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by Ridho Bahtra Final

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VO₂Max in Soccer Players: Comparison of Interval Training and Continuous Running

Ridho Bahtra^{a*}, Silvio Crisari^b, Windo Wiria Dinata^c, Nugroho Susanto^d, Yogi Andria^e

^{a,c,d,e} Universitas Negeri Padang, Indonesia

^b University Pegasso, Italia

Correspondence: ridhobahtra@fik.unp.ac.id

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3 Abstract

Soccer is a complex sport that requires excellent physical condition. One of the important physical conditions that soccer players have is endurance or VO₂Max. Therefore, a training method is needed to increase the VO₂Max of soccer players, to maintain the skills they have. This study aims to compare interval training and continuous running in increasing the VO₂Max of soccer players. This study is quasi-experimental with a two-group post-test design. The subjects in this study were 24 people with an average age of 23.46 years. All players are members of one of the amateur clubs in West Sumatra. They are players who only train 3 times a week. The subjects were then grouped into 2 groups through the ordinary matched pairing technique so that the interval training group was 12 people and the continuous running group was 12 people. The player's VO₂Max data is obtained by conducting a test using a multi-stage fitness test (bleep test). After all the data is obtained then analyzed using the t-test. The results indicate a significant difference between the two training methods, where interval training is more effective than continuous running, it can be seen that $t_{count} > t_{table} = 2.17 > 1.796$. So, it can be concluded that interval training is better than continuous running in improving the VO₂Max of soccer players.

Keywords: Continuous running; exercise; interval training; performance; soccer; VO₂Max.

5 1. Introduction

Soccer is a sport that needs physical, technical, tactical, and mental. To be successful in football a player must have good physical, technical, tactical, and psychological abilities (Menegassi et al., 2018; Ade et al., 2014). The competitive performance of soccer players is a complex construction between physical conditioning, technical, tactical, and mental (Los Arcos et al., 2017). Soccer is an intermittent competitive sport. Soccer is characterized by an intermittent training profile in which periods of low to moderate-intensity activity are punctuated by high-intensity efforts (Clemente et al., 2016; Michailidis et al., 2022). Soccer is a highly demanding intermittent sport characterized by fluctuations between low and high-intensity activities (Hulton et al., 2022). Soccer is an intermittent sport consisting of high-intensity activity with long periods of running, and low-intensity activity and walking (Penichet-Tomas et al., 2022).

So much action from the players that the distance covered in the game becomes very long. In one game the players cover a distance of between 10-12 km (Taylor, 2016; Emmonds et al., 2016; Najafi et al., 2015; Villaseca-Vicuña et al., 2021). During a soccer match, players cover a distance of about 9-14 km (Theocharis et al., 2022). So, professional soccer players during a game cover a distance of 9-14 km, of which about 10% of them are covered at a speed of more than 19 km/h. (Michailidis et al., 2022). Of the total distance covered, about 1,150 m were run at speeds over 20 km·h⁻¹, with about 60 sprints performed; this again depends on the role of the position (Barnes et al., 2014). The

total distance traveled by the teams and players in one match includes the distance traveled while walking, jogging and running from low to high intensity in different directions (Longo et al., 2019).

To support high performance during the aforementioned stunts requires good physical condition. One of the components needed is durability. Endurance is the body's capacity to carry out activities for a long time without experiencing fatigue and is characterized by rapid recovery (Wiguna, 2017; Bahtra et al., 2022; Sidik et al., 2019; Arianto & Setyawan, 2019). To determine whether an athlete's endurance is good or not is to measure and see the VO₂Max capacity. VO₂Max is considered the main indicator for evaluating cardiorespiratory fitness (Arboleda-Serna et al., 2019). VO₂Max is the main indicator for measuring athlete performance and cardiovascular adaptation to training loads (Muñoz-Martínez et al., 2017). As a sport that needs good physical condition, the VO₂Max needs of football players must be known by every coach and player. Many research results and theories suggest the VO₂Max need of a soccer player. The VO₂Max of international soccer players range from 55 – 68 ml/kg/minute (Granero-Gallegos et al., 2020; Bergka et al., 2020; Taylor, 2016). Professional soccer players have a VO₂Max that varies from 55 to 65 (Metaxas, 2021; Slimani et al., 2019).

The need for endurance and VO₂Max in a soccer match is very high, it is necessary to do structured and continuous training. In addition, the selection of the right training method must be a concern for the coach. To train endurance in this case to improve VO₂Max ability, many training methods can be used. According to (Putra et al., 2016) training that can be used to improve the Vo2max ability of soccer players include interval training, fartlek, continuous training and SSG. Meanwhile, according to Strudwick (2016), professional football teams use a variety of training methods to improve the physical condition of their players, general training (eg, continuous, circuit, interval, repeated sprints) and specific exercises (eg, small side games, technical drills, position specific exercises with the ball).

