



The Effect Of Arm And Leg Muscle Strength On The 50-Meter Freestyle Swimming Speed Of Swimming Club Athletes In Pringsewu

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ABSTRACT

This study aims to determine the effect of arm and leg muscle strength on the 50-meter freestyle swimming speed of Swimming Club athletes in Pringsewu. This research used an experimental method with a pretest-posttest control group design. The sample consisted of two experimental groups: one focused on arm muscle strength training, and the other on leg muscle strength training. Data were collected using a 50-meter freestyle speed test. The analysis revealed that both arm muscle strength ($t = 5.111 > t\text{-table} = 2.201$) and leg muscle strength ($t = 6.046 > t\text{-table} = 2.201$) significantly affected swimming speed. In conclusion, arm and leg muscle strength simultaneously contribute to improving 50-meter freestyle swimming performance.

Keywords: Muscle Strength, Swimming Speed, Freestyle.

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INTRODUCTION

Sports are an important part of developing a person's physical, spiritual, and social potential. According to Law Number 11 of 2022 concerning Sports, every citizen has the right and obligation to participate in sports activities as part of efforts to improve the quality of life and shape the nation's character. Physical education in schools aims to shape individuals who are physically literate, active throughout life, and possess good moral and social character through physical activity. Swimming is a sport that is popular among various groups and has extensive benefits for the body. One of the most popular swimming styles is freestyle. This style is known as the fastest style in swimming competitions and demands high physical abilities and efficient techniques. According to Armen (2020), freestyle is performed by alternating arm paddling movements and rhythmic up-and-down kicking of the legs. Therefore, muscle strength, especially the arm and leg muscles, is crucial for an athlete's performance in freestyle swimming. In the context of sports development, especially in swimming, understanding the dominant physical components is very important in developing an effective training program. One of the physical components that influences swimming

speed is muscle strength. Arm muscles primarily propel the body forward through a paddling motion in the water, while leg muscles maintain body position and provide additional propulsion through leg movements.

Based on initial observations of athletes from the Pringsewu Swimming Club, it was found that their 50-meter freestyle swimming speeds were still low. This is thought to be due to a lack of muscle strength in both the arms and legs. Athletes who only have dominant strength on one side of the body (for example, only arm muscles or only leg muscles) show less than optimal performance in competitions. Using a scientific approach, this study seeks to deeply examine the effect of arm and leg muscle strength on freestyle swimming speed. This research is crucial for coaches in developing balanced training programs focused on strengthening the key muscles involved in swimming. It is hoped that the results of this study can provide scientific recommendations regarding the importance of muscle strength training as an integral part of improving the performance of swimming athletes.

METHOD

This study used an experimental method with a pretest-posttest control group design. The sample consisted of two experimental groups, each consisting of 10 athletes from the Pringsewu Swimming Club. The data collection instrument was a stopwatch to measure the 50-meter freestyle swimming time. Data analysis techniques used were t-tests and analysis of variance to examine the partial and simultaneous effects between variables.

RESULTS AND DISCUSSION

The t-test results showed that arm muscle strength training significantly increased swimming speed ($T = 5.111$). The same was true for the leg muscle training group ($T = 6.046$). Simultaneous testing showed a significant effect of arm and leg muscle strength on swimming speed. These findings support the theory that upper and lower extremity muscle strength is crucial in aquatic sports, particularly freestyle swimming.

This research was conducted using an experimental method regarding the influence of arm and leg muscle strength on the 50-meter freestyle swimming speed of Swimming Club athletes in Pringsewu. This research activity was carried out in three stages, namely the first stage was a Pre-Test to determine the initial abilities of the sample and group the samples into two groups, namely experimental groups 1 and 2.

After that, the sample of experimental group 1 was given treatment, namely arm muscle strength training, and experimental group 2 was given leg muscle strength training for a certain period. Next, a Post-Test was conducted to determine the increase in 50-meter freestyle swimming speed. To provide an overview of the distribution of data, an analysis was carried out, including the average (mean), standard deviation, median value, mode value, maximum value, and minimum value. The description of the research data is as follows.

