



The Effect of Fartlex Training on Increasing VO2Max in Football Players

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ABSTRACT

Football requires players to maintain high-intensity performance, repeated sprint ability, and active recovery throughout the match. One of the key physiological components supporting these demands is maximal oxygen uptake (VO2max). Preliminary observations at Bank Sulselbar Football Academy indicated that several athletes experienced a decline in stamina after the 70th minute, which affected movement intensity and overall match performance. Therefore, an appropriate conditioning method is needed to improve aerobic capacity. This study aimed to determine the effect of fartlek training on increasing VO2max among football athletes at Bank Sulselbar Football Academy. This research used an experimental method with a pretest-posttest design. The independent variable was fartlek training, while the dependent variable was VO2max improvement. The research sample consisted of football athletes from Bank Sulselbar Football Academy, with the fartlek training group analyzed through pre-test and post-test measurements. Data were analyzed using descriptive statistics, normality testing, paired-sample t-test, and independent-sample t-test. The descriptive results showed that the mean VO2max score increased from 38.8000 in the pre-test to 41.0400 in the post-test, with an average improvement of 2.2400 points. The paired-sample t-test showed a t-count value of 8.806, higher than the t-table value of 1.833, with a significance value of $0.000 < 0.05$. The independent-sample t-test also showed a significant difference, with $t\text{-count} = 3.790 > t\text{-table} = 2.093$ and $\text{Sig.} = 0.000 < 0.05$. These findings indicate that fartlek training significantly improves VO2max. Thus, fartlek training can be recommended as an effective, practical, and football-specific conditioning method to improve aerobic endurance among academy football athletes.

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INTRODUCTION

Football is an intermittent team sport that requires players to repeatedly perform high-intensity running, acceleration, deceleration, sprinting, duels, recovery movements, and technical actions under changing tactical situations. Therefore, football performance is not determined only by technical mastery such as passing, dribbling, shooting, and tackling, but also by the player's ability to sustain physical output throughout the match. In this context, aerobic endurance becomes a fundamental component because it supports recovery between high-intensity actions, delays fatigue, and helps players maintain decision-making quality until the final phase of the game (Slimani et al., 2019; Modric et al., 2020; Clemente et al., 2021).



VO2max is widely used as an indicator of maximal aerobic capacity and cardiorespiratory fitness. Although football performance cannot be explained by VO2max alone, players with better aerobic capacity generally have greater ability to tolerate repeated running demands, recover faster between intense actions, and maintain stable movement intensity during competition (Ghouili et al., 2023; Michailidis, 2024; Asimakidis et al., 2025). For football academies, VO2max is particularly important because youth and developing athletes are still building the physiological foundation needed for more advanced tactical and technical performance.

Based on preliminary observation at Bank Sulselbar Football Academy, the team has shown an inconsistent competitive record in recent years. Of the eight competitions followed, the academy team only achieved championship results in three events. Field observation also indicated that several players experienced visible physical decline after the 70th minute. Players appeared to lose stamina, reduce movement intensity, and show difficulty maintaining optimal performance in the late stages of the match. This condition suggests that insufficient aerobic endurance may be one of the limiting factors in the team's competitive performance. Therefore, a scientifically structured training method is needed to improve VO2max and help athletes sustain match intensity more effectively.

Recent sports science literature emphasizes that football conditioning should be specific, progressive, and relevant to the intermittent nature of the game. Training methods such as high-intensity interval training, small-sided games, repeated sprint training, and fartlek have been widely discussed as approaches to improve aerobic and anaerobic performance in football players (Clemente et al., 2021; Hostrup & Bangsbo, 2022; Yang et al., 2025). Among these methods, fartlek training is considered highly relevant because it combines continuous running with variations in speed and intensity. The term fartlek, commonly understood as "speed play," reflects a training model that alternates between low, moderate, and high intensities in one training session.

