14 (3) (2025) 804 - 808
Journal of Physical Education, Sport, Health and Recreations
https://journal.unnes.ac.id/journals/peshr

The Effect of Interval Training on Increasing VO_2max in Freestyle Swimming Athletes

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Article History

Received August 2025
Accepted October 2025
Published Vol.14 No.(3) 2025

Keywords:
Swimming; Interval Training; VO_2MAX

Abstract

Swimming is one of the water sports that is already popular among the public, many components are needed to maximize swimming skills, one of which is aerobic endurance VO_2MAX. This study aims to examine the effect of interval training on increasing VO_2MAX of freestyle swimmers. This research method uses an experimental method with a One Group PreTest PostTest Design design involving 10 freestyle swimmers from the Water Speed Aquatic Club. Sample selection uses a Purposive Sampling technique, with 12 treatments. The instrument used to collect VO_2MAX data is the Aerobic Step Test 5 x 200 meters, this instrument is applied before and after using a paired sample T-test. Based on the results of data processing spss, it shows that the Sig. (2-tailed) value is 0.000 <0.05. The results of the pretest-posttest and the overall difference in athletes obtained a pretest score of 58.593 then an increase in the posttest with a value of 61,412 with an average value of 57.44. So it is concluded that there is an effect of interval training on increasing the VO_2MAX of freestyle swimming athletes..

How to Cite

Azzumar, A. M., Komarudin., Santoso, G. A., & Mulyana. (2025). The Effect of Interval Training on Increasing VO_2max in Freestyle Swimming Athletes. Journal of Physical Education, Sport, Health and Recreation, 14 (3), 804-808.

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p-ISSN 2460-724X
e-ISSN 2252-6773

INTRODUCTION

Swimming is the movement of the body in water, whether in saltwater or freshwater, performed for various purposes such as recreation, sport, training, and survival (Rohman, 2019). Swimmers achieve movement by coordinating their limbs and trunk to create propulsion and directed movement in the water. Swimming serves not only as an essential life skill but also as a competitive sport that demands a combination of excellent technique, physical strength, endurance, coordination, and consistency (Putra Agung Pratama, 2023)

There are four main swimming styles: freestyle, breaststroke, backstroke, and butterfly. Each style has distinct technical characteristics and physical requirements. Freestyle is a swimming style performed with the body lying face down, alternating leg movements up and down (flutter kick), and alternating arm swings forward across the water surface, accompanied by inhalation by turning the head to the side (McNaull, 2005)

In terms of skill, a swimmer's success depends not only on their technical mastery but also on excellent physical condition. One crucial component of physical fitness in swimming is cardiovascular endurance. This component is crucial for success, especially in events that require sustained muscle work, such as the 800-meter freestyle. This endurance is often measured using the VO_2MAX indicator, which is the maximum volume of oxygen the body can utilize per unit of time during maximal physical activity (Deliceoğlu et al., 2024)

VO_2MAX reflects the maximum capacity of the cardiorespiratory system (heart, lungs, and blood vessels) and the ability of muscles to absorb, transport, and utilize oxygen during intense exercise. Athletes with a high VO_2MAX are able to maintain speed for longer periods and delay fatigue (Gumelar et al., 2017; Haikal, 2024). Conversely, a low VO_2MAX limits the body's ability to maintain high-intensity work, resulting in decreased performance in the middle or end of a race. In endurance sports studies, VO_2MAX is often considered a key indicator of aerobic fitness that can be used to predict competitive performance (Sudarta, 2024)

One training method proven effective for increasing VO_2MAX is interval training. Interval training is a training system that combines periods of high-intensity work with periods of rest or low-intensity work (Zakky, 2020). This method not only improves aerobic capacity but also develops anaerobic capacity, as the body is forced to adapt to rapid changes in intensity (Permana, 2025). In the context of swimming, interval training is typically performed by repeating high-intensity swimming sets interspersed with measured recovery periods, making it effective for simultaneously training endurance, speed, and technical efficiency (Kharisma & Mubarok, 2020)

The urgency of my research stems from my personal experience while coaching and discussing with several fellow coaches that many of them neglect interval training, focusing on breathing techniques and fundamental movements.

