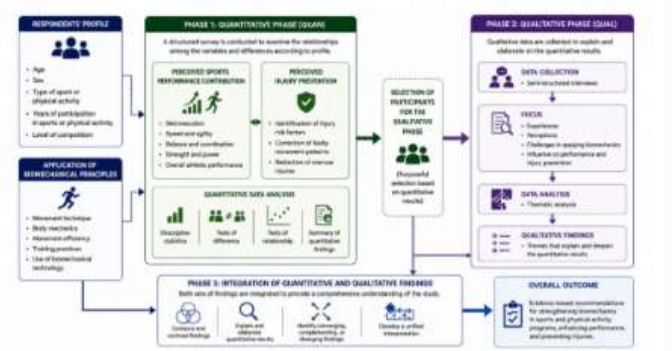


Figure 1. *Research Paradigm*

The conceptual framework of the study is anchored on an explanatory sequential mixed-methods design (QUAN → QUAL), wherein quantitative data are collected and analyzed first, followed by a qualitative phase that seeks to explain, elaborate, and provide deeper understanding of the quantitative findings.

The quantitative component examines the relationship between the respondents' profile, the application of biomechanical principles, perceived sports performance contribution, and perceived injury prevention. The respondents' profile includes age, sex, type of sport or physical activity, years of participation in sports or physical activity, and level of competition.

The principal variable, Application of Biomechanical Principles, includes movement technique, body mechanics, movement efficiency, training practices, and the use of biomechanical technology. This variable is examined in relation to two outcome variables: Perceived Sports Performance Contribution and Perceived Injury Prevention.

Perceived Sports Performance Contribution encompasses skill execution, speed and agility, balance and coordination, strength and power, and overall athletic performance. Meanwhile, Perceived Injury Prevention includes the identification of injury risk factors, correction of faulty movement patterns, and reduction of overuse injuries.

The quantitative phase involves the administration of a structured survey questionnaire, followed by descriptive and inferential statistical analyses. Descriptive statistics are used to summarize the respondents' profile and the levels of application of biomechanical principles, perceived sports performance contribution, and perceived injury prevention. Appropriate tests of difference and relationship are then used to determine whether significant differences or associations exist among the variables.

Based on the quantitative findings, selected participants are invited to participate in the qualitative phase. The qualitative component explores the participants' experiences, perceptions, and challenges regarding the application of biomechanical principles in training, competition, sports performance, and injury prevention. Semi-structured interviews are conducted, and the resulting data are analyzed thematically.

The final stage is the integration of quantitative and qualitative findings. The qualitative findings are used to explain, contextualize, and elaborate on the quantitative results, particularly findings that require further clarification or deeper understanding. Through this integration, the study develops a more comprehensive interpretation of how the application of biomechanical principles contributes to sports performance and injury prevention.

The integrated findings serve as the basis for evidence-based recommendations for improving the application of biomechanics in sports training, physical activity programs, performance enhancement, and injury prevention.

Research Design

The study employed an explanatory sequential mixed-methods research design, in which quantitative data were collected and analyzed first and qualitative data were then collected and analyzed to explain and enrich the quantitative findings (Creswell & Plano Clark, 2018).

The design was appropriate because the study first needed to measure the respondents' perceptions of the application of biomechanical principles, sports performance contribution, and injury prevention, and then to explain these results through the experiences, perceptions, and challenges of the athletes themselves. The connecting point between the phases was the selection of interview participants from the survey respondents and the presentation of the survey results during the interviews.

Research Instruments

Two instruments were used: a structured survey questionnaire for the quantitative phase and a semi-structured interview guide for the qualitative phase. The researcher-made questionnaire was developed from the research questions, the conceptual and theoretical frameworks, and the related literature, and it consisted of four parts with a total of 130 perception items.

Part I gathered the demographic and sports-related profile of the respondents: age, sex, type of sport or physical activity, years of participation, level of competition, and prior exposure to biomechanics training. These variables correspond to Research Question 1.

Part II measured the application of biomechanical principles in terms of movement technique, body mechanics, movement efficiency, training practices, and use of biomechanical technology, with ten items each (50 items). These indicators correspond to Research Question 2.

Part III measured the perceived contribution of biomechanics to sports performance in terms of skill execution, speed and agility, balance and coordination, strength and power, and overall athletic performance, with ten items each (50 items). These indicators correspond to Research Question 3.

Part IV measured the perceived effectiveness of biomechanics in injury prevention in terms of the identification of injury risk factors, correction of faulty movement patterns, and reduction of overuse injuries, with ten items each (30 items). These indicators correspond to Research Question 4.

Data Gathering Procedures

Before data collection, the researcher secured the necessary approvals from the research adviser and the appropriate authorities of the University of Makati, in compliance with institutional research guidelines and ethical clearance requirements.

The researcher then coordinated with the relevant offices, sports coordinators, and coaches to identify and reach student-athletes who met the inclusion criteria.

All participants were informed of the objectives, procedures, expected duration, potential risks and benefits, confidentiality measures, and their right to participate voluntarily or withdraw at any time without penalty.

Written informed consent was obtained from each participant before data collection.

III. RESULTS

This chapter presents the results of the study in the sequence of its explanatory sequential mixed-methods design, in which quantitative data are collected and analyzed first and qualitative data are then gathered to explain and deepen the statistical findings (Creswell & Plano Clark, 2018). The quantitative results come first: the profile of the respondents; the descriptive results on the level of application of biomechanical principles, the perceived contribution of biomechanics to sports performance, and the perceived effectiveness of biomechanics in injury prevention; the evidence on the validity and reliability of the instrument; and the inferential results on differences across profile groups and relationships among the three variables. The qualitative findings follow, presenting the emergent themes with their narrative descriptions and supporting quotations. The chapter closes with the integration of the two strands through a joint display, an account of where the findings converge, expand, and diverge, and the meta-inferences drawn from them.