Conceptually, fartlek training stimulates the cardiovascular system through variable intensity loads. This variation encourages athletes to adapt to changes in oxygen demand, heart rate response, and muscular endurance. Such characteristics are closely aligned with football match demands, where players do not run at one constant speed but repeatedly shift between jogging, cruising, sprinting, walking, and tactical repositioning (Bahtra et al., 2024; Kadhim, 2025). Fartlek also has a motivational advantage because its flexible format reduces monotony compared with repetitive continuous running.

Empirically, several studies have reported positive effects of fartlek and interval-based training on VO2max. Festiawan et al. (2020) found that both high-intensity interval training and fartlek training significantly improved VO2max. Sopyan et al. (2023) showed that fartlek and HIIT contributed to VO2max improvement in U15 and U23 football school players. Bahtra et al. (2024) reported that fartlek training produced stronger VO2max improvement than small-sided games in soccer players. Similarly, Kadhim (2025) found that varied fartlek exercises improved VO2max and specific endurance in young football players. These findings are supported by broader evidence showing that aerobic and intermittent conditioning can enhance football-related endurance and physical readiness (Hudain et al., 2024; Koç et al., 2025; Xiong et al., 2025).

Although fartlek training has been studied in various sports and football settings, several gaps remain. First, many previous studies compared fartlek with HIIT, continuous running, or small-sided games, but relatively few focused on academy-level football athletes in a specific institutional and regional context. Second, studies in Indonesian football academies are still limited, especially those examining the practical problem of late-match stamina decline. Third, many training studies discuss VO2max improvement in general terms, but do not sufficiently connect the intervention with real performance symptoms observed during competition, such as the decrease in physical output after the 70th minute.

In the case of Bank Sulselbar Football Academy, the practical issue is not merely low endurance as an isolated fitness problem. It is directly related to match sustainability, consistency of performance, and the academy's competitive achievement. Therefore, this study is important because it addresses a real training problem experienced by the team and tests whether fartlek training can become an effective conditioning solution. This focus gives the study contextual relevance for coaches, academy managers, and sports science practitioners who need evidence-based programs that are simple, economical, and applicable in the field.

This study aims to determine the effect of fartlek training on increasing VO2max among football athletes at Bank Sulselbar Football Academy. Specifically, this study seeks to examine whether a structured fartlek

training program can improve the athletes' aerobic capacity and provide empirical evidence for its use as part of football conditioning.

The novelty of this study lies in its contextual application. While fartlek has been widely recognized as an endurance training method, this research applies it to a specific academy team facing observable late-match fatigue and inconsistent competitive outcomes. The study also strengthens the practical bridge between physiological conditioning and football performance needs. Thus, the research is expected to contribute not only to academic literature on VO2max training, but also to practical coaching strategies in Indonesian football academies.

Based on the theoretical and empirical evidence, fartlek training is assumed to have a positive effect on improving VO2max because it exposes athletes to variable running intensities similar to actual football demands. For Bank Sulselbar Football Academy athletes, improving VO2max is expected to help players maintain stamina, delay fatigue, and sustain performance until the end of the match. Therefore, this study is relevant and necessary to provide scientific evidence regarding the effect of fartlek training on VO2max improvement in football academy athletes.

METHODS

This study employed an experimental research method using a one-group pretest–posttest design to examine the effect of fartlek training on the improvement of maximal oxygen uptake (VO2max) among football athletes at Bank Sulselbar Academy. The use of an experimental approach is relevant because the study aimed to test the causal effect of one independent variable, namely fartlek training, on one dependent variable, namely VO2max improvement. In sports training research, pretest–posttest designs are commonly used to evaluate physiological adaptation after structured intervention programs, particularly in endurance-based performance variables (Clemente et al., 2021; Hostrup & Bangsbo, 2023; Bahtra et al., 2024).

The research was conducted at the Bank Sulselbar football field. The population consisted of football athletes registered in the Bank Sulselbar Academy training program, while the sample involved 20 athletes selected based on active participation, physical readiness, and regular attendance during the training period. The independent variable in this study was fartlek training, which was implemented through running activities with alternating intensity, including low-intensity recovery running, moderate-paced running, and high-intensity acceleration. This model is conceptually appropriate for football because match activity is intermittent and requires players to repeatedly change speed, recover, and re-accelerate under game pressure (Modric et al., 2020; Michailidis, 2024; Kadhim, 2025).

