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# Contribution of Arm Length, Arm Muscle Strength, and Leg Strength to Freestyle Swimming Ability

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**A.** Conception and design of the study; **B.** Acquisition of data; **C.** Analysis and interpretation of data; **D.** Manuscript preparation; **E.** Obtaining funding

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**ABSTRACT**

This study aims to determine: 1) whether there is a contribution of arm's length to freestyle swimming ability; 2) whether is there a contribution of arm muscle strength to freestyle swimming ability; 3) whether is there a contribution of leg muscle strength to freestyle swimming ability and 4) is there a contribution of arm's length, arm muscle strength, and leg muscle strength to freestyle swimming ability. The population in this study were all Garuda Laut Makassar City athletes, specifically men, with a sample size of 30 athletes. The data analysis techniques used are descriptive, data normality tests, and correlation and regression analysis using the SPSS application. Based on the results of data analysis, this study concluded that: (1) Arm length contributed 31.2% to freestyle swimming ability, 2) Arm muscle strength contributed 44.2% to freestyle swimming ability, 3) Leg muscle strength contributes to freestyle swimming ability by 50.2%, and 4) Arm length, arm muscle strength, and leg muscle strength contribute to freestyle swimming ability by 59.5%.

**Keywords** : Arm Length; Arm Muscle Strength; Leg Muscle Strength; Freestyle; Swimming.

## INTRODUCTION

From time to time, sporting achievements in our country experience ups and downs due to various obstacles (Maidarman, 2016). Therefore, in efforts to improve sports performance, multi-disciplinary efforts are needed and scientific emphasis is the main factor that needs to be considered to achieve goals in swimming (Rasyid et al., 2017). These efforts must receive support from various parties in the development and progress of sports achievements in Indonesia (Yeni et al., 2019), especially the sport of swimming which is increasingly showing progress and setbacks (Siregar & Syahara, 2019). This is proven by efforts to improve the performance of swimming athletes through participation in international events. The results of the championships that were participated show that swimming has experienced achievements and failures (Wicaksono & Putri, 2020). South Sulawesi has quite good achievements in swimming. This is supported by the achievements

obtained by South Sulawesi athletes, especially in swimming. Apart from that, of course, South Sulawesi also has many shortcomings in the sport of swimming, this is due to South Sulawesi's failure to provide athletes with guarantees that can support the achievements of South Sulawesi athletes, especially in the sport of swimming. Makassar has quite good athlete development in the sport of swimming. This is supported by the large number of young athletes and swimming clubs which always produce potential athletes in Makassar who can compete with some existing athletes, especially in eastern Indonesia. Apart from that, of course, Makassar also has shortcomings in the sport of swimming, this is due to Makassar's failure to retain its potential athletes in Porda and then in Bantaeng where Makassar is unable to compete with other regions, especially in the sport of swimming. The Garuda Laut Club in Makassar City has quite a good athlete development by producing several potential athletes. This is supported by the ability of the Garuda Laut Club athletes to be able to compete with clubs in South Sulawesi. Apart from that, of course, the Garuda Laut Club also has shortcomings in the sport of swimming, this is supported by the failure of the Garuda Laut Club athletes who have not been able to compete with national athletes.

Swimming is a branch of water sports which consists of several styles, namely: freestyle, breaststroke, backstroke and butterfly style. Each of these four swimming styles, in their implementation, has its technique or way of doing it (Wardhani, 2022 ). However, in this research, the author only chose one style that will be the point of attention, namely freestyle. Freestyle is the only description of swimming (Putra, 2017). This style is the fastest style and based on this style our greatness will be judged. Apart from that, freestyle has good style mechanics which often occurs in talented people who may do it without realizing it (Syarifuddin et al., 2019).

