15 (1) (2026) 202 - 208
Journal of Physical Education, Sport, Health and Recreations
https://journal.unnes.ac.id/journals/peshr

The Effect of Interval Training and Continuous Running on Improving the Aerobic Capacity of Youth Football Players

Rizkya Ananda Firdaus[1], Mona Fiametta Febrianty[2]✉, Oktoviana Nur Ajid[3]

Study Program of Sport Physical Coaching, Faculty of Sport and Health Education, Indonesian University of Education, Bandung, 40154, West Java, Indonesia[12]
Study Program of Sport Coaching Education, Faculty of Sport and Health Education, Indonesian University of Education, Bandung, 40154, West Java, Indonesia[3]

Article History

Received January 2026
Accepted February 2026
Published Vol.15 No.(1) 2026

Keywords:
Interval Training; Continuous Run; Aerobic Capacity; VO_2Max; Youth Football

Abstract

This study aims to determine the effect of interval training and continuous running on increasing the aerobic capacity of adolescent football athletes and to compare the effectiveness of the two methods. This study used an experimental method with a two-group pretest–posttest design. The sample consisted of 30 extracurricular youth football athletes from Subang Senior High School 2, selected using a total sampling technique. The instrument used to measure aerobic capacity was the Yo-Yo Intermittent Recovery Test Level 1 (YYIR1). Data were analyzed using statistical tests through the SPSS application, including normality tests, homogeneity tests, paired sample t-tests, and independent sample t-tests. Data analysis was carried out through normality tests, homogeneity tests, paired sample t-tests, and independent sample t-tests to determine differences in effects between groups. The results of the study showed, 1) Interval training is effective in increasing VO2max in soccer athletes. 2) Continuous running is also effective in increasing cardiovascular endurance, and 3) There is a substantial difference in the effects between the two methods, with interval training showing greater improvements than continuous running.

How to Cite

Firdaus, R. A., Febrianty, M. F., & Ajid, O. N. (2026). The Effect of Interval Training and Continuous Running on Improving the Aerobic Capacity of Youth Football Players. Journal of Physical Education, Sport, Health and Recreation, 15 (1), 202-208.

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✉ Correspondence address :
E-mail: monafiametta@upi.edu

p-ISSN 2460-724X
e-ISSN 2252-6773

INTRODUCTION

Football is a team sport and football is a type of game that requires excellent physical condition, so a good, strong, tough team is a team that consists of players who are able to play compactly, meaning they have good teamwork (wicaksana, 2016). Therefore, all team components, from coaches and players, must contribute to developing athletes in terms of effective and programmed training (Nasution & Suharjana, 2015). In football, the element of good and prime physical condition and being ready to face the opponent during the match is an important basic element in the game of football (rofik et al., 2021). A football player in dealing with such things must be coached and trained from the start and must maintain physical fitness (Muslim Bin Ilyas & Sutriawan, 2025). Therefore, physical fitness plays a significant role in supporting a football game, as physical condition is crucial in football. Therefore, a coach must also incorporate good physical training into their training regimen (Thakur, 2025).

In the sport of football, the energy systems used are aerobic endurance and anaerobic endurance, which can be seen from the activity and game of football for 2 x 45 minutes, clearly using the aerobic and anaerobic energy systems, so that every football player needs to have quality endurance in facing every match (Suhadak, 2019). In the world of sports, endurance plays a very important role in every branch of movement sport (Amory & Satria, 2024). Football is the sport that is most dominant in the use of strength and endurance (chan et al., 2016)Many football teams have low levels of endurance (VO2max), this is caused by several factors, including a lack of well-programmed training systems, a lack of championships held, and inappropriate training to increase VO2max endurance (arun & narayanasamy, 2025). An athlete's strength lies in their ability to provide oxygen as needed. Athletes with good fitness have higher VO2max values and can perform more vigorous activities than athletes with low endurance, so VO2max is a determining factor in sports (Abidin dkk., 2024)

Based on the researchers' observations, many young football athletes experienced fatigue during the second half, hampering their offensive and defensive strategies. This is in line with researc (Ridho Bahtra et al., 2021) which states that player fatigue is caused by low VO_2max, so that the players are unable to maintain the intensity of the game until the end of the match. The low vo_2. The max is thought to originate from inappropriate training methods. Therefore, the increase in VO_2max through appropriate training methods is important so that player performance remains stable throughout the match.

