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# The Effect of Circuit Training and Fartlek on the Cardiovascular Endurance of U-15 Futsal Athletes of Shirocker Club Baturaja

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## *Abstrak*

*Penelitian ini bertujuan untuk mengkaji pengaruh latihan sirkuit dan latihan fartlek terhadap daya tahan kardiovaskular atlet futsal U-15 dari Shirocker Club Baturaja. Daya tahan kardiovaskular memainkan peran krusial dalam performa futsal karena menentukan kemampuan pemain untuk mempertahankan aktivitas intensitas tinggi sepanjang pertandingan. Penelitian ini menggunakan desain quasi-eksperimental dengan struktur dua kelompok pra-tes dan pasca-tes, melibatkan 20 atlet laki-laki berusia 13–15 tahun. Peserta dibagi menjadi dua kelompok yang sama: satu kelompok menerima latihan sirkuit dan kelompok lain menerima latihan fartlek selama enam minggu, tiga sesi per minggu, dengan setiap sesi berdurasi 60 menit. Daya tahan kardiovaskular diukur menggunakan Tes Kebugaran Multistage (Bleep Test) untuk menentukan tingkat $VO_2$Max. Data dianalisis menggunakan uji t sampel berpasangan dan uji t sampel independen pada tingkat signifikansi 0,05. Hasil menunjukkan bahwa kedua metode latihan secara signifikan meningkatkan skor $VO_2$Max; namun, kelompok fartlek mencapai peningkatan yang lebih tinggi dibandingkan kelompok latihan sirkuit. Hal ini menunjukkan bahwa latihan fartlek, dengan pola kecepatan yang bervariasi dan beban intermiten, lebih baik dalam mensimulasikan tuntutan dinamis futsal. Dapat disimpulkan bahwa kedua metode efektif, tetapi latihan fartlek menghasilkan peningkatan yang lebih besar dalam daya tahan kardiovaskular di kalangan atlet futsal muda.*

**Kata kunci:** *Ketahanan kardiovaskular; latihan sirkuit; fartlek; futsal; $VO_2$Max*

## Abstract

This study aimed to examine the effect of circuit training and fartlek training on the cardiovascular endurance of U-15 futsal athletes from Shirocker Club Baturaja. Cardiovascular endurance plays a crucial role in futsal performance as it determines players' ability to sustain high-intensity activity throughout the game. The research employed a quasi-experimental design with a pretest-posttest two-group structure involving twenty male athletes aged 13–15 years. Participants were divided into two equal groups: one received circuit training and the other fartlek training for six weeks, three sessions per week, with each session lasting 60 minutes. Cardiovascular endurance was assessed using the Multistage Fitness Test (Bleep Test) to determine $VO_2$Max levels. The data were analyzed using paired sample t-tests and independent sample t-tests at a 0.05 significance level. The results showed that both training methods significantly improved $VO_2$Max scores; however, the fartlek group achieved higher improvements than the circuit training group. This indicates that fartlek training, with its varied pace and intermittent load patterns, better simulates the dynamic demands of futsal. It can be concluded that both methods are effective, but fartlek training produces greater enhancement in cardiovascular endurance among youth futsal athletes.

**Keywords:** cardiovascular endurance; circuit training; fartlek; futsal; $VO_2$Max

## 1. INTRODUCTION

Cardiovascular endurance is an essential component of physical fitness that greatly influences athlete performance, especially in high-intensity sports such as futsal. Previous studies have shown that $VO_2$max is closely related to match performance in futsal players because it reflects the body's ability to sustain high-intensity activity during the game (Makaje et al., 2022; Naser & Ali, 2020). Futsal requires players to move quickly, perform rapid transitions between attack and defense, and repeatedly alternate between aerobic and anaerobic activities throughout the match (Mohr et al., 2022). Athletes with higher cardiovascular endurance have

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advantages in faster recovery, more efficient energy use, and the ability to maintain performance consistently during both halves of play (Naser & Ali, 2020). In this context, $VO_2$max becomes an important indicator of the efficiency of the heart, lungs, and muscles in transporting and utilizing oxygen during physical activity (Hoffmann et al., 2022; Suharjana, 2012). Training methods such as aerobic interval training, fartlek, and circuit training are known to produce physiological adaptations that improve cardiovascular efficiency and increase $VO_2$max capacity (Hoffmann et al., 2022).