Table 1
Profile of Respondents in Terms of Age

Age	f	%
15–18	22	20.00
19–22	74	67.27
23–26	14	12.73
27 and above	0	0.00
Total	110	100.00

Most of the respondents were 19 to 22 years old (67.27%), followed by those aged 15 to 18 (20.00%) and 23 to 26 (12.73%), while no respondent was 27 years or older. The sample is therefore made up of adolescents and young adults who are still in the stage of refining their sport skills. This matters for the interpretation of the results because, as Motor Learning Theory explains, skills at this stage continue to be acquired and refined through practice and feedback (Schmidt, 1975), so the way biomechanical principles are taught and corrected is likely to shape how these athletes move. McSweeney et al. (2021) likewise emphasized that the running biomechanics of adolescents carry implications for injury prevention and rehabilitation that are specific to their developmental stage. The absence of respondents aged 27 and above, however, means that the perceptions of older and more mature athletes are not represented, and the findings should be read as reflecting a young athletic population.

Table 2
Profile of Respondents in Terms of Sex

Sex	f	%
Male	69	62.73
Female	38	34.55
Prefer not to say	3	2.73
Total	110	100.00

Male respondents made up the majority of the sample (62.73%), while females accounted for 34.55% and 2.73% preferred not to state their sex. The predominance of male respondents may reflect the composition of the athletic programs from which the sample was drawn. Because Dynamic Systems Theory holds that movement emerges from the interaction of individual, task, and environmental constraints (Thelen & Smith, 1994), differences in body structure and training experience between male and female athletes could shape how biomechanical principles are applied and perceived. The smaller share of female respondents therefore limits how fully their perspectives are captured, and the three respondents who preferred not to state their sex were necessarily excluded from the sex-based comparisons in the inferential analysis.

Table 3
Profile of Respondents in Terms of Type of Sport or Physical Activity

Type of sport or physical activity	*f*	%
Individual sport	35	31.82
Team sport	57	51.82
Fitness training	12	10.91
Recreational physical activity	5	4.55
Others	1	0.91
Total	**110**	**100.00**

More than half of the respondents were engaged in team sports (51.82%), followed by individual sports (31.82%), fitness training (10.91%), recreational physical activity (4.55%), and other activities (0.91%). The dominance of team and individual sports indicates that the respondents are mainly competitive athletes whose activities involve sport-specific skills such as rapid changes of direction, landing, striking, and coordinated whole-body action. These are the demands for which the reviewed literature describes biomechanics as most relevant, including speed and agility (Vancini et al., 2024) and balance and coordination (Yılmaz et al., 2024). Penichet-Tomas (2024) also argued that biomechanics is a practical tool for recreational and developmental participants, yet these groups are thinly represented here, with only six respondents in recreational and other activities combined. Since task demands differ across activities (Thelen & Smith, 1994), the findings speak mainly to athletes in organized team and individual sports.

Table 4
Profile of Respondents in Terms of Years of Participation

Years of participation	*f*	%
Less than 1 year	4	3.64
1–3 years	26	23.64
4–6 years	38	34.55
More than 6 years	42	38.18
Total	**110**	**100.00**

The respondents were largely experienced participants. Those with more than six years of participation formed the largest group (38.18%), followed by those with four to six years (34.55%), one to three years (23.64%), and less than one year (3.64%), so that 72.73% had been involved in sports or physical activity for at least four years. This level of experience lends credibility to their ratings, since most respondents have accumulated years of instruction, practice, and correction against which to judge how biomechanics is applied in their training. Schmidt's (1975) schema theory explains that repeated practice across varied situations builds the generalized motor programs that guide skilled movement, which suggests that these respondents have had ample opportunity to encounter biomechanical principles in practice. Beginners, on the other hand, are few, and the perspectives of athletes who are new to structured training are only minimally represented.

Table 5
Profile of Respondents in Terms of Level of Competition

Level of competition	*f*	%
Recreational	8	7.27
School	74	67.27
Amateur	21	19.09
Professional	7	6.36
Total	**110**	**100.00**

Two thirds of the respondents competed at the school level (67.27%), while 19.09% competed at the amateur level, 7.27% at the recreational level, and 6.36% at the professional level. The study therefore captures biomechanics as it is experienced mainly in school-based sport, a setting that the reviewed literature identified as underrepresented, since much of the existing research focuses on elite athletes and laboratory settings. The reviewed literature also emphasized that biomechanics is relevant not only in elite competitive sport but also in school-based physical education and community sports programs, and Penichet-Tomas (2024) described it as a practical tool for developmental contexts. The small number of professional athletes, however, means that the results cannot be taken to describe the application of biomechanics at the highest competitive levels, where access to sports science support is likely to differ.

Table 6. presents the distribution of the respondents according to their prior exposure to biomechanics training.

Table 6
Profile of Respondents in Terms of Prior Exposure to Biomechanics Training

Prior exposure to biomechanics training	f	%
None	20	18.18
Classroom discussion only	32	29.09
Coaching or training session	32	29.09
Video or motion analysis	17	15.45
Wearable device or digital monitoring	6	5.45
Others	3	2.73
Total	110	100.00

Most respondents had encountered biomechanics in some form, but mainly through instruction rather than technology. Classroom discussion and coaching or training sessions were each reported by 29.09% of the respondents, while 15.45% had experienced video or motion analysis, 5.45% had used a wearable or digital monitoring device, and 2.73% reported other forms of exposure. Nearly one in five (18.18%) had no exposure at all. The small share of technology-based exposure contrasts with the reviewed literature, in which Rebelo et al. (2023) and Vancini et al. (2024) described wearable sensors, motion analysis, and video as central to modern biomechanical practice. It is consistent, however, with the observation in the reviewed literature that cost, accessibility, technical expertise, and institutional support restrict the use of biomechanical technology in developing contexts. Because exposure varies considerably among the respondents, it serves as an important grouping variable in the tests of difference that follow.

Overall, the profile describes a group of young, mostly male, school-level athletes in organized team and individual sports who have several years of experience but limited exposure to technology-based biomechanical analysis. This profile suits the study's aim of examining biomechanics outside the elite and laboratory settings that dominate the literature, but it also bounds the findings: the results that follow describe athletes of this kind within a single institution and should be generalized to older, professional, or recreational populations with caution.

