

## Effect of circuit and interval training on VO<sub>2</sub>max in futsal players

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### Abstract.

**The study purpose** was Interval training consists of repetition of a maximum intensity exercise. Circuit training exercises are performed by performing several training posts. This combination of several posts is likened to a circuit. Detailed data on which of these two exercises is more effective at increasing VO<sub>2</sub> max is very limited. This study aimed to determine the effect of interval training and circuit training on increasing VO<sub>2</sub>max capabilities. this study, we used a quasi-experimental. **Method** (pre-test, post-test, and control group design). The sample included 156 athletes from Futsal Academy in Cianjur City, Indonesia. The sample selection was done via the random sampling technique, and 30 athletes participated in this study. The samples were divided into two groups, which included the interval training group (n=15) and circuit training group (n=15). The study was carried out for two months with 18 sessions three times a week. A multistage test using bleep was used as the instrument for this study. Data analysis was performed via analysis of variance (ANOVA) statistics using SPSS 21. **Result** of this study showed that Were obtained from the interval training and circuit training groups, where the VO<sub>2</sub>max increased by 0.63 for the circuit training group with a value of 0.00 <0.05, whereas for the interval training group, the value was 0.89 for the t-test with a value of 0.00 <0.05. Thus, T count values for the interval training and circuit training groups were greater than the T Sig or outside the Ho reception area. Thus, there was a difference in the increase in VO<sub>2</sub>max from the two groups **Conclusion** (1) there was a significant effect of interval training with VO<sub>2</sub>max improvement, (2) there was a significant effect of circuit training with VO<sub>2</sub>max improvement, (3) there was a significant difference between the interval training and circuit training in terms of the effect on VO<sub>2</sub>max improvement, circuit training was found to be better than interval training in terms of the effect on VO<sub>2</sub>max improvement.

**Keywords:** Bleep test, circuit training, interval training, VO<sub>2</sub>max

### Introduction

The development of the times is growing by maintaining the ability of a healthy body to play an appropriate role in integral human education, it is important to encourage the participation of children, youth and youth in the practice of physical activity to make it a habit and a good lifestyle refers that sport is a human activity that discusses five components: game, movement, agonistic, institution, and project. (Honório et al., 2021) which together define a better definition of sport. Because futsal is full of motion and activity, because according to (Korobeynikov et al., 2020) Among modern sports that can be distinguished is the futsal sport which is a combination of sports and physical activity components. Futsal is an official sport that was introduced by the International Federation of Football Associations (FIFA). Futsal, as a rising sport, has attracted more and more fans all over the world. due to the ease of finding space for its training, it is one of the most widespread sports in Brazil, played by more than 12 million people in over 100 countries (Romero et al., 2020). Futsal is an indoor sport played by one goalkeeper and four field players. This game is also called a five-sided indoor game, which consists of two rounds of 2 × 20 min of duration with high intensity and intermittent action. This game requires a high physical, tactical, and technical effort from the players (Naser et al., 2017). For this reason, optimal physical condition is needed to support the performance of futsal athletes in every match. In accordance with prior opinions (Matzenbacher et al., 2014), the characteristics of intermittent futsal sport require high physical, technical, and tactical abilities from athletes throughout a competition with an emphasis on the ability to make decisions in a short time and on the creativity of the athletes. These characteristics are very important in futsal. High physical, technical, and tactical skills should be mastered by athletes to recognise, adapt to and organise their actions in a match (Müller et al., 2018). Therefore, the athletes should be trained well during the competitive period. The trainers should arrange the schedule well and train the athletes appropriately during a short pre-season to maximize their performances (F. C. d. A. Nogueira et al., 2018) Another challenge, for most individuals, is a number of interrelated cognitive processes that drive goal-directed behavior with an appropriate exercise program.(Greco & DE RONZI, 2020) For this study, we were interested to determine how futsal

athletes can survive a training period that is done on a small and simple court. Many studies have been conducted regarding the futsal game, especially for increasing athletic abilities and performance (Barcelos et al., 2017). According to previous studies, trainers applied conventional techniques to train athletes in which trainers only worked the physical basics regardless of the characteristics of the futsal sport, which requires high physical, technical, and tactical abilities from athletes. Physical exercise and sports performance involve effective and targeted body movements (Sole, 2018). This is because futsal is an intermittent modality in which aerobic metabolism is responsible for supplying 75% of the energy used during the game (de Oliveira et al., 2019). Since this game requires a high physical ability and intensity, with rapid changes in direction, it is necessary for trainers to find a creative solution to help athletes improve their VO<sub>2</sub>max, which is the maximum amount of oxygen one can utilize during exercise. because in my opinion(Coppola & Raiola, 2019) VO<sub>2</sub> max capacity is considered one of the basic elements of training. High-intensity training, even if done in a few seconds, accustoms the body to both aerobic and anaerobic ATP synthesis.

