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Article

Impact of Resistance Band Training on Arm Muscle Power in 11-12-Year-Old Male Freestyle Swimmers: A 2024 Study at Aquatic Swimming Club Medan

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Abstract

This study investigates the effect of resistance band exercise variations on arm muscle power in 50-meter freestyle swimmers aged 11-12 years at the Aquatic Swimming Club Medan in 2024. Swimming, particularly the freestyle stroke, requires significant arm strength for optimal performance, and many young athletes struggle to meet competition standards due to insufficient muscle power. The research, conducted from July 25 to September 17, 2024, employed an experimental design with a one-group pretest-posttest structure. Eight athletes were selected using purposive sampling based on specific criteria, including proficiency in freestyle swimming and active club membership. The study utilized the Two-Hand Medicine Ball Put test to measure arm muscle power. Statistical analysis, specifically a paired t-test, was performed on the pre-test and post-test data. The results showed a significant improvement in arm muscle power, with the pre-test mean score of 24.96 increasing to 25.47 after six weeks of resistance band training. The calculated t-value of 9.643 was greater than the critical t-value of 1.894 at a 0.05 significance level, indicating that the observed improvement was statistically significant. This study concludes that resistance band training effectively enhances arm muscle power in young swimmers, which is critical for improving their performance in competitive swimming. The findings suggest that such training can be a beneficial addition to swimming programs, especially for athletes in the 11-12 age group. Future research could explore the long-term effects of resistance band training on swimming performance, investigate the impact of combined training methods, and assess the sustainability of these training gains in larger, more diverse swimmer populations.

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INTRODUCTION

Swimming is a popular sport for improving physical fitness, particularly because it engages major muscles such as the arms and legs. Additionally, swimming is favored by the public as a means of entertainment, recreation, and competition. In Indonesia, especially in major cities, many swimming facilities are available to support recreational activities and the development of accomplished athletes. One of the most frequently contested styles is freestyle, known as the fastest swimming technique. According to Hudayhana (2014), freestyle swimming is the easiest style to learn compared to other swimming techniques. The primary factor influencing freestyle swimming is speed. This style requires basic techniques and proper coordination between arm and leg movements to achieve optimal speed.

Success in swimming, including freestyle, heavily depends on physical condition, particularly muscle strength, endurance, and speed. In freestyle, arm muscle strength plays a crucial role in generating the thrust that propels the swimmer forward. Therefore, a structured, well-planned, and precise training program is essential to enhance athletes' performance.

After conducting observations and interviews on January 10, 2024, at the Aquatic Swimming Club Medan with the coach, located at Bahagia Swimming Pool, Jl. Bahagia By Pass, Sidorejo II, Medan Kota District, Medan City, North Sumatra 20226, it was found that the club's training process is well-structured. However, the club also faces challenges. During the selection for the National Swimming Championship (KRAPSI), only a few male athletes aged 11-12 managed to meet the 50-meter freestyle time limit set by the North Sumatra PRSI as a requirement to qualify for the National Swimming Championship. One contributing factor is insufficient arm muscle strength, which impedes their ability to perform optimally. This study seeks to address this issue by exploring the effectiveness of resistance band training in improving arm muscle power, thus enhancing the athletes' performance and helping them meet competition standards.

Based on observations at the Aquatic Swimming Club Medan, many male athletes in the 11-12 age group failed to meet the time limit established by the North Sumatra PRSI to qualify for the National Swimming Championship. The coach mentioned that one of the main reasons is the lack of arm muscle strength, in addition to the athletes experiencing boredom with the existing training programs. This has resulted in suboptimal 50-meter freestyle swimming speeds.

The researcher is interested in exploring training methods using resistance bands, which are known to be effective in increasing arm muscle strength. This training includes various techniques such as Straight Arm Lat Pulldown, Resistance Band Tricep Kickbacks, Upright Rowing, Bicep Curls, and Overhead Press. The purpose of this study is to determine the effect of these training variations on the arm muscle power of male freestyle swimmers aged 11-12 in the 50-meter category at the Aquatic Swimming Club Medan in 2024.

