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How do block training and circuit training affect physical fitness? A comparative study of futsal athletes

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ABSTRACT

Background: Physical fitness is a fundamental component of performance in futsal, a sport that demands high levels of stamina, strength, and endurance. Despite the abundance of training programs available, few have been systematically tested for their effectiveness in enhancing fitness among futsal athletes. **Research Objectives**: This study aims to compare the effectiveness of block training and circuit training in improving physical fitness among male futsal athletes. **Methods**: A quasi-experimental design with a two-group pretest-posttest structure was employed. Twenty male futsal athletes from Universitas PGRI Pontianak were selected through purposive sampling and divided equally into a block training group and a circuit training group. Both groups underwent 12 training sessions over four weeks, each performed at full intensity (100% 1RM) using 10 fitness stations, including leg press, bench press, and sit-ups. Physical fitness was assessed using the Cooper test. Data were analyzed using paired and independent t-tests, with normality confirmed through the Shapiro-Wilk test. **Finding/Results**: Both training methods significantly improved the athletes' physical fitness levels ($p < 0.05$). Although circuit training yielded slightly better average improvements than block training, the difference between the two was not statistically significant ($p = 0.385$). **Conclusion**: Both block and circuit training are effective in enhancing the physical fitness of futsal athletes. While circuit training may offer slight advantages in practical implementation, the absence of a statistically significant difference suggests that both methods can be applied flexibly based on training goals and athlete preferences. Future research should explore comparisons with other conditioning methods, such as high-intensity interval training (HIIT) or plyometrics, to identify the most optimal training strategy.

Keywords: Block training; circuit training; physical fitness; futsal; athletic performance

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INTRODUCTION

Exercise is a physical activity that can be done by all age groups, including the elderly (Mashud et al., 2024; Rismanto et al., 2024; Suryadi et al., 2022). These activities make a significant contribution to an individual's

physical, emotional, and psychological well-being (Hughes et al., 2020). One of the main benefits of exercise is that it improves health while reducing the risk of disease (Meo et al., 2021). Research shows that women in rural areas tend to have lower levels of physical activity than those living in urban areas (Moreno-Quispe et al., 2021). In addition, research data shows that physical activity levels in modern youth tend to decrease (Lipošek et al., 2019). This decline contributes to a decrease in physical fitness, especially among athletes.

Physical fitness has an important role in supporting the performance of futsal athletes, which requires a combination of physical abilities such as cardiovascular endurance, muscle strength, agility, and speed (Satrio & Winarno, 2019). As a high-intensity sport, futsal requires players to be able to perform explosive movements, such as fast sprints, sudden changes in direction, and complex maneuvers in a short time (Costa Miranda et al., 2020). Therefore, a specifically designed training program is needed to meet the physical needs of players. A futsal player should ideally have endurance, repeated sprint ability, leg strength, as well as technical skills such as passing, shooting, agility, and good coordination (Naser et al., 2017). This confirms that futsal requires an optimal level of physical fitness.

Lack of physical activity has been identified as one of the risk factors for various health disorders, including stress (Østerås et al., 2017), and cardiovascular disease (Vancampfort et al., 2019). Based on these facts, it can be concluded that physical activity has a significant impact on health. For people with breast cancer, exercise is an effective strategy to improve physical fitness (Dieli-Conwright et al., 2018). According to Septianto et al. (2024), physical fitness is influenced by external factors, including physical activity. Several studies have also shown that sports activities can improve physical fitness (Cocca et al., 2020; Wang, Zeng, et al., 2023; Wang, Liu, et al., 2023; Zhang et al., 2023), which in turn contributes to improved athlete performance (De Oliveira et al., 2021). In addition, poor physical fitness is also associated with injury risk in the sport of futsal (Angoorani et al., 2021). Team sports demand high levels of physical fitness, making it an important component of athletic performance (Mancha-Triguero et al., 2020).

The importance of physical fitness in team sports, such as futsal, lies in its ability to support physical endurance and optimal performance. As a high-intensity sport, futsal demands maximum endurance, strength, agility, and speed from the players (Stubbs-Gutierrez & Medina-Porqueres, 2021). Circuit training is one method that is often used because it is able to integrate various fitness components in one training session (Suniga et al., 2025). Two training methods that are often applied to improve physical fitness are block training and circuit training. Block training focuses on developing one fitness component intensively over a period of time before moving on to another component (Mallo, 2012). Meanwhile, circuit training combines various fitness components in a single session, allowing for the simultaneous development of physical abilities (Dhanaraj & Palanisamy, 2013).

