IJPESS
Indonesian Journal of Physical Education and Sport Science
p-ISSN 2775-765X | e-ISSN 2776-0200
Volume 5, No. 2, June 2025 Page. 155-164
http://journal.unucirebon.ac.id/index.php ijpess

The Effect of Physical Training at Different Distances Using a Trampoline on Developing Certain Physical and Physiological Abilities for Achieving the 100m Breaststroke in Youth

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Received: 05 March 2025, Approved: 21 March 2025, Published: 30 June 2025

Abstract

Study purpose. This study aimed to design a physical training programme that incorporates different distances to improve specific physical and physiological abilities and utilise trampolines to improve 100m breaststroke performance in young swimmers.

Materials and Methods. The researchers employed the experimental method by conducting pre- and post-tests on both the experimental and control groups. The research population consisted of youth swimmers from the Al-Hashd Al-Shaabi Sports Club, specializing in the 100m breaststroke event during the 2022 competitive season. A total of 12 swimmers were selected using a comprehensive sampling approach and were divided into two groups: an experimental group and a control group, with six swimmers in each. The experimental group underwent a physical training program utilizing the trampoline with varied distances, guided by heart rate monitoring, implemented over three training sessions per week for eight weeks. Data analysis was conducted using the SPSS statistical software.

Results.The improved results indicate that the specific exercises included in the training program were effective in developing speed, enabling swimmers to complete the race distance as quickly as possible, resulting in better performance. Swimmers with this characteristic can achieve maximum speed in a race, which directly impacts performance.

Conclusions. The study concluded that physical training using the trampoline at different distances had a significant positive impact on developing specific physical abilities, which contributed to enhancing 100m breaststroke performance in youth swimmers.

Keywords: Trampoline, Physical Abilities, Breaststroke.

DOI: https://doi.org/10.52188/ijpess.v5i2.1157

Introduction

One of the landmark progresses made by the world in the last couple of years is in different fields of science such as Sports Training Science. This is a domain where principles and methodologies based on science are applied to enable coaches to elicit optimal performances from athletes with minimal exertion. The contemporary method of training becomes a very important method for the coach. If only it is used in the right direction. Among the list of sporting activities, swimming acquires the topmost position due to its performance levels and popularity throughout the world. One of the key factors influencing this development is the adaptation of swimmers to heart rate indicators through structured training programs. These programs incorporate physical exercises at varying distances based on heart rate measurements, with the aim of enhancing specific physical abilities through the use of trampolines. Such training contributes to improving 100m breaststroke performance (Mohammed, 1997).

Heart rate-based training reflects the physiological adaptations elicited from training and, therefore, forms the nucleus of the design of training programs which are effective and efficient. The relationship between the efficiency of circulation, respiration, and muscles determines athletic performance since circulation plays a great role in the success of an athlete in a particular event. Recent research indicates that heart rate monitoring provides a good estimate of the level of effort and may help prevent overtraining, leading to constant fatigue and injuries. Seeing this background, trampoline training represents one of the tendencies, which forms the dynamical balance of swimmers further improving the neuromuscular coordination, thus favoring better motor actions in the water.

Training on dry land, specifically on the core muscles, ensures high motor efficiency and more energy for repetitive movements in shorter races like the 100m breaststroke. As a fact, aerobic and anaerobic training at an optimal heart rate guarantees distributed effort that is thoughtful enough to create the ability to perform for longer periods without performance decrement. For swimming the breaststroke, there is a balance between strength and fluidity, between breathing accuracy and resistance-performance relationships and which are all direct results of the level of cardiovascular fitness.

It helps lower the anxiety that comes from feelings one might have towards competition with building a teaching environment with the recognition of what the body can do and where the boundary is that can be most effective when realized.

One should remember that the measurement of heart rate has moved away from the traditional notions. Rather, it is modern digital technology that has taken over, like wearable devices that not only give real-time accurate readings that can be stored for future reference in the adjustment of training loads, but also make it so much easier for coaches to control loads, monitor progress, and better the effectiveness of training sessions.