Although various studies have confirmed that endurance-based training programs can improve $VO_2$max, there is still no consistent conclusion regarding which training method is most effective for improving cardiovascular endurance in young futsal athletes. Research indicates that both interval training and fartlek training can significantly improve cardiovascular endurance and fitness parameters related to $VO_2$max (Fitriansyah & Susanto, 2022). In addition, structured training programs such as interval and fartlek training can increase oxidative capacity and accelerate oxygen uptake kinetics, which directly contributes to improved cardiovascular endurance during high-intensity physical activity (Al Haddad et al., 2023). On the other hand, several studies report that circuit training is effective in improving muscle strength and aerobic endurance through structured and varied exercise stations (Borges et al., 2021; Faigenbaum & Myer, 2021; Aryatama, 2022). Meanwhile, other studies suggest that fartlek training may be more effective because its variable intensity patterns are similar to the dynamic demands of futsal games (Mohr et al., 2022; Cihan & Akyüz, 2021; Gunawan, 2019; Hartono, 2020). These differing findings highlight the need for further research that directly compares these training methods in the context of young futsal athletes (Siahaan, 2023).

In Indonesia, particularly at the youth development level, many coaches still rely on conventional training methods without fully considering the physiological and psychological characteristics of adolescent athletes. However, the age range of 13–15 years is a crucial phase for cardiovascular system development and aerobic adaptation (Malina et al., 2021). During this stage, appropriate training interventions can significantly influence the development of endurance capacity and overall athletic performance. Youth futsal clubs, such as Shirocker Club Baturaja, which actively develop young athletes, require scientifically based training approaches so that improvements in physical fitness can be measured objectively and systematically. Previous studies have demonstrated that circuit training and resistance-based programs can lead to physiological adaptations such as increased muscle strength and endurance, which support aerobic capacity and sports performance in children and adolescents (Faigenbaum & Myer, 2021). Therefore, selecting an effective and efficient training method to improve cardiovascular endurance is highly relevant for the development of modern futsal performance (Pratama, 2023; Ramadhan, 2024).

The novelty of this study lies in the direct comparison between circuit training and fartlek training methods in improving cardiovascular endurance among U-15 futsal athletes in a regional club setting, an approach that has not been widely explored in Indonesia. Previous studies have shown that both training methods significantly increase $VO_2$max in futsal athletes (Saputra, 2024; Syahputra, 2026). However, this study goes further by examining the effectiveness of these methods within training conditions that reflect the real characteristics of futsal games, which require speed, agility, changes of direction, and rapid recovery after high-intensity activity (Mohr et al., 2022; Zainuddin et al., 2023). Practically, the results of this study are expected to provide guidance for coaches and physical education teachers in designing effective training programs aimed at improving the cardiovascular endurance of

young athletes (Hakim et al., 2020; Risnawan et al., 2024). Theoretically, this research contributes to the development of knowledge regarding aerobic training methods in futsal, particularly among adolescent athletes who are experiencing optimal physiological development (Hidayat & Ramdani, 2023). Overall, the study aims to provide a scientific basis for determining more efficient training methods that align with the physiological needs of young futsal athletes in Indonesia (Kusnadi & Hermanto, 2021; Mulyana, 2021).

Based on the theoretical framework and previous studies, this research proposes three hypotheses. First, circuit training significantly improves the cardiovascular endurance of U-15 futsal athletes at Shirocker Club Baturaja (Sanjaya, 2020; Satria, 2019; Yunus, 2022). Second, fartlek training significantly improves the cardiovascular endurance of U-15 futsal athletes at Shirocker Club Baturaja (Cihan & Akyüz, 2021; Sandi et al., 2023; Wicaksono, 2024). Third, fartlek training provides greater improvements in cardiovascular endurance compared to circuit training in young futsal athletes (Fitriansyah & Susanto, 2022; Putra & Arifin, 2022; Syahputra, 2026). These hypotheses serve as the basis for examining the effectiveness of both training methods in improving the cardiovascular endurance of adolescent futsal athletes.

