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Application of combination of physical training methods to improve the aerobic capacity of football players

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ABSTRACT

Aerobic ability is essential in football because it directly influences endurance and the capacity to maintain performance throughout a match. This study aimed to evaluate the effectiveness of combining physical training methods to enhance aerobic capacity in football players. The research method used was an experimental design with a one-group pre-test and post-test approach. The participants in this study were 20 football players from South Sulawesi, who were preparing for the 2024 Aceh and North Sumatra National Sports Week. The training program incorporated aerobic, anaerobic, and strength exercises in a structured manner. Training sessions were conducted three times a week for a total of 16 sessions. To assess improvements in aerobic capacity, the Vo2Max test was conducted before and after the training period. The study results showed a significant increase in the Vo2Max values of players following the application of the combined physical training methods ($p<0.05$). The combination of aerobic, anaerobic, and strength training methods effectively enhances the aerobic capacity of football players. This integrated training approach leads to notable improvements in players' aerobic fitness, positively impacting their performance and endurance during matches.

KEYWORDS

Aerobic; Football; Combination Training; Vo2Max Test; Physical Endurance

1. INTRODUCTION

The increase in Vo2Max is attributed to the rise in O2 content in the arteries and veins, as well as an increase in maximum cardiac output (Pitnawati et al., 2023). Individuals with high Vo2Max levels not only excel in endurance activities but also recover their physical condition more quickly than those with lower Vo2Max levels (Rutkowski et al., 2016). Consequently, athletes can perform subsequent activities sooner and sustain their performance over a longer duration (Boullosa et al., 2020).

Aerobic endurance refers to the body's ability to perform activities or work for an extended period without significant fatigue and with rapid recovery (Darajat et al., 2024; Sabillah et al., 2024; Saputra et al., 2025). It describes a condition in which the body can sustain prolonged work or training without experiencing excessive fatigue afterward (Alnedral et al., 2024; Hidayat et al., 2024; Pranoto et al., 2024). According to Sukadiyanto, aerobic endurance also refers to the ability to carry out work activities continuously, with high intensity, and for a prolonged period (Haris et al., 2024; Nusri et al., 2024).

Aerobic exercise (with oxygen) involves large muscle groups and is performed at a relatively low intensity over a long duration, allowing fuel sources to be converted into ATP primarily through the citric acid cycle as the predominant metabolic pathway (Hargreaves & Spriet, 2020). It can be maintained for fifteen to twenty minutes to several hours in one session. Aerobic endurance represents a unified concept of physical condition components that cannot be separated, both in terms of improvement and maintenance (You et al., 2022). This implies that improving physical condition requires developing all components, even when prioritizing specific areas based on individual needs or status.

Aerobic exercise is defined as continuous movement, performed without stopping. Examples include walking, jogging, cycling, or swimming rhythmically, with intensity ranging from low to moderate. Exercise is a systematic process of training or working, performed repeatedly with progressively increasing exercise or workload. Aerobic activities are particularly beneficial for improving and maintaining the health and endurance of the heart, lungs, blood circulation, muscles, and joints (Latuheru & Arfanda, 2023; Markus et al., 2021)

Continuous running for more than 30 minutes at a moderate tempo, below the anaerobic threshold, promotes effective aerobic adaptation. This type of continuous training is performed without rest for 30 minutes (Makaracı et al., 2023). As a result, the working capacity of the body's

organs becomes more efficient during prolonged activities, enabling athletes to stay fit without experiencing significant physical fatigue.

Athletes with strong endurance can control the rhythm and patterns of their game, adjust strategies as needed, and compete with resilience, showing determination and avoiding easy defeat during matches. Therefore, this study aims to evaluate the effectiveness of combining physical training methods to enhance aerobic capacity in football players.

2. METHODS

2.1. Study Design and Participants

The research method used in this study was an experimental design with a one-group pre-test and post-test approach. The participants in this study were 20 football players from South Sulawesi, who were preparing for the 2024 Aceh and North Sumatra National Sports Week. These players were selected based on their active involvement in football and their current physical conditioning, ensuring they were suitable for the physical training intervention. The participants underwent both a pre-test and a post-test to assess the changes in their aerobic capacity following the training program.

2.2. Instruments and Procedure

The study utilized a combination of training methods, including Continuous, Fartlek, and Interval training, to enhance the participants' aerobic capacity. The Multistage Fitness Test (MFT) was used to assess the players' aerobic endurance at both the pre-test and post-test stages. Training sessions were conducted three times a week for a total of 16 sessions, with each session designed to progressively increase the intensity and duration of the workouts to achieve the desired physical conditioning outcomes. Data collection occurred in two phases: the initial test to measure baseline fitness levels and the final test after the intervention to evaluate improvements in aerobic endurance.