VO2max was measured before and after the treatment using a field-based aerobic endurance test appropriate for football athletes. Field tests such as the Yo-Yo Intermittent Recovery Test and multistage fitness test are widely used to estimate aerobic capacity because they reflect the intermittent endurance demands of football (Suryadi et al., 2023; Düking et al., 2024; Kusuma et al., 2025). The pretest was conducted before the fartlek program, while the posttest was administered after the intervention. The collected data were analyzed descriptively and inferentially. Descriptive analysis was used to present mean, standard deviation, and score improvement, while a paired-sample t-test was used to determine whether the difference between pretest and posttest VO2max scores was statistically significant. This procedure was expected to provide empirical evidence regarding the effectiveness of fartlek training in improving VO2max among Bank Sulselbar Academy football athletes.

RESULTS AND DISCUSSION

Result

The results of this study describe the effect of fartlek training on the improvement of VO2max among football athletes at Bank Sulselbar Football Academy. The analysis was conducted through descriptive statistics, normality testing, paired-sample t-test, and independent-sample t-test. The descriptive analysis was used to identify the initial and final VO2max conditions of the athletes, while the inferential analysis was used to determine whether fartlek training produced a statistically significant effect.

Descriptive Statistical Analysis

Table 1.

Descriptive Analysis of VO2max Before and After Fartlek Training

Descriptive Statistics	Pre-test	Post-test
N	10	10
Mean	38.8000	41.0400
Std. Deviation	4.51122	4.46920
Variance	20.351	19.974
Range	16.20	15.20
Minimum	31.80	35.00
Maximum	48.00	50.20
Sum	388.00	410.40

Based on Table 1, the mean VO2max score of the athletes before receiving fartlek training was 38.8000, while the mean score after treatment increased to 41.0400. This indicates an average improvement of 2.2400 points. The minimum score also increased from 31.80 in the pre-test to 35.00 in the post-test, while the maximum score increased from 48.00 to 50.20. These descriptive findings show that fartlek training produced a positive change in the aerobic capacity of the football athletes. However, descriptive statistics alone cannot fully answer the research hypothesis. Therefore, further statistical testing was required to determine whether the improvement was significant.

Normality Test

Table 2.

Normality Test Results

Variable	Kolmogorov–Smirnov		Shapiro–Wilk		α	Interpretation
	Statistic	Sig.	Statistic	Sig.		
Fartlek Training	0.127	0.200	0.965	0.840	0.05	Normal

Table 2 shows that the VO2max data in the fartlek training group were normally distributed. The Kolmogorov–Smirnov test obtained a significance value of 0.200, which is greater than 0.05. Similarly, the Shapiro–Wilk test obtained a significance value of 0.840, which is also greater than 0.05. Therefore, the data met the assumption of normality. Since the data were normally distributed, parametric statistical tests were appropriate for testing the research hypothesis.

Paired-Sample t-Test

Table 3.

Paired-Sample t-Test of VO2max Before and After Fartlek Training

Group	Test	Mean	Mean Difference	t-count	df	Sig. (2-tailed)	t-table
Fartlek Training Group	Post-test	41.0400	2.24000	8.806	9	0.000	1.833
	Pre-test	38.8000					

Based on Table 3, the paired-sample t-test showed that the t-count value was 8.806, which was higher than the t-table value of 1.833. The significance value was 0.000, which is lower than $\alpha = 0.05$. This result indicates a statistically significant difference between the pre-test and post-test VO2max scores. Therefore, the null hypothesis was rejected, and the alternative hypothesis was accepted. In other words, fartlek training had a significant effect on improving VO2max among football athletes at Bank Suselbar Football Academy. The mean increase of 2.2400 points demonstrates that the athletes experienced measurable improvement in maximal oxygen capacity after participating in the fartlek training program.

Independent-Sample t-Test

Table 4.

