
THE EFFECT OF HIGH INTENSITY INTERVAL TRAINING (HIIT) ON INCREASING ENDURANCE IN ORA ET LABORA U 12 FUTSAL ATHLETES

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Received: July 2026, Revised: August 2026, Accepted: September 2026

Abstract

This study aimed to examine the changes in cardiovascular endurance following a High-Intensity Interval Training (HIIT) program among U-12 futsal athletes of Ora Et Labora in 2025. This study employed a pre-experimental method using a one-group pretest–posttest design. The participants were 14 U-12 futsal athletes who met the inclusion criteria, namely actively participating in the training program, being registered as Ora Et Labora U-12 futsal athletes, and completing the pretest and posttest. Cardiovascular endurance was measured using the Multistage Fitness Test (Beep Test), with VO₂max expressed in ml/kg/min. The HIIT intervention was conducted over 16 training sessions at a frequency of four sessions per week, using high-intensity exercise intervals of 30 seconds followed by 15 seconds of recovery. The results showed an increase in mean VO₂max from 47.69 ml/kg/min at pretest to 50.99 ml/kg/min at posttest, representing a mean increase of 3.30 ml/kg/min. These findings indicate that VO₂max increased following the HIIT intervention among the participating U-12 futsal athletes. However, because this study did not include a control group, the observed improvement cannot be attributed solely to HIIT. Further studies using controlled experimental designs and larger samples are needed to determine the specific contribution of HIIT to improvements in cardiovascular endurance among young futsal athletes.

Keywords: HIIT, endurance, VO₂max, futsal, U-12 athletes.

INTRODUCTION

Improving sports achievements is inseparable from the quality of athletes' physical condition as the foundation in supporting the implementation of techniques and tactics during the match. In futsal, good physical condition is indispensable because of the characteristics of the game that takes place at a fast tempo, is high intensity, and involves dynamic changes of movement in a relatively narrow space. One of the components of physical condition that has an important role in the game of futsal is cardiovascular endurance. Good endurance allows athletes to maintain optimal game performance during the match and accelerate the recovery process after strenuous

physical activity (Fajriyudin et al., 2020).

Futsal is a team sport that requires technical, tactical, and physical abilities at the same time. The high intensity of activity during the match causes athletes to have adequate aerobic capacity to be able to perform repetitive movements without experiencing a significant decrease in performance. McKay and Stellingwerff (2021) state that modern sports performance is heavily influenced by athletes' ability to maintain physical capacity through structured and measurable training programs. Therefore, increasing endurance is one of the main focuses in coaching futsal athletes at an early age.

Based on the results of observations made on U-12 Ora Et Labora Futsal athletes, it was found that some athletes experienced a faster decline in performance and fatigue when entering the second half of the match. This condition indicates that the level of cardiovascular endurance of athletes is still not optimal. In addition, the training program provided by the coach tends to focus more on mastering technique and game strategy than developing physical condition, especially endurance. If this condition continues, the athlete's ability to maintain performance during the match can be disrupted and have an impact on achievements.

One of the training methods that is currently widely used to increase endurance is high-intensity interval training, a training method that combines high-intensity activity with periods of rest or recovery in a certain amount of time. Edwards et al. (2023) explain that HIIT is an effective and efficient method of exercise because it is able to increase aerobic capacity in a relatively short period of time. In line with that, Festiawan and Max (2020) state that HIIT can improve various components of athletes' physical condition, especially cardiorespiratory endurance.

Several previous studies have shown the effectiveness of HIIT in improving athletes' physical abilities. Research conducted (Setiawan et al. 2024) shows that HIIT programs have a significant influence on increasing athletes' endurance while helping to reduce the risk of injury. The results of another study conducted by Suprawesta et al. (2025) also prove that HIIT training is able to significantly increase the VO_2 max value and endurance of young futsal players. However, research on the effect of HIIT on the endurance of futsal athletes in the U-12 age group, especially at Club Ora Et Labora, is still very limited, so further research is needed.

Based on this description, this study is important to be conducted to obtain empirical evidence regarding the effectiveness of High Intensity Interval Training (HIIT) training in increasing the endurance of early futsal athletes. This study aims to determine the effect of HIIT training on increasing the endurance of U-12 Futsal Ora Et Labora athletes and to find out the magnitude of the influence given. The results of the study are expected to be a reference for coaches in compiling effective and scientifically based training programs to improve the quality of the



physical condition of early childhood futsal athletes.