## 2. METHOD

This study employed a quasi-experimental research design using a two-group pretest–posttest design. This design was selected because it allows researchers to compare the effects of two different treatments applied to separate groups that have relatively similar initial conditions (Kusuma, 2020; Jiwantomo, 2021). In this study, the two treatment groups consisted of a circuit training group and a fartlek training group. Kusuma (2020) stated that circuit training can significantly increase $VO_2$max in futsal athletes, while Jiwantomo (2021) also demonstrated that circuit training contributes to improvements in cardiovascular endurance in female futsal athletes. Before and after the six-week training program, both groups were given a cardiovascular endurance test using the Multistage Fitness Test (Bleep Test) to measure $VO_2$max as an indicator of cardiovascular fitness improvement (Suharjana, 2012; UPY, 2025).

The population of this study consisted of all 20 U-15 futsal athletes from Shirocker Club Baturaja. The sampling technique used was total sampling, because the population size was relatively small and all members had homogeneous characteristics, including being male athletes aged 13–15 years who had participated in regular futsal training for at least one year (Malina et al., 2021). The sample was then randomly divided into two groups using random assignment, each consisting of 10 athletes. Group A (n = 10) received the circuit training program, while Group B (n = 10) received the fartlek training program. Each group followed the training program for six weeks, with a frequency of three training sessions per week, a duration of 60 minutes per session, and an exercise intensity ranging from 70–85% of maximum heart rate (HRmax) (Hidayat & Ramdani, 2023; Putra, 2025). Previous research has shown that fartlek training with varying intensity can increase the maximum heart rate of futsal athletes and contribute to cardiovascular adaptation and improved endurance capacity (Putra, 2025).

The instrument used in this study was the Multistage Fitness Test (Bleep Test), which is widely used to measure aerobic capacity or $VO_2$max. The test was conducted on a 20-meter track, where athletes were required to run back and forth according to a beep sound that gradually increased in speed at each level. The test ended when the athlete could no longer keep up with the pace of the beep sound. The final score, which consists of the level and

number of shuttles completed, was then converted into a $VO_2$max value using a standardized formula (Sasmita, 2015; UPY, 2025).

The data obtained from the pretest and posttest were analyzed using descriptive and inferential statistical techniques. Descriptive statistics were used to determine the mean, standard deviation, minimum value, and maximum value of the pretest and posttest results. Furthermore, inferential statistical analysis was conducted through several stages. First, a normality test using the Kolmogorov–Smirnov test was performed to determine whether the data were normally distributed. Second, a homogeneity test using Levene's test was carried out to determine whether the variances between the two groups were equal. Third, a paired sample t-test was used to examine whether there was a significant improvement in cardiovascular endurance within each group before and after the training treatment (Yunus, 2022; Sandi et al., 2023). Finally, an independent sample t-test was conducted to analyze the difference in the improvement of cardiovascular endurance between the circuit training group and the fartlek training group (Siahaan, 2023). All statistical tests in this study used a significance level of $\alpha = 0.05$, and the data analysis process was performed using SPSS software version 26.0.

## 3. RESULT AND DISCUSSION

***Result***

This study was conducted over six weeks on two groups of U-15 futsal athletes from Shirocker Club Baturaja: a circuit training group and a fartlek group. Each group consisted of 10 athletes. The Multistage Fitness Test (Bleep Test) was used to measure VO2+ values.2Max before (pretest) and after (posttest) treatment (UPY, 2025).