Although there have previously been many studies that discuss circuit training on physical fitness (Sumaryanti & Tomoliyus, 2020; Suniga et al., 2025), and even 24-week combined circuit and mobility training on physical fitness and body composition (Pugliese et al., 2025). Furthermore, most previous studies have examined the effectiveness of each method separately without a clear comparison in one study (Gutiérrez-Arroyo et al., 2023; Mallo, 2012), especially in the sport of futsal which has unique characteristics such as high intensity and shorter game duration than soccer. As for the research conducted on basketball players with training block of specific circuit training. However, no study has directly compared their effectiveness in the context of futsal.

The novelty of this study lies in comparing the effectiveness of block training and circuit training, two approaches with different characteristics, to determine which method is more effective in improving the physical fitness of futsal athletes. While both block and circuit training have been independently studied, few studies have directly compared their impact on futsal athletes' physical fitness using a controlled experimental design. This study was designed to address the unique physical needs in futsal, which distinguishes it from other sports (Lago-Fuentes et al., 2018). Therefore, this study aims to compare the effectiveness of block training and circuit training on the physical fitness of futsal athletes. With the results of this study, it is hoped that futsal coaches can design more efficient and effective training programs according to the needs of athletes. It can also be the basis for innovation in sports training programs.

METHOD

Participants

The research participants in this study consisted of 20 male futsal athletes from Universitas PGRI Pontianak, who were selected through purposive sampling technique. These athletes were actively involved in regular training and competitive matches, ensuring that they met the criteria to participate in this study. The age range of the participants was within the 18-22 years category with an average body weight and height of 170cm/68kg, ensuring homogeneity in physical and physiological characteristics. In addition, the participants had varying levels of playing experience, with some being more experienced competitors while others were developing their skills at university level. The study was conducted under partly cloudy weather conditions, with a real-time temperature of 32°C, humidity of 77%, and wind speed of 11 km/h. These environmental factors were noted as they could affect the athletes' physical performance during training and testing sessions. The inclusion of these specific details ensures a comprehensive understanding of the external conditions that might affect the results of the study.

Research Design

In this study, there were two treatments, so it used a two group pretest posttest design. This study compares between pretest and posttest, the groups in this study were given treatment with block training and circuit training on physical fitness before and after the treatment given, as for the research design picture as follows.

Table 1. Two Group Pretest Posttest Research Design

O1	**X1**	**O2**
O1	**X2**	**O2**

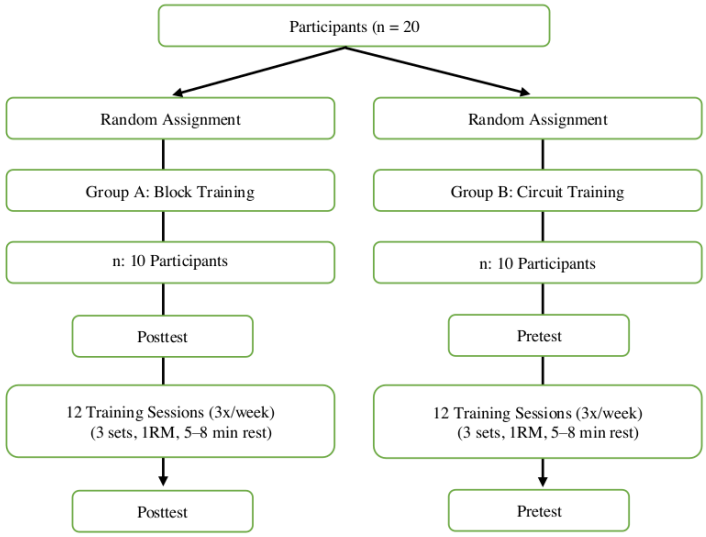

Figure 1. Experimental Design Diagram

Research Procedure

The study began with an initial measurement (pretest) to evaluate the initial condition of the participants' physical fitness. This measurement was carried out using a cooper test in accordance with the established implementation procedures (Alvero-Cruz et al., 2019). Furthermore, participants were given treatment in the form of block training and circuit training programs. This exercise uses 10 fitness equipment, namely triceps, leg press, pull down, calf raise, butterfly, leg extension, bench press, sit-ups, back-ups and biceps. Exercises were performed in 3 sets per session with maximum repetitions (1 RM) and rest between sets for 5-8 minutes. The program was carried out for 12 sessions, with full intensity 3 times a week. After the treatment was completed, a final measurement (posttest) was conducted to evaluate the improvement of participants' physical fitness. If the results show improvement, then the exercise program is declared effective and can be recommended for trainers and fitness instructors.