The gap in this research is that athletes may not fully understand the concept of interval training, or coaches may not implement an appropriate interval program. dengan tingkat kemampuan Atlet. Excessively strenuous interval training can impact results. Therefore, the solution to this gap is to adjust the intensity and duration of the intervals to the athlete's fitness level.

The problem encountered in the field was observed at a water speed aquatics club. Based on observations, the athletes lacked aerobic endurance due to infrequent interval training, with coaches only focusing on breathing techniques and basic movements. To improve endurance, an interval training program is needed.

A previous study, "Interval Training Effects on Cardiorespiratory Capacity of Swimmers," was published by (Xingyu et al., 2023), Mei Zan, and Yang Chao. The study, published in the journal SciFLO Brazil, explained that interval training focuses on interval and intermittent training, which can stimulate the aerobic energy transmission system in athletes, but it was not specific to specific strokes and distances. The novelty of this study is exploring how to apply interval training increase VO_2MAX, specifically in 800-meter freestyle swimmers, to align with the athletes' physical capacity needs and provide a clearer picture of the effectiveness of interval training in specific age groups and experience levels.

METHODS

This study uses a quantitative approach, often referred to as a traditional research method due to its long history and established tradition as a research method. The researchers employed a quantitative approach because the research data is numerical and the analysis uses statistics (Evenetus et al., 2019)

The research design used is a one-group pretest-posttest. With this design, the researcher

conducts two observations: one before the experiment (O1), known as the pretest; the second observation (O2), known as the treatment; and the second observation (O2), known as the posttest (Cadenas-Sanchez et al., 2024)

The subjects of this study were 10 freestyle swimmers from the Water Speed Aquatic Club. The sample was selected using a purposive sampling technique, with the following criteria: Males aged 14-17 years old, who had participated in provincial-level competitions. The treatment was administered over twelve intensive sessions, each lasting approximately 18 minutes.

The instrument used to collect pretest and posttest data in this study was the 5 x 200 meter Aerobic Step Test, as this instrument was relevant to the research being conducted. The purpose of this test is to provide objective information about the swimmers' aerobic fitness capacity or endurance. It was administered during the pretest and posttest to determine aerobic endurance (VO_2MAX).

Interval Training Test, a swimming test that utilizes the principles, which involves varying speed intensity within a single session to measure endurance, speed adaptation, and swimming efficiency under non-uniform conditions (Abdulkareem, 2022). Swimming is a form of swimming training that combines alternating high and low speeds in one session without a clear rest period. Interval training test in swimming is used to assess aerobic and anaerobic capacity, as well as adaptive responses to variations in training intensity (M. Abijar Algipari, 2022).

Data analysis was performed using a paired sample t-test using SPSS version 21. Testing was performed at a significance level of 0.05 to determine whether there was a significant difference between the pre-test and post-test results. If the Sig. (2-tailed) value is <0.05, it can be concluded that interval training can increase VO_2MAX in freestyle swimmers.

RESULTS AND DISCUSSION

Table 1. Description of table

	N	Min	Maxi	Mean	Std. Deviation
PreTest	10	51.415	59.593	54.99	2.14
PostTest	10	54.747	61.412	57.44	2.46
Valid N (listwise)	10				

Based on the results of the descriptive statistical analysis in **Table 1**, the number of subjects in this study was 10 people. The minimum pre-test score was 51.415, while the maximum pre-test score was 58.593, with an average score of 54.99. Then, after participating in the interval training program for 12 meetings, there was an increase with a minimum post-test score of 54.747 and a maximum post-test score of 61.412, with an average of 57.44.