Table 7
Level of Application of Biomechanical Principles in Terms of Movement Technique

Item	M	SD	Verbal Interpretation
1. I apply proper movement techniques during sports or physical activity.	3.07	0.74	High
2. I observe correct body positioning while performing movement skills.	3.25	0.70	Very High
3. I adjust my movement technique based on feedback from coaches or trainers.	3.36	0.66	Very High
4. I recognize the role of proper technique in supporting sports performance.	3.22	0.71	High
5. I practice correct movement execution during training or activity sessions.	3.34	0.69	Very High
6. I follow correct starting, movement, and finishing positions during activities.	3.19	0.81	High
7. I check my body position before performing a skill or movement.	3.20	0.74	High
8. I correct movement errors after receiving instruction or feedback.	3.12	0.73	High
9. I perform movements using safe and proper technique.	3.03	0.71	High
10. I apply technique cues given by a coach, trainer, teacher, or instructor.	3.15	0.72	High
Composite mean	**3.19**	**0.48**	**High**

Note. $N = 110$. 3.25–4.00 = Very High (Strongly Agree); 2.50–3.24 = High (Agree); 1.75–2.49 = Low (Disagree); 1.00–1.74 = Very Low (Strongly Disagree).

Movement technique obtained a composite mean of 3.19 (SD = 0.48), interpreted as high. The strongest ratings were given to adjusting movement technique based on feedback from coaches or trainers (M = 3.36), practicing correct movement execution during training (M = 3.34), and observing correct body positioning (M = 3.25), all interpreted as very high. The lowest ratings went to performing movements using safe and proper technique (M = 3.03) and applying proper movement techniques during activity (M = 3.07). The pattern suggests that the respondents' technique is driven largely by external feedback: they respond readily when a coach or trainer corrects them, yet they are less confident that they consistently perform movements safely and properly on their own. This is consistent with Motor Learning Theory, which holds that feedback about movement quality is the means by which learners correct errors and refine skills over time (Schmidt, 1975). Penichet-Tomas (2024) similarly emphasized that biomechanical feedback allows athletes to refine movement patterns and improve the precision of skill execution. The gap between responsiveness to feedback and independent execution indicates that the corrective process is working but that the corrected technique has not yet been fully internalized.

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Table 8. shows the level of application of biomechanical principles in terms of body mechanics.

Body mechanics registered a composite mean of 3.02 (SD = 0.52), interpreted as high. The respondents rated highest their recognition of how body alignment affects movement performance (M = 3.20) and their avoidance of unnecessary body strain (M = 3.12).

Table 8
Level of Application of Biomechanical Principles in Terms of Body Mechanics

Item	*M*	*SD*	Verbal Interpretation
1. I maintain proper posture while performing sports or physical activities.	2.94	0.77	High
2. I use proper lifting, landing, and turning techniques.	2.92	0.81	High
3. I recognize how body alignment affects movement performance.	3.20	0.70	High
4. I avoid unnecessary body strain during movement activities.	3.12	0.66	High
5. I receive or apply training that emphasizes proper body mechanics.	3.05	0.70	High
6. I maintain body alignment during movement transitions.	3.10	0.73	High
7. I use proper knee, hip, and trunk position during movement tasks.	2.97	0.78	High
8. I apply safe landing mechanics during jumping or movement activities.	2.86	0.82	High
9. I control my body position while accelerating, stopping, or changing direction.	3.08	0.78	High
10. I avoid awkward body positions during training or physical activity.	2.97	0.76	High
Composite mean	**3.02**	**0.52**	**High**

Note. *N* = 110. 3.25–4.00 = Very High (Strongly Agree); 2.50–3.24 = High (Agree); 1.75–2.49 = Low (Disagree); 1.00–1.74 = Very Low (Strongly Disagree).

The lowest ratings were for applying safe landing mechanics during jumping (M = 2.86), using proper lifting, landing, and turning techniques (M = 2.92), and maintaining proper posture (M = 2.94). Awareness of correct mechanics therefore runs ahead of its execution, and landing emerges as the weakest point. This matters because McSweeney et al. (2021) emphasized that appropriate movement mechanics reduce stress on the musculoskeletal system and that poor mechanics lead to compensatory patterns that raise the risk of overuse injury. Weir (2024) likewise identified landing mechanics and lower-limb alignment as primary targets of movement retraining. From the standpoint of Kinetic Chain Theory, a weak landing compromises the transfer of force through the connected body segments, which makes the lower ratings on landing and turning a practical concern for both performance and safety.

Table 9. presents the level of application of biomechanical principles in terms of movement efficiency.

Table 9
Level of Application of Biomechanical Principles in Terms of Movement Efficiency

Item	*M*	*SD*	Verbal Interpretation
1. I perform movements with minimal unnecessary effort.	3.09	0.77	High
2. I execute sports or physical activity skills smoothly.	2.83	0.68	High
3. I recognize that efficient movement helps conserve energy.	3.10	0.68	High
4. I develop more efficient movement through repeated practice.	3.04	0.69	High
5. I focus on movement quality, not speed alone.	3.02	0.73	High
6. I reduce unnecessary movements during skill execution.	2.91	0.80	High
7. I perform movements with proper rhythm and control.	3.02	0.69	High
8. I use energy efficiently during repeated activities.	3.14	0.78	High
9. I maintain movement quality even during longer practice activities.	3.00	0.81	High
10. I adjust movement patterns to reduce wasted effort.	3.13	0.69	High
Composite mean	**3.03**	**0.49**	**High**

Note. *N* = 110. 3.25–4.00 = Very High (Strongly Agree); 2.50–3.24 = High (Agree); 1.75–2.49 = Low (Disagree); 1.00–1.74 = Very Low (Strongly Disagree).

Movement efficiency yielded a composite mean of 3.03 (SD = 0.49), interpreted as high. The highest-rated items were using energy efficiently during repeated activities (M = 3.14) and adjusting movement patterns to reduce wasted effort (M = 3.13), while executing skills smoothly (M = 2.83) and reducing unnecessary movements during skill execution (M = 2.91) were rated lowest. The respondents thus understand and pursue energy conservation but are less certain that their actual movement is smooth and free of wasted motion. Vancini et al. (2024) explained that biomechanical evaluation enables practitioners to detect such inefficiencies and design individualized interventions, and Penichet-Tomas (2024) linked movement efficiency with improved technical execution and reduced fatigue. The lower ratings on smoothness suggest that the respondents would benefit from the kind of systematic movement evaluation these authors describe, since inefficiencies of this type are difficult to detect without it.

