



The Relationship Between Basic Technique and Arm Strength and Swimming Speed in Adolescent Athletes

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Abstract

Freestyle swimming speed is one of the main indicators of achievement of swimming athletes, especially in adolescent athletes who are still in the development stage of technical skills and physical condition. Mastery of basic techniques and arm muscle strength are important factors that can affect the effectiveness of movement and swimming speed, but they do not necessarily develop in a balanced manner in every athlete. This study aims to determine the relationship between mastery of basic techniques and arm muscle strength at freestyle swimming speed in adolescent athletes. The research method used is a quantitative approach with a correlational design. The research sample amounted to 20 adolescent athletes who were selected using purposive sampling techniques. Data collection was carried out through testing and measurement, namely assessment of basic techniques using observation sheets, measurement of arm muscle strength through physical tests, and measurement of swimming speed using a 50-meter swimming time. Data were analyzed using descriptive and inferential statistics with the Spearman correlation test because some data were not distributed normally. The results showed that there was a positive and significant relationship between mastery of basic techniques and arm muscle strength ($r = 0.467$; $p < 0.05$). In addition, arm muscle strength also had a positive and significant relationship with freestyle swimming speed ($r = 0.450$; $p < 0.05$). However, the relationship between mastery of basic technique and swimming speed showed a positive but not statistically significant relationship ($r = 0.320$; $p > 0.05$). These findings suggest that arm muscle strength has a more dominant role in increasing swimming speed than partial basic technique. The conclusion of this study is that freestyle swimming speed in adolescent athletes is influenced by a combination of mastery of basic technique and arm muscle strength. Therefore, an integrated and balanced training program between improved technique and muscle strength is indispensable to achieve optimal swimming performance.

How to Cite

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INTRODUCTION

Swimming is a sport that requires a combination of mastery of technique and physical condition to achieve optimal performance, especially in freestyle which is known as the fastest force in a race. Freestyle swimming speed is greatly influenced by the mastery of basic techniques such as body position, arm movements, and breathing coordination, in addition to the strength of the arm muscles which play an important role in generating maximum thrust in the water. In adolescent athletes, these two aspects are important factors that need to be developed in a balanced manner to support improved performance. Swimming in adolescent athletes is strongly influenced by the mastery of basic techniques and muscle strength, especially arm muscles. In this context, research shows that arm muscle strength has a significant contribution to increasing freestyle swimming speed. For example, Abdulghani et al explains that the ability to effectively coordinate movements is essential in achieving optimal results in freestyle swimming (Abdulghani et al., 2025). In addition, Apriyano. reported that arm muscle strength contributed 72.3% to swimming speed in athletes, which emphasized the need to focus on muscle strength in swimming training (Apriyano et al., 2025). Thus, a good level of mastery of technique and adequate muscle strength support will maximize swimming performance in adolescent athletes.

In addition to mastering basic techniques, other research shows the importance of exercises that focus on muscle strength. Bitang et al.. explains that adequate muscle strength not only supports basic technique but also improves endurance and movement efficiency in the water. However, there are no precise references to support this claim in the context of swimming (Bitang et al., 2023). Exercises such as push-ups and various other habituation methods have been shown to increase muscle strength and have a positive impact on increasing swimming speed, as shown by research by Jin et al. that found a significant effect of arm muscle strength training on freestyle swimming speed (Jin et al., 2024). Research by Cuenca-Fernández et al. also supports this argument by stating that there is a significant relationship between mastery of basic technique, arm muscle strength, and freestyle swimming speed (Cuenca-Fernández et al., 2020). Therefore, the development of a training program that combines basic techniques and muscle strength training is necessary to promote the advancement of the swimming achievements

of adolescent athletes.