Based on recent observations, both in competition and during training, it is very important to exercise to improve performance in futsal playing abilities (Davies, 2002). As the sports population grows, the issue of athletes' physical condition becomes more important over time(Varkiani et al., 2013). Many futsal players are assumed to not have optimally carried out the training process as expected in an effort to increase the endurance ability (VO<sub>2</sub>max), and this is because the lack of characteristics of futsal athletes and the lack of understanding of trainers in applying training materials. whereas exercise testing with direct measurement of VO<sub>2</sub> max is widely regarded as the gold standard and assessment of fitness levels (Peric & Nikolovski, 2017) to support VO<sub>2</sub>max because physical exercise can support an athlete's performance (Teatro et al., 2017). Additionally, VO<sub>2</sub>max endurance training is often used in training because better results are usually due to increased physical, mental and technical readiness in futsal players (Rezaimanesh et al., 2011), one of which is standard physical exercise, which is most typically used by trainers.

Physical exercise is described as an exercise that emphasizes basic exercise only with a large number of exercises individually or separately. In previous research, futsal players needed a good VO<sub>2</sub>max to meet the needs in every match. SSG-based programs provide a similar heart rate stimulus to players compared to a GFT program, and both programs significantly increased the VO<sub>2</sub>max parameter of young futsal players (Amani-Shalamzari et al., 2019). Additionally, another study showed endurance in futsal players who were trained in endurance (VO<sub>2</sub>max and under field conditions) (Barbero-Alvarez et al., 2015). Meanwhile, understanding of the game itself is often neglected. There are some weaknesses in the application of the physical training method. This method involves much time focusing on learning variations of forms. The second is a monotonous method of exercise. However, physical training for futsal players is very important according to (Dal Pupo et al., 2017) because futsal is characterized as an intermittent sport, where high-intensity action occurs interspersed with short recovery periods. The futsal season schedule presents similar characteristics to other team sports, with a short pre-season and long competitive season, during which players may play 1-2 regular matches per week(F. C. D. A. Nogueira et al., 2020).

Initially, we conducted an observation of several matches in Cianjur and conducted an interview with the Cianjur team coach at a regional level championship in West Java, a province in Indonesia. This initial study was aimed to determine what make the players and team successfully enter the semi-final round. The results of the interviews showed that the success of this group in entering the semi-finals occurred when the players had good stamina and performance during the competition. From this phenomenon, it was observed that physical ability is absolutely needed for futsal players to win competitions. Nevertheless, the previous semi-final Cianjur futsal players always failed to enter this round because they got tired quickly. This condition was caused because the athletes had a lack of a good VO<sub>2</sub>max. This weakness should become an evaluation method for coaching teams for preparation for national championships. Furthermore, the futsal players in the Cianjur team need to increase VO<sub>2</sub>max endurance to increase their performance during matches in a national championship. From the phenomenon above, it can be concluded that the physical condition of athletes during competition is very important. As supported by (Silva et al., 2018), however, futsal athletes need to be supported with physical and physiological preparation. Some methods can be applied by trainers to increase athletic performance. Among them are circuit training combined with the interval training method.

Therefore, this study aimed to apply these two methods to train athletes to increase their VO<sub>2</sub>max endurance and to determine which method is more effective for increasing the athletes' CO<sub>2</sub>max endurance. Among other factors, attractiveness is considered an important aspect related to the performance and abilities of futsal players (Keshvari & Senner, 2015). Of course, there have been several studies conducted on the application of training in circuit and interval training for certain competitive futsal players. However, this method is still lacking in terms of helping athletes to increase their maximum endurance via VO<sub>2</sub>max. For this reason, researchers are interested in using these two methods for training futsal athletes in Cianjur. However, this study differs from many previous studies relating to interval training and circuit training. The difference lies in the number of training sessions and the variety of exercises. There were 18 sessions conducted in this study. To be able to predict and simulate the real demands of a futsal match, a competitive game with a good standard of play must be the basis of any study. The purpose of this study was to determine the effect of interval training and circuit training on increasing VO<sub>2</sub>max.

**Materials and methods**

*Participants*

An experiment with a pre-test, post-test, and control group design was applied in which there were two experimental groups, namely the interval training experimental group and the circuit training experimental group. The sample for this study included 156 players from Cianjur Academy in Futsal, Indonesia. Then, 30 players were chosen via random sampling and were divided into two groups; 15 participants were taught using a technical method, and the other group was taught using a tactical method. This study was conducted in two months consisting of 18 sessions. The sessions were three times a week. The instrument used in this study was in the form of a test, the bleep test. Data were analysed using the analysis of variance (ANOVA) statistics (SPSS 21) technique.