Table 2. Circuit Training Program

Exercise	Block and Circuit Training
Intensity	100% or 1 RM
Post/Set	10 Posts / 3 sets per post
Time	10-12 seconds per post
Rest	5 - 8 minutes

Data Analysis

Before conducting a different test, it is necessary to conduct a normality prerequisite test, if the data is normal then it is tested with the T test if not then using a non-parametric test. Data is normally distributed if the significance value is $p > 0.05$, and the data is said to be abnormal if the significance value is $p < 0.05$. If the prerequisite test passes which means the data contributes normally, then the data will be analyzed using the t-test which is used to calculate the effectiveness of the treatment. The research was conducted using the t-test with the help of the SPSS 26 application.

RESULTS AND DISCUSSION

Table 3 displays the results of the Shapiro-Wilk normality test to check whether the data is normally distributed or not. The Statistic value is the Shapiro-Wilk statistical value, while df indicates the degrees of freedom, and Sig. is the significance value (p-value). Sig. (p-value) on all data is greater than 0.05, so the data is considered normally distributed.

Table 3. Shapiro-Wilk Normality Test Results

Results	Statistic	df	Sig.
Pretest Block	0.948	10	0.642
Posttest Block	0.923	10	0.386
Pretest Circuit	0.899	10	0.216
Posttest Circuit	0.927	10	0.416

Table 4. Homogeneity Test Results

Results	Levene Statistic	df1	df2	Sig.
Based on Mean	0.013	1	18	0.909

Based on the results of Table 4 displays the results of the homogeneity test using the Levene's Test method based on the average (mean). The aim is to check whether the variance between groups is homogeneous. Interpretation: The Sig. value of 0.909 (greater than 0.05) indicates that the variance between groups is homogeneous.

Table 5. Paired Sample Test Results

Results	Exercise	Mean	Std. Deviation	df	Sig. (2-tailed)
Pair 1	Pretest Block - Posttest Block	0.94400	0.44091	9	0.000
Pair 2	Pretest Circuit - Posttest Circuit	1.04600	0.09812	9	0.000

Table 5 presents the results of the paired sample t-test, which is used to compare two paired measurements (e.g., before and after training). Mean is the average of the differences, Std. Deviation indicates the standard deviation, and Sig. (2-tailed) is the significance value. Pair 1 and Pair 2 have a Sig. value of 0.000 (smaller than 0.05), indicating a significant difference between the pretest and posttest in each type of exercise. Based on these results, it can be concluded that block training and circuit training have a significant effect on the physical fitness of futsal athletes.

Table 6. Independent Test Results

Results	F	Sig.	t	df	Sig. (2-tailed)
Equal variances assumed	0.013	0.909	0.890	18	0.385
Equal variances not assumed			0.890	17.990	0.385

The results in Table 6 show the results of the independent t-test to compare two independent groups. There are two scenarios: Equal variances assumed and Equal variances not assumed. The F value is the Levene statistic for the homogeneity of variance test, t is the value of the t-test statistic, and Sig. (2-tailed) is the significance value. The Sig. value in both scenarios is 0.385 (greater than 0.05), indicating no significant difference between the independent groups.

Table 6. Descriptive Results of Pretest and Postest

Results	N	Range	Minimum	Maximum	Mean	Std. Deviation
Pretest Block	10	3.11	9.55	12.66	11.4320	0.92265
Posttest Block	10	1.87	9.47	11.34	10.4880	0.57331
Pretest Circuit	10	1.78	10.46	12.24	11.3030	0.55253
Posttest Circuit	10	1.85	9.36	11.21	10.2570	0.58688

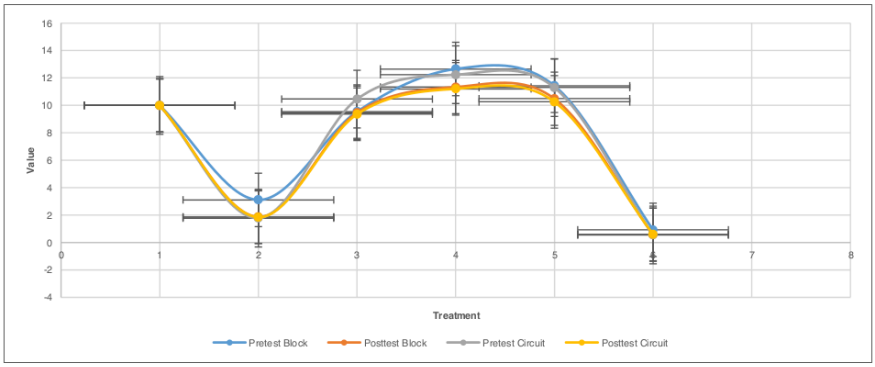

Figure 1. Descriptive Results

The descriptive results in Table 6 and Figure 1 present descriptive data, including the number of samples (N), range of values (Range), minimum and maximum values, mean (Mean), and standard deviation (Std. Deviation) for each pretest and posttest group. The Posttest Block mean (10.4880) was lower than the Pretest Block mean (11.4320), indicating a decrease. The average of Posttest Circuit (10.2570) was also lower than Pretest Circuit (11.3030), showing a similar pattern. Based on these results, the value of Posttest Circuit (10.2570) and Posttest Block (10.4880) means that the differences that occur are not so significant, but circuit training has a better impact on the physical fitness of futsal athletes.