The literature proves that training effectiveness mostly depends on gradualism and specificity. For training, the content of breaststroke training should take into consideration leg timing, hand propulsion, and breathing mechanisms by the nature of the movements and techniques used in this specific style of swimming. Thus, the creation of a training program based on empirical data from heart rate monitoring means that the training can now be made more adaptable to each swimmer.

Monitoring and improving cardiac response to exercise can track and enhance the launch and propulsion capabilities by monitoring and improving —Is what will help the swimmer achieve the neuromuscular adaptation needed for efficient performance in the breaststroke.

Just so, post-training performance indicator analysis is an unquestioned essential for continuous improvement. This data set offers clear visions of how well the training program is working and, with those details, allow for pinpointed adjustments, making the overall plan more effective. That integrated approach substantiates the very idea of "individuals' training response," presupposing that everyone chooses their own way. Thus, the heart rate is very essential in the customizations of training loads. After all of the above, one might say that the use of modern HRM-based methods in the 100-meter breaststroke training program and when used in combination with such other training aids as trampolines represents a scientifically integrated approach that contributes to accomplishing high results. The integration of knowledge in physiology and field practice improves the odds of reaching extreme levels of competitive success and sets new conceptions in the science of sports training that is more accurate and objective.

The psychological component of the training process ever remains something that can be taken into account. There have been reams of studies that have informed that training based on vital indicators like heart rate fully serves a person with a sense of being in control about their performance, therefore, it goes without saying that such persons feel more motivated to adhere to the prescribed course of training.

This research would establish the state of physical balance conditions under which minor movements collaborate to execute correct motor pathways. Moreover, through it, proprioception will be developed wherein swimmers will be able to move easily and gracefully when applying force in more than one direction or when moving against the water resistance of the aquatic medium (swimming pool). The influence of water on body resistance with the center of gravity greatly affects the movement; therefore, it is imperative to adapt properly (Mohammed, 1997). The importance of the present study lies in that it will establish scientifically sound principles for the normal criteria of the choice of the optimal values of the training distances by the heart rate, that is, the repetition of the training loads for the development of the exertion-related quality of physical preparedness. This research will eliminate certain barriers that stand in the way of the realization of competitive potential in the event under analysis, improving both technical and physical performance levels on the way to general sports success.

Materials and methods

Study participants

The research population consisted of youth swimmers from the Al-Hashd Al-Shaabi Sports Club, specializing in the 100m freestyle event for the 2021 season, with a total of 12 swimmers. The research sample was selected using a comprehensive sampling method and was divided into two groups: an experimental group and a control group, with six swimmers in each.

Homogeneity and equivalence procedures were conducted for the sample, and the results were as follows:

Table 1. Sample Homogeneity

Variable	Unit of Measurement	Mean	Median	Standard Deviation	Skewness Coefficient
Height	cm	184.32	18	4.765	0.671
Weight	kg	76.23	74	7.657	0.578
Age	years	18.44	18	8.576	0.623

Table 2. Equivalence of Physical Ability Tests and 100m Breaststroke Performance in the Experimental and Control Groups

Variables	Experimental Group		Control Group		Calculated t-value	Error Level	Statistical Significance
	$\bar{x}$	s	$\bar{x}$	s			
Maximum Speed (50m)	32.675	0.567	34.431	0.974	1.688	0.432	Not Significant

Explosive Strength of Legs	2.211	0.671	2.001	0.675	2.453	0.599	Not Significant
Speed-Endurance Strength of Arms	8.321	0.722	7.876	0.673	1.831	0.868	Not Significant
Speed Endurance for 150m Swimming	94.540	0.786	96.641	0.565	0.654	0.435	Not Significant
100m Breaststroke Performance	65.151	0.431	66.121	0.777	0.579	0.671	Not Significant

Significant at a significance level ≤ 0.05 and with 5 degrees of freedom.

Study organization

The researchers adopted the experimental method using pre- and post-testing for both the experimental and control groups, as it aligns with the nature of the study.