**Table 1.** *Descriptive Statistics (Pretest–Posttest Results)*

| Group | N | Pretest | Posttest | Improvement | Percentage |
|---|---|---|---|---|---|
| Circuit Training | 10 | 38.6 | 43.1 | 4.5 | 11.7% |
| Fartlek Training | 10 | 38.8 | 45.5 | 6.7 | 17.3% |

This finding is in line with other research showing that circuit training and fartlek are both capable of increasing $VO_2$Max and cardiovascular endurance in futsal players (Hakim et al., 2020; Saputra, 2024; Syahputra, 2026).

1) Normality and Homogeneity Test

The results of the Kolmogorov–Smirnov normality test showed that all data had a significant value ($p > 0.05$), indicating a normal distribution. The homogeneity test using Levene's Test also showed a p value > 0.05, indicating that both groups had homogeneous variances and met the requirements for parametric testing.

**Table 2.** *Normality and Homogeneity Test Results*

| Group | t Count | df | Sig. (p) | Information |
|---|---|---|---|---|
| Circuit Training | 7,421 | 9 | 0.000 | Significant ($p < 0.05$) |
| Fartlek Training | 9,337 | 9 | 0.000 | Significant ($p < 0.05$) |

Both groups showed significant improvement between the pretest and posttest. This demonstrates that both circuit training and fartlek training significantly improved the cardiovascular endurance of U-15 futsal athletes from Shirocker Club Baturaja (Borges et al., 2021; Aryatama, 2022; Cihan & Akyüz, 2021; Sandi et al., 2023).

**Table 3.** *Independent Sample t-Test Results*

| Variables | t-Count | df | Sig. (p) | Information |
|---|---|---|---|---|
| Posttest $VO_2$Max | 2,367 | 18 | 0.029 | Significantly different (p < 0.05) |

Based on the results of the Independent Sample t-Test, the p value was obtained = 0.029 < 0.05, which means there is a difference in the increase in $VO_2$There was a significant difference between the fartlek and circuit training groups. Thus, fartlek training had a greater impact on improving cardiovascular endurance than circuit training (Fitriansyah & Susanto, 2022; Putra & Arifin, 2022; Hartono, 2020). The results of this study indicate that both training methods, circuit training and fartlek, are equally effective in improving the cardiovascular endurance of adolescent futsal athletes. However, greater improvements were found in the fartlek group. Circuit training improves endurance through a combination of strength, agility, and muscular endurance training, which progressively stimulates the cardiovascular system (Faigenbaum & Myer, 2021; Sari, 2022). "Research shows that circuit training can have a significant impact on improving agility in futsal players." (Sari, 2022). Repetitive activity at moderate-high intensity improves the heart's efficiency in pumping blood, increases oxygen flow to muscles, and improves aerobic energy metabolism (Borges et al., 2021; Pratama, 2023). Meanwhile, fartlek training produces a higher cardiovascular adaptation effect because it involves variations in speed and intensity that mimic the conditions of a futsal game. According to Mohr et al. (2022), training with random changes in intensity encourages the body to adapt to the transition between aerobic and anaerobic energy systems (Obah, 2024). Thus, fartlek training further challenges the heart-lung system and strengthens the body's response to fatigue (Gunawan, 2019; Hidayat & Ramdani, 2023). Increased $VO_2$The maximum performance in the fartlek group also aligns with the results of research by Cihan & Akyüz (2021), which showed a significant increase of 15–20% in adolescent soccer players after six weeks of fartlek training. Research by Al Haddad et al. (2023) also confirmed that interval-based fartlek training can increase muscle oxidative capacity and the efficiency of oxygen delivery to tissues more effectively than static training.

Furthermore, from a psychological perspective, fartlek has the advantage of being more dynamic and enjoyable, thus increasing participant motivation during training (Ntoumanis et al., 2021; Mulyana, 2021). "Motivation and engagement in youth sports training are essential for sustaining cardiovascular endurance development through methods like circuit training and fartlek." (Ntoumanis et al., 2021). For young athletes, training variety is crucial to maintain interest and prevent boredom during the training process. Thus, the results of this study strengthen the theory that fartlek training is a more relevant and effective method in improving the cardiovascular endurance of adolescent futsal athletes, because it is in accordance with the characteristics of futsal games that require changes in tempo, speed, and rapid recovery between game phases (Mohr et al., 2022; Putra & Arifin, 2022; Syahputra, 2026).