In freestyle swimming, a swimmer requires certain physical conditions and techniques to perform rowing movements which consist of pull and push (pull and push) movements (Hasanuddin, 2019). In addition, the coordination of movements between the arms and legs is a very dominant factor in carrying out the freestyle swimming movement process (Sobriyanyo et al., 2020). It is important to know that arm movements are the main driver in freestyle swimming, therefore how these arm movements are carried out must be truly understood and can be carried out correctly, as well as leg movements in swinging (Rona et al., 2020).

In the principles of coaching science, the physical component that is needed to be able to excel in swimming is the physical condition component. One of the physical components that will be developed to achieve optimal performance is muscle strength (Wicaksono & Putri, 2020). Apart from that, it is supported by a regular, systematic, programmed and continuous physical training approach. Other supports that support the desired achievements are technical and mental so a series of supporting sports achievements is a physical training approach according to the characteristics of the sport, technical and mental accuracy (Sefriana, 2020).

In freestyle swimming, the forward thrust in this sport is dominant in physical conditions related to arms length, arm muscle strength and leg muscle strength. Where the length of the arm functions as a rower so that the longer a person's overall arm will be, the farther it will reach when recovering (Mulyawati & Indraswari, 2018) so that the shorter the time taken for a certain distance, the strength of the arm muscles affects the distance of the pushing power when rowing. and likewise, the strength of the leg muscles influences the distance of the thrust when making a swing. In freestyle, the most fundamental factor is the strength factor, that strength is the basis for movement performance because almost everything in vigorous movement performance depends on the ability to apply a large amount of force against resistance, increasing strength often contributes to better

movement performance, strength has a relationship with freestyle swimming performance (Krisna & Maidarman, 2022).

Various obstacles can cause a swimmer's swimming speed to be less than optimal, such as the hands not being strong enough to pull and push, poor coordination of movements between the hands and feet causing ineffectiveness in taking a breath or the body's forward speed, and lack of movement speed. legs when swinging, and so on (Kurniawan & Winarno, 2022). Therefore, one of the efforts made to improve freestyle swimming ability is to train in physical condition (Pratama et al., 2022).

Listening to the description above, it can be said that to be able to swim freestyle quickly, besides needing to be supported by good technique, it must also be supported by adequate physical ability. This is because, without adequate physical abilities, it is difficult to develop good freestyle swimming techniques (Kusmita et al., 2022). Likewise, with good physical abilities, the implementation of freestyle swimming movement techniques will be able to be performed perfectly. Thus, physical ability is one of the most essential factors in supporting the performance of swimming athletes. The most important physical abilities to get attention include speed, strength, power, endurance, flexibility and coordination. This does not mean that other physical elements are not necessary, but they are also supportive. However, for swimming, these six physical elements are the main factors that determine the success of swimming athletes in achieving achievements (Marza & Argantos, 2020). If you look at it from observation, an athlete's ability in freestyle swimming is greatly influenced by whether the athlete's physical abilities are good or not. The physical components in question are arm strength and leg muscle strength.

The role of leg muscle strength in freestyle swimming is especially needed when the legs are swinging, where fast swinging movements of the legs can help push the body forward, which can also maintain the position of the legs so that they remain high in a streamlined state so that the resistance will become smaller. (Ilmah et al., 2021). All of this is a support in obtaining good freestyle swimming speed. Another physical element that is no less important in supporting freestyle swimming speed is arm strength (Shanty et al., 2021). The role of arm strength is especially important when the arms make rowing movements, namely pulling and pushing movements, where this movement is the most important forward movement of the body (Krisna & Maidarman, 2022). Therefore, the stronger the arms in the rowing movement, the faster the forward speed of the body, and the faster forward speed of the body supports the swimmer to reach the finish line quickly. This is important because the swimmer who reaches the finish line more quickly in a race is declared the winner.