Statistical analysis

Tests used in the research

1. **50m Breaststroke Test:**
   a. **Objective:** To measure the maximum speed for the 100m breaststroke event.
   b. **Tools Used:** 3 stopwatches, a whistle, recording forms, supporting team.
   c. **Performance Description:** Start with hands on the edge and feet on the platform, launch upon the starting signal, swim 50m at maximum speed while maintaining proper breaststroke technique, and finish with maximum speed while maintaining proper technique.
   d. **Evaluation Criteria:** Measure the time it took to swim 50m breaststroke at maximum speed, evaluate the breaststroke technique with a focus on arm and leg movements, assess breathing during the swim, and focus on breathing depth.
   e. **Notes:** Three timers record the time for each swimmer, following the same procedure as the previous test.
2. **Explosive Leg Strength Test** (Ma'ani, 1999):
   a. **Objective:** To measure leg muscle power through repeated jumps.
   b. **Tools Used:** Large trampoline area, sand weights (1.5, 2, 3 kg).
   c. **Procedure:** Jump continuously for 30 seconds, rest for 15 seconds, then repeat jumping for 30 seconds.
   d. **Instructions:** The swimmer stands with feet shoulder-width apart, bends the knees, swings the arms back, and then jumps upwards, extending the legs and swinging the arms.
   e. **Test Description:** Begin on the trampoline with feet on the surface, launch quickly using explosive leg strength, jump to the highest possible level while maintaining correct body posture. Repeat for 60 seconds and measure the number of jumps within this time frame.
   f. **Recording:** Each swimmer performs three attempts, and the best attempt is recorded.
3. **Speed-Endurance Arm Strength Test** (Association, 1999):
   a. **Objective:** To measure the speed-endurance strength of the arm muscles through the maximum number of arm extensions and flexions within 10 seconds.
   b. **Tools Used:** A person to count the number of arm extensions and flexions.
   c. **Test Description:** The swimmer assumes a prone position with their chest touching the ground while bending the arms fully, then extends the arms fully.
   d. **Recording:** Count the number of arm extensions and flexions to determine the arm strength characteristic for speed endurance.
4. **Speed Endurance for 150m Swimming** (Ma'ani, 1999):

a. **Objective:** To measure speed endurance.
b. **Tools Used:** Stopwatches, whistles, recording forms.
c. **Performance Description:** The swimmer starts from the starting platform, jumps into the water at the sound of the whistle, and swims the distance at maximum speed to reach the designated end of the 150m course.
d. **Recording:** Measure the time taken in minutes and seconds, along with the distance completed.

5. **100m Breaststroke Performance Test** (Reis, 2010):
   a. **Objective:** To measure the time taken to swim 100m at maximum speed.
   b. **Tools Used:** Stopwatches, whistles, recording forms.
   c. **Performance Description:** The swimmer starts from the starting platform, assumes the proper preparation position, and, at the sound of the start signal, jumps into the water to swim the 100m at maximum speed until reaching the end of the course.
   d. **Recording:** Measure the time in minutes, seconds, and fractions of a second, along with the distance completed.

Pilot Experiment:

The researchers conducted a pilot experiment on 4 swimmers on July 4, 2022, at the Al-Kadhimiyah Sports Club / Baghdad Governorate. The pilot experiment allowed the researchers to:

a. Evaluate the suitability of the devices and tools used in the research.
b. Measure the time required for performing the tests.
c. Familiarize with the physical training program using different distances and the trampoline.
d. Identify any difficulties the researchers might face while conducting the main tests.

Pre-Tests:

The pre-tests were conducted by the researchers on July 7, 2022, at the Al-Shaab Olympic Swimming Pool / Baghdad Governorate.

Training Program Used in the Research:

a. The training program was implemented from July 10, 2022, to September 9, 2022.
b. Duration of the exercises in weeks: 8 weeks.
c. Total number of training units: 24 training units.
d. Number of weekly training units: 3 units.
e. Weekly training days: Saturday, Monday, Wednesday.
f. Training method used: High-intensity interval training method, Repetition training method.

