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Effectiveness of resistance band swimming training on muscle strength in swimmers with physical disabilities in the 50-meter freestyle

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Abstract

Resistance band training can increase muscle strength in swimmers with physical disabilities, especially because muscle strength problems often hinder achieving optimal performance. This study aimed to determine the effect of resistance band training on the muscle strength of swimmers with physical disabilities number 50 meters freestyle. This research method uses a one-group pretest-posttest design with an experimental approach. This study used a one-group pretest-posttest pre-experimental design research design. This research instrument used a total sampling recruitment technique involving 28 Jakarta Para Swim athletes. PretestPretest and post-test tools, including a 50-meter freestyle swimming course, were used in this study. Using IBM SPSS Statistics version 27, data analysis methods included a t-test at a significant level of 0.05, normality and homogeneity tests, and prerequisite tests. The results of this study state that the average speed of 28 athletes is 42.21 freestyle meters before the test and 38.77 freestyle meters after the test there is an increase in the average speed of 50 meters freestyle by 10%, or 3.44 seconds in resistance band training for swimmers with disabilities number 50 meters freestyle with an increase of 10%, namely 3.44 seconds. These results provide a basis for disability sports coaches and practitioners to integrate resistance band training as part of a training program to improve swimming performance for athletes with physical disabilities.

Keywords: Disability, resistance bands, swimming, people with physical disabilities.

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INTRODUCTION

Swimmers with disabilities that affect their bodies encounter considerable physical obstacles, especially regarding muscle strength, which directly influences their capacity to attain ideal speed and efficiency in the water. These issues are frequently exacerbated by biomechanical constraints, like asymmetrical body movements or limited mobility in specific regions of the body. Resistance band training presents a viable approach to overcome these obstacles (Iversen et al., 2017). Resistance bands offer adjustable resistance that aids in preserving and enhancing muscle strength and stability while minimizing the chance of injury. This approach provides a more secure and versatile option than conventional weight training, particularly for athletes with physical constraints (Hughes et al., 2018). Furthermore, resistance bands are helpful for strength development and are extensively utilized in rehabilitation to facilitate the healing of weakened or injured muscles (Lee et al., 2017).

The significance of strength for swimmers is paramount. Strength directly affects coordination, propulsion, and overall performance in swimming (Komar et al., 2012). In adaptive sports designed for athletes with disabilities, particular training techniques are essential for achieving competitive performance. In the absence of specialized training suited to their requirements, swimmers with impairments may lag behind their non-disabled peers. Progressive resistance training utilizing implements such as resistance bands has demonstrated efficacy due to its adaptability to individual capabilities, rendering it suitable for athletes of diverse skill levels (Utomo et al., 2020). Resistance bands are advantageous because to their safety for joints and soft tissues, providing various resistance levels to accommodate diverse training objectives (Lee et al., 2017; Makaruk et al., 2024).

Observations at the Jakarta Para Swim event identified special obstacles encountered by swimmers with disabilities, notably deficiencies in upper body muscle strength, including the arm muscles (Pratama et al., 2021). This constraint highlights the necessity for specialized training tools

that can improve swimming technique and physical strength. Resistance bands, due to their portability, elasticity, and versatility, serve as an effective solution for athletes. These instruments facilitate a diverse array of exercises that enhance endurance, balance, agility, and muscle mass, rendering them essential for swimmers with impairments (Ali et al., 2022; Amalia et al., 2023; Nilhakim, 2022; Wahono & Nasution, 2022).

The physiological advantages of resistance bands are especially pertinent in competitive swimming. Events such as the 50-meter freestyle, which necessitates explosive force and propulsion, require competitors to possess robust and effective musculature. Resistance training utilizing resistance bands efficiently engages primary swimming muscles, including the shoulders, back, and core, while reducing strain on joints and soft tissues. This is particularly crucial for athletes with impairments since their elevated injury risk requires training approaches that emphasize safety and adaptation (Fisher et al., 2011; Hughes et al., 2018). Moreover, the capacity to tailor resistance levels enables athletes to enhance their strength incrementally, hence facilitating improved propulsion and less drag in the water (Komar et al., 2012).