METHODS

Research Design

This study uses an experimental method with a one-group pretest-posttest design, involving a single sample group without a control group. The research was conducted at Bahagia Swimming Pool, Medan City, North Sumatra, from July 25 to September 17, 2024, over six weeks with a training frequency of three times a week (Monday, Wednesday, and Friday).

Participants

The study population consisted of 20 athletes in the Age Group III category at the Aquatic Swimming Club Medan, with 8 male athletes aged 11–12 selected as the sample through purposive sampling based on specific criteria, such as freestyle swimming ability and active club membership.

Training Protocol

The participants underwent resistance band training designed to target arm muscle power. The training included exercises such as Straight Arm Lat Pulldowns, Resistance Band Tricep Kickbacks, and Bicep Curls.

Instruments

Arm muscle power was measured through the Two-Hand Medicine Ball Put test. Data collection was carried out through initial tests (pre-test) before the treatment and final tests (post-test) after the treatment. Measurements were repeated three times for accuracy.

Statistical Analysis

The data obtained were analyzed using a paired sample t-test to determine significant differences between pre-test and post-test results, assessing the effect of the treatment on arm muscle power. To determine whether the hypothesis proposed in this study can be accepted or rejected, individual test scores were analyzed through statistical processes (Sudjana, 2002, 2005). The statistical test process includes the following steps: (1) calculating the average of pre- and post-test results, (2) calculating the standard deviation of pre- and post-tests, (3) performing a normality test through the Liliefors test, (4) performing a homogeneity test through the F test, (5) calculating the standard deviation of difference scores, (6) calculating the average of difference scores, and (7) performing hypothesis testing through the Paired Sample T-Test.

$$X = \frac{\sum X1}{n} \quad (1)$$

$$S_1^2 = \frac{n \sum X_1^2 - (\sum X_1)^2}{n\,(n-1)} \quad (2)$$

$$Z_i = \frac{Xi - \bar{X}}{S} \quad (3)$$

$$F = \frac{Varians\ Terbesar}{Varians\ Terkecil} \quad (4)$$

$$S_B^2 = \frac{n \sum B_1^2 - (\sum B_1)^2}{n\,(n-1)} \quad (5)$$

$$\bar{B} = \frac{\sum B}{n} \quad (6)$$

$$t = \frac{\bar{B}}{\frac{S_B}{\sqrt{n}}} \quad (7)$$

RESULTS & DISCUSSION

This study aims to test the effect of resistance band training on the improvement of arm muscle power in male freestyle swimmers aged 11–12 from Aquatic Swimming Club Medan. Data collection was conducted over 6 weeks through pre-test and post-test measurements on 8 samples.

A general description of each variable studied, particularly the pre-test and post-test data on arm muscle strength, was used to examine the research findings. The highest pre-test result was achieved by Sample 8 with a score of 3.38, while the lowest pre-test result was recorded by Sample 1 with a score of 2.95. Based on the post-test data, Sample 8 achieved the best result with a score of 3.44, while Sample 1 obtained the lowest score of 3.04.

Table 1. Pretest and Posttest Data

Data Description	Arm Muscle Power Data Results	
	Pre-tesT	Post-tesT
Sample Size (n)	8	8
Maximum Value	3,38	3,44
Minimum Value	2,95	3,04
Median	3,075	3,15
Mean	24,96	25,47
Standard Deviation	0,14223	0,13804
T-Statistic	0,19	0,18
T table	0,285	

The pre-test data, with a sample size of eight individuals, had a range of 0.43, a maximum value of 3.38, and a minimum value of 2.95. The median of the pre-test data was 3.075, and the mean was 3.12. The post-test results, also with a sample size of eight individuals, had a range of 0.4, a maximum value of 3.44, and a minimum value of 3.04. The post-test mean was 3.18375, while the median was 3.15.

The standard deviations before and after testing were 0.14223 and 3.13804, respectively. The standard deviation of the difference was 0.02, and the mean difference was 0.0675. The calculated t-value (t-hit) for the pre-test and post-test was 9.643. The distribution of the pre-test and post-test data can be observed in the table and graph.