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Table 10. presents the level of application of biomechanical principles in terms of training practices.

Training practices obtained a composite mean of 3.04 (SD = 0.48), interpreted as high. The respondents agreed most that training activities are designed to improve movement quality (M = 3.21), that sessions include drills for correct movement patterns (M = 3.18), and that warm-up and cool-down activities are included (M = 3.14).

Table 10
Level of Application of Biomechanical Principles in Terms of Training Practices

Item	*M*	*SD*	Verbal Interpretation
1. My training activities include exercises based on biomechanical principles.	2.98	0.70	High
2. Coaches or trainers provide feedback about proper movement mechanics.	2.95	0.73	High
3. Warm-up and cool-down activities are included in training or activity sessions.	3.14	0.67	High
4. Strength and flexibility exercises are included in training or activity sessions.	2.92	0.74	High
5. Training activities are designed to improve movement quality.	3.21	0.66	High
6. Training sessions include drills that develop correct movement patterns.	3.18	0.78	High
7. Training activities include reminders on safe movement execution.	2.97	0.76	High
8. Training sessions allow time for correcting movement errors.	2.83	0.71	High
9. Training plans include gradual progression of movement difficulty.	3.10	0.81	High
10. Training practices include monitoring of fatigue, posture, or movement quality.	3.13	0.74	High
Composite mean	**3.04**	**0.48**	**High**

Note. *N* = 110. 3.25–4.00 = Very High (Strongly Agree); 2.50–3.24 = High (Agree); 1.75–2.49 = Low (Disagree); 1.00–1.74 = Very Low (Strongly Disagree).

The lowest ratings were for time allotted to correcting movement errors (M = 2.83), inclusion of strength and flexibility exercises (M = 2.92), and feedback from coaches about proper movement mechanics (M = 2.95). Training is therefore designed with movement quality in mind, but the time and explicit mechanical feedback needed to act on errors appear limited. Rebelo et al. (2023) and Vancini et al. (2024) described biomechanically informed training as one that continuously evaluates movement quality and adjusts training accordingly. Because Motor Learning Theory places feedback and practice at the center of skill refinement (Schmidt, 1975), the limited time for error correction may restrict how much of the intended movement quality is actually achieved.

Table 11. shows the level of application of biomechanical principles in terms of the use of biomechanical technology.

Table 11
Level of Application of Biomechanical Principles in Terms of Use of Biomechanical Technology

Item	*M*	*SD*	Verbal Interpretation
1. I use video analysis to review movement performance.	2.31	0.81	Low
2. Motion analysis technology helps identify movement errors.	2.39	0.87	Low
3. Wearable devices are used to monitor movement or performance data.	2.33	0.76	Low
4. Biomechanical technology provides feedback on movement technique.	2.48	0.94	Low
5. I use available biomechanical technology during training or activity sessions.	2.45	0.82	Low
6. I review recorded movements to identify technique errors.	2.45	0.72	Low
7. I use available digital tools to monitor speed, timing, distance, or movement quality.	2.44	0.71	Low
8. I receive movement feedback from video, apps, sensors, or digital platforms.	2.37	0.80	Low
9. I compare current movement performance with previous recordings or feedback.	2.42	0.86	Low
10. I apply feedback from biomechanical technology during practice.	2.34	0.75	Low
Composite mean	**2.40**	**0.58**	**Low**

Note. *N* = 110. 3.25–4.00 = Very High (Strongly Agree); 2.50–3.24 = High (Agree); 1.75–2.49 = Low (Disagree); 1.00–1.74 = Very Low (Strongly Disagree).

The use of biomechanical technology was the only sub-variable interpreted as low, with a composite mean of 2.40 (SD = 0.58), and every one of its ten items fell within the low range. Even the highest-rated item, the view that biomechanical technology provides feedback on movement technique (M = 2.48), remained low, while the use of video analysis to review performance (M = 2.31), the use of wearable devices (M = 2.33), and the application of feedback from technology during practice (M = 2.34) were rated lowest. This item also carried the largest spread of responses (SD = 0.94), indicating that access to technology varies considerably among the respondents. The finding stands in contrast to the literature, where Rebelo et al. (2023) and Vancini et al. (2024) described wearable sensors, motion analysis, and digital platforms as central to modern biomechanical practice. It is, however, consistent with the observation in the reviewed literature that cost, accessibility, technical expertise, and institutional

support limit the adoption of biomechanical technology in developing settings. Notably, video analysis, which the literature regards as an accessible entry point that still yields valuable insight, was the least used of all, suggesting that the barrier is not only equipment but also the habit and know-how of integrating recorded feedback into practice.

Table 12. summarizes the composite means of the five sub-variables of the application of biomechanical principles.

Table 12

Summary of the Level of Application of Biomechanical Principles

Sub-variable	*M*	*SD*	Verbal Interpretation	Rank
Movement Technique	3.19	0.48	High	1
Body Mechanics	3.02	0.52	High	4
Movement Efficiency	3.03	0.49	High	3
Training Practices	3.04	0.48	High	2
Use of Biomechanical Technology	2.40	0.58	Low	5
Overall	**2.94**	**0.42**	**High**	

Note. *N* = 110. 3.25–4.00 = Very High (Strongly Agree); 2.50–3.24 = High (Agree); 1.75–2.49 = Low (Disagree); 1.00–1.74 = Very Low (Strongly Disagree).

The overall application of biomechanical principles was high (M = 2.94, SD = 0.42). Movement technique ranked first (M = 3.19), followed closely by training practices (M = 3.04), movement efficiency (M = 3.03), and body mechanics (M = 3.02), while the use of biomechanical technology ranked last and was the only low sub-variable (M = 2.40). The respondents therefore apply biomechanics mainly through observation, instruction, and coach feedback rather than through objective measurement. Penichet-Tomas (2024) noted that biomechanical assessment helps identify technical errors that are not easily observable through visual assessment alone, which suggests that the absence of technology may cap how far the other dimensions can develop. Viewed through Dynamic Systems Theory, the environment in which the respondents train, including the resources available to them, acts as a constraint that shapes how biomechanics is applied (Thelen & Smith, 1994). This contrast between practice-based and technology-based application is a point the qualitative phase is positioned to explain.

