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THE RELATIONSHIP ARM MUSCLE STRENGTH AND LEG MUSCLE STRENGTH WITH RESULTS OF 50 METER FREESTYLE SWIMMING SPEED

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Abstract
The purpose of this study was to determine the relationship arm muscle strength and leg muscle strength in swimming speed of 50 meters in Club Swimmer Tirta Kartika. The method used in this research is correlational description. The samples used were 30 athletes. Sampling using total sampling technique. Data analysis using product moment correlation. The results of data analysis show that (1) the relationship between arm muscle strength and the results of the 50 meter freestyle swimming speed on male athletes of rx_1y = 0.852 > r(0,05)(13) = 0,441 and on female athletes of rx_1y = 0.954 > r(0,05)(13) = 0,441 (2) the relationship between leg muscle strength and the 50 meter freestyle swimming speed on male athletes of rx_2y = 0.856 > r(0,05)(13) = 0,441 and on female athletes of rx_2y = 0.975 > r(0,05)(13)= 0,441 (3) the relationship between arm muscle strength and strength leg muscles with a 50 meter freestyle swimming speed on male athletes of rx_1x_2y = 0.856 > r(0,05)(13)= 0,441 and on famele athletes of rx_1x_2y = 0.978 > r(0,05)(13)= 0,441. The conclusion of this study is that there is a relationship arm muscle strength and leg muscle strength in swimming speed of 50 meters in Club Swimmer Tirta Kartika.

Keywords*: arm muscle strength, leg muscle strength, swimming.*

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INTRODUCTION

Swimming is a complex type of sport and has various purposes, including recreational sport, educational sport, rehabilitation sport and achievement sport. To achieve maximum swimming performance, a directed and long process is needed to achieve it, so basic principles are also needed to produce athletes who excel. Coaches or trainers must also be able to create training programs in a planned, systematic and progressive manner so that achieve maximum performance.

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According to Law of the Republic of Indonesia Number 11 of 2022 concerning Sports "that for the quality of life and human welfare, national development in the field of sports is carried out in a planned, systematic, integrated, tiered and sustainable manner, and is oriented towards achievement and improving the welfare of sports players, so that development and management is directed at achieving quality public health and fitness, equitable access and fulfillment of sports infrastructure, achievement and improvement of the sports climate, as well as sports governance that is in line with community development and world sports competition.

Swimming is a type of sports activity that uses the body to float and cross water with the feet and hands (Subagyo, 2017:53). There are four types of styles in swimming, including breaststroke, freestyle (crawl stroke), backstroke and butterfly stroke. Based on distance traveled, age, gender and swimming style, swimming numbers in the competition can be grouped (Rahmadana & Maidarman, 2018). The freestyle swimming numbers for the men's and women's categories according to the International Swimming Federation (FINA) and according to Indonesian Aquatics include 50 m, 100 m, 200 m, 400 m, 800 m and 1500 m.

Freestyle is swimming with the body position facing the surface of the water, both hands are alternately moved forward with a paddling motion, while both legs are alternately whipped up and down, up and down, with the center of movement coming from the groin. Breathing is done when the arm is moved out of the water, when the body becomes tilted and the head turns to the side. When taking a breath, the swimmer can choose to turn left or right. Freestyle swimming (crawl) is a way of swimming that resembles an animal, so it is called crawl style, which means "crawling" (Haller in Rahmadana & Maidarman, 2018). Freestyle is a swimming style that involves hand movements over the surface and allows you to move in the water faster than other styles. Freestyle swimming is a way to swim quickly.

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Factors that support success in freestyle swimming include muscle strength in the arms and muscle strength in the legs. Arm muscle strength and leg muscle strength are good potentials for gaining speed in freestyle swimming. Freestyle swimming is a swimming style that requires complex movements. In swimming, there are basic techniques, including starting, sliding, foot movements, hand movements, reversals and finishes. To be able to perform swimming movements well requires the ability to coordinate arm and leg movements as well as breathing in harmony. Freestyle is one of the fastest and most popular styles that athletes participate in in swimming competitions.

The ability to swim freestyle does not come from swimming alone, but requires programmed weight training, and the most important thing is adding training loads to increase the performance of the body's muscles. Swimming performance is determined by the smallest time limit, so that physical ability regarding speed really determines swimming performance, especially freestyle swimming, all of which will not be achieved if it is not supported by other physical conditions. One force tends to hold it back, called the resistance caused by the water having to be pushed forward, the second force is the force that pushes it forward, called the push obtained from the movement or pulling of the arms and the pushing of the legs. Strength in this case is the strength of the arm muscles and leg muscles, which together play a role in producing forward movement in swimming.