There is one method for improving VO2 max performance in athletes that has been widely recommended. One exercise to increase heart rate variability (VO2 max) is intensive interval training.(Abreu et al., 2019). According to the theory behind interval training, participants should not exceed a certain amount of time during a single training session based on their physical condition as indicated by an indicator. Because physical limitations serve as the basis for the upcoming training procedure, (Smith & Fukuda, 2010).

Another method for improving an athlete's VO2 max is continuous running. In general, continuous running involves prolonged periods of continuous loading, with the length of the loading time depending on the sport being performed. This training, also known as long-distance running, involves running at a specific speed and distance without rest until the entire distance has been covered (Busyairi & Ray, 2018)

Interval training is also known as intensity interval training, defined as a type of exercise consisting of several short sessions of varying duration that are short or moderate and intense, with each session ending with a sufficient rest period (khapipudin et al., 2022). Continuous running is the activity of running continuously without rest until the time limit (Mustofa et al., 2021).

Interval and continuous running training haven't yet been implemented. Trainers still only use the method of running for a set duration (journal, 2021). Meanwhile, in physical training, there are many methods that can be used to increase VO2max. Therefore, researchers want to conduct research on methods to effectively increase VO2max (hernawan et al., 2021).

Researchers feel the gap in the field is because coaches only apply running training methods with durations determined by the coach himself, while this method is not appropriate to the characteristics of the game of football. Therefore, the right training method is needed to improve the aerobic capacity of young football athletes. In football training, there are also many complaints regarding the boredom of training with the same methods without other variations in training (Savard & Savard, 2013).

Previous research has shown that extensive interval training significantly impacts the VO2max capacity of PS Putra Koto Mambang football players. This is evident in the improvement of PS Putra Koto Mambang's VO2max,

which was poor before treatment. Therefore, the extensive interval training method is effective for improving aerobic endurance (Ridho Bahtra et al., 2021).

In addition, the results of previous research also showed a significant increase in VO_2max after HIIT training, which means the HIIT method is effective in increasing the aerobic capacity of adolescent futsal athletes. These findings indicate that HIIT can be an efficient and time-effective training alternative for improving cardiovascular performance (khapipudin et al., 2022).

Based on the research results, continuous running training has been proven to have a greater influence on increasing VO_2max compared to circuit training. This is shown by the average value of VO_2 higher max in the continuous running group, which indicates that training patterns with continuous duration and stable intensity are more effective in increasing the cardiovascular capacity of athletes (Abidin dkk., 2024).

The study results showed that continuous running training was effective in improving the aerobic fitness of football players aged 15–18 years. This improvement did not occur in the control group, therefore, this training method is recommended for aerobic endurance improvement programs. Furthermore, this structured and continuous training also helps improve players' ability to maintain game intensity (Arifuddin, 2016)

From several previous studies, this study's innovation lies in its attempt to replace the common endurance training method of long-distance running with interval training and continuous running to improve aerobic capacity in young soccer athletes. The purpose of this study was to examine the effects of interval training and continuous running on improving aerobic endurance.

METHODS

The method used in this study is the experimental method with a population approach in this study of 54 extracurricular athletes of Subang Senior High School 2. The sampling method in this study uses total sampling, which is a sampling technique where the sample is the same as the population. (Sugiyono, 2015)The total sample used was 30 extracurricular athletes of Subang Senior High School 2 U16-U17. The instrument in this study researchers used the yo-yo intermittent recovery test level 1 as an instrument to collect data, a reliable and valid measure of aerobic fitness. The test begins with running back and forth on a straight track with a length of 2x20 m from point B to point C then back to point B with increasing speed following the beep signal that changes at each stage. At the end of each stage there is a time interval of 10 seconds used for resting by actively walking at point A, then preparing to return to point B to continue running to point C in the next stage. The yo-yo test is used to measure the fitness level of football players, with a high validity value (r = 0.968), and reliability (r = 0.996). Football provides physical stressors that disrupt the balance of the body's metabolism, causing a back response of the body's organs to the training load carried out in the form of increased respiratory frequency, heart rate, decreased cardiovascular performance resulting in fatigue (Kusuma, 2020). The analysis was conducted using SPSS version 24 to ensure more accurate and objective results.

RESULTS AND DISCUSSION

The data obtained through the research was then collected and analyzed to reach conclusions that were understandable to all parties. Based on this, the data obtained from the research was then analyzed using SPSS 24.