3. On the Perceived Contribution of Biomechanics to Sports Performance

The third research question determined the perceived level of contribution of biomechanics to sports performance in terms of skill execution, speed and agility, balance and coordination, strength and power, and overall athletic performance.

Table 13. presents the perceived contribution of biomechanics to sports performance in terms of skill execution.

Table 13

Perceived Contribution of Biomechanics to Sports Performance in Terms of Skill Execution

Item	*M*	*SD*	Verbal Interpretation
1. Biomechanics helps me understand how to perform sports skills accurately.	3.15	0.71	High
2. Proper biomechanics supports my technical execution of sports skills.	3.09	0.66	High
3. Proper movement mechanics supports my consistent skill performance.	3.17	0.69	High
4. Biomechanical knowledge supports my confidence during performance.	3.15	0.73	High
5. Correct biomechanics supports my learning of complex sports skills.	3.31	0.65	Very High
6. Biomechanics helps me identify correct body position during skill execution.	3.26	0.69	Very High
7. Biomechanics helps improve my awareness of movement errors during skill performance.	3.06	0.71	High
8. Biomechanics helps guide proper sequencing of movement skills.	3.27	0.66	Very High
9. Biomechanics helps refine my technique during repeated practice.	3.19	0.66	High
10. Biomechanics helps support safer and more controlled skill execution.	3.23	0.70	High
Composite mean	**3.19**	**0.45**	**High**

Note. *N* = 110. 3.25–4.00 = Very High (Strongly Agree); 2.50–3.24 = High (Agree); 1.75–2.49 = Low (Disagree); 1.00–1.74 = Very Low (Strongly Disagree).

Skill execution obtained a composite mean of 3.19 (SD = 0.45), interpreted as high. Three items reached the very high range: that correct biomechanics supports the learning of complex sports skills (M = 3.31), guides the proper sequencing of movement skills (M = 3.27), and helps identify correct body position during execution (M = 3.26). The lowest-rated item was that biomechanics improves awareness of movement errors during performance (M = 3.06). The respondents value biomechanics most as a guide to how skills are structured and learned, which agrees with Penichet-Tomas (2024), who reported that biomechanical assessment enhances technical performance by identifying optimal movement patterns. The emphasis on sequencing also reflects Schmidt's (1975) schema theory, in which generalized motor programs organize the order and timing of movement. The relatively lower rating on error awareness fits the low use of technology reported earlier, since the literature notes that many technical errors are not easily seen without objective analysis.

Table 14. presents the perceived contribution of biomechanics to sports performance in terms of speed and agility.

Table 14

Perceived Contribution of Biomechanics to Sports Performance in Terms of Speed and Agility

Item	*M*	*SD*	Verbal Interpretation
1. Proper movement mechanics supports my speed development.	2.94	0.79	High
2. Biomechanics helps me understand efficient change of direction.	3.11	0.78	High
3. Efficient body movements support quicker response during activity.	3.11	0.73	High
4. Biomechanically sound training supports my agility development.	3.08	0.77	High
5. Proper biomechanics reduces my unnecessary movements.	3.07	0.80	High
6. Biomechanics helps me identify proper foot placement during speed or agility tasks.	3.12	0.71	High
7. Biomechanics helps support safe acceleration and deceleration.	3.05	0.73	High
8. Biomechanics helps improve my movement control during quick direction changes.	2.97	0.80	High
9. Biomechanics helps reduce wasted movement during speed drills.	3.22	0.73	High
10. Biomechanics helps guide proper body position during agility activities.	3.19	0.71	High
Composite mean	**3.09**	**0.52**	**High**

Note. $N = 110$. 3.25–4.00 = Very High (Strongly Agree); 2.50–3.24 = High (Agree); 1.75–2.49 = Low (Disagree); 1.00–1.74 = Very Low (Strongly Disagree).

Speed and agility recorded a composite mean of 3.09 (SD = 0.52), interpreted as high. The respondents agreed most that biomechanics helps reduce wasted movement during speed drills (M = 3.22) and guides proper body position during agility activities (M = 3.19). The lowest ratings were given to the contribution of movement mechanics to speed development (M = 2.94) and to movement control during quick direction changes (M = 2.97). Biomechanics is thus seen as a tool for cleaner, better-positioned movement more than as a direct source of speed. This reading is in line with Vancini et al. (2024), who explained that biomechanical insight improves stride efficiency and directional control. The lower rating on control during rapid direction changes connects with the weaker ratings on landing and turning mechanics in Table 8, pointing to deceleration and change of direction as a common area of need.

Table 15. presents the perceived contribution of biomechanics to sports performance in terms of balance and coordination.

Table 15

Perceived Contribution of Biomechanics to Sports Performance in Terms of Balance and Coordination

Item	*M*	*SD*	Verbal Interpretation
1. Biomechanics helps me understand balance during sports activities.	3.05	0.79	High
2. Proper body alignment supports my coordination.	3.11	0.70	High
3. Biomechanics supports my better control during movement.	3.17	0.73	High
4. Biomechanics helps me recover balance after movement.	3.05	0.79	High
5. Biomechanics supports my overall body control.	3.19	0.70	High
6. Biomechanics helps me identify body positions that support stability.	3.15	0.76	High
7. Biomechanics helps me coordinate arm, leg, and trunk movements.	3.11	0.67	High
8. Biomechanics helps me maintain body control during complex movement patterns.	3.02	0.75	High
9. Biomechanics helps guide my balance during landing, turning, or reaching movements.	3.01	0.72	High
10. Biomechanics helps improve my awareness of center of gravity during activity.	3.25	0.62	High
Composite mean	**3.11**	**0.49**	**High**

Note. $N = 110$. 3.25–4.00 = Very High (Strongly Agree); 2.50–3.24 = High (Agree); 1.75–2.49 = Low (Disagree); 1.00–1.74 = Very Low (Strongly Disagree).

Balance and coordination yielded a composite mean of 3.11 (SD = 0.49), interpreted as high. The highest ratings were for awareness of the center of gravity during activity (M = 3.25), overall body control (M = 3.19), and better control during movement (M = 3.17). The lowest were for guiding balance during landing, turning, or reaching (M = 3.01) and maintaining control during complex movement patterns (M = 3.02). The respondents credit biomechanics with improving their sense of stability and body control, which agrees with Yılmaz et al. (2024), who found that structured proprioceptive and neuromuscular training improves coordination, balance, and movement efficiency. Once again, balance during landing and turning drew the lowest rating, reinforcing that dynamic and transitional movements are where the respondents feel least supported.