2.3. Statistical Analysis

Data analysis was performed using SPSS (Statistical Package for the Social Sciences). A paired t-test (correlated t-test) was applied to analyze pre-test and post-test data, aiming to determine whether there was a statistically significant improvement in the players' aerobic capacity. The significance level was set at $p < 0.05$. Additionally, a Kolmogorov-Smirnov test was conducted to assess the normality of the data distribution in both groups.

3. RESULTS

To determine whether the data from the two groups are normally distributed, a Kolmogorov-Smirnov test was conducted. As Table 2 shows, both the pre-test (p = 0.161) and post-test (p = 0.532) have significance values greater than 0.05, indicating that both datasets are normally distributed.

Table 1. Normality Test

	Pre-test	**Post-test**
N	20	20
Mean	410.350	638.835
SD	16.158	43.413
Kolmogorov-Smirnov Z	1.038	0,46319444
Sig. (2-tailed)	0,16111111	0,53194444

In this study, Vo2Max was measured at two stages: pre-test and post-test, with 20 participants. The pre-test Vo2Max value had a mean of 41.03 and a standard deviation of 1.61, while the post-test Vo2Max values had a mean of 63.88 and a standard deviation of 4.34. Additionally, with a p-value of 0.000 (<0.05), these results demonstrate a significant increase in Vo2Max in the post-test, highlighting the positive impact of the physical training combination method (Table 2).

Table 2. Comparison of pre-test and post-test Vo2Max values and significance of the training intervention

Variables	**N**	**Mean**	**SD**	***p***
Pre-test	20	41.0350	1.61	0.000
Post-test	20	63.8835	4.34	
Mean Difference		22.8485		

4. DISCUSSION

The study results showed a significant increase in the Vo2Max values of players following the application of the combined physical training methods (p<0.05). This increase indicates that the player's body becomes more efficient in absorbing and using oxygen during intense physical activity. This has implications for increasing aerobic endurance, which is important for football players to maintain a high tempo throughout the match. High-intensity interval training, which is often used in the combination method, has been shown to significantly increase Vo_2Max, which reflects an increase in the aerobic capacity of the player.

The application of the combination method of physical training in soccer players is an effective approach to improve aerobic capacity, which is an important component in the physical performance of players. Aerobic capacity plays a role in maintaining endurance during the match, supporting faster recovery, and maintaining the intensity of the game throughout. Aerobic training focuses on improving cardiovascular endurance and the efficiency of muscle oxygen use. Soccer is a sport that requires repeated high-intensity activity over long game durations. Therefore, increasing aerobic capacity allows players to last longer without fatigue. With the right training, such as a combination of physical training methods, the ability of a player's body to use oxygen efficiently can be improved, so they can maintain consistent performance on the field (Fatahilah et al., 2024).

The combination of these various types of training provides more varied stimulation for the player's body, resulting in more optimal training outcomes (Filipovic et al., 2019). This aligns with research conducted by Syamsudin et al. (2021), which found that interval training, combining high- and low-intensity phases, is an effective method for increasing Vo2Max, an important indicator of aerobic capacity. Similarly, Collins et al. (2022) emphasized that strength training plays a significant role in enhancing movement efficiency and muscle endurance in players. By integrating aerobic training with strength training, players can improve their endurance and maintain performance during repeated sprints throughout a match, avoiding a drastic decline in performance.

The application of combined physical training methods not only improves aerobic capacity in the short term but also provides long-term benefits for players. Continuous training that enhances aerobic capacity can reduce the risk of injury caused by muscle fatigue. Additionally, varied training helps maintain players' motivation by preventing boredom associated with monotonous routines. With improved physical condition, players are able to perform more consistently during competitions.

However, the implementation of combined training methods requires careful adjustments based on individual players' needs. Factors such as initial fitness level, age, and playing position significantly influence training responses. Training programs must be tailored to support the goal of improving aerobic capacity while avoiding overtraining, which can lead to injuries. Supporting elements, such as proper recovery through adequate nutrition and rest, are also critical. Players who receive optimal nutritional intake recover more quickly and effectively, ultimately enhancing training outcomes.

5. CONCLUSIONS

The application of a combination of physical training methods can provide significant improvements in the aerobic capacity of football players, which has a positive impact on performance and physical endurance during matches. With increased Vo2Max, players are able to maintain optimal performance during the match, minimize fatigue, and reduce the risk of injury. These results support the importance of variation and proper training planning in football training programs, both for improving aerobic endurance and overall performance.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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