International Journal of Sociologies and Anthropologies Science Reviews
Volume 5 Issue 2: March-April 2025: ISSN 2985-2730
Website: https://so07.tci-thaijo.org/index.php/IJSASR/index

The Effects of Plyometric Training on 50 Meters Crawl Swimming Speed Performance in Swimmers

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Received 02/09/2024 Revised 11/09/2024 Accepted 11/10/2024

Abstract

Background and Aim: This research aimed to study and compare the effects of plyometric training on crawl swimming speed performance in swimmers.

Materials and Methods: This research employed a quasi-experimental design. The subjects were selected from a population of 43 swimmers tested in a 50-meter freestyle swim. The times were recorded and ranked from highest to lowest. A total of 20 swimmers were selected using the ranking method, and they were divided into two equal groups of 10 by drawing lots: an experimental group and a control group. The experimental group performed plyometric training, while the control group underwent traditional training. Both groups trained twice a week for eight weeks. The 50-meter crawl stroke speed was measured before and after the experiment. The data were analyzed using means, standard deviations, and a t-test to determine the significant differences in performance before and after the experiment, as well as between the two groups.

Results: After eight weeks of training, the results indicated that: 1) The 50-meter crawl stroke speed in both the control and experimental groups improved significantly compared to pre-training levels ($p < .05$). 2) There were significant differences in the 50-meter crawl stroke speed between the control and experimental groups, with the experimental group showing greater improvement ($p < .05$).

Conclusion: The findings of this study demonstrated significant improvements in swimming speed for both the conventional and plyometric training groups at the 0.05 significance level. However, the plyometric training group showed notably greater improvements in speed compared to the conventional training group. These results suggest that plyometric training enhances 50-meter freestyle swimming performance by improving muscle strength, speed, and coordination. Incorporating plyometric exercises into conventional training programs could provide athletes with a competitive edge, as it focuses on both power development and the quick muscle response necessary for optimal swimming performance.

Keywords: Plyometric Training; Swimming; Performance; Crawl Stroke; Training

Introduction

Swimming is widely recognized as one of the most effective forms of exercise, lauded for its comprehensive benefits in enhancing aerobic fitness, flexibility, strength, muscle toning, and coordination. Health and fitness professionals frequently recommend swimming due to its low risk of injury and its minimal impact on muscles and tendons. This makes it an ideal sport for people of all ages, from recreational swimmers to competitive athletes. The benefits of swimming extend beyond general fitness; it plays a crucial role in improving cardiovascular and respiratory systems. Regular swimming exercises lead to enhanced heart and lung capacity, contributing to overall health improvements. American Academy Of Pediatrics. (2019) highlights swimming as a vital activity, especially for youth, not only for its health benefits but also for its life-saving potential in water-related accidents. Moreover, swimming engages all parts of the body, making it an efficient full-body workout that supports the development of physical fitness and technical skills necessary for competitive success.

Swimming has also become a prominent feature in global sports competitions such as the Asian Games and the Olympic Games. These events emphasize the importance of swimming as a discipline that promotes physical well-being, fosters teamwork, and encourages the pursuit of excellence. Price et al (2024) note that competitive swimming significantly contributes to the development of national athletes, helping them maintain strong, disease-free bodies and enhancing their ability to perform various activities effectively.

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Given its dual role in exercise and competition, swimming requires a multifaceted approach to training. Athletes must continually develop their physical fitness and technical skills to excel in the sport. As Barbosa et al. (2010) explain, competitive swimming is a race against time, where success hinges on the athlete's training, physical condition, and mastery of swimming techniques such as starting, stroking, kicking, breathing, and turning. The ability to execute these movements with precision and speed is directly linked to the athlete's overall physical fitness. To optimize performance, many swimmers incorporate plyometric training into their routines. Potdevin et al. (2011) describe plyometrics as a training method that enhances muscle power by combining strength with speed, thus reducing the amortization phase of muscle contraction. This type of training is particularly beneficial for swimmers, as it helps them generate the explosive power needed to overcome water resistance more effectively.