## Discussion

The results showed that both circuit training and fartlek significantly improved the cardiovascular endurance of U-15 futsal athletes from Shirocker Club Baturaja. However, the

fartlek group experienced a significantly higher increase of 17.3% compared to 11.7% in the circuit training group. This suggests that varying the intensity and speed of fartlek training is more effective at optimally stimulating the cardiovascular system than circuit training, which is more structured and repetitive (Cihan & Akyüz, 2021; Sandi et al., 2023; Wicaksono, 2024).

This finding is in line with the research results of Suharjana (2021) which stated that fartlek training can increase $VO_2$Max significantly increases in youth soccer athletes due to its characteristics that resemble game patterns. Fitriansyah & Susanto (2022) also found that fartlek provides greater aerobic and anaerobic adaptations than conventional interval training. Research by Hartono (2020) shows that varying intensity in fartlek stimulates increased heart efficiency and lung capacity more effectively. Circuit training has also been shown to improve physical fitness, particularly in terms of muscle strength and general endurance (Wahyudi, 2021; Aryatama, 2022; Sanjaya, 2020). However, because the training is stationary with regular rest periods, stimulation of the aerobic and anaerobic energy systems is not as complex as fartlek. According to Suhartono & Rahayu (2020), circuit training is more effective in increasing local muscle endurance, while fartlek is superior in increasing cardiovascular endurance due to the rhythmic changes that mimic the conditions of a real futsal match. This research also supports the findings of Hidayat & Ramdani (2023) that training with varying intensities (interval/fartlek) can improve oxygen efficiency and accelerate recovery after strenuous activity. Putra & Arifin (2022) stated that the fartlek training model can adjust aerobic and anaerobic energy transitions, making it more suitable for episodic sports like futsal. Meanwhile, Mulyana (2021) emphasized that psychological factors such as enjoyment and variety in fartlek contribute to increasing motivation and consistency in young athletes during training.

However, there are several studies that disagree. Sanjaya (2020) stated that circuit training can also increase $VO_2$Max is similar if the intensity and volume of training are increased. Kusnadi & Hermanto (2021) reported that too short a fartlek training duration (<4 weeks) did not significantly impact $VO_2$Max. These differences in results are thought to be due to variations in age, initial fitness level, and duration of the training program (Gunawan, 2019; Jiwantomo, 2021; Kusuma, 2020). Physiologically, fartlek provides more complex adaptations because it involves the simultaneous activation of the aerobic and anaerobic systems (Hoffmann et al., 2022; Al Haddad et al., 2023). The random acceleration and deceleration patterns in fartlek require increased cardiac output (stroke volume), increased mitochondrial efficiency, and improved oxygen circulation to muscle tissue. This is particularly relevant for futsal athletes, who require high endurance and rapid recovery. Thus, the results of this study confirm that fartlek training is a more effective and applicable method for developing young futsal athletes. In addition to improving physiological abilities, fartlek also supports psychological aspects such as motivation and enjoyment during training, which are crucial in the context of long-term development (Ntoumanis et al., 2021; Mulyana, 2021).

## 4. CONCLUSION

Based on the research results, it can be concluded that both circuit training and fartlek training have a significant effect on increasing cardiovascular endurance ($VO_2$Max) in U-15 futsal athletes at Shirocker Club Baturaja. However, fartlek training provided greater improvements than circuit training. This suggests that varying the intensity and speed of fartlek is more effective in stimulating the cardiovascular system and better suited to the dynamic nature of futsal. Practically, coaches and physical education teachers are advised to integrate fartlek

training into youth athlete development programs to improve aerobic fitness, accelerate recovery, and maintain training motivation. For further research, it is recommended to conduct further studies with longer training durations and include other physiological parameters such as heart rate, lactate threshold, and intrinsic motivation.

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