Based on observations and observations of Tirta Kartika Swimmer club athletes, many athletes are still lacking in maximizing hand strokes towards the back so that athletes tend to be less fast in swimming, when moving the leg stroke only one of the legs looks good so that the leg movement when swimming stroke freestyle is not yet fast, the coordination of head movements when taking a breath with the hands is not in harmony so that when carrying out the freestyle swimming movement cycle is not correct, and there are athletes whose freestyle swimming technique is not good so that when participating in the competition the time limit achieved is not in accordance with the target.

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METHOD

In the research, researchers used a survey method with one data collection and quantitative research with a descriptive approach. Analysis of correlational research data using the product moment correlation formula. The population in this study was the Swimmer Tirta Kartika club swimming athletes, totaling 30 people. The sample for this study was the same as the total population, namely, 30 Swimmer Tirta Kartika swimming club athletes with 15 men and 15 women. The research location is the STO Swimming Pool in Metro City, Lampung. The research data collection time was carried out on February 29 2024. The instruments used in this research were the push and pull dynamometer (measuring arm muscle strength), leg dynamometer (measuring leg muscle strength), and swimming pool (50 meter freestyle swimming test).

In this research, researchers used statistical data analysis, namely scientific methods prepared to collect, compile, present and analyze in the form of numbers. The reason researchers use statistical analysis techniques is because the data to be studied is quantitative data. Data analysis to test the hypothesis between X1 and Y, and X2 and Y, uses statistics through product moment correlation. However, before carrying out analysis tests using the correlation formula, this research first carried out a prerequisite test to determine the suitability of the data, namely by carrying out validity and reliability tests.

1. Validity Test

   The results of the 50 meter freestyle swimming speed validity test were obtained according to Kirkendall, Gruber, Johnson (in Farokie et al., 2016) with a validity value of 0.95, so the freestyle swimming speed validity test was declared valid.

2. Reliability Test

   Reliability shows the extent to which the measurement results with the tool can be trusted (Suryabrata, 2004:28). The reliability test results for the 50 meter freestyle swimming speed were 0.69. The reliability coefficient value obtained was 0.69 (Cronbach's Alpha) with 0.05. Because the reliability

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coefficient value is 0.69 > 0.05, the freestyle swimming speed reliability test is declared reliable.

RESULT AND DISCUSSION

Based on research that was carried out at the Swimmer Tirta Kartika swimming club with a research sample of 30 athletes, as well as data collection techniques using tests and measurements with one data collection. The instruments used in this research were a pull and push dynamometer to measure arm muscle strength, a leg dynamometer to measure leg muscle strength and a stopwatch to measure 50 meter freestyle swimming speed. It can be concluded that arm muscle strength (X1) and leg muscle strength (X2) provide a very strong relationship with 50 meter freestyle swimming speed (Y) in Swimmer Tirta Kartika swimming club athletes. From the assessments that have been carried out, data was obtained for arm muscle strength, leg muscle strength, and freestyle swimming speed which is depicted in the table as follows.

Table 1. Description of research data on male athletes

Results	Variable Results		
	Arm Muscle Strength (X1)	Kekuatan Otot Tungkai (X2)	Arm Muscle Strength (X1)
N	15	15	15
Sum	443,5	586	799
Average	29	39	53
SD	5,731395021	7,279805	15,542265

Table 2. Description of research data on female athletes

Results	Variable Results		
	Arm Muscle Strength (X1)	Leg Muscle Strength (X2)	Swimming Speed (Y)
N	15	15	15
Sum	325	406	899
Average	21,66	27	59,95
SD	4,280446498	6,971051	19,60675178

From the table above, the results of research and tests on the variable arm muscle strength in swimming athletes at the Swimmer Tirta Kartika club show that the average arm muscle strength in male athletes is 29 kg and in female

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athletes it is 21.66 kg, standard deviation of arm muscle strength for male athletes it is 5.73 and for female athletes it is 4.28, the maximum value of arm muscle strength for male athletes is 38 kg and for female athletes 28, and the minimum value of arm muscle strength for male athletes is 19 kg and female athletes is 15.5 kg.

The leg muscle strength variable in Swimmer Tirta Kartika athletes shows that the average leg muscle strength in male athletes is 39 kg and female athletes is 27 kg, the standard deviation of leg muscle strength in male athletes is 7.27 kg and female athletes is 6.97 kg , the maximum value of leg muscle strength for male athletes is 51 kg and female athletes is 36.5, and the minimum value of leg muscle strength for male athletes is 28 kg and for female athletes is 16 kg.