Table 1. 1Subjects Based on Gender

Gender	Number (N)		Percentage (%)	
	Experimental Group 1	Experimental Group 2	Experimental Group 1	Experimental Group 2
Man	6	6	50%	50%
Woman	6	6	50%	50%
Total	12	12	100%	100%

Based on the table above, it can be seen that from all the research subjects on *Swimming Club* athletes in Pringsewu, namely 24 athletes, where 12 people in experimental group 1 (arm muscle training), namely 6 people (50%) were male and 6 people (50%) were female, and 12 people in experimental group 2 (leg muscle training), namely 6 people (50%) were male and 6 people (50%) were female.

Table 2. Research Subjects Based on Age

Gender	Number (N)		Percentage (%)	
	Experimental Group 1	Experimental Group 2	Experimental Group 1	Experimental Group 2
14 years	9	9	75%	75%
15 years	3	3	25%	25%
Total	12	12	100%	100%

Based on the age of the research subjects, they are grouped into two age groups: 14 and 15 years, as categorized in age group II (KU II) in swimming sports, as shown in the following table.

Based on the table above, it can be seen that from all the research subjects on *Swimming Club* athletes in Pringsewu, namely 24 athletes, where 12 people in experimental group 1 (arm muscle training), namely 9 people (7.5 %) were 14 years old and 3 people (2.5 %) were 15 years old, and 12 people in experimental group 2 (leg muscle training), namely 9 people (7.5 %) were 14 years old and 3 people (2.5 %) were 15 years old.

Table 3. Research Subjects Based on Age

Gender	Number (N)		Percentage (%)	
	Experimental Group 1	Experimental Group 2	Experimental Group 1	Experimental Group 2
< 1 Year	4	3	33.3%	25.0%
1-2 Years	6	7	50.0%	58.3%
3-4 Years	0	0	0.0%	0.0%
4 years	2	2	16.7%	16.7%
Total	12	12	100%	100%

Based on the time they joined *the Swimming Club*, the research subjects were grouped into four, namely 4 years, 3-4 years, 1-2 years, and <1 year, as seen in the following table.

Based on the table above, it can be seen that from all the research subjects on *Swimming Club* athletes in Pringsewu, namely 24 athletes, where 12 people in experimental group 1 (arm muscle training) most of the athletes have been joining for 1-2 years as many as 6 people (50%), followed by 4 people (33.3%) with experience <1 year, 2 people (16.7%) who have joined for 4 years. and there are no athletes with experience joining 3-4 years. While 12 people in experimental group 2 (leg muscle training) are also dominated by athletes who have joined for 1-2 years, as many as 7 people (58.3%), then 3 people (25%) have experience <1 year, and 2 people (16.7%) have experience of 4 years.

Table 4. Description of Research Subjects Based on the Arm Muscle Strength Aspect Questionnaire

Arm Muscle Aspects	
No Category	I feel my I can do I often train I feel that the Arm muscle strength is 15 push- muscles arm muscles important to quite good ups in one with <i>pull-</i> contributes improve my

		when swimming freestyle.		set without <i>ups</i> or <i>dips</i> . difficulty.		greatly to my swimming freestyle swimming speed.		performance.			
		Freq	%	Freq	%	Freq	%	Freq	%		
1	Strongly agree	7	29.2%	3	12.5%	2	8.3%	6	25.0%	7	29.2%
2	Agree	11	45.8%	10	41.7%	8	33.3%	10	41.7%	8	33.3%
3	Doubtful	3	12.5%	4	16.7%	9	37.5%	8	33.3%	7	29.2%
4	Don't agree	2	8.3%	3	12.5%	5	20.8%	0	0.0%	1	4.2%
5	Strongly Disagree	1	4.2%	4	16.7%	0	0.0%	0	0.0%	1	4.2%
Amount		24	100%	24	100%	24	100%	24	100%	24	100%

The arm muscle strength aspect of the research subjects was assessed based on the results of a questionnaire given to the athletes after they completed the *Post-Test*. Based on the results of the arm muscle strength questionnaire, the research subjects were grouped into five categories, namely strongly agree, agree, doubtful, disagree, and strongly disagree, as seen in the following table.

