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The Contribution of Arm Muscle Strength and Leg Muscle Explosive Power to Breaststroke Swimming Speed for a Distance of 20 Meters

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ABSTRACT

This study aims to determine the contribution of arm muscle strength and leg muscle explosive power to the speed of 20-meter breaststroke swimming in students of the Faculty of Sports Sciences, Makassar State University. Types of descriptive research. The research variables consisted of independent variables, namely arm muscle strength and leg muscle explosive power, while the dependent variable was the speed of swimming breaststroke 20 meters. The population in this study was 30 people. The sampling technique is by random selection by lottery (simple random sampling). Data analysis techniques used are correlation analysis (r) and regression (R) at a significant level of 95% or α 0.05. Departing from the results of data analysis, this study concluded that: (1). there is arm muscle strength against the swimming speed of 20 meters breaststroke, obtained regression value (r) = 0.947 with a probability level (0.003) or α 0.05, for the value of R square (coefficient of determination) = 0.897. This translates to 89.7% of the speed of swimming the 20-meter breaststroke explained by arm muscle strength. (2) the explosive power of the leg muscles against the swimming speed of the 20-meter breaststroke, obtained regression value (r) = 0.881 with a probability level (0.000) or α 0.05, for the value of R square (coefficient of determination) = 0.775. This translates to 77.5% of the speed of swimming the 20-meter breaststroke. (3) arm muscle strength and muscle explosive power against the swimming speed of 20 meters breaststroke, obtained regression value (r) = 0.948 with probability level (0.008) or α 0.05, for R square value (coefficient of determination) = 0.899. This means that 89.9% of the speed of swimming in the 20-meter breaststroke is explained by the strength of the leg muscles and the explosive power of the leg muscles.

Keywords: Muscle Strength; muscle explosiveness; Speed; Swimming pool; Breaststroke.

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INTRODUCTION

Swimming is one of the sports of the aquatic sports group and people who pursue it, physiologically must have certain skills (PRSI, 2000). It is explained that swimming has been done since the existence of humans in this world, at that time mainly as a martial

tool in dealing with nature at that time (Rashid et al., 2017). History shows that cities or villages in ancient times were located around large rivers. In 1908 during the Olympic Games in London an international swimming union was formed called the Federation International de Natation Amateur in short FINA (Son, 2017).

In Indonesia, swimming sports unions began to form on March 21, 1951, under the name of the Indonesian Swimming Association (PBSI), then in 1959 changed to the Indonesian Swimming Association (PRSI) (Mulyawati &; Indraswari, 2018). Swimming is a different sport when compared to sports in general. Swimming sports are carried out in water, so in addition to the gravity factor of the earth is also influenced by the upward pressure of water (Yeni et al., 2019). Under normal circumstances (on land) the human body can move freely under the influence of gravity, in water it must learn to adapt movement to water. This causes movements that look strange, then creates movements that are considered the most profitable. The movement then becomes a style in swimming (Syarifuddin et al., 2019).

Breaststroke swimming became popular when in 1875 English swimmer Matthew Webb became the first person to swim the Channel Bay using breaststroke. In the development of this breaststroke, several variations of his hand movements arose which later became the forerunner of butterfly-style swimming (Hasanuddin, 2019). Early in 1966 Russian swimmer Nikola Pankain began to develop this force that could increase the speed of movement of the hands performing the resting phase (Kusmita et al., 2022), eliminating the attitude where the hands will come back together under the chest (Siregar &; Syahara, 2019). This is a renewal in the rhythm of his style with the possibility of slightly delaying the position of taking a breath. This development played an important role and is now called the European breaststroke (Kurniawan &; Winarno, 2022).

To be able to take part in a swimming competition, and especially to achieve high achievements, swimmers are not enough just to be armed with the ability to do swimming movements well (Wicaksono &; Putri, 2020), but must also be able to start, reverse, adjust speed, and enter the finish in the right way (Rona et al., 2020). It is not uncommon for good swimmers to lose in races, due to shortcomings in starts and reversals (Sefriana, 2020). In addition, because in general the entire swimming distance cannot be reached with "all out" energy (Shanty et al., 2021), the swimmer must be able to regulate and control his speed at all distances contested (Sham & Bismar, 2020).