The swimming speed variable for swimming athletes at the Swimmer Tirta Kartika club shows that the average swimming speed for male athletes is 53 seconds and female athletes is 59.95 seconds, the standard deviation of swimming speed for male athletes is 15.54 and for female athletes is 19.60. The maximum swimming speed for male athletes is 32.38 seconds and female athletes is 39.2 seconds, and the minimum swimming speed for male athletes is 88.24 seconds and female athletes is 90.58 seconds.

Relationship between Arm Muscle Strength (X1) and 50 Meter Freestyle Swimming Speed (Y)

The first hypothesis test was "There is a significant relationship between arm muscle strength and 50 meter freestyle swimming speed in Tirta Kartika Swimmer Club athletes. The results of hypothesis testing using product moment correlation analysis can be seen in the following table:

Table 3. Relationship Arm Muscle Strength (X1) and Swimming Speed (Y)

	Correlation	r Count	r Table	Description	Criteria
Male Athletes	X1.Y	0,8512	0,441	Significant	Very Strong
Female Athletes	X1.Y	0,9546	0,441	Significant	Very Strong

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Testing criteria, Ho is accepted if r count < r table and Ho is rejected if r count > r table. The conclusion of the correlation test was carried out by consulting the calculated r count (X1.Y) = 0.8512 with r table = 0.441 for male athletes and the calculated r count (X1.Y) = 0.9546 with r table = 0.441. This means that r count > r table, thus the hypothesis which reads "There is a significant relationship between arm muscle strength and freestyle swimming speed in Tirta Kartika Swimmer club athletes" is accepted.

The magnitude of the correlation/relationship value (r) between arm muscle strength and swimming speed is 0.8512 for male athletes (very strong) for female athletes 0.9546 (very strong) and explains the large percentage influence of the independent variable on the dependent variable called coefficient of determination which is the result of squaring r, obtained a coefficient of determination (r2) for male athletes of 0.7245 and for female athletes of 0.9113, which implies that the influence/contribution of the independent variable (arm muscle strength) to the dependent variable (speed swimming) is 72.45% for male athletes and 91.13% for female athletes, while the rest is influenced and determined by other factors.

Relationship between Leg Muscle Strength (X2) and 50 Meter Freestyle Swimming Speed (Y)

The second hypothesis test was "there is a significant relationship between leg muscle strength and 50 meter freestyle swimming speed in Tirta Kartika Swimmer Club athletes. The results of hypothesis testing using product moment correlation analysis can be seen in the following table:

Table 4. Relationship Leg Muscle Strength (X2) and Swimming Speed (Y)

	Correlation	r Count	r Table	Description	Criteria
Male Athletes	X2.Y	0,8563	0,441	Significant	Very Strong
Female Athletes	X2.Y	0,9756	0,441	Significant	Very Strong

Testing criteria, Ho is accepted if r count < r table and Ho is rejected if r count > r table. The conclusion of the correlation test was carried out by

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consulting the calculated r count (X2.Y) = 0.8563 with r table = 0.441 for male athletes and the calculated r count (X2.Y) = 0.9756 with r table = 0.441. This means that r count > r table, thus the hypothesis which reads "There is a significant relationship between leg muscle strength and freestyle swimming speed in Tirta Kartika Swimmer club athletes" is accepted.

The magnitude of the correlation/relationship value between leg muscle strength and swimming speed is 0.8563 for male athletes (very strong) for female athletes 0.9756 (very strong) and explains the large percentage influence of the independent variable on the dependent variable called coefficient of determination which is the result of squaring r, obtained a coefficient of determination (r2) for male athletes of 0.7332 and for female athletes of 0.9518, which implies that the influence/contribution of the independent variable (leg muscle strength) to the dependent variable (speed swimming) was 73.32% for male athletes and 95.18% for female athletes, while the rest was influenced and determined by other factors.

