



THE EFFECT OF CIRCUIT AND INTERVAL TRAINING ON MAXIMUM OXYGEN VOLUME (VO_{2MAX}) IN PROFESSIONAL FUTSAL ATHLETES

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Article Info

Article History :

Received : February 2022

Revised : March 2022

Accepted : March 2022

Keywords:

Circuit training, futsal players, interval training, VO_{2max}

Abstract

Futsal is one of the most popular sports in society and has attracted more and more fans all over the world. There are more than 12 million people spread over 100 countries who have played futsal. Futsal is played by one goalkeeper and four field players with a duration of two rounds of 2×20 minutes. Therefore, every player must have a good physical condition to play optimally. Maximum oxygen volume (VO_{2max}) is an indicator that can be used to determine the status of a person's physical condition. This study aims to compare the effect of circuit and interval training on VO_{2max} in professional futsal athletes. The method used in this research is quantitative with a two-group pretest-posttest design. A total of 24 teenage boys, aged 16-21 years with a body mass index (BMI) of 19 kg/m² – 23 kg/m² participated in this study. Interval training and circuit training are carried out with an intensity of 80% – 90% HR_{max}, a frequency of 3 times/week for 8 weeks. VO_{2max} was measured using the 20-M Shuttle Run Test with two measurements, namely pre-training and post-training. The results showed the average pre-training VO_{2max} between interval training group (ITG) vs. circuit training group (CTG) (37.82 ± 2.39 vs. 38.56 ± 2.79 mL/kg/min ($p \geq 0.05$)), post-training ITG vs. CTG (39.69 ± 2.51 vs. 42.88 ± 2.71 mL/kg/min ($p \leq 0.001$)), delta ITG vs. CTG (1.88 ± 0.99 vs. 4.32 ± 1.09 mL/kg/min ($p \leq 0.001$)). Based on our results, we show that interval training and circuit training increase VO_{2max} . However, circuit training is more effective in increasing VO_{2max} compared to interval training on professional futsal athletes.

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ISSN 2685-6514 (Online)

ISSN 2477-331X (Print)

INTRODUCTION

Futsal comes from the word futebol de salão (Portuguese) which means football room, while in Spanish, futsal comes from the word futbol de sala, which means football room. Futsal is a large ball sport that is played in teams and each team has five main players. In addition, each team is also allowed to have a reserve player (Taufik et al., 2021).

Futsal is an official sport introduced by the International Federation of Football Associations (FIFA). Currently, futsal is one of the most popular sports in the community and has attracted more fans around the world (Taufik et al., 2021). Romero et al. (2020) reported that more than 12 million people from 100 countries have played futsal. Futsal is played by one goalkeeper and four field players with a duration of two rounds of 2 × 20 minutes. Therefore, every player must have a good physical condition to play optimally (Naser et al., 2017).

Good physical condition is also needed to improve technique and apply the tactics that have been given by the coach during training and competition. The components of physical condition consist of endurance, strength, speed, flexibility, agility, coordination, balance, and reaction. Every athlete needs some of these components to improve performance so that they can reach peak performance (Villela, 2013).

Futsal games require optimal physical abilities because futsal games are carried out with high intensity, with rapid changes in direction, so an effective method is needed to increase the maximum oxygen volume (VO_{2max}). VO_{2max} is an indicator that can be used to determine the status of a person's physical condition and is one of the key elements of training (Coppola & Raiola, 2019; Habibi et al., 2014). Several methods with interval training and circuit training can be used to

increase VO_{2max} (Cuesta-Vargas et al., 2011). However, the effect of interval training and circuit training on improvement is still a matter of controversy.

This study aims to compare the effect of circuit and interval training on VO_{2max} in professional futsal athletes.

METHODS

Experimental Design

This study uses quantitative research methods with a two-group pretest-posttest design. A total of 24 teenage boys, aged 16 – 21 years with a body mass index (BMI) of 19 kg/m² – 23 kg/m² participated in this study and all respondents have filled out and signed the informed consent.