Post-Tests: After completing the training program, the post-tests were conducted on September 11, 2022, on the sample. The researchers ensured that the conditions were similar to the pre-tests in terms of (time, place, tools used, and test execution method) at the Al-Shaab Olympic Swimming Pool / Baghdad Governorate.

Statistical Methods Used in the Research: The researchers used the SPSS statistical software package to find the appropriate statistical treatments.

Results

Table 3. This table shows the means, standard deviations, average differences, difference deviations, and the calculated t-value between the pre- and post-tests for the experimental group in physical abilities and the performance of the 100m breaststroke in the research

Variables	Pre-Test		Post-Test		Mean Difference	t-value*	Error Level	Indication
	x̄	s	x̄	s				
Maximum Speed (50m)	32.675	0.678	31.325	0.778	0.896	8.675	0.001	Sig.
Explosive Strength of Legs	2.211	0.892	2.453	0.456	0.631	9.811	0.004	Sig.
Speed-Endurance Strength of Arms	8.321	0.754	10.653	0.689	0.431	9.567	0.003	Sig.
Speed Endurance for 150m Swimming	94.540	0.871	92.321	0.543	0.678	6.897	0.001	Sig.
100m Breaststroke Performance	65.151	0.543	64.453	0.621	0.876	4.861	0.000	Sig.

*Significant at a significance level ≤ 0.05 and with 5 degrees of freedom.

Table 4. This table shows the means, standard deviations, and the calculated t-value between the pre- and post-tests for the experimental group in some physiological variables related to the performance of the 100m breaststroke in the research

Variables	Unit of Measurement	Pre-Test		Post-Test		t-value	Indications
		x̄	s	x̄	s		
Heart Rate at Rest	Beats per minute (bpm)	73.10	1.97	71.00	1.18	2.99	Sig.
Maximum Heart Rate	Beats per minute (bpm)	181.00	6.29	175.60	3.98	3.03	Sig.
Vital Capacity	Milliliters per liter (mL/L)	2697.52	110.89	2953.00	102.46	5.20	Sig.

Significant at a significance level ≤ 0.05 and with 5 degrees of freedom.

Presentation and Analysis of the Pre- and Post-Test Results of Physical Abilities and 100m Breaststroke Performance in the Control Group.

Table 5. This table shows the means, standard deviations, the mean differences, standard deviations of the differences, and the calculated t-value between the pre- and post-tests for the control group in physical abilities and the performance of the 100m breaststroke in the research

Variables	Pre-Test		Post-Test		Mean Difference	Calculated t-value	Error Level	Statistical Significance
	x̄	s	x̄	s				
Maximum Speed (50m)	34.431	0.543	33.123	0.897	0.541	5.897	0.001	Significant
Explosive Strength of Legs	2.001	0.786	2.223	0.783	0.923	4.598	0.004	Significant
Speed-Endurance Strength of Arms	7.876	0.556	9.111	0.935	0.821	5.871	0.003	Significant
Speed Endurance for	96.641	0.456	94.567	0.563	0.762	7.477	0.007	Significant

150m Swimming								
100m Breaststroke Performance	66.121	0.743	65.761	0.841	0.665	8.632	0.001	Significant

Significant at a significance level ≤ 0.05 and with 5 degrees of freedom.