Table 1. Descriptive Statistics

	N	Min	Max	Mean	Standard Deviation	Gain
Pretest Interval Training	15	13.2	15.7	14.30	.78	3.86
Post-Test Interval Training	15	16.8	19.3	18.16	.66	
PreTest Continuous Run	15	13.3	15.7	14.76	.79	2.26
PostTest Continuous Run	15	15.6	17.8	17.02	.75	

Based on the results of the descriptive test in **Table 1**, it can be seen that the group given interval training treatment experienced an increase in the average VO_2. The maximum heart rate increased from 14:30 in the pretest to 18:16 in the posttest. Meanwhile, the group given continuous run training experienced an increase from 14.76 to 17.02. These results indicate that both types of training equally improved the aerobic capacity of adolescent football athletes, but a higher increase was seen in the interval training group. The relatively small standard deviation values in each group indicate that the data distribution between subjects was quite uniform and there were no striking differences.

Table 2. Normality Test Shapiro-Wilk

Group	Statistics	df	Sig.	Result
Pretest Interval Training	.94	15	.46	Normal
Post-Test Interval Training	.95	15	.68	
PreTest Continuous Run	.89	15	.08	
PostTest Continuous Run	.88	15	.05	

Based on **Table 2**, the significance value obtained is (0.46, 0.68, 0.08) > 0.05 and the significance value (0.05) = 0.05, so H0 is accepted, so it can be concluded that all data are normally distributed.

Table 3. Homogeneity

	Levene Statistics	df1	df2	Sig.	Result
Homogeneity Based on Mean	.22	1	28	.63	homogeneity
Based on Median	.22	1	28	.64	
Based on Median and with adjusted df	.22	1	27.78	.64	
Based on trimmed mean	.21	1	28	.65	

Table 4. Paired Sample Test

Group	Mean Pre	Mean Post	Gain	t	Sig.	Result
Interval	14.30	18.16	3.86	18.00	0.00	significant
Continuous Run	14.76	17.02	2.26	47.46	0.00	

Based on **Table 4**, a significance value of 0.63 > 0.05 is obtained, so H0 is accepted, so it can be concluded that the data is homogeneous.

Based on the **Table 4**, the sig.(0.00) < 0.05 value is obtained, so Ho is rejected, so it can be concluded that there is a significant influence of the interval training method on increasing the aerobic capacity of young football athletes.

Based on the **Table 4**, the sig value (0.00) < 0.05 is obtained, so Ho is rejected, so it can be concluded that there is a significant influence of the continuous run training method on increasing the aerobic capacity of young football athletes.

The results of the study showed that the interval training method had a significant effect on increasing the aerobic capacity of young football athletes (R Festiawan, 2020) Interval training is a training method that is carried out with an alternating work and rest pattern, where the work phase is carried out at high intensity and the rest phase is carried out at low intensity or active recovery (Paul B Laursen & Jenkins, 2002). This work-rest pattern creates fluctuating physiological stress, requiring the body to quickly adjust its cardiovascular, respiratory, and energy metabolism responses to meet the demands of the exercise (Gibala, 2019). In the intensive work phase, the heart rate increases to 85–95% of the maximum heart rate, which causes an increase in the need for oxygen by muscle tissue (astorino, 2025). This condition stimulates an increase in cardiac output and stroke volume, so that the heart is able to pump more blood with each contraction (M Ilyas, 2025). Meanwhile, in the active recovery phase, the body has time to reduce its physiological load slightly but still maintains metabolic activity, so that the adaptation process occurs more effectively (Tønnessen, 2020). This pattern increases the efficiency of the heart, lungs, and blood vessels in delivering oxygen to the muscles (Boutcher, 2011).

The findings of this study are in line with the results of research (Jannah, 2024) which explains that interval training can significantly increase aerobic capacity after six weeks of an exercise program. This improvement is due to increased efficiency of the cardiovascular system and the lungs' ability to deliver oxygen to active tissues (wahyudin et al., 2021) also showed that interval training was able to increase VO_2max by 10–12% after eight weeks of intensive training, strengthening the evidence that this method is effective for improving aerobic fitness.

In the context of football, interval training is particularly relevant because the game's pattern is intermittent, involving fast sprints, sudden stops, changes of direction, and repeated high-intensity running (P B Laursen & Buchheit, 2019). Interval training mimics these conditions, so that the adaptations obtained are more in line with the demands of the match (Milanović, 2015). Thus, this method is very suitable for adolescent athletes who are in the development phase of endurance capacity and heart strength (astorino & others, 2025).

In addition, the results of this study are strengthened by the opinion (bahtra & others, 2023) which states that interval training can provide a greater increase in VO_2max than other training methods because it combines the activation of the aerobic and anaerobic energy systems. This adaptation allows athletes to maintain high game intensity, which is very important in modern football. Thus, it can be concluded that interval training has a significant influence on increasing the aerobic capacity of adolescent

football athletes because the characteristics of the training are in accordance with the physiological demands and characteristics of the modern football game (festiawan, 2020).