In this study, researchers tried to compare two training methods, namely the interval training and the continuous running. These two training methods have different characters. Interval training is marked by the recovery at the time of loading. While continuous running is an exercise without rest during loading. With these two different characters we will find something new in training to increase VO₂Max. Is training interspersed with or without rest more effective? So, this will add to the coach reference in endurance training to increase VO₂Max.

Interval training with the characteristic of having a rest time during loading while the continuous method does not have a rest period. Interval training is one of the exercises that can be used to increase VO₂Max. One of the effective and significant training in improving the aerobic ability of soccer players is interval training (Ferrari Bravo et al., 2008; Rustiawan, 2020). Improve body composition and cardiorespiratory fitness more effectively with interval training (Mazurek et al., 2014). Interval training and moderate-intensity continuous training (MICT) both resulted in significant increases in VO₂Max in middle-aged and older adults (Poon et al., 2021). This method is recommended to increase aerobic and anaerobic capacity in a short time (Yalcin et al., 2022). In addition to interval training, continuous training is also often used by coaches to improve the physical condition of players. Moderate-intensity continuous exercise has a positive effect on VO₂Max and heart function (Mahdiabadi, 2021). Continuous running exercise can increase VO₂Max (Syahroni et al., 2020). The continuous running exercise showed a very large increase in maximal aerobic strength (Milanović et al., 2015). Moderate intensity continuous running can increase VO₂Max (Yalcin et al., 2022). There is a significant effect of interval running and continuous running exercises on VO₂Max (Hasibuan & Damanik, 2019). Developing aerobic capacity can be done by running continuously. This can improve the efficiency of the relationship between oxygen uptake and energy output (Macpherson & Weston, 2015). The purpose of this study was to see the effectiveness of interval training with continuous running in improving the VO₂Max of soccer players.

2. Method

The subjects in the study were male soccer players with an average age of 23.46 years, which amounted to 24 people. The selected subjects were in good health and had no history of injury. All players are members of one of the amateur clubs in West Sumatra. They are players who only train 3 times a week. The subjects were then grouped into 2 groups through the ordinary matched pairing technique so that the interval training group was 12 people and the continuous running group was 12 people.

This type of study is a quasi-experimental design with a two-group post-test design. Before the treatment (treatment) is given a pretest to the sample. Pretest data is used for grouping samples. The sample is divided into two groups using ordinary match pairing so that the two samples are homogeneous. Then a lottery was carried out to select the groups of interval training and continuous running. The research was conducted in 16 sessions with a frequency of 3 times a week. The training program for both groups was carried out at the same time with the same training duration.

Table 1. Two-group post-test design

Pre-test	Grouping	Exercise Group	Post-test
T ₁	Ordinary Matched Pairing	Interval Training Continuous Running	T ₂

To get the VO₂Max data, it is necessary to do tests and measurements. The test instrument used to obtain VO₂Max data is a multi-stage fitness test (beep test). Data analysis techniques using the t-test. Before the t-test, the analysis requirements test was carried out, namely the data normality test

3. Result

The aim of this research was to see the difference between interval training and continuous running. After treatment of the sample, data is obtained to be processed at the next stage. From the data, it can be seen that the interval training group has the top VO₂Max value of 52.20 and the poor of 38.1, while the continuous running group has the top VO₂Max value of 51.6 and the poor of 38.5. For full details, see the table and graph below.

Table 2. Difference VO₂Max between interval training and continuous running

Interval Class	Interval Training	Continuous Running
38,10 – 40,92	3	3
40,93 – 43,75	2	3
43,76 – 46,58	2	2
46,59 – 49,41	3	2
49,42 – 52,24	2	2
Total	12	12

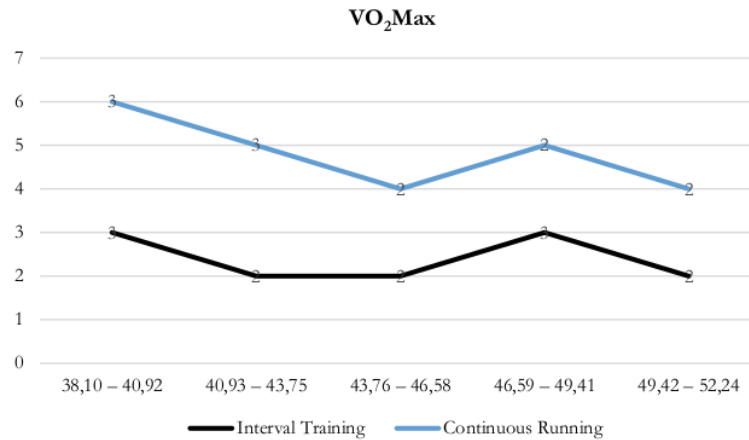


Figure 1. Difference VO₂Max between Interval Training and Continuous Running

From the table and figure above it can be seen that interval training is better than continuous training. However, it is necessary to carry out further testing through the t-test. Before the t-test, the data normality test was conducted to see if the data were normally distributed. The complete results of the data normality test can be seen in the following table.