Table 16. presents the perceived contribution of biomechanics to sports performance in terms of strength and power.

Strength and power obtained a composite mean of 3.05 (SD = 0.50), interpreted as high. The respondents rated highest the role of biomechanics in aligning body segments during strength-based activities (M = 3.18) and in using muscular strength appropriately (M = 3.13).

Table 16

Perceived Contribution of Biomechanics to Sports Performance in Terms of Strength and Power

Item	*M*	*SD*	Verbal Interpretation
1. Proper biomechanics supports force production during my movement.	3.03	0.72	High
2. Correct technique helps me use muscular strength appropriately.	3.13	0.67	High
3. Biomechanics supports my explosive movement performance.	2.97	0.72	High
4. Efficient body mechanics reduce energy loss during my activity.	3.07	0.76	High
5. Proper movement mechanics supports my power output.	3.05	0.85	High
6. Biomechanics helps guide proper force application during movement.	2.86	0.80	High
7. Biomechanics helps align my body segments during strength-based activities.	3.18	0.77	High
8. Biomechanics helps support controlled jumping, pushing, pulling, or lifting movements.	3.00	0.77	High
9. Biomechanics helps reduce unnecessary strain during strength activities.	3.11	0.72	High
10. Biomechanics helps improve timing of force application during performance.	3.12	0.71	High
Composite mean	**3.05**	**0.50**	**High**

Note. N = 110. 3.25–4.00 = Very High (Strongly Agree); 2.50–3.24 = High (Agree); 1.75–2.49 = Low (Disagree); 1.00–1.74 = Very Low (Strongly Disagree).

The lowest ratings were for guiding proper force application (M = 2.86) and supporting explosive movement (M = 2.97). Alignment is visible and can be coached through observation, whereas force application is difficult to perceive without measurement. The reviewed literature explains that biomechanical analysis allows practitioners to examine how force is produced and transferred across body segments, and Rebelo et al. (2023) identified force platforms among the tools that make such measurement possible. Kinetic Chain Theory likewise emphasizes the efficient transfer of force through interconnected segments, a quality the respondents seem to sense less clearly than alignment.

Table 17. presents the perceived contribution of biomechanics to sports performance in terms of overall athletic performance.

Table 17

Perceived Contribution of Biomechanics to Sports Performance in Terms of Overall Athletic Performance

Item	*M*	*SD*	Verbal Interpretation
1. Biomechanics contributes to my overall sports or activity performance.	3.17	0.70	High
2. Proper movement mechanics supports my athletic performance.	3.09	0.75	High
3. Biomechanics supports my efficient performance during training or competition.	3.30	0.68	Very High
4. Biomechanical knowledge supports my confidence in performing sports or physical activities.	3.19	0.68	High
5. Biomechanics is important in supporting athletic performance.	3.25	0.77	Very High
6. Biomechanics helps connect technique, training, and performance outcomes.	3.32	0.77	Very High
7. Biomechanics helps identify my areas for performance improvement.	3.28	0.78	Very High
8. Biomechanics helps guide performance-related corrections during practice.	3.34	0.62	Very High
9. Biomechanics helps support consistent performance across repeated activities.	3.27	0.78	Very High
10. Biomechanics helps me understand how movement quality affects performance.	3.41	0.63	Very High
Composite mean	**3.26**	**0.51**	**Very High**

Note. N = 110. 3.25–4.00 = Very High (Strongly Agree); 2.50–3.24 = High (Agree); 1.75–2.49 = Low (Disagree); 1.00–1.74 = Very Low (Strongly Disagree).

Overall athletic performance was the only performance sub-variable interpreted as very high, with a composite mean of 3.26 (SD = 0.51). Seven of its ten items reached the very high range, led by the view that biomechanics helps the respondents

understand how movement quality affects performance (M = 3.41), guides performance-related corrections during practice (M = 3.34), and connects technique, training, and performance outcomes (M = 3.32). The lowest, though still high, was the item stating that proper movement mechanics supports athletic performance (M = 3.09). The respondents therefore hold a strong, integrated belief in the value of biomechanics for their performance as a whole. This view matches Penichet-Tomas (2024), who described biomechanics as a multidisciplinary field supporting performance enhancement, and the position in the reviewed literature that overall athletic performance is the combined result of technique, physical capacity, efficiency, and coordination, all of which biomechanics informs.

Table 18. summarizes the composite means of the five sub-variables of the perceived contribution of biomechanics to sports performance.

Table 18
Summary of the Perceived Contribution of Biomechanics to Sports Performance

Sub-variable	*M*	*SD*	Verbal Interpretation	Rank
Skill Execution	3.19	0.45	High	2
Speed and Agility	3.09	0.52	High	4
Balance and Coordination	3.11	0.49	High	3
Strength and Power	3.05	0.50	High	5
Overall Athletic Performance	3.26	0.51	Very High	1
Overall	**3.14**	**0.40**	**High**	

Note. *N* = 110. 3.25–4.00 = Very High (Strongly Agree); 2.50–3.24 = High (Agree); 1.75–2.49 = Low (Disagree); 1.00–1.74 = Very Low (Strongly Disagree).

The overall perceived contribution of biomechanics to sports performance was high (M = 3.14, SD = 0.40), making it the highest-rated of the three main variables. Overall athletic performance ranked first (M = 3.26) and was the only very high sub-variable, followed by skill execution (M = 3.19), balance and coordination (M = 3.11), speed and agility (M = 3.09), and strength and power (M = 3.05). The ranking shows that the respondents perceive the contribution of biomechanics most strongly in general and technique-related terms and less strongly in physical-capacity components such as speed, strength, and power. This suggests that the contribution of biomechanics is recognized where it is visible through coaching and practice, consistent with Penichet-Tomas (2024) and Vancini et al. (2024), while its contribution to force and speed, which the literature associates with measurement tools, is felt less directly.