This study compares the effectiveness of block training and circuit training in improving the physical fitness of futsal athletes. Both are different training methods, with their own advantages. Block training emphasizes

the development of one fitness component intensively over a period of time before moving on to another. In contrast, circuit training allows the development of various fitness components simultaneously in one session. The results of this study indicate that there is no difference in the effect of block training and circuit training on physical fitness in futsal athletes.

The results showed that block training provided better improvements based on mean scores in certain components, such as muscular strength and cardiovascular endurance, due to its intensive focus. This is in line with the opinion of (Mallo, 2012), which states that this method is ideal for building a strong physical foundation through gradual and structured training. However, the weakness of block training lies in the lack of efficiency in developing overall fitness components in a short period of time, making it less suitable for athletes who have a limited training schedule (Painter et al., 2012).

On the other hand, circuit training is superior in improving various aspects of fitness simultaneously, such as agility, muscular strength, and endurance (Lee & An, 2022). It is also more appealing to athletes as it involves a variety of movements, thus reducing boredom during training (Dhanaraj & Palanisamy, 2013). However, a drawback of this method is the lack of in-depth focus on developing specific components. Athletes with specific needs, such as improving leg strength for futsal, may require additional methods to achieve maximum results.

This study also found that circuit training is more effective in preparing futsal athletes for their sport-specific needs. As a high-intensity sport, futsal requires an optimal combination of agility, endurance and strength (Costa Miranda et al., 2020). Circuit training is able to replicate the intensive movement patterns of futsal, such as sprints, dribbles, and quick direction changes, making it more relevant to the demands of the game. Another study revealed that significant differences were shown in extracurricular basketball and futsal on VO_2 max values (Mahendra & Hidayat, 2020).

A study revealed that the level of physical fitness in extracurricular basketball and futsal students is still relatively low (Suryadi, 2022; Suryadi & Rubiyatno, 2022). This statement is reinforced by Kang et al. (2015) obtained the results of a multicomponent training program can improve the physical fitness of elderly women, so this is an illustration to improve and maintain physical fitness. This means that exercise in accordance with the portion will affect physical condition (Zawawi & Burstiando, 2020).

Some exercises that can be done to improve physical fitness, one of which is by doing physical activity through sports (Hardinata et al., 2024; Ramirez-Campillo et al., 2021; Rubiyatno et al., 2023; Suratmin et al., 2024; Suryadi et al., 2021), and food intake also needs to be considered (Kuswari et al., 2019). Fartlek training can be used to increase VO_2 max of basketball athletes (Fernandes, 2019), and by performing isometric exercises in the general physical preparation system of basketball players to prevent injury (Bolotin & Bakayev, 2016).

However, this study has some weaknesses. Firstly, the sample used was limited to futsal athletes with a certain fitness level, so the results may not be generalizable to other groups, such as beginners or professional athletes. Secondly, the duration of the intervention may not have been sufficient to observe the long-term effects of these two training methods. This is in line with the view of Lago-Fuentes et al. (2018) who suggested that further research is needed to evaluate the effect of the training methods over a longer period. Despite the limitations mentioned, this study should be an important contribution to physical fitness, as well as physical fitness research, and is beneficial for explaining the main negative factors (Kljajevi et al., 2022).

CONCLUSION

This study shows that both block training and circuit training are equally effective in improving the physical fitness of futsal athletes. No significant difference was found between the two training methods in terms of fitness improvement, which means each method has its own advantages. Block training is more suitable for intensive development of specific fitness components, while circuit training is more efficient for improving overall fitness and is more relevant to the physical needs in futsal games. However, this study has several limitations, such as the relatively small sample size and the duration of the program which only lasted for four weeks, so the results cannot be widely generalized. In addition, external factors such as nutritional intake, physical activity outside of training, and sleep quality were not strictly controlled and may affect the results.

Therefore, future research is recommended to include a larger and more diverse sample size, use a longer exercise duration, and consider measuring additional fitness variables such as VO_2 max, body composition and psychological aspects. Future research could also explore the effects of combining block training and circuit training to produce a more adaptive training program that suits the individual athlete's preparation phase.

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CONFLICT OF INTEREST

Clearly explain whether there are any conflicts of interest related to the reported research.

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