Success in winning a race or accelerating a force comes from the swimmer's ability to generate thrust while reducing drag (Sobriyanyo et al., 2020), Increase thrust can be done by increasing thrust, that is, doing strength training and muscle explosive power (Rona et al., 2020), Especially the strength of the arm muscles and the explosive power of the leg muscles, while to reduce the resistance can be done by swimming with the correct force (Sahabuddin et al., 2022) and following the biomechanics of human motion to create an efficient motion (Goddess, 2021) To reduce water obstacles when swimming. Power and explosive power are very important roles in swimming speed (Wardhani, 2022). Along with the times, swimming sports developed based on their goals, namely as a sport of achievement, health, and recreation (Primary et al., 2022). Based on the facts, the results of the observation that the researchers did that almost all students majoring in coaching program swimming courses. Especially breaststroke swimming. It does not yet have a good force structure and the speed is still lacking. This is seen from 30 students there are only 10 people who can swim breaststroke quickly and in good style.

Factors that greatly affect the speed of breaststroke swimming are physique and technique. Physical influences are arm strength and leg muscle explosive power on breaststroke swimming ability in students of the Faculty of Sports Sciences, Makassar State

University. Athletes who have good posture regarding arm muscle strength and leg muscle explosive force are one of the good potential to gain ability in swimming. Therefore, people who have the arm strength and explosive force of leg muscles on average have good physical abilities such as speed, endurance, flexibility, and others. Therefore, it can be said that body structure is a precondition that can support the ability to swim in athletes to get maximum results in competition.

METHODS

This study has independent variables and dependent variables. There are two independent variables, namely: arm muscle strength (X1) and leg muscle explosive power (X2), while the dependent variable is the speed of swimmers 20 meters breaststroke (Y). This research is a type of descriptive research that aims to determine the contribution of arm muscle strength and leg muscle explosive power to the speed of 20-meter breaststroke swimming to students of the Faculty of Sports Sciences, Makassar State University. Thus the research design model used is descriptive correlational. Before conducting tests and measurements, the subject warms up first. Research officers prepare research facilities and infrastructure, namely: stopwatches, whistles, pull-ups, and stationery. The next stage recorded the students who were the subjects, then carried out measurement and physical condition tests which included the explosive power of leg muscles and arm muscle strength against the speed of swimming the 20-meter breaststroke at the UNM swimming pool. Research instruments are tools or facilities used by researchers in collecting data so that work is easier and the results are better, in the sense that it is more careful, complete, and systematic so that data is easily processed (Suharsimi Arikunto, 1998). The implementation of the study is a correlational method, test techniques, and measurement of taking carried out by measuring arm muscle strength and leg muscle explosive power against the speed of swimming 20 meters breaststroke. Population is the entire subject of research (Suharsimi Arikunto, 2006), population is all possible measurements that need attention. This study took samples with total sample techniques. The population in this study is students of Sports Coaching Education, Faculty of Sports Science, Makassar State University. The sample is a portion or representative of the population studied (Suharsimi Arikunto, 2006). The sample represents a portion of the population under investigation, whose generalization (conclusion) is imposed on all individuals or populations. The sampling technique used in this study is total sampling, so the subjects in this study were 30 students of Sports Coaching Education, Faculty of Sports Sciences, Makassar State University. The data collection technique used is a correlational method with test and measurement techniques in the field. The data collection is carried out in two stages. The first stage tests and measures the explosive power of the leg muscles and the strength of the arm muscles. The second stage is a 20-meter breaststroke swimming speed test. The form of data in this study is the form of numbers, namely data from measuring arm muscle strength and leg muscle explosive power against the speed of swimming 20 meters breaststroke. Three measurement techniques are carried out on all samples. The data that goes through this test is still rough. The data was then analyzed using a correlational statistical test with the SPSS 20 package.

RESULTS AND DISCUSSION

Descriptive data analysis is entered to get an overview of the data including mean, standard deviation, maximum data, minimum data, range, frequency table, and graph. Furthermore, testing of analysis requirements is carried out, namely data normality tests.

For hypothesis testing using regression tests. Descriptive analysis was performed for arm muscle strength data, leg muscle explosive power data, and 20-meter breaststroke swimming speed data. A summary of the results of the analysis is listed in Table 1 as follows.