4. Perceived Effectiveness of Biomechanics in Injury Prevention

The fourth research question determined the perceived effectiveness of biomechanics in injury prevention in terms of identification of injury risk factors, correction of faulty movement patterns, and reduction of overuse injuries. The results are presented in Tables 19 to 22.

Table 19. presents the perceived effectiveness of biomechanics in injury prevention in terms of the identification of injury risk factors.

Table 19
Perceived Effectiveness of Biomechanics in Injury Prevention in Terms of Identification of Injury Risk Factors

Item	*M*	*SD*	Verbal Interpretation
1. Biomechanics helps identify movement errors that may cause injuries.	3.08	0.72	High
2. Coaches, trainers, or instructors identify injury risks through movement observation.	3.02	0.64	High
3. I recognize movements that may increase injury risk.	3.08	0.68	High
4. Biomechanical assessment helps identify actions that may reduce injury risk.	2.83	0.69	High
5. Early identification helps guide actions that may reduce injury risk.	2.93	0.79	High
6. Biomechanics helps identify poor posture during movement activities.	2.96	0.75	High
7. Biomechanics helps identify unsafe landing, turning, or stopping patterns.	3.12	0.73	High
8. Biomechanics helps recognize repeated movement patterns that may cause strain.	3.16	0.66	High
9. Biomechanics helps identify imbalance or poor alignment during activity.	3.05	0.75	High
10. Biomechanics helps identify movement habits that require correction.	2.97	0.74	High
Composite mean	**3.02**	**0.46**	**High**

Note. *N* = 110. 3.25–4.00 = Very High (Strongly Agree); 2.50–3.24 = High (Agree); 1.75–2.49 = Low (Disagree); 1.00–1.74 = Very Low (Strongly Disagree).

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The identification of injury risk factors obtained a composite mean of 3.02 (SD = 0.46), interpreted as high. The respondents agreed most that biomechanics helps recognize repeated movement patterns that may cause strain (M = 3.16) and identify unsafe landing, turning, or stopping patterns (M = 3.12). The lowest ratings were for biomechanical assessment helping identify actions that reduce injury risk (M = 2.83) and early identification guiding preventive action (M = 2.93). The respondents can recognize risky movements from experience, but they place less confidence in formal assessment as a basis for preventive action. Wang et al. (2024) stressed that understanding biomechanical mechanisms is essential in identifying musculoskeletal injury risk, and the reviewed literature describes biomechanical screening as a means of detecting early movement dysfunction before injury occurs. The lower ratings on assessment are consistent with the limited use of biomechanical technology, since formal screening of this kind depends on structured evaluation.

Table 20. presents the perceived effectiveness of biomechanics in injury prevention in terms of the correction of faulty movement patterns.

The correction of faulty movement patterns registered a composite mean of 3.02 (SD = 0.44), interpreted as high. The highest-rated items were monitoring movement quality after corrective feedback (M = 3.11) and repeating corrected movement patterns during practice (M = 3.08), whereas following corrective drills given by a coach (M = 2.93) and modifying technique when a movement causes discomfort (M = 2.95) were rated lowest.

Table 20

Perceived Effectiveness of Biomechanics in Injury Prevention in Terms of Correction of Faulty Movement Patterns

Item	*M*	*SD*	Verbal Interpretation
1. I correct improper movement techniques when errors are identified.	3.00	0.73	High
2. Coaches, trainers, or instructors provide corrective feedback on movement patterns.	3.04	0.69	High
3. Proper biomechanics helps address harmful movement habits.	3.00	0.68	High
4. Corrective exercises support improved movement patterns.	3.06	0.69	High
5. I apply biomechanical feedback during training or activity sessions.	3.02	0.72	High
6. I adjust posture after receiving movement correction.	3.00	0.75	High
7. I modify technique when a movement pattern causes discomfort or strain.	2.95	0.71	High
8. I repeat corrected movement patterns during practice.	3.08	0.73	High
9. I follow corrective drills given by a coach, trainer, or instructor.	2.93	0.73	High
10. I monitor movement quality after receiving corrective feedback.	3.11	0.77	High
Composite mean	**3.02**	**0.44**	**High**

Note. $N = 110$. 3.25–4.00 = Very High (Strongly Agree); 2.50–3.24 = High (Agree); 1.75–2.49 = Low (Disagree); 1.00–1.74 = Very Low (Strongly Disagree).

The respondents are attentive to their movement once corrected, but adherence to structured corrective drills and self-initiated adjustment in response to discomfort are weaker. Weir (2024) highlighted movement retraining that targets landing mechanics, trunk stability, and lower-limb alignment as essential to restoring proper mechanics, and such retraining depends on consistent engagement with corrective drills. Motor Learning Theory explains that corrected patterns are retained only through repeated practice with feedback (Schmidt, 1975), which makes the lower adherence to corrective drills an important consideration.

Table 21. presents the perceived effectiveness of biomechanics in injury prevention in terms of the reduction of overuse injuries.

Table 21
Perceived Effectiveness of Biomechanics in Injury Prevention in Terms of Reduction of Overuse Injuries

Item	*M*	*SD*	Verbal Interpretation
1. Proper biomechanics helps manage repetitive stress during activity.	3.03	0.70	High
2. Efficient movement decreases unnecessary body strain.	2.90	0.73	High
3. Proper training techniques help reduce risk factors related to overuse injuries.	3.00	0.69	High
4. Biomechanical principles help manage training loads.	2.83	0.84	High
5. Applying biomechanics supports safer training or physical activity.	3.04	0.66	High
6. Biomechanics helps identify repeated movements that may cause overuse strain.	3.05	0.76	High
7. Biomechanics helps guide proper rest, pacing, or recovery during training.	2.82	0.78	High
8. Biomechanics helps adjust technique to reduce repeated stress on joints or muscles.	2.94	0.77	High
9. Biomechanics helps monitor fatigue that may affect movement quality.	3.05	0.75	High
10. Biomechanics helps support safer repetition of skills during training.	2.98	0.77	High
Composite mean	**2.96**	**0.54**	**High**

Note. $N = 110$. 3.25–4.00 = Very High (Strongly Agree); 2.50–3.24 = High (Agree); 1.75–2.49 = Low (Disagree); 1.00–1.74 = Very Low (Strongly Disagree).