Plyometric exercises, which include jumping, lifting, and throwing movements, are essential for developing the muscle strength and speed required in competitive swimming. Potdevin et al. (2011) emphasize the importance of designing plyometric training programs that target both the upper and lower body, ensuring a comprehensive development of muscular performance. The application of plyometrics in swimming training is grounded in principles of exercise science. Haff. (2013) outlines key elements of effective training programs, including frequency, intensity, and the type of exercises used. These principles ensure that athletes are not only improving their strength and speed but also optimizing their overall training regimen to achieve peak performance. Kiely. (2012) further underscores the importance of structured training periods, which are critical for realizing the long-term success of any athletic program.

Objectives

Main Objective

To examine the impact of plyometric training on crawl stroke swimming speed in competitive swimmers.

Subsidiary Objectives

1. To evaluate the specific effects of plyometric training on the speed performance of swimmers during the crawl stroke.
2. To compare the effectiveness of plyometric training on crawl stroke swimming speed across different groups of swimmers.

Conceptual Framework

This study investigates the effects of plyometric training on 50-meter freestyle swimming performance. It is a quasi-experimental research design that integrates exercise principles and structured training programs specifically tailored for swimming. The study applies the principles and theories of plyometric training to enhance and develop the performance of swimmers in the 50-meter freestyle event.

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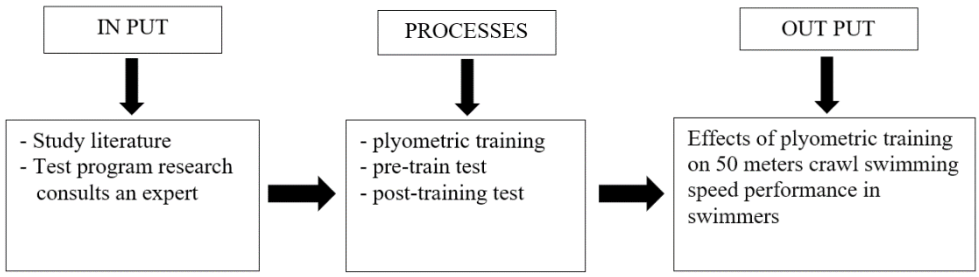

Figure 1 Conceptual Framework

Methodology

Population: The population for this research comprised 43 male swimmers from Guangzhou, China. These participants were selected based on specific criteria relevant to the study.

Sample Group: From the population of 43 swimmers, a sample was selected based on their performance in a 50-meter freestyle swim. The swimmers were timed, and their results were ranked from highest to lowest. The top 20 swimmers were selected using the ranking method. These 20 swimmers were then divided into two equal groups of 10 participants each through a random drawing process. One group was designated as the experimental group, while the other served as the control group. Criteria for Selecting Research Participants: 1. Must be a Chinese swimmer. 2. Must be physically fit. 3. Must have no underlying medical conditions. 4. Must be willing to participate in the study. Criteria for Exclusion from Research: 1. Inability to participate in activities due to illness. 2. Frequent absence from training sessions. 3. Presence of a chronic disease. 4. Inability to cooperate with teammates. Termination Criteria for the Study: 1. The occurrence of a disaster or epidemic severe enough to prevent the continuation of the research. 2. Less than 80% of projects after a certain period.

Tools Used in Research to Collect Data

1. Plyometric Training Program Combined with 50-Meter Freestyle Swimming Training: A program specifically designed to integrate plyometric exercises with swimming drills to enhance performance.

2. Plyometric Test for Swimming: An assessment tool used to measure the effectiveness of plyometric training on swimming performance.

3. Plyometric Test Record for Swimming: A record sheet designed to document and track the results of the plyometric tests conducted on swimmers.