Regarding the arm length factor, those who have long arms with ideal height and body size are one of the potential factors that determine their ability to swim freestyle. The role of arm's length is especially needed when swimmers perform hand recovery movements and when rowing, with long arms, coupled with strong rowing, it is very effective in supporting speed in swimming so that there is a greater possibility of obtaining more optimal swimming results. This is not visible in athletes Garuda Laut Makassar City Beginner Swimming, where the average body posture is not in ideal condition, thus affecting the physical conditions such as arm length, arm muscle strength and leg muscle strength in freestyle swimming.

Therefore, to get good freestyle swimming ability, besides having to be supported by good technique, it must also be supported by several elements of physical ability such as arm length, arm muscle strength and leg strength. Even though current swimming performance in Makassar has reached the optimal level of swimming ability, especially

freestyle, we need to examine in depth whether there are still inhibiting factors in physical ability, namely arm length, arm muscle strength and leg strength as supporting factors for implementing freestyle swimming, in addition to other factors. mastery of swimming techniques, namely the coordination of movements in general, has not been able to be displayed by most the beginner swimming athletes in the Garuda Laut city of Makassar.

## METHODS

The method used in this variable is the descriptive method. The research variables to be studied in this study are: (1) The independent variable consists of arms length, arm muscle strength, and leg muscle strength, while (2) The dependent variable is freestyle swimming ability. The research design or research design used in this research is correlational. The population in this study were all 43 Garuda Laut Makassar City athletes. The samples taken or used in this research were all 30 Garuda Laut athletes. This sample selection was carried out by random sampling.

Data collected in this study included: Arm Length, Arm Muscle Strength Leg Strength, and Freestyle Swimming Ability. The collected data needs to be analyzed descriptively and inferentially to test research hypotheses. The descriptions used in this research are as follows: (1) Descriptive data analysis is intended to obtain a general description of the data which includes total value, range, average, standard deviation, minimum value, and maximum value, and (2) Analysis inferentially used to test research hypotheses using correlation and regression tests. So the overall statistical data analysis used generally uses applications in the SPSS version 21.00 program with a significance level of 95% or α = 0.05.

## RESULTS AND DISCUSSION

### Result

Descriptive analysis of research data consisting of test scores for arm length, arm muscle strength, leg strength, and freestyle swimming ability can be seen in the summary of descriptive analysis results listed in **Table 1** below:

**Table 1.**
Descriptive analysis results

| Variable | N | Sum | Mean | Stdv | Range | Min. | Max. |
|---|---|---|---|---|---|---|---|
| Arm Length | 30 | 2416,50 | 80,5500 | 5,14793 | 19,98 | 70,09 | 90,07 |
| Arm Muscle Strength | 30 | 1068,00 | 35,6000 | 4,88206 | 17,00 | 26,00 | 43,00 |
| Leg Muscle Strength | 30 | 2084,62 | 69,4873 | 16,84506 | 59,00 | 40,50 | 99,50 |
| Freestyle Swimming | 30 | 1040,34 | 34,6780 | 3,90661 | 13,79 | 29,27 | 43,06 |

Based on the summary of the results of the descriptive analysis of the data in **Table 1** above, it can be described as follows:

a. For arm length data, from 30 samples a total value was obtained of 2416.50 and the average obtained was 80.5500 with a standard deviation of 5.14793 from a data range of 19.98 between a minimum value of 70.09 and a maximum value of 90.07.
b. For arm muscle strength data, from 30 samples a total value was obtained of 1068.00 and the average obtained was 35.6000 with a standard deviation of 4.88206 from a data range of 17.00 between a minimum value of 26.00 and a maximum value of 43.00.

c. For leg muscle strength data, from 30 samples a total value of 2084.62 was obtained and the average obtained was 69.4873 with a standard deviation of 16.84506 from a data range of 59.00 between a minimum value of 40.50 and a maximum value of 99.50.
d. For freestyle swimming ability data, from 30 samples a total value of 1040.34 was obtained and the average obtained was 34.6780 with a standard deviation of 3.90661 from a data range of 13.79 between a minimum value of 29.27 and a maximum value of 43.06.