The design used is the Pretest-Posttest Control Group design. In this design, there are two groups selected randomly, then given a pretest to determine the initial state, is there a difference between the experimental group and the control group. Pretest results are good if the experimental group scores are not significantly different. In detail, the Pretest-Posttest Control Group design can be seen in table 1:

Table 1. Pretest - Posttest Control Group Design

Sampel	Pretest	Treatment	Posttest
N	O <sub>1</sub>	X	O <sub>2</sub>
N	O <sub>3</sub>	X	O <sub>4</sub>

Information:

N = Random Sampling, X = Treatment in the experimental class, O<sub>1</sub> = Experimental class pretest, O<sub>2</sub> = Experimental class posttest, O<sub>3</sub> = Control class pretest, O<sub>4</sub> = Control class posttest

*Procedure*

Before starting the measurements, the athletes performed a warm-up routine, which included a number of interval workouts and an accelerating circuit. Each participant was then instructed to divide into two groups in which one was taught through a technical approach (15 people), and the other group was taught through a tactical approach (15 people). The research instrument used in the study was to measure VO<sub>2</sub>max pretest and posttest, namely the instrument from the Multi Stage Fitness Test (MSFT) to monitor the development of the athlete's maximal oxygen absorption (VO<sub>2</sub>max). Resources needed According to (Mackenzie, 2012). This test consists of 23 levels where each level lasts about one minute. Each level consists of a series of 20m shuttles where the initial speed is 8.5 km/h and increases by 0.5 km/h in each level. On cassette/CD, one beep indicates the end of the shuttle and 3 beeps indicate the start of the next level.

The test is carried out as follows: 4 Measure the 20 meter section and mark each end with a cone mark 4 Athlete performs a jogging and stretching warm-up program Exercise 4 The test is performed 4 The athlete must place one foot above or beyond the 20m marker at the end of each shuttle 4 If the athlete arrives at the end of the shuttle before the beep, the athlete must wait for the beep and then continue walking 4 The athlete continues to run as long as possible until he can follow the speed determined by the tape at which point they must retreat voluntarily 4 If the athlete fails to reach the final plane before the beep, they must be allowed 2 or 3 more shuttles to try to regain the required speed before being drawn 4 Record the level and number of shuttles completed at that level. Athlete 4 At the end of the test, the athlete performs a warm-up program, including stretching exercises.

The treatments were done in two months that were conducted in 18 sessions with a frequency of three meetings per week. There were two sessions used to conduct the tests, the pre-test and post-test. These tests were given to determine the effectiveness of circuit training and interval-training exercises for improving VO<sub>2</sub>max. We initially conducted a bleep test for the pre-test. Then, they were given treatment according to their group, namely the interval and circuit training groups (each had the same population but different groups had different treatments). In every treatment of the 18 sessions, the participants did a warm up as the opening activity and ended with a cool down activity.

**Results**

The data description is a general description of each variable to support the discussion. Through this general description, improvements in the variables were observed from the initial conditions to the condition after treatment. The results on the improvement of VO<sub>2</sub>max were obtained from the bleep test.

The data used for analysis included those from the pre-test before treatment and post-test that was conducted after completing the training process using the interval training and circuit training methods. A summary of the data showing the increase in VO<sub>2</sub>max is shown in Table 2.

Table 2. overall results for VO2max

	Interval Before	Interval After	Circuit Training Before	Circuit Training After
Mean	33.13	34.13	32.133	35.93
Standard Error	0.51	0.50	0.999	1.34
Median	34	34	32	35
Mode	34	33	32	40
Standard Deviation	1.959	1.922	3.871	5.175
Sample Variance	3.838	3.695	14.981	26.781
Kurtosis	2.308	0.246	-0.512	0.895
Skewness	-1.201	-0.705	0.011	0.576
Range	8	7	13	21
Minimum	28	30	25	27
Maximum	36	37	38	48
Sum	497	512	482	539
Count	15	15	15	15
Confidence Level (95.0%)	1.085	1.065	2.143	2.866

*Hypothesis Testing*

The next step was to test the similarity of the two means (one group). This is done to compare the effect of the interval training approach with that of circuit training in terms of increasing VO2max. Table 3. Paired sample T-test of VO2max upon circuit training and interval training of futsal players

Paired sample correlations		N	Correlation	Sig.
Group 1	Circuit Training	15	.881	.000
Group 2	Interval Training	15	.631	.000

Table 3 shows the result of the calculation of the paired sample t-test. As shown in this table, we found that using the circuit training produced a value of 0.00 <0.05 and the value resulting from the interval training method was 0.00 <0.05. Thus, there was a significant difference before and after circuit training and interval training in terms of VO2max (improvement) in futsal player. The means of the paired two samples are presented in the following table.

