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Relationship between Arm Length, Power Arm Muscles and Power Lemb Muscles on Butterfly Style Swimming Achievement

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ABSTRACT: This study aims to determine the relationship between arm length, arm muscle power and leg muscle power on butterfly swimming performance. This research uses a survey method. Data collection techniques use tests and measurements. The population in this study were swimming athletes aged 12 to 13 years in the Special Region of Yogyakarta Province. The research used was population research with a total of 27 athletes. The main instruments used are the arm length test, arm muscle power test, leg muscle power test and 25 meter butterfly swimming test. The data analysis used is the normality test, linearity test, correlation test and multiple regression analysis test with a significance level of 5%.

The results showed that the relationship between arm length and butterfly swimming performance was 0.617, the relationship between arm muscle power and butterfly swimming performance was 0.460, the relationship between leg muscle power and butterfly swimming performance was 0.838 and the relationship between arm length, arm muscle power and leg muscle power on butterfly swimming performance is 0.897. The correlation between arm length is greater than arm muscle power because each athlete's butterfly swimming technique is not the same (how much the elbow bends when the arm is pulled).

KEYWORDS: arm length, arm muscle power, leg muscle power and butterfly swimming.

I. INTRODUCTION

Swimming is a sport that is very popular in Indonesia, this is proven by the large number of swimming clubs and people who come to several swimming pools to swim, ranging from recreation, treatment or therapy to performance coaching. Swimming as an activity in water can have the following aims: Swimming for recreation is an activity in water that can bring joy and satisfaction to the people who do the activity. When swimming for recreation, the use of swimming technique, style and speed is not given priority, because this sport aims to restore a person's condition from fatigue due to work. Swimming for health is a swimming activity that is carried out because it can maintain and improve physical fitness. By swimming regularly for health, a person can improve the condition of the body, namely the heart becomes stronger, blood circulation becomes smoother and the lungs become stronger. Swimming for achievement is a swimming sport that is carried out regularly and programmed to obtain maximum performance at regional, national and international levels. Swimming for achievement requires good technique, speed and swimming style to achieve maximum performance. Swimming for self-defense is a person's ability to overcome and deal with natural conditions, especially in water, for example flood conditions in rivers. Swimming for selfdefense only prioritizes the ability to save oneself, so this swimming is only to protect oneself when facing nature (Agus Kahpi, 1986: 15). Swimming is divided into four styles, namely: crawl style, backstroke, breaststroke and butterfly style. Sismadiyanto (2005: 71) states as follows:

"Butterfly style is an advanced style or advanced swimming, while crawl style, backstroke and breaststroke are basic swimming, so butterfly swimming is given after basic swimming is given. Butterfly swimming was initially introduced as a part of "Breaststroke swimming. Butterfly swimming is done using frog leg movements because at that time the frog leg stroke was considered the most advantageous compared to other leg movements." Soejoko Hendromartono (1992: 139) stated, "at that time the butterfly style was only used to overtake an opponent, to enter the finish line or to swim in the last lane of long distance swimming". In 1952 FINA (Federation Internationale de Natation) separated the butterfly style from the breaststroke and formalized the use of dolphin foot strokes or dolphin foot strokes as butterfly stroke swimming leg movements. This is because butterfly swimming can be done

over a distance of 200 meters and butterfly swimming always beats breaststroke swimming. The movement of the dolphin's butterfly-style swimming legs is more beneficial for swimmers because the dolphin's leg movements can follow the arm swing movements well (F.X. Sugiyanto and Agus Supriyanto, 2004: 43-44). After 1953, the record breaking for butterfly style was always done with dolphin leg butterfly style and not frog leg butterfly style.

Butterfly swimming was chosen as research because butterfly swimming is advanced swimming and the up and down movement of butterfly swimming has a level of difficulty in carrying out the movement so that butterfly swimming is used as advanced swimming. Therefore, research needs to be carried out to determine the relationship between arm length, arm muscle power and leg muscle power on butterfly swimming performance. To achieve butterfly swimming performance, a swimming athlete needs elements of physical condition such as: arm muscle power, leg muscle power, strength, flexibility, and body posture related to arm length, body height and leg length. This will be beneficial in the effectiveness of the movements with a record of mastery of the same technique.