Evidence endorses the incorporation of resistance band training into swimming-specific training regimens. Combining resistance training with swimming technique instruction has been demonstrated to improve strength, swimming efficiency, and overall performance (Cools et al., 2014). Nonetheless, a considerable study vacuum persists concerning the utilization of resistance band training specifically for swimmers with disabilities. Although research has shown the efficacy of resistance training in enhancing performance for able-bodied athletes, the specific requirements of swimmers with impairments are still little investigated.

This study seeks to fill this gap by assessing the efficacy of adjustable resistance bands in enhancing athletes with physical limitations' 50-meter freestyle swimming speed. The 50-meter freestyle is very challenging as it necessitates the use of full effort within a brief timeframe. Resistance bands have demonstrated efficacy in enhancing muscle thrust and propulsion,

which are essential for success in this event (Fisher et al., 2011; Makaruk et al., 2024). This study aims to uncover training regimens that can enhance the performance potential of swimmers with disabilities by concentrating on this specific population.

The practical ramifications of this research transcend individual athletes. The results will offer significant insights for coaches, trainers, and policymakers in formulating inclusive and effective training programs. This study illustrates the advantages of resistance band training, thereby advancing adaptive sports and bolstering global initiatives to enhance the involvement of athletes with impairments in competitive sports. Moreover, adjustable resistance bands serve as an economical, portable, and versatile training apparatus that may be seamlessly included in training programs for swimmers with impairments (Guo et al., 2022; Manihuruk et al., 2023; Nilhakim, 2022).

Resistance band training constitutes a novel and inclusive method for enhancing the strength, technique, and overall performance of swimmers with physical limitations. Resistance bands serve as a secure and versatile instrument, facilitating the performance parity between impaired and non-disabled athletes while tackling the unique obstacles encountered by the former. Additional study is crucial to refine these training methodologies and guarantee their extensive implementation in adaptive sports. This study addresses the specific requirements of swimmers with impairments, so advancing the overarching objective of promoting inclusivity and excellence in sports.

METHODS

This research is a quantitative descriptive research that seeks to describe and analyze data derived from existing facts. This research design facilitates systematic and efficient data collection and analysis that is aligned with the research objectives. This study utilized a one-group pretest-posttest design, a pre-experiment framework consisting of three main stages: an initial assessment (pre-test) to ascertain the initial condition of the subjects, the administration of an intervention involving specific

exercises, and a concluding evaluation (posttest) to assess the changes or outcomes resulting from the intervention. This design effectively illustrates the treatment effect; however, it lacks a control group for comparison, so the resulting data only shows intra-group changes.

This study was conducted at Jakarta Para Swimming, a specialized swimming club for athletes with impairments in Jakarta, the capital region of Indonesia. The study sought to thoroughly engage all athletes with impairments who are active members of this club. To guarantee that the data gathered adequately reflected the entire population, the study utilized a comprehensive sampling technique, incorporating every individual within the community into the research sample. The total population consisted of 28 athletes, each serving as research subjects. This approach attempted to eradicate sample bias and offer a comprehensive picture of the qualities, performance, or causes under investigation among the athletes. Total sampling is especially appropriate in contexts when the population is comparatively small and manageable, as demonstrated in this instance. This strategy enables researchers to obtain a comprehensive understanding of the phenomena being studied, encompassing all conceivable variations and distinct characteristics within the population. Consequently, the study attained extensive coverage of the research subjects, guaranteeing that the findings could be extrapolated to all athletes with impairments inside the Jakarta Para Swimming Club.

Based on the previously established taxonomy and identified physical, physiological, and biomechanical factors in swimming performance, we developed an instrument designed to measure relevant aspects of 50-meter freestyle swimming performance for athletes with physical disabilities. For example, travel time, swimming strategy, propulsion strength, and body stability in the water. Technology and measurement tools are also very useful for more objective and measurable results.

Performance in the 50-meter freestyle is judged by travel time. High times are accurately recorded by instruments such as manual stopwatches

or sensor-based automatic timing systems (Komar et al., 2012). In addition, video analysis of movements provides valuable information about the swimming techniques of athletes with physical disabilities that can help coaches and researchers to find strengths and weaknesses.