Table 4. Paired two sample t-test for the means for the circuit training and interval training groups

	Circuit Training Group VO2max		Interval Group VO2max	
Mean	32.13	35.93	33.13	34.1
Variance	14.98	26.78	3.84	3.7
Observations	15	15	15	15
Pearson Correlation	0.88	0.00	0.63	0.00
Hypothesized Mean Difference	0.00		0.00	
df	14		14	
t Stat	-3.63		-4.18	
P(T<=t) one-tail	0.00		0.00	
t Critical one-tail	1.76		1.76	
P(T<=t) two-tail	0.00		0.00	
t Critical two-tail	2.14		2.14	

The results of the calculations shown Table 3 were obtained from the interval training and circuit training groups, where the VO2max increased by 0.63 for the circuit training group with a value of 0.00 <0.05, whereas for the interval training group, the value was 0.89 for the t-test with a value of 0.00 <0.05. Thus, T\_count values for the interval training and circuit training groups were greater than the T\_Sig or outside the Ho reception area. Thus, there was a difference in the increase in VO2max from the two groups. The value from the circuit training group was greater than that of the interval training group. Therefore, it can be concluded that interval training is better than circuit training for increasing VO2max in futsal players.

## Discussion

The same situation is evidenced in an in-field investigation where, according to the size of the field and the number of players, the goalkeeper intervention differs, VO<sub>2</sub>max in this case with identical results requires a prime condition with us where the smaller size of the field leads the players to create distance. shorter on the pitch, with more changes of direction and more action near goal. This study found differences between the circuit training method and the interval training method in terms of helping futsal athletes increase their VO<sub>2</sub>max. This is in accordance with several previous studies that used this form of exercise as encouragement but with different comparisons. In this study, we conclude that the difference between circuit training and interval training affects the VO<sub>2</sub>max of futsal players by providing two more effective treatments to increase VO<sub>2</sub>max, and for increasing VO<sub>2</sub>max, circuit training is better than interval training or the control group. Therefore, this effective circuit-training program can be a reference for today's futsal coaches. For further study, a wider sample can be used and then different exercises so that better and more significant results can be obtained to improve the VO<sub>2</sub>max in futsal athletes.

Our tests of our hypothesis showed that both circuit training and interval training have a significant effect on improving futsal athletes. Nevertheless, the circuit training method was found to be better than the interval training method. Based on our findings, these differences are due to the following reasons: a) the training process involved in the two training methods, b) the development and improvement of the futsal athletes' VO<sub>2</sub>max, and c) test results regarding the VO<sub>2</sub>max bleep ability test. Previous studies have shown that interval training is very important for athletes, one of which is intensity interval training consisting of short intense exercises alternating with periods of recovery with passive movement or light intensity (Roy, 2013), and interval training is an appropriate method and type of training because it is very effective and efficient at increasing the desired physical component (Fajrin et al., 2018). Therefore, the findings of this study showed that interval training can be very important for training to increase VO<sub>2</sub>max endurance according to the theory above and the results of this study, which showed that interval training can increase VO<sub>2</sub>max ability. Interval training is not considerably different from circuit training. It involves a large number of exercises arranged like games. According to previous research, the circuit training method influences aerobic capacity and VO<sub>2</sub>max endurance. Thus, circuit training is suitable for increasing VO<sub>2</sub>max. In accordance with this view, futsal players need technique, tactics and physicality to develop well to have good physical abilities (Fathoni & Rachman, 2020), and they should do circuit exercises, which supports this view. As a result, these results showed that circuit training is more effective than interval training at improving the VO<sub>2</sub>max of futsal players.

## Conclusion

Considering the objectives described in this study, in this analysis we can refer that this study tested both circuit training and interval training to increase VO<sub>2</sub>max, and of these two types of exercise, circuit training was found to be better than interval training. There is a significant effect between interval training found on the results of VO<sub>2</sub>max (increase). (2) There is a significant effect of exercise concentration on VO<sub>2</sub>max (increase). (3) There is a significant difference between interval training and circuit training in terms of increasing VO<sub>2</sub>max. We found that circuit training was better than interval training or control groups for VO<sub>2</sub>max improvement. Those factors lead to better circuit training with game situations, liking with better support in VO<sub>2</sub>max and faster direction changes, qualities that are important in this player. For the development of small side game players should be between another factor, part of the training moment at this level of training. With this, it is understood as a valid instrument for learning in team sports, in this case, in Futsal, according to the athlete's development process in the training process in increasing VO<sub>2</sub>max.

**Competing Interests** The authors declare that they have no competing interests

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