4. Design of the Plyometric Training Program: The program was meticulously designed by incorporating feedback from experts and integrating 50-meter freestyle swimming training with plyometric exercises.

5. Expert Validation of the Plyometric Program: The program was reviewed and validated by four experts in sports science and swimming to ensure its quality and relevance.

6. Modification of the Plyometric Program: Based on the feedback from the experts, the program was refined and adjusted to better meet the needs of the swimmers.

7. Pilot Testing of the Plyometric Program: The refined program was tested on a group of 20 swimmers to assess its effectiveness before being implemented in the main study.

8. Adjustment of Swimming Training: Following the initial application of the plyometric program, adjustments were made to the swimming training regimen of the experimental group.

9. Physical Fitness Testing: The physical fitness of the swimmers was assessed before and after the training period using the following methods: 1) Speed Test: Swimming speed was measured using a standardized swimming speed test. 2) Research Equipment: Stopwatch, Whistle, Marker, Record Sheet and Tape Measure

Instrument and Quality Inspection of Instruments Used in the Research. 1. Expert Evaluation: Experts with extensive knowledge and experience in sports science and swimming were consulted to

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review and validate the Plyometric training program. 2. Application of the Program: The validated program was applied to the sample group, and the instruments were checked for accuracy. The Index of Item-Objective Congruence (IOC) value was calculated based on expert suggestions. 3. Program Implementation: The program, adjusted according to expert feedback, was implemented with the sample group to further validate the research data.

Research Design

The study was structured around two groups: an experimental group and a control group. The experimental group performed plyometric training combined with swimming exercises, while the control group followed their usual swimming training regimen. Three tests were conducted at different stages: (1) before the experiment (pre-test), (2) after 4 weeks, and (3) after the completion of the 8-week training program (post-test).

Data Collection

The steps for data collection were as follows: 1) Approval and Permission: A formal request for permission to use the location and equipment for data collection was submitted to the appropriate authorities. 2) Sample Group Briefing: The swimmer sample group was briefed on the research objectives, data collection procedures, and consent forms. 3) Preparation of Training Location: The training location was prepared, and research assistants were enlisted to help with data collection. 4) Division of Sample Group: The sample group was divided into two groups: the experimental group and the control group. Pre-tests were conducted before the start of the training. 5) Training Program Implementation: Both groups followed their respective training plans for 8 weeks. The experimental group underwent plyometric training combined with swimming exercises, while the control group continued their regular swimming training. 6) Testing and Evaluation: The control group was subjected to three types of tests—pre-test, mid-test (after 4 weeks), and post-test (after 8 weeks). 7) Summary and Discussion: The research results were summarized, and the findings were discussed about the objectives of the study.

Data Analysis

1. General Information Analysis: The general information of the sample was analyzed using the mean ($\bar{X}$) and standard deviation (S.D).

2. Fitness Testing Analysis: The results of the fitness tests conducted before and after the 8-week training period were analyzed by calculating the mean ($\bar{X}$) and standard deviation (S.D)

Results

The Effects of Plyometric Training on 50-Meter Freestyle Swimming Speed Performance in Swimmers This study aims to investigate the impact of plyometric training on the swimming performance of swimmers, specifically focusing on their 50-meter freestyle (crawl) swimming speed. The research also seeks to compare the swimming speed of participants before and after an 8-week plyometric training program. The obtained data were analyzed statistically by finding the average and the standard deviation, divided into 4 steps as follows: Part 1 General information of the population. Part 2 Test results of the control group and the experimental group. Part 3 Comparison of the differences between the control group and the experimental group. Part 4 Analysis, conclusion, and interpretation.