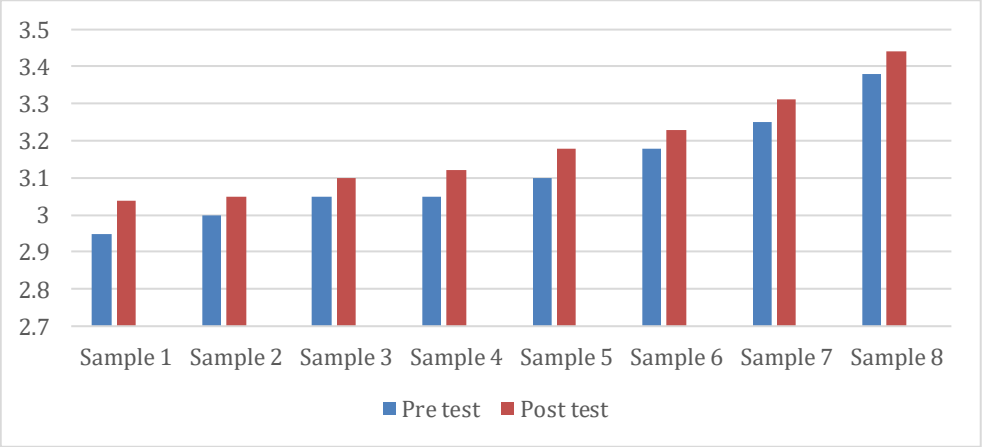

Fig 1. Histogram of Pre and Post Tes Data

To ensure that the sample data is normally distributed within the research population, a normality test was conducted using the Liliefors test. The normality of the pre-test and post-test data was calculated, and the results showed that Lo = 0.19, Ltable=0.285, n = 8, and α=0.05\alpha = 0.05. Since Lo < Ltable, this indicates that the sample was drawn from a normally distributed population.

Table 2. Normality Test

Training	Mean and Standard Deviation	N	Lo	Lt	Conclusion
Resistance Band	Pre test $\bar{x}$ = 3,12 S = 0,14223	8	0,19	0,285	Normal
	Post test $\bar{x}$ = 3,18375 S = 0,13804	8	0,18	0,285	Normal

To determine whether the samples are homogeneous, a homogeneity test was conducted. The purpose of the homogeneity test is to identify the degree of similarity between the variances in the pre-test and post-test data.

Table 3. Homogeneity Test

Variable	F-Calculated	F-table	Alpha	dk(n-1)	Conclusion
Variance of Pre-Test and Post-Test	1,028	3,79	0,05	7	Homogeneous

The homogeneity test for each treatment was complemented with a variance test at a significance level of α=0.05\alpha = 0.05. For the pre-test and post-test medicine ball data, the homogeneity test for arm muscle power using the medicine ball showed that Ftable = 3.79 and F-calculated = 1.028 at α=0.05 (with degrees of freedom n−1 = 7). Therefore, since Fcalculated < Ftable, it can be concluded that the data originates from a homogeneous variance.

This study examined the effect of resistance band training on the arm explosive power of male freestyle swimmers aged 11–12 years from the Aquatic Swimming Club Medan in 2024. A paired t-test was used to evaluate this hypothesis.

Table 4. Hypothesis Test

	Pre-Test	Post-Test	Value Difference	dk (n – 1)	Tcalculated	Ttable
N	8	8	8	7	9,643	1,894
Σ	24,96	25,47	0,51			
X	3,12	3,18	0,06			
S	0,142	0,138	0,02			

Based on the hypothesis results, it was found that resistance band training positively impacts the arm power of male swimmers aged 11–12 years. The hypothesis test yielded a distribution with Dk= n - 1 = 7 at a significance level of α=0.05 with t-table=1.894. The results demonstrated that resistance band training significantly increased arm power, as t-calculated > t-table.

Therefore, the alternative hypothesis (H_a) is accepted, and the null hypothesis (H_o) is rejected. Based on the study's findings, male swimmers from the Aquatic

Swimming Club Medan in 2024 who engaged in resistance band training exhibited significantly greater arm power.

This study examines the effect of resistance band training on improving the arm muscle power of male freestyle swimmers aged 11–12 years from the Aquatic Swimming Club Medan. The club actively trains athletes to improve their performance, particularly in freestyle swimming. Based on observations, the low arm muscle power was found to impact the swimmers' speed.