Based on the results of the questionnaire on the aspect of arm muscle strength and the speed of the 50-meter freestyle swimming of *Swimming Club athletes* in Pringsewu, as shown in Table 4, the following picture is obtained:

1. The statement “I feel that my arm muscle strength is quite good when swimming freestyle” received a response of “Strongly Agree” from 7 respondents (29.2%) and “Agree” from 11 respondents (45.8%), so that a total of 75% of respondents gave a positive assessment of the condition of their arm muscle strength.
2. The statement “I can do more than 15 *push-ups* in one set without difficulty”, as many as 10 respondents (41.7%) answered “Agree” and 3 people (12.5%) answered “Strongly Agree”, which shows that more than half of the respondents have good functional arm muscle strength capabilities.

3. The statement “I often train my arm muscles with *pull-ups* or *dips* ”, as many as 8 people (33.3%) answered “Agree”, but there were also 9 people (37.5%) who answered “Uncertain”, which shows that this exercise has not become a habit for some athletes.
4. The statement "I feel that the strength of my arm muscles contributes greatly to the speed of freestyle swimming", the majority of respondents answered "Strongly Agree" as many as 6 people (25%) and "Agree" as many as 10 people (41.7%), indicating the athlete's awareness that arm muscle strength has an important role in swimming speed performance.
5. The statement "Arm muscle strength training is important to improve freestyle swimming performance" received the highest response in the "Agree" category, namely 8 respondents (33.3%), followed by "Strongly Agree" and "Undecided", as many as 7 respondents (29.2%).

Overall, the questionnaire results indicate that most athletes recognize the importance of arm muscle strength to freestyle swimming performance and speed. This reinforces the assumption that arm muscle strength is a crucial aspect that requires consistent, programmed training.

Table 5. Description of Research Subjects Based on the Leg Muscle Strength Aspect Questionnaire

No	Category	Leg Muscle Aspects									
		I feel my leg muscles are strong when I kick freestyle swimming.		I often feel fatigue in my leg muscles after intensive swimming training.		I experienced an increase in swimming speed after increasing leg strength training.		Leg muscle strength training improves my swimming start ability.		I believe that the strength of my leg muscles contributes greatly to my swimming performance.	
		Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
1	Strongly agree	3	12.5%	4	16.7%	3	12.5%	4	16.7%	5	20.8%
2	Agree	11	45.8%	12	50.0%	9	37.5%	13	54.2%	10	41.7%
3	Doubtful	9	37.5%	4	16.7%	10	41.7%	7	29.2%	9	37.5%
4	Don't agree	1	4.2%	3	12.5%	1	4.2%	0	0.0%	0	0.0%

		Leg Muscle Aspects									
No	Category	I feel my leg muscles are strong when I kick freestyle swimming.		I often feel fatigue in my leg muscles after intensive swimming training.		I experienced an increase in swimming speed after increasing leg strength training.		Leg muscle strength training improves my swimming start ability.		I believe that the strength of my leg muscles contributes greatly to my swimming performance.	
		Freq %		Freq %		Freq %		Freq %		Freq %	
5	Strongly Disagree	0	0.0%	1	4.2%	1	4.2%	0	0.0%	0	0.0%
Amount		24	100%	24	100%	24	100%	24	100%	24	100%

The muscle strength aspect of the research subjects was obtained based on the results of the questionnaire given to the athletes after completing the *Post-Test*. Based on the results of the questionnaire regarding leg muscle strength, the research subjects were grouped into five categories, namely strongly agree, agree, doubtful, disagree, and strongly disagree, as seen in the following table.