Sports performance can achieve excellent results from determining factors consisting of 4 aspects, namely: (1) Biological/physical aspects consisting of the body's basic abilities, namely strength, speed, agility and coordination, power, power. muscle endurance, heart and lung power, flexibility. The functions of the body's organs are the working power of the heart and blood circulation and the working power of the lungs. Posture and body structure, namely the height and length of the body and the size, width and weight of the body. Nutrition is an adequate amount of food and the nutritional value of food that meets needs. (2) Psychological aspects consisting of: Intellectual/intelligence IQ is determined from experience and talent, motivation, personality. (3) Environmental aspects consist of: Sports facilities and infrastructure, surrounding weather and climate, parents, socio-economic life. (4) Supporting aspects include awards (Mochamad Sajoto: 1988). To achieve maximum performance in the field of sports, many factors are determined, one of which is a carefully structured effort, namely through coaching efforts, through early breeding, as well as increasing achievement through related scientific approaches.

Dadeng Kurnia (1998: 8) stated the following: "To achieve swimming achievements, the seeds of swimming athletes are also determined through the characteristics, namely coordination of skills, condition of skills, intellectual or emotional level, composition of leg height, arm length, surface area of hands and soles. feet will influence the achievement of swimming achievements." Dapan (1998: 66) explains as follows: "To achieve maximum sports performance requires thorough physical, technical and mental preparation. In preparing a training program it must be aimed at the movement skill components, namely physical, technical and mental. The movement skill component will always related to each other in achieving maximum sporting performance."

Aribinuko Tjiptoadhidjojo (2000: 3) states, "The main components in sports to achieve maximum performance are coordination, flexibility, strength, speed and endurance. According to Dadeng Kurnia (1998: 17) to achieve achievement in swimming is determined by several factors namely "strength", "power", flexibility, endurance, speed, style/technique, "start", reversal and "finish", competition strategy and psychology. Reaching peak performance in swimming can be achieved through improving skills , knowledge, attitude of training and application delivered by the coach to athletes. Improved skills through coordination and condition training, the main coordination skills of various swimming styles and starting and turning methods. Condition training consists of basic swimming endurance training, general endurance training, basic swimming speed training, speed endurance training. In general, the grouping of swimming training consists of basic "motor" movement training, basic training, progressive training and elite training. Progressive training, meaning that in carrying out the training process it is carried out from easy to difficult, simple to complex, general to specific, part to whole, light to heavy, from quantity to quality, and carried out steadily, progressively and continuously. Applying the principles must be done gradually, carefully, continuously and precisely. This means that each training goal has a certain time period for the athlete's body to adapt. After the adaptation period is reached, the training load must be increased. If the training load is increased suddenly, the body will not be able to adapt and it will even be damaged and result in injury and pain. Elite training means carrying out the training process at the level of a national athlete who already has achievements in the sport they are involved in.

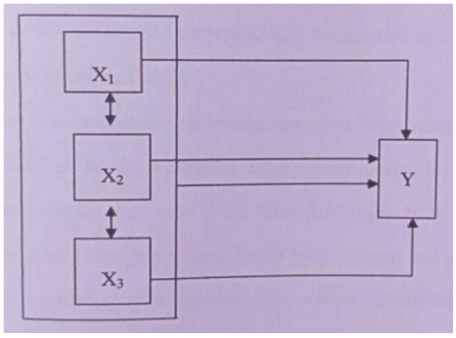
In butterfly swimming, the physical component is the most important factor in supporting butterfly swimming performance. Each physical component has a different role in supporting achievement in butterfly swimming. The most dominant physical components that support butterfly swimming are power (speed strength) and flexibility. Power is the most dominant component, especially arm muscle power and leg muscle power. The butterfly swimming movement moving forward is influenced by the power of the arm muscles and the power of the leg muscles. Arm muscle power and leg muscle power are what propel the swimmer forward in butterfly swimming. Forward thrust is generated from arm movements and leg movements that push backwards, bringing the swimmer forward. Another dominant physical component of the butterfly style is flexibility. In butterfly swimming, the body movements are different from other styles of swimming. In butterfly swimming, a swimmer's body

movements always go up and down to adjust the movement of the arms and the swing of the legs. Body movements that always go up and down like following a wave path require good body flexibility.

Butterfly swimming is a swimming style that is different from other swimming styles because the pushing phase forward by the strength of the arm muscles is done with two arms together and is divided into two stages, namely the pulling stage and the recovery or rest stage (F.X. Sugiyanto and Agus Supriyanto, 2004: 44). During the pulling stage, all the strength of the hand pushes forward, but during recovery, there is no push movement from the hand. In terms of butterfly style leg muscle strength, the leg movement resembles that of a dolphin so it has a big boost because it is done using two legs together, but in butterfly style swimming, the dolphin's leg movements are effective, using two foot strokes per swing. arm (F.X. Sugiyanto and Agus Supriyanto, 2004: 47); (Falaahudin, et al., 2024). Body flexibility in butterfly swimming is very necessary because it follows a unified movement of hand movements and continued swinging of the legs so that a good butterfly swimmer has body flexibility, especially the flexibility of the back muscles because the more flexible the back muscles are, the more movement the shoulders or body raises. the front will be fast and if the position of the shoulders or front of the body goes back down then the body position will be stream line, the stream line position is the position of the butterfly swimmer's body in the position that has the least water resistance, namely the horizontal swimmer's body position (F.X. Sugiyanto and Agus Supriyanto, 2004: 3-4). It is hoped that arm length, arm muscle power and leg muscle power will contribute a lot to achieving butterfly swimming achievements. For this reason, research needs to be carried out to determine the relationship between arm length, arm muscle power, and leg muscle power on butterfly swimming ability.