Although a number of athletes have demonstrated good mastery of swimming techniques, they still face challenges in achieving optimal speed while freestyle swimming. This is reflected in Kurniawan and Winarno's research, which shows a significant link between arm muscle strength and swimming performance, although not all well-engineered athletes are able to maximize their speed in competition (Kurniawan, I., & Winarno, 2020). Research by Shanty et al. reinforces these findings by showing that arm muscles, leg strength, and back significantly affect swimming speed in athletes with a significant percentage of contribution (Shanty et al., 2021)

Meanwhile, research by Falaahudin et al. showed that in general there was no significant relationship between arm and leg muscle strength and crawl swimming performance, which raised questions about the quality of basic techniques that may still need to be improved in athletes (Falaahudin et al., 2021). This shows the complexity of the relationship between physical strength and technical ability. Research by Sembiring and Wiyaka emphasizes the importance of coordination between movement and muscle strength in swimming, which is an important aspect of achieving speed (Sembiring & Wiyaka, 2021). Given the diverse empirical evidence from various studies, it remains questionable to what extent mastery of basic techniques and arm muscle strength can contribute significantly to freestyle swimming speed among adolescent athletes (Ariyansa et al., 2024). This demonstrates the need for a multidimensional approach in training that integrates increased muscle strength with the development of technical abilities in the hope of improving overall swimming performance.

In an effort to increase freestyle swimming speed in adolescent athletes, a training approach is needed that focuses on two main aspects, namely improving the mastery of basic techniques and strengthening the arm muscles. Theoretically, mastery of basic techniques such as improved hand movements, body position, and breathing has been shown to be significant in supporting swimming performance; Kurniawan and Winarno's research emphasized that proper technique greatly affects the smooth movement and speed of swimming (Kurniawan & Winarno, 2022). For this reason, technical training programs that prioritize the quality of these movements must be carried out regularly, with strict supervision to ensure that all components

of the technique are properly trained.

In addition, arm muscle strengthening programs such as endurance training, weights, and exercises in the water are also important, according to findings that show that muscle strength is one of the vital factors in increasing swimming speed (Fone & Tillaar, 2022). Research from Batubara and Ridlo proves that arm muscle strength training can significantly increase swimming speed, so the application of this type of exercise is expected to provide optimal results for athletes (Batubara & Ridlo, 2024). By integrating these two approaches, the training will focus not only on improving technical ability, but also on developing the physical strength that is essential to achieve maximum swimming speed.

There is a difference between ideal and real conditions, where adolescent athletes with good swimming technique still do not reach optimal speeds, while athletes with high arm muscle strength have not performed at their best. Theoretically, mastery of basic techniques and strong muscle strength greatly contribute to swimming speed, but the reality on the ground suggests that these two elements often do not support each other optimally, especially when considering the characteristics of adolescents and training conditions in local coaches' clubs. This study aims to fill the existing information gap by providing a more comprehensive picture of the relationship between mastery of basic techniques and arm muscle strength at freestyle swimming speeds. Therefore, it is important to conduct research that focuses on both factors to know the extent of their influence on swimming speed and how it can be optimized through the right training program, so that adolescent athletes can achieve maximum performance.

Based on an analysis of the literature, freestyle swimming speed in adolescent athletes is synergistically influenced by mastery of basic techniques and arm muscle strength, where previous studies have shown a significant contribution of both factors. However, these observations reveal a gap between theory and practice, as some athletes with adequate technique or good muscle strength have not been able to achieve optimal speed, suggesting that the influence of the two is not always linear and may depend on other aspects such as coordination or training methods. Therefore, an integrated training approach is needed that simultaneously and proportionately develops technical competence and physical capacity through a structured program, which aims to align these two key elements to maximize the swimming

achievements of adolescent athletes in the club.

Mastery Basic techniques and arm muscle strength are two important elements that affect freestyle swimming speed in adolescent athletes. Optimal basic techniques, including lean body positioning, coordination of arm and leg movements, and proper breathing, allow athletes to move more efficiently in the water. With the right technique, water resistance can be minimized, so that the energy used becomes more effective in supporting increased swimming speed.