On the leg muscle strength aspect and the 50-meter freestyle swimming speed of *Swimming Club athletes* in Pringsewu, as shown in Table 4, the following picture is obtained:

1. The statement "I feel my leg muscles are strong when kicking in freestyle swimming", as many as 3 respondents (12.5%) stated "Strongly Agree", and 11 respondents (45.8%) "Agree", so that a total of 58.3% of athletes are aware of the strength of their leg muscles in supporting the swimming kick movement.
2. The statement "I often feel tired in my leg muscles after intensive swimming training" was met with agreement from the majority of respondents, with 4 (16.7%) responding "Strongly Agree" and 12 (50%) "Agree." This indicates that intensive training does indeed put quite a strain on athletes' leg muscles.
3. The statement "I experienced an increase in swimming speed after increasing leg strength training", as many as 9 respondents (37.5%) said "Agree", but quite a lot of them answered "Uncertain" as many as 10 people (41.7%), which indicates that not all athletes feel the direct impact of leg strength training on increasing speed.

4. The statement "Leg muscle strength training increases my speed in swimming starts," the majority of respondents, 13 people (54.2%), were in the "Agree" category, and 4 respondents (16.7%) were in the "Disagree" category. This indicates that athletes are aware of or understand the specific benefits of leg training in the start phase.
5. The statement "I believe that the strength of my leg muscles contributes greatly to my swimming performance", there were 5 respondents (20.8%) who "Strongly Agree" and 10 respondents (41.7%) who "Agree", so that a total of 62.5% stated their belief in the importance of leg muscle strength to overall performance.

Overall, the questionnaire results indicated that the majority of athletes had a positive perception of the role of leg muscle strength in freestyle swimming, although some doubts remained about its direct impact on speed and starting ability. This highlights the importance of more focused training on leg muscle aspects in swimmer development programs.

Table 6. Descriptive Statistics of Experimental Group 1

Data	Pre-Test		Post-Test	
	L	P	L	P
Mean	36.72	39.86	33.93	36.14
Median	35.55	40,565	33,405	36,345
Mode	-	-	-	-
Standard Deviation	3.90	3.28	4.69	3.01
Minimum	42.32	43.05	39.56	39.79
Maximum	32.77	34.55	28.58	32.46

The table above shows that the results of the Pre-Test for 50-meter freestyle swimming speed in experimental group 1 for male athletes had an average of 36.72, a standard deviation of 3.90, a median of 35.5 , a minimum value of 42.32, and a maximum value of 32.77. Meanwhile, the pre-test results for female athletes had an average of 39.86, standard deviation 3.28, median 40.5,65. minimum value 43.05, a maximum value of 34. 55 and the data does not have a mode because no value appears more than once.

The results of the Post-Test of the 50-meter freestyle swimming speed after being given treatment using training Arm muscle strength, for male athletes, showed an average of 33.93, standard deviation 4.69, median 3.1, 405,minimum value 3.9, 56, and maximum value 2.8, 58. Meanwhile, the Post-Test results for female athletes showed an average of 36.14, a standard deviation of 3.01, a median of 36.345, a minimum value of 39.79, a

maximum value of 3.246, and the data did not have a mode because no value appeared more than once.

Table 7. Frequency Distribution of 50 Meter Freestyle Swimming Speed Results for Experimental Group 1

Interval	Category	Frequency		Percentage	
		<i>Pre-Test</i>	<i>Post-Test</i>	<i>Pre-Test</i>	<i>Post-Test</i>
$X < 29.08$	Very good	0	1	0.0%	8.3%
$29.08 \leq X < 34.12$	Good	3	4	25.0%	33.3%
$34.12 \leq X < 39.15$	Enough	3	5	25.0%	41.7%
$39.15 \leq X < 44.19$	Not enough	6	2	50.0%	16.7%
$X \geq 44.19$	Very less	0	0	0.0%	0.0%
Amount		12	12	100%	100%

