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Effect of High Intensity Interval Training (HIIT) on VO2max Capacity of Bhayangkara FC U19 Players

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Abstract

Study purpose. The study was conducted to prove the effect of giving interval training with high intensity (High Intensity Interval Training or HIIT) on the VO2max capacity of soccer players.

Materials and methods. Quasi experiment with one group pretest posttest design on Bhayangkara FC football players aged under 19 as many as 25 players. VO2max measurements were taken before and after being given HIIT treatment using the yo-yo intermittent recovery test level 2. Analysis using paired sample t test with the help of the SPSS version 26 application.

Results. Paired Sample t-Test results show a significance value of 0.00. This value is much smaller than alpha (0.05), which means that there is a significant difference between VO2max before and after training.

Conclusion. Research shows that high-intensity interval training (HIIT) can significantly increase VO2max of Bhayangkara FC U19 football players.

Keywords: Interval Training, High Intensity, HIIT, Football
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Introduction

VO2max or often referred to as maximal aerobic capacity is the body's ability to absorb and use oxygen during strenuous physical activity (Lee & Zhang, 2021). VO2max can be used as an indicator of cardiovascular fitness and is often used to assess an athlete's endurance (Candra, 2020; Narlan, Priana, & Gumilar, 2023). VO2max is expressed as millilitres of oxygen used by the body per kilogram of body weight every minute (ml/kg/min) (Iswahyudi, Fajar, Sugeng, & Derana, 2020). A high VO2max indicates that a person has a good aerobic capacity (Barus, 2020), which means that the body can process oxygen more efficiently in producing energy so that the body can perform physical activities for a long duration without significant fatigue (Mashuri & Artanayasa, 2021).

In the game of football, VO2max plays a very important role because the football field has a large size and long duration of play so that football players are required to have high cardiovascular endurance (Sandika & Mahfud, 2021). Players with high VO2max will be able

to maintain the intensity of the game (Kavanagh et al., 2023). In addition, a high VO2max contributes to a fast (Sabater-Pastor et al., 2023) and player strength (Putra & Ita, 2019). This allows football players to stay focused during the game, as football is a game that requires its players to remain at peak performance for 90 minutes or more (Atiq, Purnomo, & Ali, 2023).

To increase VO2max, football players can do high-intensity interval training (HIIT) (Irfan & Kasman, 2021). High-intensity interval training was chosen because it can simulate the conditions of a real football game, such as repetitive sprints and long runs (Nicolò et al., 2020). A high VO2max not only helps football players in terms of physicality, but also affects their ability to make quick and precise decisions during the game (Kusuma, 2019), because the brain also needs a good supply of oxygen for the thinking process (Putri, Rahardiantini, & Saputry, 2022).

VO2max has a positive correlation with the recovery of football players, the higher the VO2max the player has, the better the recovery will be (Puspodari & Lusianti, 2022). When the body can absorb and use oxygen effectively, the recovery process after high-intensity physical activity will go faster (Yamamoto & Yoshizawa, 2020). This should be a concern because the match schedule that every football will go through is relatively denser. Players who have good recovery abilities between training and matches, allowing players to remain at the peak of their performance (Kellmann et al., 2018) and avoid injuries caused by fatigue (Sa'roni & Graha, 2019).

The role of VO2max is not only important for each individual football player, but also has an impact on the tactics and strategy of the game as a whole. Coaches often use their players' VO2max data as a basis for designing the strategies to be used (Suganda & Kamil, 2023). Teams with players who have high VO2max can apply pressing strategies in all areas of the field, where each player will continue to press the opponent by grabbing the ball (Paskalis, Wati, & Rubiyatno, 2022). This strategy requires excellent stamina as each player is required to move quickly continuously during the match (Pratama & Hariyanto, 2022).

High Intensity Interval Training (HIIT) is a training method that combines high-intensity training with low-intensity training as a recovery phase (Sunjoyo et al., 2023). This form of training has a significant correlation with increasing an athlete's VO2max (Ma et al., 2023). The training duration of each interval and the number of training sessions may vary depending on the fitness level of the individual and the purpose of the study (Tanzila & Hafiz, 2019). High-intensity exercise can significantly increase VO2max, as it encourages the body to adapt to increased oxygen demand and oxygen transport efficiency (Herlan & Komarudin, 2020).

Research on the effect of HIIT training on VO2max of Bhayangkara FC U19 football players is very necessary to do, because VO2max is the main indicator in determining cardiovascular fitness and aerobic capacity in sports that require long endurance with high intensity (Karba, Permadi, & Parwata, 2024; Rahadianti, 2023). By understanding how HIIT can be effectively applied in football, coaches can design shorter training programmes that still have an optimal impact on the VO2max of football players. This is of course very important because every football player is required to have a very busy competition schedule (Fatoni & Nugroho, 2019).