For this reason, after data on arm length, arm muscle strength, leg muscle strength, and freestyle swimming ability for this research were collected, before carrying out inferential statistical analysis for hypothesis testing, a requirement test was first carried out, namely normality using the Kolmogorov-Smirnov Test. From the Kolmogorov-Smirnov test carried out, it can be seen in **Table 2** below:

**Table 2.**
Data normality test results

| Variable | Kolmogorov Smirnov | | α | Information |
|---|---|---|---|---|
| | Statistic | P | | |
| Arm Length | 0.501 | 0.963 | 0.05 | Normal |
| Arm Muscle Strength | 1.274 | 0.078 | 0.05 | Normal |
| Leg Muscle Strength | 1.204 | 0.110 | 0.05 | Normal |
| Freestyle Swimming | 0.966 | 0.308 | 0.05 | Normal |

Based on **Table 2**, which is a summary of the results of data normality testing for each research variable, it can be described as follows:

a. The results in testing the normality of arm length data, the Kolmogorov-Smirnov Test value was 501 with a probability level (P) of 963 greater than the α value of 0.05. Thus, the arm-length data obtained follows a normal distribution or normal distribution.
b. The results in testing the normality of arm muscle strength data obtained the Kolmogorov-Smirnov Test value of 1,274 with a probability level (P) of 078 greater than the α value of 0.05. Thus, the arm muscle strength data obtained follows a normal distribution or normal distribution.
c. The results in testing the normality of leg muscle strength data obtained the Kolmogorov-Smirnov Test value of 1,204 with a probability level (P) of 110 greater than the α value of 0.05. Thus, the leg muscle strength data obtained follows a normal distribution or normal distribution.
d. The results in testing the normality of freestyle swimming ability data obtained the Kolmogorov-Smirnov Test value of 966 with a probability level (P) of 308 greater than the α value of 0.05. Thus, the freestyle swimming ability data obtained follows a normal distribution or normal distribution.

To test this hypothesis, a regression test was carried out on arm length, arm muscle strength, and leg muscle strength on the freestyle swimming ability of Garuda Laut Athletes in Makassar City.

**There is a contribution of arm length to the freestyle swimming ability of Garuda Laut Makassar City Athletes.**

Regression analysis was carried out to determine the contribution of the independent variable to the dependent variable. The regression analysis used is simple regression analysis at 95% or α0.05. This is intended to determine the contribution of arm length to

the freestyle swimming ability of Garuda Laut Athletes in Makassar City, obtained according to the summary in **Table 3** below:

**Table 3.**
Regression analysis results for the first hypothesis

| VARIABLE | N | R | $R^2$ | F | t | P | α |
|---|---|---|---|---|---|---|---|
| Arm Length ($X_1$) Freestyle Swimming (Y) | 30 | -0,424 | 0,312 | 12,713 | -3,565 | 0,000 | 0,05 |

Based on the test results as shown in **Table 3**, the regression equation is:
$Y = a + bX_1$
$Y = 68,835 + -0,424\ X_1$
So what is contained in the regression equation can be explained as follows:

a. a. The constant of 68.835 states that if the arm length does not change, then the freestyle swimming ability of Garuda Laut Makassar City athletes will be 68.835.
b. b. The regression coefficient for the arm length variable is -0.424, stating that every additional one percent (1%) of the arm length variable will cause an increase in the freestyle swimming ability of -0.127 athletes of Garuda Laut Makassar City.

There is a contribution of arm length to the freestyle swimming ability of Garuda Laut Makassar City Athletes. Based on the results of regression analysis testing of arm length data on freestyle swimming ability in **Table 3**, a regression value of -0.559 was obtained with a significance level of 0.000 < α0.05, for a coefficient of determination of 0.312. This means that there is a 31.2% influence of arm length on the freestyle swimming ability of Garuda Laut Athletes in Makassar City.