Independent-Sample t-Test of Post-test VO2max Scores

VO2max Football Athletes	Group	Mean	Mean Difference	t-count	df	Sig. (2-tailed)	t-table
Post-test	Fartlek Training	41.0400	1.45000	3.790	18	0.000	2.093
Post-test	Control	39.5900					

Table 4 shows the comparison of post-test VO2max scores between the fartlek training group and the comparison group without fartlek training. The fartlek training group obtained a mean score of 41.0400, while the comparison group obtained an estimated mean score of 39.5900 based on the reported mean difference of 1.45000. The t-count value was 3.790, which was higher than the t-table value of 2.093. In addition, the significance value was 0.000, which is lower than 0.05. This means that there was a significant difference in VO2max improvement between the group that received fartlek training and the group that did not receive fartlek training.

These findings empirically confirm that fartlek training is effective in improving VO2max among football athletes. Conceptually, fartlek training combines variations of low, moderate, and high-intensity running, which stimulates cardiovascular adaptation and improves the body's ability to utilize oxygen during physical activity. This training model is relevant to football because the game requires repeated changes in speed, intensity, and recovery throughout the match. Therefore, the increase in VO2max found in this study indicates that fartlek training can be used as an appropriate conditioning method to improve the aerobic endurance of Bank Sulselbar Football Academy athletes.

Overall, the results show that fartlek training produced a significant positive effect on VO2max. The increase from 38.8000 to 41.0400 in the experimental group demonstrates that a structured fartlek training program can improve the cardiorespiratory fitness of football athletes. These findings support the research hypothesis that fartlek training contributes significantly to VO2max improvement among football athletes at Bank Sulselbar Football Academy.

Discussion

The findings of this study indicate that fartlek training had a significant effect on improving VO2max among football athletes at Bank Sulselbar Football Academy. This was proven by the paired-sample t-test result, where the t-count value was 8.806, which was higher than the t-table value of 1.833, with a significance value of $0.000 < 0.05$. The descriptive data also showed an increase in the mean VO2max score from 38.8000 in the pre-test to 41.0400 in the post-test, with a mean difference of 2.2400 points. These results demonstrate that the implementation of fartlek training produced a measurable and statistically significant improvement in the athletes' aerobic capacity.

Conceptually, the improvement in VO2max can be explained through the physiological characteristics of fartlek training. Fartlek is a training method that combines continuous running and interval running by alternating low, moderate, and high-intensity movements in one session. This variation stimulates the cardiovascular, respiratory, and muscular systems to work more efficiently in transporting and utilizing oxygen during physical activity (Festiawan et al., 2020; Clemente et al., 2021; Hostrup & Bangsbo, 2023). Unlike monotonous continuous running, fartlek provides fluctuating intensity patterns that are more similar to the movement demands of football, where players repeatedly switch from jogging to sprinting, walking, accelerating, and recovering during match play (Modric et al., 2020; Bahtra et al., 2024; Kadhim, 2025).

Empirically, the increase from 38.8000 to 41.0400 indicates that fartlek training can improve the ability of football athletes to consume and use oxygen more effectively. Although the increase of 2.2400 points may appear moderate, it is meaningful in football conditioning because even small improvements in aerobic capacity can support better recovery between high-intensity actions, reduce fatigue accumulation, and help players maintain performance intensity until the final minutes of the match. This is consistent with findings that aerobic fitness is related to running performance, repeated sprint recovery, and overall match endurance in football players (Slimani et al., 2019; Modric et al., 2020; Papadopoulos et al., 2023; Asimakidis et al., 2025).

The result of this study also supports previous research showing that variable-intensity running methods are effective for improving VO2max. Festiawan et al. (2020) reported that high-intensity interval training and fartlek training significantly improved VO2max. Sopyan et al. (2023) found that fartlek training contributed to VO2max improvement among U15 and U23 football school players. Bahtra et al. (2024) showed that fartlek training produced stronger VO2max improvement than small-sided games in soccer players. Kadhim (2025) also confirmed that varied fartlek exercises improved VO2max and specific endurance in young football players. These findings are supported by broader evidence that high-intensity and intermittent training models

can improve aerobic endurance and oxygen consumption performance in team-sport athletes (Milanović et al., 2015; Clemente et al., 2021; Ma et al., 2023; Yuan et al., 2024; Yang et al., 2025).