Another aspect assessed in freestyle is the force of the push of the hands and feet. Other instruments, such as a swimming ergometer or power meter, can measure the power generated by the swimmer (Hughes et al., 2018). These tools provide quantitative data on the muscle forces used for pulling and pushing. They are also useful for athletes with physical disabilities that may prevent them from developing symmetrical strength or may limit the use of certain limbs.

Body stability in the water should also be assessed as athletes with disabilities have difficulty in maintaining an aerodynamic body position. Posture is recorded using devices such as motion capture systems or buoyancy devices to determine posture and body stability while swimming. (Makaruk et al., 2024). This data is essential to maximize efficient movement as an athlete.

In addition to physical measurements, we must also consider some aspects of adaptation to physical limitations. Depending on the condition of the disability, this assessment may also include the evaluation of specific movements adapted to the condition of the disability (e.g., dominant leg or dominant hand). However, for muscle strength training, adaptive instruments (e.g., resistance bands) may be used in the preparation and evaluation of swimming performance (Fisher et al., 2011). Before the training was conducted, an initial test was conducted to see the maximum ability in swimming freestyle with a distance of 50 meters to determine the maximum training program of three workouts a week for a total of eighteen times. In this study there was a comparison group. To see the improvement before and after training. The final test, which is doing a 50-meter freestyle swimming retest, is the last step after the training so that, in the end, the effectiveness of training using resistance bands can be known.

This study conducted data analysis to statistically assess changes between pretestpretest and posttest results. The first step taken was to conduct a normality test to assess the normal distribution of the data. This test uses the Kolmogorov-Smirnov or Shapiro-Wilk method, with a significance level of 0.05. A significance value that exceeds 0.05 indicates that the data is normally distributed.

If the data was normally distributed, the analysis continued with a paired t-test to assess the mean difference between the pre-test and post-test. This test assesses whether the resistance band treatment resulted in a significant change. If the data were not normally distributed, non-parametric tests, such as the Wilcoxon signed rank test, were used, as these tests are appropriate for data that do not meet the assumption of normality.

Research Procedure

Research involving resistance bands using a one-group pretest-posttest design consists of three main phases: initial assessment (pre-test), implementation of resistance band exercise intervention, and subsequent evaluation (post-test). This study aims to assess the impact of resistance band training in improving muscle strength and 50-meter freestyle swimming speed in athletes with physical limitations.

During the pre-test phase, initial measurements were taken to assess the athletes' initial ability in 50-meter freestyle swimming speed. This data includes travel time, maximum speed, and minimum speed, as measured by a valid and reliable instrument, such as a digital stopwatch or automated system. This baseline data serves as a benchmark to evaluate changes in performance post-treatment. Accuracy in this assessment is critical to guarantee that the baseline data accurately represents the person's actual status before therapy.

The treatment phase consisted of a resistance band training regimen aimed at strengthening the major muscles used in swimming, including the shoulders, back, and core muscles. Exercises are performed progressively, with measurable increases in intensity, a defined training frequency (e.g.,

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three times per week), and consistent duration for all participants. Each training session was carefully designed to target key muscle groups, using safe strategies to reduce the chance of damage, especially in athletes with physical impairments. Direct supervision by a coach or researcher during treatment is essential to guarantee the execution of the exercises according to the established protocol.

RESULTS

The table below displays descriptive information about the 50-meter freestyle swimming speed results before and after the test.

Table 1. Results of PretestPretest and Posttest of 50-meter Freestyle Speed

	N	Minimum	Maximum	Means	Std. Deviation
PretestPretest	28	29.22	65.00	42.2071	10.52052
Post-Test	28	27.67	59.48	38.7757	9.01522
N valid (according to the list)	28				

From the results of freestyle swimming speed with a distance of 50 meters for athletes with disabilities before carrying out training using resistance bands, the initial ability level of athletes averaged 42.2071 with a standard deviation of 10.52052, 65 is the maximum ability, and 29.22 is the minimum ability. As for swimming speed after the implementation of training using resistance bands with a standard deviation of 9.01522, an average of 38.7757, a maximum of 59.48, and a minimum of 27.67. Training using resistance bands effectively increases 50-meter freestyle swimming speed in physically disabled athletes, as indicated by a decrease in average time from 42.21 seconds to 38.78 seconds, with more consistent data distribution, as seen from the standard deviation which decreased from 10.52 to 9.02. According to the study's findings, there was a rise both before and after carrying out training with resistance bands on increasing 50-meter freestyle swimming speed in athletes with disabilities. If the data is presented in the form of a diagram, it can be seen in the picture below:

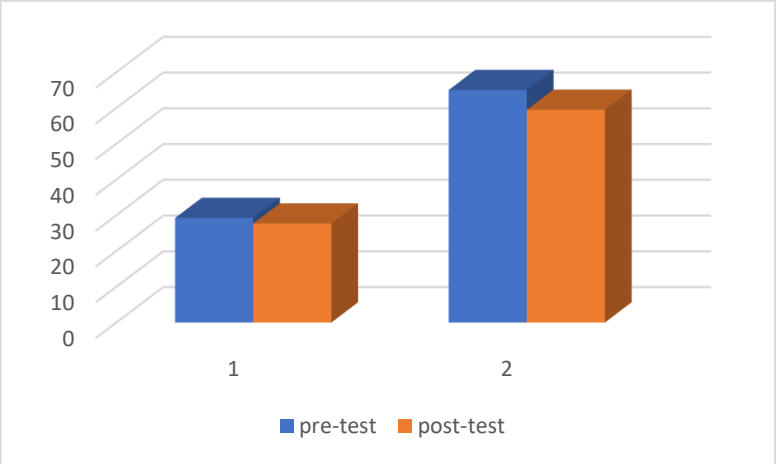

Figure 1. PretestPretest and Posttest Results of 50-meter Freestyle Speed

Muscle strength scores went down from 29.22 on the pre-test to 27.67 on the post-test after using the resistance band. The fact that the participants were trained in swimming indicates that either the intervention did not have the desired effect or other factors affected the results. This result could mean that there wasn't enough time for adaptation, the training intensity wasn't right, or there were outside factors like fatigue or inconsistent training. More research is needed to find the best way to train swimmers with physical disabilities and find any problems that might hinder them from getting stronger muscles.

The normality test was carried out to determine the distribution of research variables using the Kolmogorov-Smirnov method. Based on the results of data analysis, the normality test on the 50-meter freestyle swimming ability test shows a significance value of more than 0.05. This indicates that the data collected is normally distributed. This indicates that the data collected is normally distributed.

In addition, based on decision-making, the homogeneity test was conducted using the Levene test to ensure that the data groups in the sample came from a homogeneous population. The data on the pre-test and post-test variables are homogeneous in this study, which is indicated by the level of significance based on the mean > 0.05. Based on the results of the homogeneity test, it can be said to be homogeneous.

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Based on the pre-test- and post-test data analysis of 50-meter freestyle swimming capacity with resistance band training, a significance of 0.000 <0.05 is obtained, indicating that the pre-test and post-test variables of 50-meter freestyle swimming capacity of blind athletes are significantly different. Based on the results of the data analysis, there are 28 athletes with an average pre-test 50-meter freestyle speed of 42.21 and an average post-test 50-meter freestyle speed of 38.77. Thus, there is an increase in the average speed of 50 meters freestyle by 10% or 3.44 seconds. Based on this data, there is a significant improvement in resistance band training for swimmers with disabilities in the 50-meter freestyle competition. This indicates a change in athlete performance. This analysis highlights the possibility of a significant difference in swimming speed before and after the trial.

DISCUSSION

The results of data analysis show that training using resistance bands has an influence on the ability to swim 50 meters freestyle in athletes with disabilities where there is a difference in the average 50-meter speed with an increase of 10%, namely 3.44 seconds. This is in line with the principle of the exercise, resistance band is an exercise that can help increase arm and leg strength to increase speed while swimming, besides that it can also train flexibility, as a superset killer and make athletes have more varied movements.

Resistance bands in training have developed into an important component of muscular strength training to improve swimming performance (Jariono et al., 2024). With resistance bands, athletes can work the major muscles used in swimming, including the shoulders, back, core, and legs, with adjustable intensity (Rahman et al., 2021). It has been proven that they help improve muscle strength, endurance, and stability without putting strain on the joints, which makes them a risk-free option for physically challenged athletes (Manihuruk et al., 2023). According to Fisher et al. (2011), muscular strength is essential in the context of swimming as it allows for the creation

of optimal propulsion and the maintenance of technique efficiency, ultimately increasing the athlete's speed and endurance while swimming.