Table 1.
The results of descriptive analysis of data for each variable.

Variable	Statistical Value					
	N	Mean	Sd.	Min.	Max.	Range
X1	30	9.0667	3.24763	5.00	14.00	9.00
X2	30	44.0000	10.43865	35.00	65.00	30.00
Y	30	19.6347	1.72733	17.10	22.50	5.40

To find out whether the data in this study were normally distributed, testing was carried out using the Kolmogorov-Smirnov test. A summary of the test results can be seen in Table 2.

Table 2.
The results of the data normality test for each variable.

Variable	Normal Parameters		SD	Most Extreme Differences			KS – Z	Asymp. Sig.
	N	Mean		Absolute	Positive	Negative		
X1	30	9.0667	3.24763	.204	.204	-.124	.204	.003
X2	30	44.0000	10.43865	.243	.243	-.194	.243	.000
Y	30	19.6347	1.72733	.188	.188	-.112	.188	.008

Data analysis was carried out to determine the contribution of each independent variable to the dependent variable. The analysis used was correlation analysis (r) and regression (R) at a significant level of 95% or α 0.05. The results of the analysis are listed in the following table:

Table 3.
Results of correlation analysis and regression of leg strength.

Hypothesis	N	r/R	Rs	T	Sig.
The contribution of arm muscle strength to the speed of swimming 20-meter breaststroke	30	.947	.897	15,630	0.000

Table 4.
Results of correlation analysis and equilibrium regression.

Hypothesis	N	r/R	Rs	T	Sig.
The contribution of leg muscle explosive power to the swimming speed of the 20-meter breaststroke	30	.881	.775	9,833	0.014

Table 5.
Results of correlation and regression analysis of leg strength and balance.

Hypothesis	N	r/R	Rs	F	Sig.
The contribution of arm muscle strength and leg muscle explosive power, to the speed of swimming 20-meter breaststroke	30	.948	.899	120,581	0.000

Hypothesis testing was carried out using correlation coefficient (r) and regression (R) analysis at a significant level of 95% or α 0.05. It was intended to determine the contribution of arm muscle strength and leg muscle explosive power, to the speed of swimming 20 meters breaststroke. The hypotheses tested for correctness in this study are as follows:

There is a contribution of arm muscle strength to the speed of swimming the 20-meter breaststroke.

Statistical hypothesis:

H0 : βx1y = 0

H1 : βx1y ≠ 0

Test results,

Based on the test results of the analysis of arm muscle strength data against the swimming speed of the 20-meter breaststroke, a regression value (r) = 0.947 was obtained with a probability level (0.003) or α 0.05, for the value of R square (coefficient of determination) = 0.897. This translates to 89.7% of the speed of swimming the 20-meter breaststroke explained by arm muscle strength. The t-test obtained 15.530 with a significance level of 0.000. Therefore the probability (0.003) is much smaller than α 0.05. Then H0 is rejected and H1 is accepted or the regression coefficient is significant. Thus it can be concluded that arm muscle strength contributes significantly to the speed of swimming the 20-meter breaststroke.

There is a contribution of the explosive power of the leg muscles to the swimming speed of the 20-meter breaststroke.

Statistical hypothesis:

H0 : βx2y = 0

H1 : βx2y ≠ 0

Test results,

Based on the results of the test analysis of leg muscle explosive data against the swimming speed of the 20-meter breaststroke, a regression value (r) = 0.881 was obtained with a probability level (0.000) or α 0.05, for the value of R square (coefficient of determination) = 0.775. This translates to 77.5% of the speed of swimming the 20-meter breaststroke explained by balance. The t-test obtained 9.833 with a significance level of 0.000. Therefore the probability (0.000) is much smaller than α 0.05. Mak a H0 is rejected and H1 is accepted or the regression coefficient is significant. Thus it can be concluded that the explosive power of the leg muscles contributes significantly to the swimming speed of the 20-meter breaststroke.

There is a contribution of arm muscle strength and leg muscle explosive power to the swimming speed ability of the 20-meter breaststroke.