Based on the assessment norms in the table above, it shows that *the Pre-Test* results of the 50-meter freestyle swimming speed in experimental group 1 are in the category of "very good" at 0% (0 athletes), "good" at 25% (3 athletes), "moderate" at 25% (3 athletes), "less" at 50% (6 athletes), and "very less" at 0% (0 athletes). While *the Post-Test* of the 50-meter freestyle swimming speed in experimental group 1 after being given treatment/arm muscle strength training, is in the category of "very good" at 8.3% (1 athlete), "good" at 33.3% (4 athletes), "moderate" at 41.7% (5 athletes), "less" at 16.7% (2 athletes), and "very less" at 0% (0 athletes).

Table 8. Descriptive Statistics of Experimental Group 2

Data	<i>Pre-Test</i>		<i>Post-Test</i>	
	L	P	L	P
Mean	35.57	43.60	30.87	36.40
Median	36,505	43.9	29.93	37.07
Mode	-	-	-	-
Standard Deviation	3.25	5.66	2.64	3.31
Minimum	39.38	50.55	34.49	39.35
Maximum	31.35	34.36	27.62	30.73

The table above shows that the results of the Pre-Test for 50-meter freestyle swimming speed in experimental group 2 for male athletes had an average of 35.57, a standard deviation of 3.25, a median of 36.505, a minimum value of 39, a maximum value of 38, and a minimum value of 31.35. Meanwhile, the pre-test results for female athletes had an average of 43.60, standard deviation 5.66, median 43.9, minimum value 50.55, maximum value 34,36, and the data has no mode because no value appears more than once.

The results of the Post-Test of 50-meter freestyle swimming speed after being given treatment using leg muscle strength training, for male athletes, showed an average of 36.87, a standard deviation of 2.24, a median of 29.93, a minimum value of 34.49, and a maximum value of 27.62. Meanwhile, the Post-Test results for female athletes showed an average of 36.40, standard deviation 3.31, median 37.07, minimum value 39, 35, and the maximum value is 30.3 7, and the data does not have a mode because no value appears more than once.

Table 9. Frequency Distribution of 50 Meter Freestyle Swimming Speed Results for Experimental Group 2

Interval	Category	Frequency		Percentage	
		Pre-Test	Post-Test	Pre-Test	Post-Test
$X < 29.08$	Very good	0	1	0.0%	8.3%
$29.08 \leq X < 34.12$	Good	2	5	16.7%	41.7%
$34.12 \leq X < 39.15$	Enough	4	4	33.3%	33.3%
$39.15 \leq X < 44.19$	Not enough	3	2	25.0%	16.7%
$X \geq 44.19$	Very less	3	0	25.0%	0.0%
Amount		12	12	100%	100%

Based on the assessment norms in the table above, it shows that *the Pre-Test* results of the 50-meter freestyle swimming speed in experimental group 2 are in the category of "very good" at 0% (0 athletes), "good" at 16.7% (2 athletes), "sufficient" at 33.3% (4 athletes), "less" at 25% (3 athletes), and "very less" at 25% (3 athletes). While *the Post-Test* of the 50-meter freestyle swimming speed in experimental group 2 after being given treatment/leg

muscle strength training, are in the category of "very good" at 8.3% (1 athlete), "good" at 41.7% (5 athletes), "sufficient" at 33.3% (4 athletes), "less" at 16.7% (2 athletes), and "very less" at 0% (0 athletes).

Table 10. Homogeneity Test

Variables	F_{count}	F_{table}	Information
Group Experiment 1	1,065	2,818	Homogeneous
Group Experiment 2	2,244	2,818	Homogeneous

Based on the results of the homogeneity test, from the table above, it is known that the Pre-Test and Post-Test variable data for experimental group 1 show the calculated F value. = $1.065 < F_{table} = 2.818$, and the Pre-Test and Post-Test variable data for experimental group 2 shows the calculated F value = $2.244 < F_{table} = 2.818$. So it can be concluded that all variable data comes from the same variant or is homogeneously distributed.