Materials and Methods

Study participants.

The research subjects involved in this study were Bhayangkara FC football players aged under 19 years. The number of players who participated in this study was 25 players. Subject selection is based on age criteria and active membership in the Bhayangkara FC U19 team.

Study organization.

The research conducted was a quasi-experimental study using a one group pretest-posttest design, which is a study that gives treatment in the form of high-intensity interval training (HIIT). The training was carried out 5 days per week in 2 months with details of each exercise, warming up for 10-15 minutes, sprint interval (30 seconds sprint then 90 seconds jogging) was done 6 times, shuttle run (running back and forth for 20 metres 6 times then jogging 90 seconds) was done 4 times, lateral cone drill (running slalom through 5 cones with a distance of 5 metres between cones, then sprinting 20 at the end of the slalom then jogging 60 seconds) was done 6 times, and ended with a cool down for 10 minutes. To find out the increase in VO2max for each player, VO2max measurements were taken before and after treatment using the yo-yo intermittent recovery test level 2.

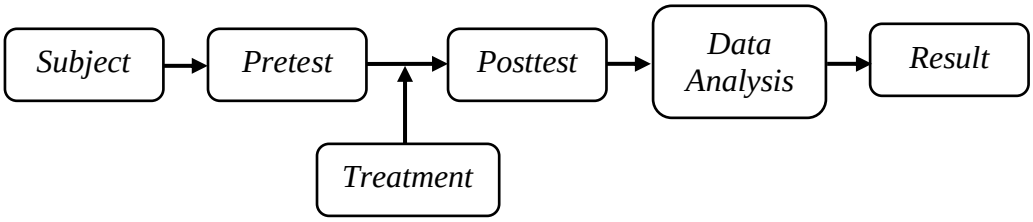

Figure 1. *Flowchart* Research Procedures

Statistical analysis.

Data analysis in this study was conducted using the Paired Samples t-Test method to compare the results before and after treatment. This analysis process was carried out with the help of the SPSS version 26 application, which provides various relevant statistical features. This application is used to ensure the accuracy of calculations and data interpretation, so that the analysis results can be relied upon in drawing conclusions.

Results

The results of VO2max measurements before and after being given interval training with high intensity can be seen in the following table

.

Table 1. VO2max values of Bhayangkara FC U19 football players

Component	*Pretest*	*Posttest*
Mean	45,02	50
Standard Error	0,47	0,54
Mode	41,44	50,18
Variasi Data	5,54	7,23

In the pretest data, the mean (average) VO2max value of Bhayangkara FC U19 football players was 45.02 with a standard error of 0.47. This shows that the average VO2max of Bhayangkara FC football players before being given training is at 45.02 ml / kg / minute, with a fairly good level of measurement accuracy. The mode or most frequently occurring value was 41.44, indicating that some participants had a lower than average VO2max. The data variation of 5.54 showed that there was little variation between players when the pretest was conducted, reflecting that most players had relatively uniform VO2max values before training.

Posttest data showed a significant increase in the average VO2max to 50 ml/kg/minute. The standard error on the posttest was slightly larger than the pretest, at 0.54 indicating a slight increase in the variation of measurement results. The mode at posttest was 50.18 which was very close to the mean value, indicating that most participants achieved VO2max values close to the mean value after being given the training. The data variation also increased to 7.23

indicating that after the training, there was an increase in variation between players, possibly due to different responses to the high intensity training.