Table 6. This table shows the means, standard deviations, and the calculated t-value between the pre- and post-tests for the control group in some physiological variables related to the performance of the 100m breaststroke in the research

Variables	Unit of Measurement	Pre-Test		Post-Test		Calculated t-value	Statistical Significance
		$\bar{x}$	s	$\bar{x}$	s		
Heart Rate at Rest	Beats per minute (bpm)	72.71	1.54	72.17	1.29	0.75	Significant
Maximum Heart Rate	Beats per minute (bpm)	181.26	6.80	180.00	4.12	0.58	Significant
Vital Capacity	Milliliters per liter (mL/L)	2692.33	112.51	2704.63	112.63	0.52	Significant

Table 7. Mean Scores, Standard Deviations, and Calculated T-Value Between Post-Test Results in Physical Abilities and 100m Breaststroke Performance in the Research for Both the Control and Experimental

Variables	Experimental Group		Control Group		Calculated t-value	Error Level	Statistical Significance
	$\bar{x}$	s	$\bar{x}$	s			
Maximum Speed (50m)	30.121	0.871	32.871	5.776	6.432	0.003	Significant
Explosive Strength of Legs	2.678	0.776	2.478	0.663	4.832	0.001	Significant
Speed-Endurance Strength of Arms	12.567	0.841	11.002	0.651	6.594	0.004	Significant
Speed Endurance for 150m Swimming	90.675	0.653	92,765	0.772	5.887	0.005	Significant
100m Breaststroke Performance	63.001	0.921	64.021	0.644	7.432	0.003	Significant

Significant at a significance level ≤ 0.05 and with 5 degrees of freedom.

Table 8. Mean Scores, Standard Deviations, and Calculated T-Value Between Post-Test Results in Physiological Variables for 100m Breaststroke Performance in the Research for Both the Control and Experimental Groups

Variables	Unit of Measurement	Experimental Group		Control Group		Calculated t-value	Statistical Significance
		$\bar{x}$	s	$\bar{x}$	s		
Heart Rate at Rest	Beats per minute (bpm)	71.00	1.18	72.17	1.29	3.99	Significant
Maximum Heart Rate	Beats per minute (bpm)	175.60	3.98	180.00	4.12	2.47	Significant

Vital Capacity	Milliliters per liter (mL/L)	2953.00	102.46	2704.63	112.63	5.17	Significant

Discussion

The results shown in Tables (7) and (8) indicate significant differences between the pre-test and post-test for the variables in the study, favoring the post-test. The researchers attribute these results to the structured training program, which included physical exercises at varying distances with the use of the trampoline. These exercises were effective in improving certain physical and physiological capacities for 100m breaststroke performance in young swimmers. The experimental group showed significant improvements in maximum speed in the post-test, highlighting the effectiveness of the training program in enhancing this key attribute.

This improvement suggests that the specific exercises included in the training program were effective in developing speed, enabling swimmers to cover the race distance as quickly as possible, leading to better performance. As stated by Hassanine and (Ma'ani, 1999), the swimmers with this characteristic can achieve maximum speed in the race, which directly impacts performance.

The use of explosive strength is particularly crucial in short-distance races, where it plays a pivotal role during the start phase of the 100m breaststroke (Ma'ani, 1999). Additionally, training that incorporates explosive power is beneficial in sports that require fast, repeated movements. The concept of power-speed integration is essential in sports activities, especially when considering the competitive levels (Mohammed, 1997). The training program's effectiveness was largely attributed to exercises based on heart rate zones and using the trampoline, which facilitated the optimal use of time and space during training. This type of training is effective in developing muscles involved in swimming, directly contributing to improved swimming performance (Reis, 2010).

Conclusions

Significant improvements were recorded between the pre-test and post-test for physical capacities and physiological variables, favoring the post-test results in the experimental group.

The findings indicate a significant improvement in the pre-test and post-test measurements for the experimental group, benefiting from physical exercises with trampoline use that enhanced physiological variables for 100m breaststroke performance.

Acknowledgment

The researchers would like to thank and appreciate the support team and the research sample that underwent the experiment.

Conflict of interest

There is none.

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Cite this article as: Kamil, Safieya Ihsan. Sheet, Shahad Haitham. (2025). The Effect of Physical Training at Different Distances Using a Trampoline on Developing Certain Physical and Physiological Abilities for Achieving the 100m Breaststroke in Youth. *Indonesian Journal of Physical Education and Sport Science (IJPESS)*, *5*(2), 155-164. https://doi.org/10.52188/ijpess.v5i2.1157