Based on the results of this analysis, it can be seen that the tcount value obtained is -3.565 which can be seen in the table above with a significance level of 0.000 < α0.05. So Ho is rejected and H1 is accepted or the regression coefficient is significant, or arm length has a significant influence on the freestyle swimming ability of Garuda Laut Athletes in Makassar City. Thus, there is a contribution of arm length to the freestyle swimming ability of Garuda Laut Makassar City athletes 31.2%. Testing of the regression model shows an F value of 12.713 with a significant level of 0.000 < α0.05. This means that freestyle swimming ability can be explained significantly by arm length in Garuda Laut Makassar City Athletes.

**There is a contribution of arm muscle strength to the freestyle swimming ability of Garuda Laut Makassar City Athletes.**

Regression analysis was carried out to determine the contribution of the independent variable to the dependent variable. The regression analysis used is simple regression analysis at 95% or α0.05. This is intended to determine the contribution of arm muscle strength to the freestyle swimming ability of Garuda Laut Athletes in Makassar City, obtained according to the summary in **Table 4** below:

**Table 4.**
Regression analysis results for the second hypothesis

| VARIABLE | N | R | $R^2$ | F | t | P | α |
|---|---|---|---|---|---|---|---|
| Arm Muscle Strength ($X_2$) Freestyle Swimming (Y) | 30 | -0,532 | 0,422 | 22,192 | -4,711 | 0,000 | 0,05 |

Based on the test results as shown in **Table 4**, the regression equation is:
$Y = a + bX_2$
$Y = 53,620 + -0,532\ X_2$
So what is contained in the regression equation can be explained as follows:

a. The constant of 53.620 states that if the arm muscle strength does not change, then the freestyle swimming ability of Garuda Laut Makassar City athletes will be 53.620.
b. The regression coefficient for the arm muscle strength variable is -0.532, stating that every additional one percent (1%) of the arm muscle strength variable will cause an increase in freestyle swimming ability of -0.532 Athletes of Garuda Laut Makassar City.

There is a contribution of arm muscle strength to the freestyle swimming ability of Garuda Laut Makassar City Athletes. Based on the results of regression analysis testing of arm muscle strength data on freestyle swimming ability in **Table 4**, a regression value of -0.665 was obtained with a significance level of 0.000 < α0.05, for a coefficient of determination of 0.442. This means 44.2% of the influence of arm muscle strength on the freestyle swimming ability of Garuda Laut Athletes in Makassar City.

Based on the results of this analysis, it can be seen that the tcount value obtained is -4.711 which can be seen in the table above with a significance level of 0.000 < α0.05. So Ho is rejected and H1 is accepted or the regression coefficient is significant, or arm muscle strength has a significant influence on the freestyle swimming ability of Garuda Laut Athletes in Makassar City. Thus, there is a contribution of arm muscle strength to the freestyle swimming ability of Garuda Laut Makassar City Athletes 44.2%. Testing of the regression model shows an F value of 22.192 with a significant level of 0.000 < α0.05. This means that freestyle swimming ability can be explained significantly by arm muscle strength in Garuda Laut Makassar City Athletes.

**There is a contribution of leg muscle strength to the freestyle swimming ability of Garuda Laut Athletes in Makassar City**

Regression analysis was carried out to determine the contribution of the independent variable to the dependent variable. The regression analysis used is simple regression analysis at 95% or α0.05. This is intended to determine the contribution of leg muscle strength to the freestyle swimming ability of Garuda Laut Athletes in Makassar City, obtained according to the summary in Table 5 below.