The results of the study showed that continuous run training had a significant effect on increasing the aerobic capacity of young football athletes (hajarudin et al., 2024) Continuous running is a form of exercise that is carried out continuously with moderate intensity for a relatively long duration without any rest breaks (Buana, 2025). This exercise pattern forces the body to maintain aerobic activity for a constant period of time, so that the cardiovascular and respiratory systems work stably to meet oxygen needs during exercise (Mustofa et al., 2021).

The results of this study align with those of Bahtra et al. (2023), who demonstrated that continuous running significantly improves cardiorespiratory function after several weeks of regular exercise. However, this improvement occurs gradually because the stimulus provided is stable, not fluctuating like interval training (Festiawan et al., 2020). Research by Mustofa et al. (2021) also demonstrates that continuous, moderate-intensity exercise is effective in improving respiratory efficiency due to the constant oxygen demand during exercise.

Based on this explanation, it can be concluded that continuous running training significantly improves the aerobic capacity of adolescent football athletes by increasing the efficiency of the cardiovascular, respiratory, and metabolic systems (Mustofa et al., 2021). Although the improvements provided are not as significant as interval training, continuous running remains an important component in developing basic aerobic endurance and maintaining long-term fitness in adolescent football athletes (Hajarudin et al., 2024).

Based on the research results, both interval training and continuous running methods significantly increased the aerobic capacity of adolescent football athletes. However, the increase in aerobic capacity through interval training was found to be greater than that through continuous running. This indicates that repeated high-intensity training stimuli can provide stronger physiological adaptations to the cardiovascular system than stable, moderate-intensity training (premiere, 2023).

Interval training provides stimulation in the form of high-intensity work phases interspersed with active recovery periods. This pattern stimulates increases in stroke volume, cardiac output, pulmonary ventilation, and oxidative enzyme activity, which play a direct role in increasing VO_2max (astorino, 2025). Meanwhile, continuous running training works by increasing muscle capillarization, increasing oxygen utilization efficiency, and gradually promoting aerobic metabolic adaptations (Mustofa et al., 2021). While both increase aerobic capacity, differences in intensity have varying impacts on the speed and extent of physiological adaptations.

In the context of the biomotor development of adolescent football athletes, basic motor skills such as cardiovascular endurance, strength, and speed are important factors determining the quality of the body's response to physical exercise. This is in accordance with the opinion of (Febrianty, 2020)which emphasizes that motor skills are the foundation of performance in both physical and sporting activities, and every Biomotor components including endurance will increase along with a structured and targeted training program.

These findings reinforce the rationale for why interval training results in greater increases in aerobic capacity: because the high intensity of each repetition places greater physiological stress on the heart, lungs, and oxygen transport system compared to continuous exercise. These adaptations include increased cardiac stroke volume, pulmonary ventilation efficiency, and the body's ability to maintain homeostasis during intense activity (tønnessen, 2020).

Overall, the results of this study confirm that interval training is a more effective option for improving aerobic capacity in adolescent football athletes. Its high intensity, alternating work patterns, and suitability to the characteristics of the game make interval training offer superior physiological adaptation compared to continuous running (Bahtra et al., 2023). Therefore, interval training can be recommended as the primary method in VO_2max improvement programs for adolescent football athletes.

CONCLUSION

Based on the results of research and discussions that have been conducted regarding the effect of interval training and continuous running on increasing the aerobic capacity of young football athletes, several things can be concluded as follows:

Interval training has been shown to be effective in improving the aerobic capacity of youth football athletes. A training regimen that combines high-intensity work phases with active recovery phases provides significant physiological

stimulation to the cardiovascular and respiratory systems. This adaptation improves the efficiency of the heart and lungs, as well as the muscles' ability to optimally utilize oxygen.

Continuous running also has a positive effect on increasing aerobic capacity, but the increase is not as significant as that achieved through interval training. This is due to the stable, moderate-intensity nature of continuous running, which results in slower physiological adaptations and tends to be more basic.

There is a subtancial ifference in the effect of interval training and continuous running on increasing aerobic capacity in adolescent football athletes. Interval training provides greater improvements because it creates greater physiological stress and faster adaptation of the aerobic and anaerobic energy systems.

Thus, it can be concluded that interval training is a more effective training method than continuous running training in increasing aerobic capacity and cardio-respiratory endurance in adolescent football athletes.

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