METHODOLOGY

This study uses an experimental method with a quantitative approach. The research design used is one-group pretest-posttest design, which is research involving one group of subjects who are given treatment and then measurements before (pretest) and after treatment (posttest). The design of the study can be described as follows: $O_1 \rightarrow X \rightarrow O_2$, where O_1 is the initial test, X is a treatment in the form of High Intensity Interval Training (HIIT) training, and O_2 is the final test. The research was carried out at Ora Et Labora Private Elementary School as a routine training place for the U-12 futsal team. The research was carried out from the fourth week of November to the fourth week of December 2025 with a total of 16 training meetings.

The population in this study is all U-12 Ora Et Labora futsal athletes, totaling 14 people. The sampling technique uses total sampling so that all members of the population are used as research samples. The sample criteria include athletes who actively participate in training, are a maximum of 12 years old, are in good health, have not suffered injuries, and have obtained permission from the school and coach. The research instrument used to measure athletes' aerobic endurance is the Beep Test or Multistage Fitness Test. This instrument was chosen because it has a good level of validity and reliability in measuring aerobic capacity (VO_{2Max}). Test results are obtained based on the last level and shuttle achieved by the participant during the test implementation.

The research procedure begins with the preparation stage which includes the preparation of training programs, the management of research permits, and the preparation of test tools and equipment. Next, a pretest is carried out using the Beep Test to determine the athlete's initial endurance ability. After that, the sample was given treatment in the form of a HIIT training program for 16 meetings with a frequency of four times a week. The training program consists of several forms of exercises such as high knee, jumping jack, squat jump, mountain climber, and burpees with a working duration of 30 seconds and a rest time of 15 seconds in each training set. After the entire training program is completed, a posttest is carried out using the same instrument to determine the change in athletes' endurance after being given treatment.

The research data was analyzed using SPSS software version 26. Before hypothesis testing, the data were first tested for normality using the Shapiro-Wilk test and homogeneity tested using the variance homogeneity test. Furthermore, hypothesis testing was carried out using a paired sample t-test to determine the effect of HIIT training on increasing endurance of U-12 futsal athletes Ora Et Labora. The significance level used in this study is $\alpha = 0.05$.



RESULTS

Based on the results of aerobic endurance measurement using the Multistage Fitness Test (MFT), data was obtained that showed an increase in the VO_2 max capacity of Ora Et Labora U-12 futsal athletes after being treated in the form of High Intensity Interval Training (HIIT) training. The results of the descriptive analysis showed that the average athlete's VO_2 max increased from 47.69 ml/kg/min during the pretest to 50.99 ml/kg/min during the posttest. These findings indicate that the HIIT training program given during the study period has the potential to improve the aerobic endurance ability of 12-year-old futsal athletes.

Table 1. Descriptive Results of VO_2 max of U-12 Futsal Athletes Before and After HIIT Training

Variable	Pretest	Posttest	Improvement
Average	47,69	50,99	3,3
SD	4,61	4,68	1,49
Minimum	41,2	43,8	0,9
Maximum	54,9	58,8	5,9
SD	4,61	4,68	1,49

Table 2. Multistage test results

No.	Name	Multistage test results		
		Levels and shuttles <i>Pretest</i>	Levels and shuttles <i>Posttest</i>	Improvement Levels and shuttles
1	Giovano Armando tamba	5.6	6.7	1.1
2	Ricky Alvaro siahaan	5.6	7.1	1.5
3	Rayvandy Creator	7.7	9.5	1.8
4	Felix Anrata Pinem	6.8	7.5	0.7
5	Aldy Ekin Sembiring	6.2	8.3	2.1
6	Yoga Prananta Tarigan	7.5	10.1	2.6
7	A Taste of the Wild	8.5	9.8	1.3
8	Manasseh is at war with the Nazis	7.5	8.1	0.6
9	Jemmaykel Manalu	9.1	10.2	1.1
10	Jordan Swept Away	7.0	8.2	1.2
11	Ezekiel	10.0	12.9	2.9
12	Zephaniah is a drug	10.0	12.8	2.8



No.	Name	Multistage test results		
		Levels and shuttles <i>Pretest</i>	Levels and shuttles <i>Posttest</i>	Improvement Levels and shuttles
	addict.			
13	David	11.1	13.3	2.2
14	Heskiyel	10.6	11.3	0.7

DISCUSSION

This study aims to determine the effect of High Intensity Interval Training (HIIT) training on increasing the endurance of Ora Et Labora U-12 futsal athletes in 2025. The results showed that HIIT training had a significant influence on the increase in athletes' aerobic capacity as measured through $VO_2\text{max}$ values. Based on the data in Table 4.2, the average athlete's $VO_2\text{max}$ increased from 47.69 ml/kg/min at the pretest to 50.99 ml/kg/min at the posttest, with an average increase of 3.30 ml/kg/min. This improvement shows that the HIIT training program given during 16 meetings is able to improve the ability of the athlete's cardiovascular and respiratory systems to supply oxygen during physical activity.