The versatility of resistance bands makes them an effective exercise tool for individuals with physical limitations as they can be used to target specific muscle areas according to individual needs. According to Christie, (2011), it is also possible to increase muscle strength even when the intensity of the exercise is modest. This is especially beneficial for athletes who have a relatively high risk of injury. In addition, resistance bands can be used to correct muscle asymmetry or weakness in certain limbs, which is often a significant obstacle for athletes who have physical limitations. (Ningsih & Hasanudin, 2023)..

Swimming instruction for individuals with disabilities is undergoing continuous development with more inclusive and evidence-based approaches. Training programs are often created with the specific needs of the athletes in mind (Maulana et al., 2024). These requirements may include modifications to swimming technique, the use of assistive devices, and an emphasis on the development of sport-relevant muscles (Sugiyanto et al., 2024). Christie, (2011) states that modern technologies, such as video analysis of movements and the use of swimming ergometers, contribute to objective performance evaluation. This allows coaches to provide more specific feedback to athletes to improve their technical efficiency and physical muscular strength.

Athletes with physical limitations can benefit from resistance bands as they offer a practical and effective solution to support their swimming training (Narita Devi et al., 2022). Resistance bands not only serve to build muscle strength, which is essential for swimming performance, but also provide an opportunity for safe and economic training, which supports the participation of athletes with disabilities in various levels of competition (Emir Rizkanto & Rusdiawan, 2021). This method illustrates how advances in training can improve the overall quality of adaptive sports performance by contributing to improved overall performance quality.

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While resistance bands have shown their efficacy in increasing muscle strength and aiding swimming performance, there are some limitations to their use, especially among physically challenged athletes (Li et al., 2024). An important limitation is the need for customized modifications for each athlete. Due to the diverse physical abilities of athletes, coaches must develop a well-tailored program that requires time and ongoing assessment (Maulana & Barikah, 2023). In addition, research on resistance bands in athletes with physical limitations often uses small sample sizes, making generalization of findings difficult (Manihuruk et al., 2023). Environmental considerations, including access to adequate facilities and the presence of well-trained coaches, may also influence the successful implementation of this strategy.

Nonetheless, the results of this study substantially enhance the literature and practice of adaptive sports. Resistance bands in swimming training provide a safe, efficient, and economical approach to improving muscle strength, especially for athletes with disabilities who face constraints in performing conventional weight training. It can serve as an important component of inclusive training programs that promote the progress of athletes with physical limitations at various levels of competition (Sugiyanto et al., 2024).

In addition, these findings form the basis for additional studies on the efficacy of resistance bands in adaptive sports. Training programs developed using this methodology could be used more widely, not only for athletes with disabilities but also for people who are rehabilitating or recovering from injury. Ultimately, resistance band methodology can serve as a means to encourage inclusion and equality in sports while increasing opportunities for athletes with unique needs to achieve optimal performance. Given these constraints and contributions, these findings are important not only for coaches and players but also for policymakers and adaptive sports program managers to formulate more successful and inclusive methods.

CONCLUSIONS

This study underscores notable improvements in athlete performance in adaptive sports, focusing on the efficacy of resistance band exercises in overcoming challenges encountered by athletes with disabilities. Resistance bands provide a safe, efficient, and economical alternative to conventional weight training, improving muscle strength and endurance while remaining accessible to individuals with limited resources or facilities. In contrast to weight training, resistance bands offer a low-impact alternative designed for individuals with disabilities. The findings significantly enhance adaptive sports by promoting inclusive and effective training programs. The research extends beyond athletes with disabilities, highlighting the implications for physical therapy and injury recovery and illustrating the versatility of resistance band exercises across diverse populations. This inclusivity promotes accessibility in sports and fitness training.

The study provides a basis for future research on resistance band training, promoting further investigation into its long-term impacts on performance, injury prevention, and overall physical health. Future research may enhance training programs, examine different resistance levels, and incorporate resistance bands into holistic, adaptive sports strategies. This research enhances inclusivity in sports by addressing the specific needs of athletes with disabilities and promoting diverse, innovative training techniques. This initiative supports wider efforts to enhance diversity and address issues encountered by underrepresented groups within the sports community.

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