II. METHOD

The approach to this research is quantitative research because the data in this research is in the form of numbers and analysis uses statistics. The method used in the research is a correlational descriptive method. In this method, researchers try to describe as clearly as possible the relationship between arm length (X1), arm muscle power (X2), leg muscle power (X3) and butterfly swimming (Y). The research design is explained in Figure 1 below:



Information:
X1 = Arm length
X2 = arm muscle power
X3 = leg muscle power
Y = Butterfly Style Swimming

Figure 1. The research conceptual framework

III. RESEACH RESULTS

a. Description of Research Results

The description of the results of this research will discuss the relationship between arm length, arm muscle power, and leg muscle power on butterfly swimming ability. From the data obtained, a prerequisite test will be carried out, namely each variable data will be tested using the data normality test with the chi square test and continued with the linearity test. Each independent variable will be tested using the F test or variance test to determine the linearity relationship with the dependent variable. From the data obtained, proceed with Hypothesis testing. The first hypothesis test tests the correlation between an independent variable that is connected or correlated with the dependent variable. From the correlation data obtained between one independent variable and the dependent variable, it will be tested using the r test. Next, testing the partial correlation of each independent variable with the dependent variable will be tested using the t test. In partial correlation, it connects one independent variable with the dependent variable by constantizing the other independent variables.

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1. **Prerequisite Testing**
   a). **Normality test**

Table 1. Normality Test calculation results.

No	Variable	x2 count	X2 tabel	conclusion
1	Sleeve length	4,372	9,488	normal
2	Arm muscle power	0,724	7,815	normal
3	Leg muscle power	1,716	7,815	normal
4	Swimming butterfly style	2,856	7,815	normal

From the results of the analysis of the prerequisite test data, it is known that arm length, arm muscle power, leg muscle power and butterfly swimming have obtained data normality results, namely arm length of 4.372, arm muscle power of 0.724, leg muscle power of 1.716 and butterfly swimming. butterfly of 2,856. So from this data, arm length, arm muscle power, leg muscle power and butterfly swimming are normally distributed.

b). Linearity test

Table 2. Results of linearity calculations.

Relationship between variables	Db	F count	F(α=0,05)v1:13,v2:12	Result
X1.Y	V1=13v2=12	0,741	2,660	linier
X2.Y	V1=22 v2=3	0,649	8,648	linier
X3.Y	V1=21 v2=4	1,104	5,795	linier

From the results of the linearity test, it was found that the value of arm length with butterfly swimming was 0.741, arm muscle power with butterfly swimming was 0.649, and leg muscle power with butterfly swimming was 1.104. And from the linearity test for each of the three independent variables, namely arm length, arm muscle power, leg muscle power, it can be concluded that it has a linear relationship with the dependent variable, namely butterfly swimming.

2. Hypothesis test

a). Correlation Test of One Independent Variable with the Dependent Variable

Table 3. Simple Correlation Test Results

correlation	R count	R t bl (α=0.05)(15)	Results
X1.Y	0.617	0.514	Means
X2.Y	0.460	0.514	Means
X3.Y	0.383	0.514	Means

From the results of the correlation test between the independent variable and the dependent variable, namely arm length with butterfly swimming is 0.617, arm muscle power with butterfly swimming is 0.460, leg muscle power with butterfly swimming is 0.383. The correlation of the three independent variables with the dependent variable is negative, meaning that the greater the arm length, arm muscle power, and leg muscle power, the better the butterfly swimming will be, but the numbers of the independent variable and the dependent variable are inversely proportional, the greater the number of the independent variable,

the better the dependent variable number is small. From the data above, to carry out a calculated significance test, consult using the r table with an error level of 5% or a confidence level of 95% and a degree of freedom of n=15. So from each of the three independent variables, namely arm length, arm muscle power, and leg muscle power, it can be concluded that they have a significant relationship with the dependent variable or butterfly swimming.