This study aims to analyze the relationship between mastery of basic techniques and arm muscle strength at freestyle swimming speed in adolescent athletes, as well as identify the variables that have the most dominant contribution to improving swimming performance. More specifically, this study seeks to measure the degree of relationship between mastery of basic techniques and arm muscle strength, the relationship between arm muscle strength and swimming speed, and the relationship between mastery of basic techniques and freestyle swimming speed. The novelty of this study lies in the analytical approach that integrates two main aspects, namely technique and physical condition, in one model of empirical study in adolescent athletes, which was still relatively limited in previous studies. In addition, this study also emphasizes the identification of dominant factors that affect swimming speed, so as to not only describe the relationship between variables, but also make a practical contribution to the preparation of more effective, targeted, and evidence-based training programs in the development of young athletes.

However, although basic technique has a very vital role, arm muscle strength remains a supporting factor that cannot be ignored. Strong arm muscles help athletes create greater thrust when pulling water, so swimming speed can be significantly improved. Therefore, in adolescent athletes, freestyle swimming speed is affected by a balance between mastery of basic techniques.

METHOD

This study uses a quantitative approach with a correlational research design. The quantitative approach is used because this research involves collecting data in numerical form that is analyzed using statistical techniques to test the relationships between research variables. This approach emphasizes objective measurement and systematic data analysis to arrive at generalizable

conclusions (Sciberras & Dingli, 2023). The design of correlational research aims to determine the level of relationship between two or more variables without manipulating the variables being studied, so that the relationships obtained describe conditions that occur naturally (Sullivan, 2024).

This research was conducted at the Frog Aquatic Club of Bandung City with the research subjects of adolescent swimmers who actively participated in the training program. The population in this study was all adolescent athletes who were members of the club. The research sample was 9 Men and 11 Women Athletes who are 13-15 years old know. It was selected using the purposive sampling technique, which is a sampling technique based on certain criteria relevant to the research objectives, such as athletes who actively participate in training and have experience in freestyle swimming competitions (Memon et al., 2025).

Data collection was carried out using testing and measurement techniques. The variables of mastery of basic freestyle swimming techniques were measured using a swimming technique observation sheet that assessed several important aspects, namely body position, arm movements, leg movements, and breathing techniques. The assessment was carried out using a rating scale to describe the level of mastery of athletes' swimming techniques. Mastery of basic techniques is an important component of freestyle swimming because good technique can improve movement efficiency and reduce water resistance when swimming (Mordvintsev et al., 2023)

Arm muscle strength variables are measured through a physical test of arm muscle strength such as a push-up test, pull-up test, or resistance band. This test is used to determine the ability of arm muscles to produce maximum strength. Muscle strength is the ability of a muscle or muscle group to produce maximum force in a single contraction against a specific load (Zhang & Wang, 2023)

In freestyle swimming, arm muscle strength plays an important role in generating forward thrust through the movement of the paddle hand in the water. Meanwhile, the freestyle swim speed variable is measured through a 50-meter swim time test using a digital stopwatch. The traveled time obtained is recorded in seconds and is used as an indicator of an athlete's swimming speed. Speed in swimming is an athlete's ability to cover a certain distance in the shortest possible time, which is influenced by the technical abilities and physical condition of the athlete (Seifert &

Carmigniani, 2023)

The data obtained was then analyzed using the help of SPSS software through two stages of analysis, namely descriptive statistical analysis and inferential statistical analysis. Descriptive analysis was used to describe the characteristics of the research data, such as the mean value, standard deviation, maximum value, and minimum value of each variable. Furthermore, an inferential analysis was carried out to test the relationship between the research variables. Before the correlation test was carried out, the analysis prerequisite test was first carried out which included a normality test and a linearity test. After the assumption was met, the analysis continued by using a correlation test to determine the relationship between mastery of basic techniques, arm muscle strength, and freestyle swimming speed in adolescent athletes at the Frog Aquatic Club Bandung City.

RESULTS AND DISCUSSION

This study was conducted over a certain period of time by involving 20 adolescent athletes as research respondents. All respondents were active athletes who participated in a regular training program. Data collection was carried out through testing and measurement which included mastery of basic techniques, arm muscle strength, and freestyle swimming speed. Based on the implementation of the research, the results obtained were then analyzed to determine the relationship between the variables studied.