Table 1 Descriptive Statistics for General Data Before the

variable	Experimental group (N=10)	Control group (N=10)	t	P
	M + SD	M + SD		
Age (year)	16 ± 0.94	16 ± 1.15	.000	1.000
Hight (cm)	172 ± 4.32	170.70 ± 9.26	-.402	.692
Weight (kg)	65.68 ± 7.60	64.61 ± 6.85	-.330	.745

P > .05

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Table 1 presents the demographic characteristics of the participants before the experiment. Age: The mean age of both groups was 16 years. Experimental Group 1 (normal training) and Experimental Group 2 (plyometric training) had a mean age of 16 years. Height: The mean height for Experimental Group 1 (normal training) was 170.70 cm, while for Experimental Group 2 (plyometric training) it was 172 cm. Weight: The mean weight of Experimental Group 1 (normal training) was 64.61 kg, compared to 65.68 kg for Experimental Group 2 (plyometric training). A comparison of the mean differences in age, height, and weight between Experimental Group 1 and Experimental Group 2 indicated no statistically significant differences at the .05 level.

Table 2 Comparison of Pre-Test 50-Meter Crawl Swimming Times Between Control Group 1 and Experimental Group 2

variable	Experimental group(N=10)		Control group (N=10)		t	P
Time in 50-meter crawl swimming	$\bar{X}$	S.D.	$\bar{X}$	S.D.		
	37.41	3.03	37.40	3.27	.049	.962

P>.05

Table 2 shows the mean time for the 50-meter crawl swimming test before the experiment. Experimental Group 1 (Normal Training): The mean time was 37.40 seconds. Experimental Group 2 (Plyometric Training): The mean time was 37.41 seconds. The comparison of the mean differences in 50-meter crawl swimming times between Experimental Group 1 and Experimental Group 2 indicated no statistically significant difference at the .05 level.

Table 3 Comparison of Post-Test 50-meter Crawl Swimming Times Between Control Group 1 and Experimental Group 2

variable	Experimental group(N=10)		Control group (N=10)		t	P
Time in 50-meter crawl swimming	$\bar{X}$	S.D.	$\bar{X}$	S.D.		
	35.73	1.34	37.45	2.65	.960	.02

P<.05

Table 3 presents the mean times for the 50-meter crawl swimming test after 8 weeks of training: Experimental Group 1 (Normal Training): The mean time was 37.45 seconds. Experimental Group 2 (Plyometric Training): The mean time was 35.73 seconds. The comparison of the mean differences in 50-meter crawl swimming times after 8 weeks revealed a statistically significant difference between Experimental Group 1 (normal training) and Experimental Group 2 (plyometric training) at the .05 level.

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Table 4 Comparison of Pre- and Post-Test 50-Meter Crawl Swimming Times for Experimental Group 1 (Normal Training)

variable	Before the experiment		After the experiment 8 weeks		t	P
Time in 50-meter crawl swimming	$\bar{X}$	S.D.	$\bar{X}$	S.D.		
	35.40	3.27	37.45	2.65	1.695	.124

P > .05

Table 4 presents the average times for the 50-meter crawl swimming test for the control group (Group 1) before and after the 8-week experiment: Before the Experiment: The average time was 35.40 seconds. After the 8-week Experiment: The average time was 37.45 seconds. The comparison of the average differences in 50-meter crawl swimming times for the control group before and after the 8-week experiment showed no statistically significant difference at the .05 level.

Table 5 Comparison of Pre- and Post-Test 50-Meter Crawl Swimming Times for Experimental Group 2 (Plyometric Training)

variable	Before the experiment		After the experiment 8 weeks		t	P
Time in 50-meter crawl swimming	$\bar{X}$	S.D.	$\bar{X}$	S.D.		
	37.41	3.27	35.73	1.34	1.600	.045

P < .05

Table 5 presents the average times for the 50-meter crawl swimming test for the experimental group (Group 2), which underwent plyometric training: Before the Experiment: The average time was 37.41 seconds. After the 8-week Experiment: The average time improved to 35.73 seconds. The comparison of the average difference in 50-meter crawl swimming times for the experimental group before and after the 8-week plyometric training showed a statistically significant improvement at the .05 level.