After conducting this descriptive data, the data processing was continued to find the hypothesis by starting with the normality test. Based on the Data Normality Test (Shapiro-Wilk) The results of the normality test using Shapiro-Wilk showed that the pre-test data had a significant value of 0.675, and the post-test was 0.842. Because both values are significantly greater than 0.05, it can be concluded that the pre-test and post-test data are normally distributed, thus fulfilling the requirements for conducting parametric tests, So it can be concluded that it is normal. Based on the T-Test (Paired Samples t-Test) The results of the T-test show a test value of 3.24 with a degree of freedom (df) of 9, and a significance value (2-tailed) of 0.000. Because the significance value is <0.05, there is a significant difference between the pre-test and post-test. This shows that the interval training Test has a significant effect on increasing the VO_2MAX of freestyle swimmers.

The results of the study showed that interval training method significantly increased VO_2MAX in freestyle swimmers. Before and after the treatment, athletes underwent VO_2MAX measurements using the 5 x 200-meter Aerobic Step Test. Pretest results indicated that the average VO_2MAX of the athletes remained in the moderate category. After participating in interval training, all athletes showed a significant increase in their VO_2MAX values, as evidenced by the results of a Paired Sample t-test with a significance value of 0.000 ($p < 0.05$). The average increase was 2.58 ml/kg/minute, with some athletes showing greater progress than others.

The results of the study showed that interval training using the interval training swimming method significantly increased VO_2MAX in freestyle swimmers, indicating a significant difference between VO_2MAX values before and after the training program.

These adaptations include increased heart efficiency in pumping blood, an increase in the number of capillaries in the muscles, and an increase in the lungs' ability to transport oxygen to the blood. This is in line with the opinion of (Prastiwi et al., 2022) that VO_2MAX capacity is a key aspect of physical fitness that significantly determines a swimmer's performance in completing a freestyle race (Nugroho et al., 2021)

The training program in this study adhered to the principles of the interval training method,

which combines high, medium, and low-speed phases within a single session. This aims to alternately vary the stress on the aerobic and anaerobic energy systems. Interval training with varying intensities has been shown to accelerate the increase in VO_2MAX capacity because it forces the body to adapt to changing work rhythms (Abdulkareem, 2022)

Interval training has been proven effective in swimming. As previously stated, interval training increases heart and lung efficiency and stimulates mitochondrial formation in muscles, thus supporting optimal aerobic metabolism (Atzivanis et al., 2024)Athletes who participate in this training are better able to maintain high performance over long periods.

Furthermore, VO_2MAX has been explained as a measure of the body's ability to optimally absorb, distribute, and utilize oxygen during physical activity. Athletes with a higher VO_2MAX will have more stable performance and are less prone to fatigue (Carrier et al., 2025; Jin et al., 2025). The measurement instrument used in this study was the 5 × 200-meter Aerobic Step Test, which is considered valid for indirectly measuring VO_2MAX but is relevant in the context of swimming. As explained, using a measuring instrument appropriate to the characteristics of the sport will increase the validity of the research data (Anderson et al., 2008; Cove et al., 2025)

This study also supports previous research. For example, (Xingyu et al., 2023) stated that high-intensity interval training can train both the central (heart and lungs) and peripheral (muscle) systems, thereby accelerating aerobic capacity. Similar findings were also revealed by (Agafian et al., 2024), who found that the combination of interval training and nutritional management can increase hemoglobin levels and oxygen distribution to tissues.

By considering all the results and analysis above, it can be concluded that the interval training method is an effective strategy in increasing the VO_2MAX of freestyle swimmers and is very suitable to be part of a medium to long-term physical training system.

CONCLUSION

Based on the results of research conducted on the effect of interval training on increasing VO_2MAX in freestyle swimmers, it can be concluded that this increase occurred in all samples, both in moderate and significant categories, indicating the effectiveness of this method in increasing aerobic and anaerobic capacity in a short time. Interval training, which combines low, medium, and high intensity sequentially, can stimulate physiological adaptation of the cardiovascular system, thereby increasing the efficiency of oxygen utilization. These findings suggest that implementing a structured interval training program can be a practical and targeted solution to address low VO_2MAX, especially in adolescent athletes who are in the optimal physiological development phase.

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