An initial test was conducted on July 25, 2024, revealing that the swimmers' arm muscle power was still low. The resistance band training, using elastic bands with handles, was focused on increasing arm strength and speed. The athletes showed enthusiasm and discipline, although there were challenges such as late arrivals and disturbances from general pool visitors. The researcher addressed these challenges with regular follow-ups.

The hypothesis testing results indicated that resistance band training had a significant effect on improving arm muscle power. With this training program, athletes were able to enhance their abilities and skills, achieving their maximum performance.

Resistance band exercises are particularly beneficial for young athletes, as they provide constant resistance throughout the movement, which helps strengthen muscles in a controlled and progressive manner. This continuous resistance is crucial for swimmers who rely on efficient arm movements for propulsion, particularly in freestyle swimming. Previous studies, such as Sembiring (2021), have reported similar findings, showing that resistance band training effectively increases arm strength and overall swimming performance in young swimmers. Furthermore, the study by Ismaryati (2008) supports the idea that resistance band exercises can enhance both strength and technique in swimmers, improving their ability to meet competition standards.

The challenges encountered during the study, such as athlete lateness and distractions from public pool visitors, were addressed through regular monitoring and evaluations. These disruptions, although inevitable in a public training setting, did not detract from the overall success of the training program. The athletes' discipline and motivation played a crucial role in ensuring the success of the training regimen. This highlights the importance of athlete commitment and focus in the training process, as noted in studies like those of Harsono (1998) and Mulyana (2013), who emphasized

the connection between athlete discipline, training consistency, and performance improvement.

While this study supports the effectiveness of resistance band training, it also has limitations, primarily the small sample size of only eight athletes. As previous research has suggested, a larger sample size would help increase the generalizability of the findings (Ratno & Simanjuntak, 2022). Future studies could explore the long-term effects of resistance band training, particularly its sustainability in improving muscle power and swimming performance over time. Additionally, combining resistance band training with other forms of strength training, such as weightlifting or core strengthening exercises, could provide a more comprehensive approach to improving swimming performance. As Lumintuarso (2013) proposed, a multi-faceted approach to athletic training may yield better results in developing well-rounded athletes.

Future research could explore the long-term effects of resistance band training on swimming performance, investigate the impact of combined training methods, and assess the sustainability of these training gains in larger, more diverse swimmer populations (Hartono, Sukur, Miftakhudin, & Marhadi, 2024). Investigating the impact of resistance band training over extended periods could provide valuable insights into its effectiveness as a long-term training method. Moreover, exploring how combining resistance band training with other strength training techniques could optimize training outcomes and further enhance swimming performance would be beneficial (Van Hooren, Aagaard, & Blazevich, 2024). Lastly, conducting studies with a larger, more varied sample could ensure that the findings are more universally applicable and better reflect the broader athletic community.

In conclusion, resistance band training has proven to be an effective technique for enhancing arm muscle power, which directly influences swimming performance. The results of this study are aligned with previous research, confirming the benefits of resistance band exercises in youth athletic training. Moving forward, it would be valuable to conduct studies that investigate the combined effects of various training methods, as well as explore the long-term benefits of resistance band training on swimmers' overall physical conditioning.

CONCLUSION

This study aimed to investigate the effects of resistance band training on arm muscle power in 11-12-year-old male freestyle swimmers at the Aquatic Swimming

Club Medan. The results revealed a significant improvement in arm muscle power, with the pre-test mean of 24.96 increasing to 25.47 post-test, demonstrating the effectiveness of resistance band exercises in enhancing muscle strength and, consequently, swimming performance. This research highlights the importance of structured training programs and athlete discipline, as the athletes' motivation played a key role in the success of the program, despite challenges like athlete lateness and pool disruptions. The findings suggest that resistance band training can be an accessible, practical, and effective method for improving arm strength in young swimmers, offering an alternative to more costly training methods. However, the study's small sample size warrants caution in generalizing the results. Future research should involve larger, more diverse populations to confirm these findings, explore the long-term effects of resistance band training on swimming performance, and assess the sustainability of the gains made. Additionally, combining resistance band training with other strength training methods, such as weightlifting or core exercises, could be explored to further enhance athletic performance in swimmers. Overall, this study provides valuable insight into the role of resistance band training in improving arm muscle power and offers practical implications for youth swim training programs.

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