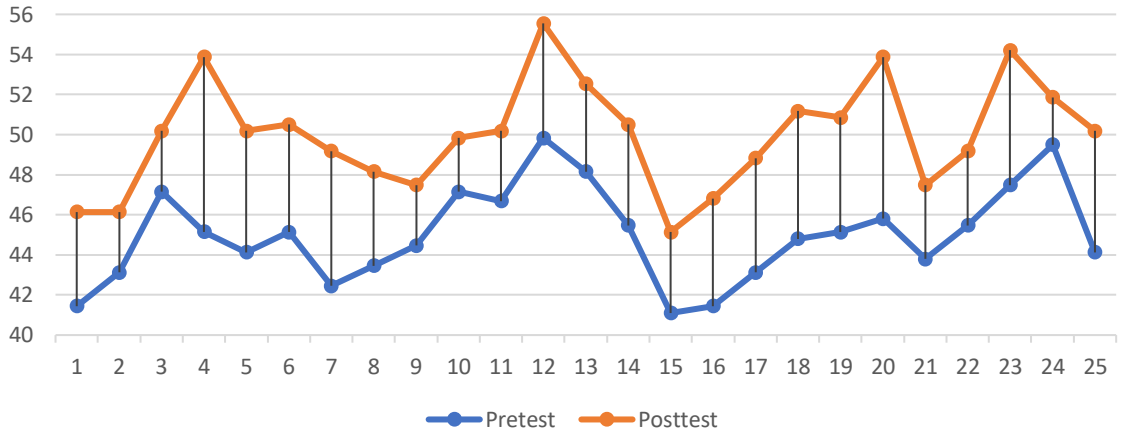

Figure 2. Comparison of Data Pretest dan Posttest

Table 2. Research Hypothesis Testing Results

	Normality	**Paired Samples Test**		
		t	**df**	**Sig. (2-tailed)**
Posttest - Pretest	0,2	14,996	24	0,000

The normality test results show a significance value of 0.2. This value is greater than alpha (0.05) which indicates that the data is normally distributed. Thus the normality assumption is met and statistical analysis using the parametric Paired Sample t-Test method can be used to test the research hypothesis.

Furthermore, the results of the paired sample t-test showed a significance value of 0.00. This value is much smaller than alpha (0.05) which means that there is a significant difference between VO2max before and after training. These results indicate that the high-intensity interval training (HIIT) given significantly affects the increase in VO2max of Bhayangkara FC U19 football players. In other words, the high intensity interval training applied had a real effect on increasing the aerobic capacity of football players.

Discussion

High intensity interval training (HIIT) is recognised as one of the effective training methods to increase VO2max (Festiawan, Suharjana, Priyambada, & Febrianta, 2020), especially for sports that require high endurance such as football (Hernawan, Rohendi, & Kardani, 2021). In this study, Bhayangkara FC U19 football players showed a significant increase in VO2max values when they were given a HIIT exercise programme. This finding is in line with previously conducted research which shows that HIIT helps the body utilise more oxygen during strenuous physical activity (Astawan & Widhiyanti, 2023). With an increase in VO2max, players can improve their endurance (Ma'ruf, Pamungkas, & Kurniawan, 2024) and perform faster sprints (Albiach, Mir-Jimenez, Moreno, Moltó, & Martínez-Gramage, 2021).

The increase in VO2max in Bhayangkara FC U19 players after being given HIIT shows that this exercise is able to provide physiological adaptations that support the athletic performance of soccer players (Setiawan, Jannah, Kurniawan, & Nurhayati, 2024). HIIT encourages the body to work at a very high intensity for a short period of time, followed by a relatively short recovery period (Parwata, 2022). HIIT forces the cardiovascular system and

muscles to adapt quickly, increasing the efficiency of oxygen transport and utilisation. During high-intensity interval training, the body requires a greater supply of oxygen for energy production, forcing the cardiovascular system and respiratory system to work harder (Herawati, Purwaningsih, Abkhoir, Saputri, & Kurniasari, 2022). The number and function of mitochondria as energy production sites will increase during physical activity (Lesmana, 2019). With that said, high-intensity interval training (HIIT) can not only increase the oxygen capacity in the body, but it can also improve the body's ability to use oxygen effectively during physical activity.

A high VO2max is very important because players must be able to maintain a high intensity of play throughout the match (Christy, Raharjo, Andiana, & Yunus, 2022). Improved VO2max allows Bhayangkara FC U19 players to increase their endurance (Mubarok & Kharisma, 2022), which contributes to improved overall performance on the field. With a higher VO2max, players can recover faster between sprints and run longer without experiencing a drop in performance (Busyairi & Ray, 2018).

This study also found that the importance of integrating HIIT into football training programmes, especially for young players such as Bhayangkara FC U19 football players. Young age is an ideal period to develop aerobic capacity and other physiological adaptations that can improve long-term athletic performance (Susanto, Alimuddin, & Syafrianto, 2019). By systematically implementing HIIT in training, coaches can help players reach their maximum potential more quickly and efficiently (Rahman, Nurkholis, & Ismalasari, 2020).

Conclusions

The study showed that high-intensity interval training (HIIT) was significantly able to increase the VO2max of Bhayangkara FC U19 football players. This suggests that HIIT training can improve players‘ aerobic ability, which has a direct impact on endurance, players’ ability for repeated sprints, and players' overall ability on the field. It is hoped that HIIT can be implemented into routine training programmes, especially at the developmental stages of young athletes. Given its effectiveness, HIIT can be used as a major component in an effort to improve players' physical fitness. In addition, adjustments to the intensity and duration of HIIT training should continue to be monitored and tailored to the individual needs of the player, to ensure each player can reach their maximum potential optimally and safely. Further research is also recommended to explore the long-term impact of HIIT on player performance and health, so that its benefits can be more widely applied in football training.

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