Training Protocol

The training program is implemented and supervised by professional officers from the Department of Sports Science (IKOR) Faculty of Sports Science (FIK) State University of Malang (UM). Interval and circuit training programs were carried out with an intensity of 80% – 90% HR_{max}, a frequency of 3 times/week for 8 weeks. Interval training and circuit training are carried out at the Ken Arok sports hall and Champion Futsal Tidar, Malang, East Java every 08.00 a.m – finish.

Data Collection

Data was collected by measuring VO_{2max} using the 20-M Shuttle Run Test (Majorga-Vega et al., 2015). VO_{2max} was measured twice, namely pre-training and 24 hr post-training during 4-weeks.

Materials and Apparatus

Heart rate monitoring during exercise using a polar heart rate monitor (Polar H7 Bluetooth Smart Heart Rate Sensor, USA). Body weight (BW) using an

OMRON digital scale (OMRON Model HN-289, Osaka, Japan). Body height (BH) was measured using a Stadiometer (Portable Seca® Stadiometer, USA). BMI is calculated using weight (kg) divided by height (m²). Resting heart rate (RHR) and blood pressure were measured using an OMRON digital blood pressure meter (OMRON Model HEM-7130L, Ltd. JAPAN).

Data Analysis

SPSS software version 21.0 was used for data analysis. The data was first tested using a descriptive test to determine the distribution and concentration of the data. Then continued normality test using a parametric test with Shapiro-Wilk. The paired samples t-Test was used to compare the mean VO₂max of the two measurements in each group with a significance level ($p \leq 0.01$), while the independent sample t-Test was used to determine whether there was a difference in the mean VO₂max between the two unpaired groups with a significance level ($p \leq 0.01$).

RESULTS

The results of data analysis of respondent's characteristics are shown in Table 1

Table 1. Characteristics of research respondents

Variable	Group		p-value
	ITG (n = 12)	CTG (n = 12)	
Age (yrs)	18.58±1.51	18.92±1.56	0.600
BW (kg)	59.42±4.19	58.00±4.45	0.431
BH (kg)	1.65±0.03	1.66±0.04	0.608
BMI (kg/m ²)	21.69±1.01	20.98±0.91	0.080
SBP (mmHg)	114.17±7.93	116.67±7.78	0.444
DBP (mmHg)	78.33±7.18	80.83±6.69	0.387
RHR (bpm)	65.83±5.99	66.83±4.30	0.643

Based on the results of the independent sample t-Test, which is shown in Table 1, it shows that there is no significant difference in all data on the characteristics of respondents between groups ($p \geq 0.05$). The results of the VO₂max analysis between pre-training vs. post-training in each group are shown in Figure 1 and Figure 2.

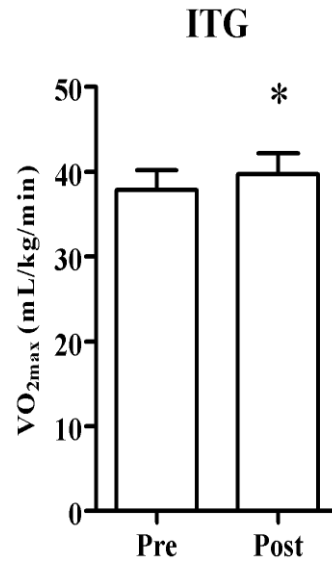


Figure 1. The results of the analysis of the average VO₂max between pre-training vs. post-training at ITG.

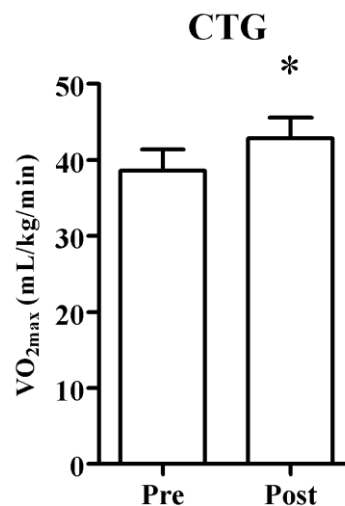


Figure 2. The results of the analysis of the mean VO₂max between pre-training vs. post-training on CTG.