The reduction of overuse injuries obtained a composite mean of 2.96 (SD = 0.54), interpreted as high, and was the lowest of the injury prevention sub-variables. The respondents agreed most that biomechanics helps monitor fatigue that may affect movement quality (M = 3.05) and identify repeated movements that may cause overuse strain (M = 3.05). The lowest ratings were for guiding proper rest, pacing, or recovery (M = 2.82) and managing training loads (M = 2.83). Load and recovery management thus emerges as the weakest link in the respondents' injury prevention practice. Rebelo et al. (2023) reported that wearable technologies and force platforms are used precisely to assess workload, fatigue, and injury risk, and Vancini et al. (2024) emphasized that biomechanical monitoring ensures training loads remain appropriate. McSweeney et al. (2021) further identified overuse injury as a particular concern among young athletes. Given the low use of such technology among the respondents, it is understandable that load management is the area where biomechanics is perceived as least effective.

Table 22. summarizes the composite means of the three sub-variables of the perceived effectiveness of biomechanics in injury prevention.

Table 22
Summary of the Perceived Effectiveness of Biomechanics in Injury Prevention

Sub-variable	*M*	*SD*	Verbal Interpretation	Rank
Identification of Injury Risk Factors	3.02	0.46	High	1
Correction of Faulty Movement Patterns	3.02	0.44	High	2
Reduction of Overuse Injuries	2.96	0.54	High	3
Overall	**3.00**	**0.40**	**High**	

Note. $N = 110$. 3.25–4.00 = Very High (Strongly Agree); 2.50–3.24 = High (Agree); 1.75–2.49 = Low (Disagree); 1.00–1.74 = Very Low (Strongly Disagree).

The overall perceived effectiveness of biomechanics in injury prevention was high (M = 3.00, SD = 0.40). Identification of injury risk factors and correction of faulty movement patterns shared the same composite mean (M = 3.02) and ranked first and second, while reduction of overuse injuries ranked last (M = 2.96). Although high, injury prevention was rated below performance contribution (M = 3.14), which suggests that the respondents associate biomechanics more readily with performing well than with staying injury-free. Penichet-Tomas (2024) and Wang et al. (2024) positioned injury prevention as one of the central applications of biomechanics, so the lower standing of this variable signals that its preventive value is not yet as fully recognized by the respondents as its performance value.

SUMMARY OF FINDINGS

The study examined the application of biomechanical principles, the perceived contribution of biomechanics to sports performance, and the perceived effectiveness of biomechanics in injury prevention among 110 student-athletes of the University of Makati, using an explanatory sequential mixed-methods design. A validated four-point questionnaire was administered in the

quantitative phase, and in-depth interviews with twelve purposively selected participants were conducted in the qualitative phase to explain the statistical results.

Based on the integrated findings, the following conclusions are drawn.

1. Biomechanics is applied as coached technique rather than as applied science. The student-athletes apply biomechanical principles at a high level, but mainly through correct form taught and drilled by coaches. The scientific basis of movement and the tools for measuring it remain largely outside everyday training, which is why technique is strong and the use of technology is low.
2. Visible feedback is the mechanism that links exposure to benefit. The null hypothesis of no significant difference is rejected for prior exposure to biomechanics training in the application of biomechanical principles and in the perceived contribution to sports performance, and it is not rejected for the other profile variables. Athletes who have seen their own movement analyzed apply biomechanics more and value it more, whereas knowledge without feedback and years of experience alone do not make the same difference.
3. The barrier is structural and instructional, not attitudinal. Athletes value biomechanics and are willing to use it. What limits its application is limited practice time, a high athlete-to-coach ratio, general rather than specific correction, and the absence of guidance in using available technology.
4. Injury prevention is practiced reactively, and overuse is its blind spot. The null hypothesis of no significant difference in the perceived effectiveness in injury prevention is not rejected for any profile variable. Prevention is recognized less readily than performance because its benefits are less visible, risk is detected mostly after the fact, and load, recovery, and pain go largely unmanaged.
5. Performance and protection are outcomes of the same corrected movement. The null hypothesis of no significant relationship is rejected. The application of biomechanics, its perceived contribution to performance, and its perceived effectiveness in injury prevention rise together, and athletes experience well-executed movement as serving both performance and safety.

Taken together, these conclusions indicate that the most direct way to strengthen the application of biomechanics in the respondents' setting is to make movement visible through guided, low-cost feedback, to build load and recovery management into training, and to give coaches the time and support to deliver specific correction.

In light of the conclusions, the following recommendations are offered.

Theory

1. Researchers and educators may use the integrated view proposed in Chapter 5, in which the environment shapes access to visible feedback, feedback shapes motor learning, and corrected movement serves both performance and protection, as a framework for studying biomechanics in school and community sport.
2. Applications of Motor Learning Theory in sport may distinguish more clearly between exposure that provides knowledge and exposure that provides feedback on the learner's own movement, since only the latter was associated with higher application and perceived benefit.
3. Applications of Dynamic Systems Theory may treat program resources, including time, staffing, technology, and scheduling, as environmental constraints that shape movement as much as individual characteristics do.
4. Kinetic Chain Theory may be used to frame injury prevention and performance as joint outcomes in athlete education, given the strong relationship between the two found in this study.

Practical Output

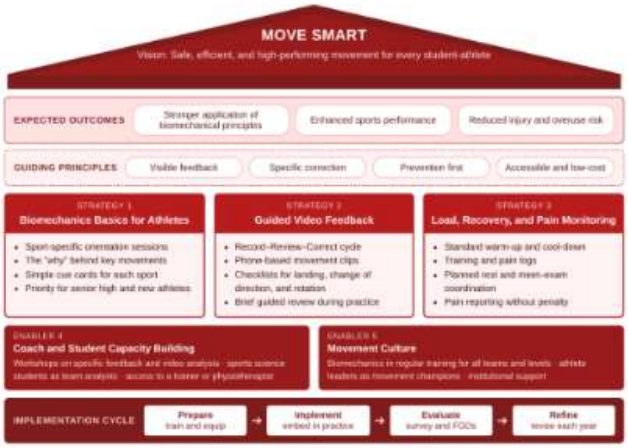


Figure 2. *MOVE SMART Strategic Framework*

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