**Table 5.**
Regression analysis results for the third hypothesis

| VARIABLE | N | R | $R^2$ | F | t | P | α |
|---|---|---|---|---|---|---|---|
| Leg Muscle Strength ($X_3$) Freestyle Swimming (Y) | 30 | -0,164 | 0,502 | 28,202 | -5,311 | 0,000 | 0,05 |

Based on the test results as shown in **Table 5**, the regression equation is:
$Y = a + bX_3$
$Y = 46,094 + -0,164\ X_3$
So what is contained in the regression equation can be explained as follows:
a. The constant of 46.094 states that if the leg muscle strength does not change, then the freestyle swimming ability of the Makassar City Garuda Laut Athletes is 46.094.
b. The regression coefficient for the leg muscle strength variable is -0.164, stating that every additional one percent (1%) of the leg muscle strength variable will cause an increase in freestyle swimming ability of -0.164 Garuda Laut Athlete Makassar City.

There is a contribution of leg muscle strength to the freestyle swimming ability of Garuda Laut Athletes in Makassar City. Based on the results of regression analysis testing

of leg muscle strength data on freestyle swimming ability in **Table 5**, a regression value of -0.708 was obtained with a significance level of 0.000 < α0.05, for a coefficient of determination of 0.502. This means 50.2% of the influence of leg muscle strength on the freestyle swimming ability of Garuda Laut Athletes in Makassar City.

Based on the results of this analysis, it can be seen that the tcount value obtained is -5.311 which can be seen in the table above with a significance level of 0.000 < α0.05. So Ho is rejected and H1 is accepted or the regression coefficient is significant, or leg muscle strength has a significant influence on the freestyle swimming ability of Garuda Laut Athletes in Makassar City. Thus, there is a contribution of leg muscle strength to the freestyle swimming ability of Garuda Laut Makassar City athletes of 50.2%. Testing of the regression model shows an F value of 28.202 with a significant level of 0.000 < α0.05. This means that freestyle swimming ability can be explained significantly by leg muscle strength in Garuda Laut Athletes in Makassar City.

**There is a contribution of arm length, arm muscle strength, and leg muscle strength to the freestyle swimming ability of Garuda Laut Makassar City Athletes**

Regression analysis was carried out to determine the contribution of the independent variable to the dependent variable. The regression analysis used is simple regression analysis at 95% or α0.05. The complete results of the regression analysis can be seen in the attachment. This is intended to determine the contribution of arm length, arm muscle strength, and leg muscle strength to the freestyle swimming ability of Garuda Laut Athletes in Makassar City, obtained according to the summary in **Table 6** below:

**Table 6.**
Regression analysis results for hypothesis four

| VARIABLE | N | R | $R^2$ | F | P | α |
|---|---|---|---|---|---|---|
| Arm length (X1), arm muscle strength (X2) and leg muscle strength (X3) Freestyle swimming (Y) | 30 | 0,771 | 0,595 | 12,741 | 0,000 | 0,05 |

Based on the test results as shown in **Table 6**, the regression equation is:

$Y = a + bX_1 + bX_2 + bX_3$

$Y = 3,591 + -0,019\ X_1 + 1,254\ X_2 + 0,007\ X_3$

There is a contribution of arm's length, arm muscle strength, and leg muscle strength together to the freestyle swimming ability of Garuda Laut Athletes in Makassar City. Based on the results of regression analysis testing data on arm length, arm muscle strength, and leg muscle strength on freestyle swimming ability in Garuda Laut Athletes in Makassar City in **Table 6**, a regression value (Ro) of 0.771 was obtained with a significance level in the sig column, equal to (0.000) < α 0.05 for an R Square value (coefficient of determination) 0.595. This means a 59.5% contribution of arm's length, arm muscle strength, and leg muscle strength together to the freestyle swimming ability of Garuda Laut Athletes in Makassar City. Meanwhile, the remainder (100% - 59.5% = 40.5%) was caused by other factors not included in the research.

From the ANOVA test or Ftest, the Fcount was 12.741 with a significance level of 0.000. Because the significance (0.000) is much smaller than α 0.05, the regression model can be used to predict arm length, arm muscle strength, and leg muscle strength on freestyle swimming ability in Garuda Laut Athletes in Makassar City (can be applied to the population where the sample was taken ).