The results of the paired samples t-Test shown in Figure 1 and Figure 2 show that there is a significant difference in the mean VO_{2max} between pre-training vs. post-training in each group ($p \leq 0.001$). The results of the analysis of mean VO_{2max} based on the observation points of pre-training, post-training, and delta between CTG vs. ITG are shown in Table 2.

Table 2. Mean VO_{2max} analysis based on pre-training, post-training, and delta observation points between CTG vs. ITG

Period	Group		p-value
	ITG (n = 12)	CTG (n = 12)	
Pre	37.82±2.39	38.56±2.79	0.492
Post	39.69±2.51	42.88±2.71*	0.000
Delta	1.88±0.99	4.32±1.09*	0.000

Based on the results of the independent sample t-Test analysis, it was shown that there was no significant difference in the mean VO_{2max} of pre-training between CTG vs. ITG (37.82±2.39 vs. 38.56±2.79 mL/kg/min ($p \geq 0.05$)), while the mean VO_{2max} of post-training ITG vs. CTG (39.69±2.51 vs. 42.88±2.71 mL/kg/min ($p \leq 0.001$)), and delta ITG vs. CTG (1.88±0.99 vs. 4.32±1.09 mL/kg/min ($p \leq 0.001$)) showed a significant difference (Table 2).

DISCUSSION

The results of our study showed that there was a significant difference in the mean VO_{2max} between pre-training vs. post-training in the interval training group (ITG) and circuit training group (CTG) (Figure 1 and Figure 2). These results are in line with the research conducted by Taufik et al. (2021) concluded that interval training and circuit training increased VO_{2max} in futsal players. Likewise, the results of research conducted by Festiawan

et al. (2020) reported that Oregon circuit training was effective in increasing VO_{2max} in Sudirman Expedition VII athletes. Research Romadhoni et al. (2018) also reported an increase in VO_{2max} after 4 weeks of circuit training in futsal players. Research conducted by Dwisetoyo et al. (2019) also showed an increase in VO_{2max} after a 6-week training interval in futsal extracurricular players. The increase in VO_{2max} in these two groups was probably due to the effect of the interval training and circuit training intervention which was carried out with a frequency of 3 times/week for 8 weeks.

The results of this study indicate that interval training and circuit training are beneficial in increasing VO_{2max} . However, circuit training is more effective in increasing VO_{2max} compared to interval training for professional futsal athletes (Table 2). Research conducted by Taufik et al. (2021) reported that circuit training was more effective in increasing VO_{2max} compared to interval training for futsal players. Several mechanisms underlying the specific effects of high-intensity interval training and circuit training intervention programs on increasing VO_{2max} for futsal players have been proposed. Normal VO_{2max} capacity for Indonesian male futsal players ranges from 45 mL/kg/min – 52 mL/kg/min (Juniarsyah et al., 2019), while normal VO_{2max} capacity for Latin American male futsal players ranges from 60 mL/kg/min – 70 mL/kg/min (Sekulic et al., 2020; Stubbs-Gutierrez & Medina-Porqueres, 2020; Castagna et al., 2009). The increase in VO_{2max} capacity after an interval training program and high-intensity circuit training for 8 weeks may be due to an increase in oxidative enzyme activity in muscles (Dalleck et al., 2004).

High-intensity circuit training further increases fast-twitch muscle fibers, thus increasing muscle contraction faster than interval training. Muscle fibers are

designed to produce strong explosive power with the use of more energy sources. Fast-twitch muscle fibers require more fuel than slow-twitch muscle fibers, so the post-training recovery process can be more effective (Malleth et al., 2017). High-intensity circuit training in a short period, performed 4-5 times per week, causes an increase in peak oxygen uptake compared to interval training (Rodas et al., 2000), so that circuit training is more effective in increasing VO_{2max} compared to interval training (Taufik et al. al., 2021).

CONCLUSION

The results of our study show that interval training and circuit training performed with a high-intensity frequency 3 times/week for 8 weeks increased VO_{2max} . However, circuit training is more effective in increasing VO_{2max} compared to interval training on professional futsal athletes.

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