Statistical hypothesis:

H0 : Rx1,2,y = 0

H1 : Rx1,2,y ≠ 0

Test results,

Based on the test results of data analysis of arm muscle strength and muscle explosive power on the swimming speed of the 20-meter breaststroke, a regression value (r) = 0.948 was obtained with a probability level (0.008) or α 0.05, for the value of R square (coefficient of determination) = 0.899. This means that 89.9% of the speed of swimming in the 20-meter breaststroke is explained by the strength of the leg muscles and the explosive power of the leg muscles. From the ANOVA test or F test, the F count is 120.581 with a significance level of 0.000. Because the probability (0.008) is much smaller than α 0.05, regression models can be used to predict the swimming speed of the 20-meter breaststroke (applicable to the population in which the sample was taken). Thus, it

can be concluded that arm muscle strength and leg muscle explosive power have contributed significantly to the swimming speed of the 20-meter breaststroke.

Discussion

There is a contribution between arm muscle strength and breaststroke swimming ability in students of the Faculty of Sports Science, Makassar State University by 89.7%. The results of statistical analysis showed that there was a significant contribution between arm muscle strength and 20-meter breaststroke swimming skills in students of the Faculty of Sports Sciences, Makassar State University. The results of this study show a relevant relationship with the theory that is the basis or reference in this study. Theoretically, the role of arm strength in breaststroke swimming activities is an important element in doing hand pull movements (pull) which is useful for lifting the body until the chest comes out above the surface of the water. This situation is a series of movement patterns in breaststroke swimming for breath-taking. If the strength of the arm is weak, it will affect the movement of taking breath, this will result in all patterns of motion series not optimal. Then as a result it will reduce the ability to swim breaststroke. The strength of the arm in question is the strength of the arm to perform pull movements that are done quickly in a relatively long time. This is due to doing strong and fast hand movements repeatedly for a relatively long time. So if this is not fulfilled by a breaststroke swimmer, it will be certain that the resulting breaststroke swimming ability will be relatively longer. Thus arm strength has a great contribution in achieving maximum time. In addition to taking a breath, the speed of the rate is also affected by the strength of the arm. It is certain that if arm strength decreases, then the resulting rate will be slower and take a lot of time, so it can be said that arm strength contributes to the movement of taking breath and as a driving force to get a fast whole body rate with the coordination of all other body segments. This contribution has been proven in the results of this study, which states there is a significant contribution between the endurance of arm strength and the ability to swim breaststroke.

There is a contribution between the explosive power of leg muscles and the speed of swimming 20 meters breaststroke in students of the Faculty of Sports Sciences, Makassar State University by 77.5%. The results of statistical analysis showed that there was a significant contribution between the explosive power of the legs and the ability to swim breaststroke in students of the Faculty of Sports Science, Makassar State University. If the results of this research are associated with the underlying theory and frame of mind, then basically the results of this research support and strengthen the theory and results of previous research that already exist. If analyzed theoretically, in breaststroke swimming leg movement is the main source of energy as a rowing tool to go fast. When driving will not be separated from the resistance factor as an obstacle to the forward rate of the body, among them is the mass of the body itself and water. To overcome this, strength and speed are needed, in this case, called explosive power or power on the legs to fight resistance as an obstacle. The resulting leg explosive force is not only against one-foot movement but is needed to get the maximum speed of the body's forward speed by covering a relatively long distance. So that the movement of the feet is not only once, but several movements, so the explosive power of the legs needed must be able to last a long time. Thus the results of this study have proven that there is a significant contribution between the explosive power of the legs and the ability to swim breaststroke in students of the Faculty of Sports Science, Makassar State University.

There was a significant contribution of arm muscle strength and leg muscle explosive power to the speed of 20-meter breaststroke swimming in students of the Faculty of Sports Science, Makassar State University by 89.9%. It can be explained that these two

independent variables together make a real contribution to the ability to swim breaststroke, leg explosive power about fast footwork in kicking, arm strength about pulling and pushing movements related to hand recovery movements and when rowing.

CONCLUSION

Based on the results of research and discussion that has been presented, a conclusion can be drawn as follows:

1. Arm muscle strength contributes to the ability to swim breaststroke in students of the Faculty of Sports Science, Makassar State University.
2. The explosive power of leg muscles contributes to the ability to swim breaststroke in students of the Faculty of Sports Science, Makassar State University.
3. Arm muscle strength and leg muscle explosive power contributed to the speed of 20-meter breaststroke swimming in students of the Faculty of Sports Sciences, Makassar State University.

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