Table 3. Data normality test results

Training Methods	N	Lo	L _t	Description
Interval Training	12	0.1186	0.2420	Normal
Continuous Running	12	0.1348	0.2420	Normal

Based on the table above, it can be seen that the data for the two groups are normally distributed. These results indicate that the data can be continued for the t-test. The complete results of the hypothesis testing are described in the following table.

Table 4. Hypothesis test results

Training Methods	Max	Min	Mean	SD	t count	α	t table	Results
Interval Training	52.2	38.1	45.07	4.44	2.17	0.05	1.796	Significance
Continuous Running	51.6	38.5	44.48	4.03				

From the data above, it can be seen that $t_{count} > t_{table} = 2.17 > 1.796$. These results explain that interval training is better than the continuous running in increasing the VO₂Max ability of soccer players.

4. Discussion

Based on the results obtained, interval training is more effective in increasing VO₂Max compared to continuous exercise. This is because interval training has a recovery time during loading, while continuous training does not have a rest time. With the rest period, it is suspected that the condition of the players is better prepared to undergo the next loading. In addition, the rest time reduces boredom or player saturation. Continuous exercise that does not have rest time makes players feel bored so the intensity of the exercise carried out sometimes decreases so that it does not fall into the training zone. Although it can increase the player's VO₂Max, it does not meet the VO₂Max standard of soccer. In football, the best players can reach max. VO₂ levels of 65-70 ml/kg/min, depending on their age, level of individual performance and position on the pitch (Taylor, 2016).

2 The body's ability to consume oxygen optimally during activity and training is called VO₂Max (Sidik et al., 2019; Bahtra et al., 2022). Intense training, especially through aerobic processes, can increase maximum oxygen consumption (VO₂Max) (FIFA, n.d.; Taylor, 2016; Watulingas et al., 2013). Many experts and research results suggest the VO₂Max require of soccer players. A soccer player's VO₂Max requirement is at a level 55 to 68 ml/kg/min (Slimani et al., 2019; Mahdiabadi, 2021; Granero-Gallegos et al., 2020).

In soccer matches, the require for VO₂Max is very high. Coaches have responsibility to improve or maintain the VO₂Max capacity of their players. Increasing VO₂Max must be done with structured, systematic, and continuous exercise. And last but not least, the coach must be able to choose the right method or form of training to increase the player's VO₂Max. Interval training is one of the exercises that can be used to increase VO₂Max. Interval training is very good at improving the aerobic abilities of soccer players (Ferrari Bravo et al., 2008). Interval training has a significant effect on increasing VO₂Max (Hasibuan & Damanik, 2019). In addition to interval training, continuous training is also often used by coaches to increase VO₂Max. Moderate-intensity continuous exercise has a positive effect on VO₂Max and heart function (Mahdiabadi, 2021). Continuous running exercise can increase VO₂Max (Syahroni et al., 2020). The continuous running exercise showed a very large increase in maximal aerobic strength (Milanovic et al., 2015). There is a significant effect of interval running and continuous running exercises on VO₂Max (Hasibuan & Damanik, 2019).

Players who have good VO₂Max help their performance in matches. The increase in VO₂Max will help improve the performance of players during the game (Alexander & Mier, 2011), improve the potential of players to affect the result of soccer matches (Ishee & Foster, 2013). The ability to move a lot during a match and a fast recovery period is only owned by players who have high VO₂Max (Turnley, n.d.).

The two methods above are structured based on the similarity of intensity and duration or length of exercise time. However, based on the research results, the interval training is better than the continuous running. In the training process, the interval training is carried out with many repetitions but there is a recovery period so that players have the opportunity to restore their condition. Interval training is described as high intensity exercise that varies in the number and intensity of intervals, timing and nature (active or passive) of recovery periods and total volume (Poon et al., 2021). On the other hand, the continuous method is carried out continuously without a rest period, this is expected to make players bored with undergoing training. Thus, it is suspected that players who train with the extensive interval method have more motivation in undergoing the training process than the continuous method because of the rest period, so this affects the increase in the player's VO₂Max capacity.

Exercises to increase endurance should be by the character of soccer itself. The advantages of endurance training using a ball include: 1) training is more effective and efficient because it increases physical and technical abilities at the same time, 2) increases player motivation in training, 3) eliminates player boredom because of practicing lots of variations and using a ball, 4) makes it easier for the coach set practice (Bahtra et al., 2022). So, coaches need to provide physical exercise, especially endurance or VO₂Max. Exercises that are done regularly and continuously will have a good effect on increasing VO₂Max. High-intensity soccer matches need good endurance or VO₂Max.

5. Conclusion and Recommendation

Increasing the VO₂Max of soccer players is a very important thing for coaches to do. Players who have a high VO₂Max will play with good performance during the game. Players who have good technical skills and understanding of tactics will not be able to play optimally without being supported by good VO₂Max, so players like this will find it difficult to compete with players at the international level. One of the recommended exercises to increase VO₂Max is interval training. This is based on the

results of research that has been done, where interval training is better than continuous running in increasing VO₂Max.

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