b). Partial correlation test

Table 4. partial correlation

Partial correlation	r- partial	t	Conclusion
X1.Y-(X2.X3)	0.477	-2.601	Means
X2.Y(X1.X3)	0.435	-2.315	Means
X3.Y-(X1.X3)	0.767	-5.738	Means

From the results of the partial correlation test, it was obtained that the t value of the pure relationship was between arm length and butterfly swimming of -2.601, arm muscle power with butterfly swimming of -2.315, and leg muscle power of butterfly swimming of -2.315. 5,738. At the calculated value of arm length, arm muscle power and leg muscle power are less than the t table value. Thus it can be concluded that arm length, arm muscle power and leg muscle power have a pure relationship to butterfly swimming.

c). Multiple Correlation Coefficient of Three Independent Variables

Table 5. Multiple correlation coefficient

Relationship between variables	Regression line equation	Correlation coefficient
X1X2X3.Y	63.236-0.278X1-0.019X2-0.073X3	0.897

From the regression line equation Y=63.236-0.278X1-0.019X2-0.073X3, a multiple correlation coefficient can be obtained between the three independent variables together, namely arm length, arm muscle power, leg muscle power for butterfly swimming of 0.897.

d). Multiple Correlation Test for Three Independent Variables

Table 6. Multiple Correlation Test Results with Three Independent Variables.

Multiple correlation	F count	Ft(a-0.05)(3/23)	Conclusion
X1X2X3.Y	31.394	3.028	Means

From the results of the multiple correlation coefficient, an F test was carried out to determine the hypothesis formulation and it was found that the calculated F was 31.394. From these data it can be concluded that there is a relationship between arm length and butterfly swimming of 0.617, arm muscle power to butterfly swimming of 0.460, leg muscle power to butterfly swimming of 0.838, and a relationship between arm length. , arm muscle power and leg muscle power for butterfly swimming is 0.897.

IV. DISCUSSION

From the results of the analysis of the prerequisite test data, it is known that arm length, arm muscle power, leg muscle power and butterfly swimming have obtained data normality results, namely arm length of 4.372, arm muscle power of 0.724, leg muscle power of 1.716 and butterfly swimming. butterfly of 2,856. So from this data, arm length, arm muscle power, leg muscle power and butterfly swimming are normally distributed.

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From the results of the linearity test, it was found that the value of arm length with butterfly swimming was 0.741, arm muscle power with butterfly swimming was 0.649, and leg muscle power with butterfly swimming was 1.104. And from the linearity test for each of the three independent variables, namely arm length, arm muscle power, leg muscle power, it can be concluded that it has a linear relationship with the dependent variable, namely butterfly swimming.

From the results of the correlation test between the independent variable and the dependent variable, namely arm length with butterfly swimming is 0.617, arm muscle power with butterfly swimming is 0.460, leg muscle power with butterfly swimming is 0.383. The correlation of the three independent variables with the dependent variable is negative, meaning that the greater the arm length, arm muscle power, and leg muscle power, the better the butterfly swimming will be, but the numbers of the independent variable and the dependent variable are inversely proportional, the greater the number of the independent variable, the better the dependent variable number is small. From the data above, to carry out a calculated significance test, consult using the r table with an error level of 5% or a confidence level of 95% and a degree of freedom of n=15. So from each of the three independent variables, namely arm length, arm muscle power, and leg muscle power, it can be concluded that they have a significant relationship with the dependent variable or butterfly swimming.

From the results of the partial correlation test, it was obtained that the t value of the pure relationship was between arm length and butterfly swimming of -2.601, arm muscle power with butterfly swimming of -2.315, and leg muscle power of butterfly swimming of -2.315. 5,738. At the calculated value of arm length, arm muscle power and leg muscle power are less than the t table value. Thus it can be concluded that arm length, arm muscle power and leg muscle power have a pure relationship to butterfly swimming.

From the regression line equation Y = 63.236-0.278

From the results of the multiple correlation coefficient, an F test was carried out to determine the hypothesis formulation and it was found that the calculated F was 31.394. From these data it can be concluded that there is a relationship between arm length and butterfly swimming of 0.617, arm muscle power to butterfly swimming of 0.460, leg muscle power to butterfly swimming of 0.838, and a relationship between arm length. , arm muscle power and leg muscle power for butterfly swimming is 0.897.

V. CONCLUSIONS

1. There is a relationship between arm length and butterfly swimming performance of * r = 0.61.
2. There is a relationship between arm muscle power and butterfly swimming performance of r = 0.46.
3. There is a relationship between leg muscle power and butterfly swimming performance of r = 0.838.
4. There is a relationship between arm length, arm muscle power and leg muscle power on butterfly swimming performance of r = 0.897.

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