From a football-specific perspective, the effectiveness of fartlek training is closely related to the intermittent nature of the game. Football athletes are required to perform repeated acceleration, deceleration, sprinting, changing direction, and tactical repositioning with short recovery periods. Therefore, a training model that exposes players to changing intensities is more relevant than training that only uses one constant running speed. Fartlek training strengthens both aerobic and anaerobic energy systems because athletes are required to sustain running duration while also responding to high-intensity speed variations (Buchheit & Laursen, 2019; Ndloomo et al., 2022; Hostrup & Bangsbo, 2023; Pratama et al., 2025). This dual adaptation is important because football players need aerobic capacity for endurance and recovery, while anaerobic ability supports explosive actions such as sprinting, pressing, and fast transitions.

The findings are also relevant to the practical problem observed at Bank Sulselbar Football Academy. Preliminary observations showed that several athletes experienced a decline in stamina after the 70th minute, which affected movement intensity and match consistency. The significant increase in VO2max after fartlek training suggests that this method can be used as a practical conditioning strategy to address late-match fatigue. Improved VO2max allows players to maintain oxygen supply, delay physiological fatigue, and recover faster between repeated high-intensity actions (Clemente et al., 2021; Michailidis, 2024; Ghouili et al., 2023; Koç et al., 2025). Therefore, fartlek training is not only statistically effective but also practically useful for football academy development.

Furthermore, the independent-sample t-test showed a significant difference between the fartlek training group and the comparison group, with a t-count value of $3.790 > t\text{-table } 2.093$ and a significance value of $0.000 < 0.05$. The post-test mean of the fartlek training group was 41.0400, while the comparison group was estimated at 39.5900. This result strengthens the argument that structured fartlek training provides a greater contribution to VO2max improvement than training without a specific fartlek program. In training theory, structured load variation, progressive intensity, and adequate recovery are essential for producing cardiorespiratory adaptation (Bompa & Buzzichelli, 2019; Kenney et al., 2020; Suchomel et al., 2021; Turner & Comfort, 2022).

Overall, the results of this study confirm that fartlek training significantly improves VO2max among football athletes at Bank Sulselbar Football Academy. The improvement is supported by physiological theory, previous empirical findings, and the specific demands of football performance. Therefore, fartlek training can be recommended as an effective, economical, and field-applicable method for improving aerobic endurance in academy-level football players. Coaches should integrate fartlek training systematically into conditioning programs, especially for athletes who show decreased stamina in the final phase of the match.

CONCLUSION

Based on the results of the study, it can be concluded that fartlek training has a significant effect on improving VO2max among football athletes at Bank Sulselbar Football Academy. The descriptive data showed that the mean VO2max score increased from 38.8000 in the pre-test to 41.0400 in the post-test, with an average improvement of 2.2400 points. This increase indicates that the athletes experienced better cardiorespiratory capacity after participating in the fartlek training program.

The inferential analysis also confirmed the effectiveness of the treatment. The paired-sample t-test showed a t-count value of 8.806, which was higher than the t-table value of 1.833, with a significance value of $0.000 < 0.05$. Therefore, the null hypothesis was rejected, and the alternative hypothesis was accepted. This means that fartlek training significantly improved VO2max in the experimental group. Furthermore, the independent-sample t-test showed a significant difference between the fartlek training group and the comparison group, with a t-count value of $3.790 > t\text{-table } 2.093$ and a significance value of $0.000 < 0.05$. The post-test mean of the fartlek group was 41.0400, higher than the comparison group mean of 39.5900.

Conceptually, fartlek training is effective because it combines continuous running and interval running through variations of low, moderate, and high intensity. This pattern is highly relevant to football, which requires repeated changes in speed, endurance, and active recovery. Therefore, fartlek training can be recommended

as an effective, practical, and field-applicable conditioning method to improve VO2max and support the physical performance of football athletes at Bank Sulsebar Football Academy.

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