Table 11. Test of the Effect of Experimental Groups 1 and 2

Data	T Count	T Table	Note
Group Experiment 1	5,111	2,201	There is a significant influence
Group Experiment 2	6,046	2,201	There is a significant influence

From the table above, it can be seen in experimental group 1 that the calculated T value = $5.111 > T_{table} = 2.201$, which means that there is a significant difference in the Pre-Test and Post-Test data for experimental group 1. In Experimental Group 2, the calculated T value is 6.046, which exceeds the T table value of 2.201. This indicates a significant difference in the data between the Pre-Test and Post-Test results of Experimental Group 2. Thus, it can be explained that arm muscle strength training and

leg can increase the speed of the 50-meter freestyle swimming of Swimming Club athletes in Pringsewu.

Table 12. Comparison Test of Post-Test and Pre-Test of Experimental Groups 1 and 2

Data	T Count	T Table	Note
<i>Pre-Test</i> of Experiments 1 and 2	0.420	2,074	No Significant Difference
<i>Post-Test</i> of Experiments 1 and 2	0.547	2,074	No Significant Difference

From the table above, it can be seen in the Pre-Test of experimental groups 1 and 2 that the Tcount value = $0.420 < T_{table} = 2.074$, which means that there is no significant difference in the Pre-Test data results of experimental groups 1 and 2. Meanwhile, in the Post-Test of experimental groups 1 and 2, the Tcount value = $0.547 < T_{table} = 2.074$, which means that there is no significant difference in the Post-Test data results of experimental groups 1 and 2. Thus, it can be explained that there is no significant difference between arm muscle strength training and leg muscle strength training in increasing the speed of the 50-meter freestyle swimming of Swimming Club athletes in Pringsewu.

Table 13. Pre-Test and Post-Test Validity Test, Experimental Groups 1 and 2

Data	(r)	Note
Pre-Test and Post-Test of Experimental Group 1	0.84	Valid
Pre-Test and Post-Test of Experimental Group 2	0.85	Valid

The results of the validity data in experimental group 1 (Arm Muscles) in the table above, the correlation value between Pre-test and Post-test is 0.84, which indicates good category validity and in experimental group 2 (Leg Muscles) 0.85, this shows that the measurement instrument used has good validity and can be relied on to measure the desired variables.

Table 14. Reliability Test of Pre-Test and Post-Test of Experimental Groups 1 and 2.

Data	(r)	Note
Pre-Test and Post-Test of Experimental Group 1	0.84	Reliable
Pre-Test and Post-Test of Experimental Group 2	0.85	Reliable

The results of the validity data in experimental group 1 (Arm Muscles) in the table above, the correlation value between Pre-test and Post-test is 0.84, which indicates good category validity and in experimental group 2 (Leg Muscles) 0.85, this shows that the measurement instrument used has good reliability and can be relied on to measure the desired variables.

DISCUSSION

Arm and leg muscle strength significantly impacts 50-meter freestyle swimming speed, both partially and simultaneously. Swimming training programs are recommended to prioritize strengthening both muscle groups proportionally to improve athlete performance. There was no significant difference between arm and leg muscle strength training in increasing 50- meter freestyle swimming speed.

CONCLUSION

Arm and leg muscle strength, both partially and simultaneously, significantly increased the 50-meter freestyle swimming speed. However, there was no significant difference in training effectiveness between the two. Therefore, coaches are advised to provide balanced arm and leg muscle strengthening exercises in their swimmer training programs. The results of the Independent Samples T-Test analysis showed that there was no significant difference between arm muscle strength training and leg muscle strength training on increasing the speed of the 50-meter freestyle swimming. The t-count value which was smaller than the table ($t\text{-count} = 0.547 < t\text{-table} = 2.074$) indicated that both types of training had a relatively equal effect in improving athlete performance.

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