Conclusion

This study is an experimental investigation aimed at examining and comparing the effects of conventional training versus plyometric training on the swimming speed of male athletes in the 50-meter freestyle. The research sample consisted of 20 male swimmers from a sports school in Guangzhou, aged 15-18 years, each with at least three years of experience in swimming training and competition. The sample was selected through purposive sampling. The swimmers were first tested for their 50-meter freestyle speed, ranked from 1 to 20, and then randomly assigned into two groups of 10 to ensure comparable swimming speed across groups. Group 1 (Control Group): Engaged in conventional training. Group 2 (Experimental Group): Underwent plyometric training in water. Both groups trained for 8 weeks, twice weekly on Tuesdays and Fridays. Research Findings: 1) Improvement in Swimming Speed: After 8 weeks, both the control group (conventional training) and the experimental group (plyometric training) demonstrated statistically significant improvements in their 50-meter freestyle swimming speed compared to their pre-experiment performance, at a significant level of .05. 2) Comparison of Training Methods: The post-experiment analysis revealed a statistically significant difference in the swimming speed improvements

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between the two groups at the .05 level. The experimental group (plyometric training) exhibited a greater percentage improvement across all variables compared to the control group (conventional training).

Discussion

The integration of plyometric training into a regular training program significantly improved swimming speed in the 50-meter freestyle, as evidenced by the statistically significant differences observed before and after training. This finding suggests that the plyometric training program developed in this study effectively enhances swimmers' speed over the 50-meter crawl distance. Plyometric training emphasizes the development of muscle contraction efficiency, which involves coordinated efforts between the nervous system and muscles, leading to faster muscle contractions and, consequently, reduced swimming times. This result aligns with the findings of Cleather and Cushion. (2019), who studied the effects of plyometric jump training on the vertical jump height of volleyball players. They found that plyometric training enhances the nervous system's ability to work with muscles, allowing for quicker responses due to the growth of muscle and joint nerves and the enlargement of muscle fibers, which accelerates muscle contraction. Sammoud et al. (2020) demonstrated that plyometric training improves swimming performance in recreationally trained swimmers by optimizing the nervous and muscular systems' response time. The ability of muscles to contract powerfully and rapidly generates the force necessary to propel the body forward, thus reducing swimming times. Further supporting these findings, McKinlay et al. (2018) discussed the benefits of a full-arm stretch pose—a strength training exercise measured by jumping rope. The study highlighted that plyometrics plays a crucial role in enhancing muscle protection and coordination, leading to increased strength and speed. Plyometric training is designed to expand muscle size, quantity, and endurance, enabling quicker or more extensive movements. In addition, Zhao et al. (2022) investigated the effects of core muscle strength training on dynamic balance in football players. This study, involving 18 male football players with an average age of 16.89±0.47 years, utilized a core muscle strength program alongside regular training over 8 weeks. The findings revealed significant improvements in core muscle strength, both in the supine ($p<0.01$) and standing ($p>0.05$) positions, as well as in dynamic balance ($p<0.01$). The study concluded that core muscle strength training, particularly using the Swiss Ball method, enhances athletes' fitness and may reduce the risk of injury. These results suggest that incorporating such training into regular programs could be beneficial for various athletes, including swimmers.

In conclusion, the evidence supports that plyometric training is an effective method for improving not only muscle strength but also the speed and coordination necessary for competitive swimming, making it a valuable addition to conventional training programs.

Recommendation

1. Gender-Specific Studies: Investigate the effects of land-based and water-based plyometric training on leg muscle explosive power and swimming speed specifically in female swimmers.

2. Diverse Swimming Styles: Explore the impact of land-based and water-based plyometric training on swimming speed across different swimming styles beyond the 50-meter freestyle.

3. Comparative Analysis: Conduct further research to compare the effectiveness of land-based versus water-based plyometric training on various aspects of athletic performance, including strength, speed, and endurance.

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