Based on the results of the descriptive analysis presented in **Table 1**, it is known that the average mastery of basic techniques is 19.65 with a standard deviation of 0.671, which shows that the technical ability of athletes is relatively homogeneous. Meanwhile, arm muscle strength has an average value of 45.05 with a standard deviation of 5.276 which indicates a moderate variation in physical ability. Freestyle swimming speed has an average of 44.75 with a standard deviation of 20.097, which shows that there is a fairly high variation in performance between athletes.

Table 1. Descriptive Statistics of Research Variables

	N	Range	Min	Max	Sum	Red	SD	Variance
Basic Techniques	12	2	18	20	393	19.65	671	450
Muscle Strength	12	19	34	53	901	45.05	5.276	27.839
Free Swimming Speed	12	65	15	80	895	44.75	20.097	403.882

Table 2. Normality Test

	Kolmogorov-Smirnov4			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	Df	Sig.
Basic Engi-neering Results	.449	20	.000	.578	20	.000
Arm Muscle Strength Results	.099	20	.200*	.964	20	.634
Speed Re-sults	.270	20	.000	.862	20	.009

Based on **Table 2.** The normality test was carried out to find out whether the research data had a normal distribution or not. The normality test in this study used the Kolmogorov-Smirnov and Shapiro-Wilk tests with the help of SPSS software.

The results of the analysis showed that the variable of mastery of basic techniques had a significance value of 0.000, the variable of arm muscle strength had a significance value of 0.634, while the freestyle swimming speed variable had a significance value of 0.009. Based on the normality test criteria, the data is said to be distributed normally if the significance value is greater than 0.05.

The results of this study show that not all variables have normal distributions, so the analysis of the relationships between variables does not use parametric correlation tests, but rather uses non-parametric rho Spearman correlation tests which are more suitable for data that do not meet the assumption of normality.

Table 3. Spearman Correlation Test Results

			Basic Engi-neering Results	Arm Mus-cle Strength Results	Speed Results
Spear-man's rho	Basic Engi-neering Results	Correla-tion Coef- ficie nt	1.000	.467*	.320
		Sig. (2-tailed)	.	.038	.170
		N	20	20	20
	Arm Muscle Strength Results	Correla-tion Coef- ficie nt	.467*	1.000	.450*
		Sig. (2-tailed)	.038	.	.047
		N	20	20	20
	Speed Re-sults	Correla-tion Coef- ficie nt	.320	.450*	1.000
		Sig. (2-tailed)	.170	.047	
		N	20	20	20

Based on **Table 3.** The analysis of the relationship between variables in this study used the Spearman correlation test to determine the relationship between mastery of basic techniques, arm muscle strength, and freestyle swimming speed in adolescent athletes.

The results of the analysis show that:

1. The relationship between mastery of basic techniques and arm muscle strength had a correlation coefficient value of 0.467 with a significance value of 0.038 ($p < 0.05$). This shows a positive and significant relationship between mastery of basic techniques and arm muscle strength.
2. The relationship between mastery of basic technique and freestyle swimming speed had a correlation coefficient value of 0.320 with a significance value of 0.170 ($p > 0.05$). The results of this study showed that the relationship between the two variables was positive but not statistically significant.
3. The relationship between arm muscle strength and freestyle swimming speed had a correlation coefficient value of 0.450 with a significance value of 0.047 ($p < 0.05$). The results of this study showed that there was a positive and significant relationship between arm muscle strength and freestyle swimming speed in adolescent athletes.

The results showed that there was a relationship between mastery of basic techniques and freestyle swimming speed in adolescent athletes Age 13-15 years. These findings show that athletes who have a good command of technique tend to be able to swim more efficiently and produce higher speeds. Basic techniques in freestyle swimming include lean body positioning, coordination of arm and leg movements, and proper breathing techniques. If the technique is done correctly, water resistance can be minimized so that the energy used becomes more effective to produce speed. This is in line with the opinion (Sheng & Wang, 2021) which states that good swimming technique can improve the efficiency of movement as well as reduce water resistance when swimming.