## Discussion

First hypothesis; The contribution of arm length to freestyle swimming ability is 31.2%. This proves that to get maximum results in freestyle swimming, long arms are needed. Arm length is one part of the body structure needed to perform freestyle swimming movements. Arm movements in freestyle swimming play a major role as a driving force and also as a balance regulator so that the body position remains in a horizontal or streamlined position. Thus, arm length contributes to freestyle swimming ability.

The second hypothesis; the contribution of arm muscle strength to freestyle swimming ability is 44.2%. This proves that to get maximum results in freestyle swimming, arm muscle strength is needed. Arm muscle strength is part of the superior extremity. The arm muscle strength referred to is the strength of the triceps and biceps muscles whose movements have an axis at the elbow joint (cubital articulation). The strength of these arm muscles plays a role in making swing movements in moving through obstacles in the water to be able to go as far as possible. In freestyle swimming, the arm movement consists of four phases: 1) swing, 2) recovery, 3) reentry, and 4) extension. These four phases are carried out alternately between the right and left hands. One of the mistakes that often occurs is not swinging fully. Correct swinging is done until the swinging hand reaches the tip of our thigh. It is a mistake if our arms swing only until they are parallel to our chest. Another mistake that often occurs is that the hands drop after re-entering the water (i.e. in the extension phase). This will hinder our progress. Apart from that, if this mistake is made at the same time as taking a breath, the arm swing movement in freestyle swimming can be done well if it is supported by physical abilities such as arm muscle strength.

Third hypothesis; the contribution of leg muscle strength to freestyle swimming ability is 50.2%. This proves that leg muscle strength is needed to obtain maximum results in freestyle swimming. The legs are one part of the body structure needed to perform freestyle swimming movements. Freestyle leg movement is a leg movement that is done up and down in a vertical plane, alternating between the left and right legs, where the movement starts from the groin. During the kicking movement (down) the knees are bent, then straightened at the end of the kick, so that when the legs move upwards they are in a straight stance. The downward kick movement is carried out with full leg muscle strength and power, while the upward leg movement is done rather slowly (relaxed). Thus, freestyle swimming can be done well if it is supported by physical abilities such as leg muscle strength.

Fourth hypothesis; The contribution of arm length, arm muscle strength, and leg muscle strength to freestyle swimming ability is 59.5%. Arm length, and body structure, play an important role in carrying out sports activities and support a person's movement skills. Arm muscle strength describes the maximum contraction produced by muscles or muscle groups. On contraction, the muscle shortens depending on the load being held. At first, the muscle performs without shortening (isometric) until it reaches a tension that is equal to the load, then a contraction occurs with shortening. It should be emphasized that the muscle strength measured is maximum. Maximal contractions can be performed in various ways with the results obtained depending on the coordination of the organist and antagonist muscles as well as the disease system involved. Leg muscle strength is the ability of the leg muscles to withstand loads while working. Strength is very important in supporting sports activities such as freestyle swimming. The three body parts studied by looking at the physical components of strength support freestyle swimming abilities. The arm is the swing in carrying out the movement, the arm muscles are the strength that functions to help the leg muscle strength and the legs help provide thrust in movement.

## CONCLUSION

Based on data analysis with statistical calculations and results of hypothesis testing as well as discussion, the results of this research are concluded as follows:

1. There is a contribution of arm length to the freestyle swimming ability of marine athletes in Makassar City, amounting to 31.2%.
2. There is a significant contribution of arm muscle strength to the freestyle swimming ability of Garuda Laut athletes in Makassar City, amounting to 44.2%.
3. Leg muscle strength significantly contributes to the freestyle swimming ability of Garuda Laut athletes in Makassar City, amounting to 50.2%.
4. There is a significant contribution of arm length, arm muscle strength and leg muscle strength to the freestyle swimming ability of Makassar City Garuda Laut athletes, amounting to 59.5%.

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