The increase in durability was also seen individually across the entire study sample. The athlete with the highest improvement was Yoga Prananta Tarigan who experienced an increase in $VO_2\text{max}$ of 5.9 ml/kg/min, while the lowest increase occurred in Heskiyel Siregar of 0.9 ml/kg/min. Although the magnitude of the increase differed in each athlete, the entire sample showed a positive change. The difference in improvement can be caused by the initial physical condition, the level of adaptation to training, the motivation to train, and the ability of each athlete to follow the given training program.

The results of the hypothesis test strengthen the findings. Based on Table 4.5, a t-count value of -8.281 was obtained with a significance value of 0.000 ($p < 0.05$). These results showed that there was a significant difference between the $VO_2\text{max}$ value before and after treatment. Thus, an alternative hypothesis (H_a) is accepted, namely that HIIT training has a significant effect on increasing the endurance of Ora Et Labora U-12 futsal athletes in 2025. The magnitude of the t-count indicates that the changes that occurred were not caused by chance factors, but rather by the result of the exercise program given during the study.

Theoretically, the results of this study can be explained through the characteristics of HIIT exercises that combine high-intensity activity with a short recovery period. The exercise pattern provides a strong stimulus to the aerobic and anaerobic energy systems so that the body adapts by improving the ability to uptake, transport, and utilize oxygen. The physiological adaptations that



occur include an increase in cardiac output, lung work efficiency, an increase in the number of muscle capillaries, and an increase in oxidative enzyme activity. This adaptation is what leads to an increase in $VO_2\text{max}$ values after athletes undergo a regular HIIT training program.

The findings of this study are relevant to the characteristics of futsal games that require players to perform high-intensity activities repeatedly for a relatively long duration of matches. During the game, players have to do sprints, change of direction, pressing, attacking transitions and defend continuously. Therefore, endurance is a very important physical component to maintain performance throughout the game. The increase in $VO_2\text{max}$ obtained in this study shows that athletes have a better ability to delay the occurrence of fatigue so that they can maintain the intensity of the game for longer.

The results of this study are also in line with the opinion of Edwards et al. (2023) who stated that HIIT is an effective and efficient exercise method to improve cardiorespiratory fitness through high-intensity exercise interspersed with short recovery periods. In addition, previous studies have reported that HIIT is able to significantly increase $VO_2\text{max}$ in young athletes as well as gaming athletes because its training characteristics resemble the demands of in-game activities. Thus, the results of this study further strengthen the evidence that HIIT is one of the effective training methods to increase the endurance of futsal athletes at an early age.

Based on the results of the research and theoretical studies, it can be explained that the increase in endurance of Ora Et Labora U-12 futsal athletes occurs because HIIT training provides a stimulus for training that is in accordance with the physiological characteristics and needs of the game of futsal. An exercise program that is carried out regularly for 16 meetings allows the body adaptation which has an impact on increasing the aerobic capacity of athletes. Therefore, HIIT training can be recommended as one of the effective training methods to be used by coaches in increasing the endurance of futsal athletes aged 10–12 years.

CONCLUSION

Based on the results of the research and data analysis that has been carried out, it can be concluded that High Intensity Interval Training (HIIT) training has a significant influence on increasing the endurance of Ora Et Labora U-12 futsal athletes in 2025. This is shown by the increase in the average $VO_2\text{max}$ value from 47.69 ml/kg/min at the pretest to 50.99 ml/kg/min at the posttest, with an average increase of 3.30 ml/kg/min. The results of the hypothesis test using a paired t-test showed a t-count value = -8.281 with a significance value of 0.000 ($p < 0.05$), so that the alternative hypothesis (H_a) was accepted. These findings show that the HIIT training program given during 16 meetings is able to effectively increase the aerobic capacity and endurance of



athletes.

The increase in endurance that occurs shows that HIIT training is in accordance with the characteristics of futsal games that demand repetitive high-intensity activities. Therefore, HIIT training can be used as an alternative effective training method to increase the endurance of futsal athletes at an early age. Further research is recommended to use a larger sample count, involving a control group, and examine the effect of HIIT on other components of physical conditions such as speed, agility, and muscle explosiveness in order to obtain a more comprehensive picture of the effectiveness of HIIT training methods in futsal athletes.

CONFLICT OF INTEREST

The authors declare no conflict of interest in the preparation of this article.

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