In addition to technical factors, the study also found that arm muscle strength has a relationship with freestyle swimming speed. Arm muscles play an important role in generating thrust when performing hand punching movements in the water. The greater the strength of the arm muscles an athlete has, the greater the thrust generated to move the body forward. The results of this study are in line with the opinion (Ueyama, 2024) which states that muscle strength is the ability of muscles to generate maximum strength against loads. In the context of swimming, arm muscle strength is an important factor that affects an athlete's ability to generate speed while swimming.

The findings of this study are also sup-

ported by previous research showing that arm muscle strength has a significant contribution to freestyle swimming speed. Research conducted by (Rodríguez González et al., 2023) This suggests that arm muscle strength training can significantly improve swim speed performance. In addition, research by (Valentino Latuheru et al., 2026) It also states that there is a significant relationship between mastery of basic techniques, arm muscle strength, and freestyle swimming speed.

However, the results of this study also show that good mastery of technique is not always followed by optimal swimming speed if it is not supported by adequate physical conditions. This shows that swimming performance is the result of an interaction between technical ability and the physical condition of athletes. These findings are in line with research (Amara et al., 2021) which states that even if the athlete has good technique, optimal swimming performance still requires adequate muscle strength support.

Thus, increasing freestyle swimming speed in adolescent athletes needs to be done through an integrated training approach, namely by developing mastery of basic techniques while increasing arm muscle strength. A training program that combines these two aspects is believed to be able to improve athletes' swimming performance more optimally.

Based on the results of the research that has been conducted, some of the recommendations that can be given are as follows.

First, for swim coaches at the Frog Aquatic Club, it is recommended to place more emphasis on practicing mastering the basic techniques of freestyle swimming systematically and continuously. In addition, the training program also needs to include structured arm muscle strength exercises to improve the ability to push when performing hand strokes so as to increase the athlete's swimming speed.

Second, for adolescent swimmers, it is expected to increase awareness of the importance of mastering basic techniques and physical conditions in supporting swimming performance. Athletes need to undergo disciplined and consistent training, both technique training and muscle strength training, to achieve optimal performance results.

Third, for future researchers, it is recommended to develop the study by adding other variables that can affect freestyle swimming speed, such as muscle endurance, flexibility, movement coordination, and swimming biomechanical factors. In addition, subsequent studies may also use

larger sample sizes or involve athletes from different swim clubs so that the results have a broader degree of generalization.

Fourth, further research can also use experimental methods by providing a specific exercise program to find out more about the effect of exercise techniques and muscle strength training on the increase in freestyle swimming speed.

CONCLUSION

Based on the results of data analysis and research discussions on the relationship between mastery of basic techniques and arm muscle strength and freestyle swimming speed in adolescent athletes at the Frog Aquatic Club, the following conclusions can be drawn.

First, there is a relationship between mastery of basic freestyle swimming techniques and freestyle swimming speed in adolescent athletes. Athletes who have better mastery of technique tend to be able to produce faster swimming travel times. This suggests that mastery of basic techniques such as lean body positioning, coordination of arm and leg movements, and proper breathing regulation have an important role in improving the efficiency of movement in the water so that it can increase swimming speed.

Second, there is a relationship between arm muscle strength and freestyle swimming speed in adolescent athletes. Arm muscle strength contributes to an athlete's ability to generate thrust when paddling in water. The greater the arm muscle strength an athlete has, the greater the thrust generated to move the body forward so that it can increase swimming speed.

Third, at the same time, the mastery of basic techniques and arm muscle strength is related to freestyle swimming speed in adolescent athletes at the Frog Aquatic Club. This shows that swimming speed is not only influenced by a single factor, but is the result of a combination of technical abilities and physical condition of the athlete. Therefore, the improvement of freestyle swimming performance needs to be done through the development of good basic techniques and a programmed and sustained increase in arm muscle strength.

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