Relationship between Arm Muscle Strength (X1) and Leg Muscles (X2) with 50 Meter Freestyle Swimming Speed (Y)

The third hypothesis test was "there is a significant relationship between arm muscle strength and leg muscle strength and 50 meter freestyle swimming speed in Tirta Kartika Swimmer Club athletes. The results of hypothesis testing using product moment correlation analysis can be seen in the following table:

Table 5. Relationship between Arm Muscle Strength (X1) and Leg Muscle Strength (X2) with Swimming Speed (Y)

	Correlation	r Count	r Table	Description	Criteria
Male Athletes	X1.X2.Y	0,8567	0,441	Significant	Very Strong
Female Athletes	X1.X2.Y	0,9789	0,441	Significant	Very Strong

Testing criteria, Ho is accepted if r count < r table and Ho is rejected if r count > r table. The conclusion of the correlation test was carried out by consulting the calculated r count (X1.X2.Y) = 0.8563 with r table = 0.441 for

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male athletes and the calculated r count (X1). This means that r count > r table, thus the hypothesis which reads "There is a significant relationship between arm and leg muscle strength and 50 meter freestyle swimming speed in Tirta Kartika Swimmer club athletes" is accepted. The magnitude of the correlation/relationship value (r) between arm and leg muscle strength and swimming speed is 0.8567 for male athletes (very strong) for female athletes 0.9789 (very strong) and it explains the large percentage influence of the independent variable on the variable. bound which is called the coefficient of determination which is the result of squaring r, obtained a coefficient of determination (r2) for male athletes of 0.7340 and for female athletes of 0.9583.

Based on product moment correlation analysis, it was found that there was a significant contribution/relationship between the independent variables arm muscle strength (X1) and leg muscles (X2) on the dependent variable, namely swimming speed (Y) of 73.40% for male athletes and 95.83% in female athletes, while the rest are influenced and determined by other factors.

Discussion

Based on the research results, descriptive data analysis, this study aims to determine the relationship between arm muscle strength and leg muscle strength and 50 meter freestyle swimming speed at the Swimmer Tirta Kartika swimming club using correlational methodology from the variables above. The results of the analysis carried out above are related to the relationship between the independent variable and the dependent variable. If seen from the results of male athletes and female athletes, female athletes have the opportunity to achieve high achievements compared to male athletes, competition for female athletes is not as competitive compared to male athletes, and it should be Female athletes can compete in national level swimming championships which can be strengthened by a good training program and the athlete's good physical condition.

This research needs to be studied further by providing an interpretation of the relationship between the analysis results achieved and the theories underlying this research. This explanation is needed so that we can know the

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suitability of the theories put forward with the research results obtained. The results obtained when linked to the framework of thinking and the underlying theories, basically the results of this research support the existing theory.

From the results of data analysis in the first hypothesis test that was carried out, it can be concluded that there is a significant relationship between arm muscle strength and 50 meter freestyle swimming speed at the Swimmer Tirta Kartika swimming club. Arm muscle strength is the muscle's ability to perform one maximum contraction against pressure or load. Arm muscle strength can be measured and determined based on test values measuring arm muscle strength using a number of tools, for example a push and pull dynamometer. If an athlete has maximum arm muscle strength, this will be followed by good speed in swimming. The stronger the arm muscles, the more influence the athlete's swimming speed will have.

From the results of data analysis in the second hypothesis test that has been carried out, it can be concluded that there is a significant relationship between leg muscle strength and 50 meter freestyle swimming speed at the Swimmer Tirta Kartika swimming club. This can be interpreted that, if the athlete has a leg muscle strength value maximum, it will be followed by a good swimming speed. Likewise, if an athlete has a low leg muscle strength value, this will also result in a weak swimming speed.

Based on the research results, the third hypothesis is in accordance with the proposed hypothesis, stating that the two independent variables studied, namely arm muscle strength and leg muscle strength, have a significant relationship with 50 meter freestyle swimming speed in Swimmer Tirta Kartika swimming club athletes. Thus, this can be interpreted that the higher the value of arm muscle strength and leg muscle strength in athletes, the better and faster their swimming speed. If seen from the magnitude of the correlation coefficient, the variable leg muscle strength has a greater relationship than arm muscle strength to the 50 meter freestyle swimming speed of Swimmer Tirta Kartika swimming club athletes. This fact is in line with the opinion that elements of physical condition

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must be improved as optimally as possible for each athlete because strength is an element that is more dominant than others and needs to be given top priority in implementing the training program.

CONCLUSION

Based on the research results, it can be concluded that several hypothesis testing results are as follows:

1. There is a significant relationship between arm muscle strength and 50 meter freestyle swimming speed in Tirta Kartika Swimmer Club Athletes in Metro City.
2. There is a significant relationship between leg muscle strength and 50 meter freestyle swimming speed in Tirta Kartika Swimmer Club Athletes in Metro City.
3. There is a significant relationship between leg muscle strength and arm muscle strength and the results of 50 meter freestyle swimming speed in Tirta Kartika Swimmer Club Athletes in Metro City.

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