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Evaluating Aerobic Endurance in Soccer Academy Players Through VO2Max Assessment

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ABSTRACTS

Purpose: This study aims to analyze the aerobic endurance of Soccer players in the Academy U-15 age group through VO2max measurement. Soccer is a popular sport that requires optimal physical fitness, one of which is indicated by the VO2max value, which describes the body's capacity to utilize oxygen during intensive physical activity. VO2 max is an important indicator for determining a player's aerobic endurance.

Materials and Methods: The research method used is a quantitative descriptive approach, utilizing the bleep test (multi-stage fitness test) to measure the VO2 max level of players. This study involved 24 samples selected by purposive sampling based on specific criteria. The data obtained were then analyzed using VO2max norms to classify the aerobic endurance levels of the players.

Result: The study's results showed that Soccer Players Academy's aerobic endurance varied, with 8% being "very poor," 50% being "poor," 17% being "fair," 21% being "good," and 4% being "excellent." Most players fell into the "poor" category, indicating a need to improve their aerobic fitness.

Conclusion: Based on these findings, it is recommended that additional training programs, such as interval training and cross-country, be implemented to improve players' VO2 max. In addition, coaches are expected to pay special attention to training planning that focuses on physical endurance and ensures a balance of nutrition and healthy lifestyles for players. This study contributes to developing measurable physical fitness-based soccer coaching programs.

Keywords: Aerobic endurance; VO2max; Bleep test; Soccer.

INTRODUCTION

Soccer is one of the most popular sports in all corners of the world. World, almost everyone in the world plays the sport. In Indonesia, almost everyone likes and plays sports, from children to adults. We can see the love of Indonesian people for soccer when The National Team is playing. When the National Team plays, the entire stadium stands are always full. Spectators, even people in villages or far from the stadium, hold viewings together to support the National Team. A phenomenon like this shows that the Indonesian people love and favour soccer; this phenomenon is proven by many soccer schools in Indonesia, which aim to develop and nurture children and adolescents with an interest in and talent for sport soccer.

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Soccer players must have well-developed physical fitness. Since the leading energy soccer players use is generated by aerobic metabolism, players must have aerobic fitness (Modric et al., 2020). An appropriate level of aerobic fitness or VO2 max can enable players to sustain repeated high-intensity actions in a soccer match, accelerate recovery, and maintain their physical condition at an optimal level during matches in a season (Slimani et al., 2019).

Good VO2 max condition is needed for maximum performance in soccer because it is played on a 75-meter x 110-meter field and lasts for an extended period (2 x 45 minutes). Proper training is essential to increasing VO2 max capacity and boosting athlete performance. Endurance training has been shown to increase VO2 max capacity in various studies. Periodic endurance training can cause an increase in VO2 max mediated by improvements and delivery of O2 to peripheral adaptation centres (Clark et al., 2016). High-intensity endurance training programs can significantly increase VO2 max in adults, adolescents, and middle-aged people (Milanović et al., 2015). According to Ravenzo et al. (2023), Efforts made in coaching sports achievements include development through several exercises that need to be understood, namely physical, technical, tactical, and mental aspects. A soccer player can show his best game and succeed. Soccer requires a very fit physical condition. Soccer is a sport that can be categorized as an aerobic sport because this game lasts for quite a long duration, namely 2x45 minutes (Dewi, 2016). Soccer players have an essential physical component, namely cardiorespiratory fitness, which is often known as the maximum oxygen volume capacity (VO2 max) (Ravenzo et al., 2023).

VO2Max represents the player's aerobic endurance ability (Bompa, Tudor O., Buzzichelli, 2018). In addition to VO2 max, speed, endurance, and Strength are also important in soccer (Rodríguez-Fernández et al., 2018). To improve VO2Max and other aspects of soccer performance, interval training involving cardiovascular exercise and strength training can be very beneficial (Arslan et al., 2020). A soccer player with good endurance can maintain his performance throughout the match (Pratama & Imanudin, 2018). VO2 max is a parameter used to measure the body's capacity to absorb and utilize oxygen during intense physical activity. The higher a person's VO2 max value, the greater their ability to maintain a high level of work over a more extended period. This condition is critical in soccer because the game often alternates between periods of high intensity and short rest periods.

VO2 max is the maximum amount of oxygen the body can absorb and use the body can absorb and use during intense physical activity until fatigue is reached (Fauzan et al., 2016). The physical condition of soccer athletes is greatly influenced by the high or low value of their VO2 max. If a person's VO2 max value is good, the athlete's physical endurance level will also be optimal. On the other hand, if the VO2max value is low, a soccer athlete's physical endurance will decrease, which can cause fatigue, emotional instability, decreased concentration, and even loss of focus during the match (Anggara & Dear Sir, 2021). VO2max's role is crucial in determining players' performance on the field. VO2 max is a parameter used to measure the body's capacity to absorb and utilize oxygen during intense physical activity. The higher the person's max value, the greater their ability to maintain a given work rate. Tall during term time which more long. Condition this is critical in soccer because games often present changeover between period intensity tall and rest short. One of the tests used to measure VO2 max is the bleep test or run Multi-Stage (Sugiarto & Rahmatullah, 2019). The bleep test can be used to evaluate athletes and coaches as a parameter achievement exercise (Sugiarto & Rahmatullah, 2019). The bleep test is a test for measuring and determining VO2 max. It aims to measure the efficiency of the heart and measure the lung moment by taking oxygen maximum (Sugiarto & Rahmatullah, 2019).

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Based on observations at one of the Soccer Schools on the moment match, the beginning match condition of each player is still in good condition, and the game is still controlled. After entering one round, the players' condition was still stable. However, at the time of the match, 25 minutes before the end, players started to experience a decline in stamina, drastically making players lose concentration. The player also lost rhythm and mastery of the ball, which influenced the accuracy of their play and affected the match control desired by the coaching team. In this problem, one factor influencing a player's performance in a match is their VO2 max capability. If this problem continues to be ignored, it will impact players' performance alone because the researcher is interested in revealing the problem that happened at soccer academy. Based on the problem, measuring the VO2 max of the soccer player's Academy is important so players can show off the game, which is good and maximum at each match. Because that researcher carrying the title "Analysis of the Aerobic Endurance of Soccer Players Soccer Academy Through Measurement VO2 max". Athletes with high VO2 max have good endurance and fitness (Palar et al., 2021). At the age of 13-19 years, children's VO2max development will be faster because growth hormone is higher than at ages over 19 years. Growth hormone, active during puberty, plays a crucial role in influencing the body's development process, including increasing the body's maximum capacity to consume oxygen during physical activity (Indrayana & Yuliawan, 2019).

METHODS

Study Participants: The population consists of players from a soccer-style academy, totaling 55 individuals. The study employs purposive sampling, selecting 24 U15 players from the academy as the sample (Firmansyah & Dede, 2022).

***Study Organization*:** This study adopts a quantitative descriptive approach using test and measurement techniques. Descriptive research systematically and factually analyzes and solves problems based on data describing a population's characteristics and properties (Budiwanto, 2012).

***Statistical Analysis*:** The bleep test is used to measure the aerobic endurance of soccer players, given the physical demands of a 90-minute match. In data analysis, the initial step involves testing the students to measure their ability level. The raw data is then analyzed using test norms to estimate the maximum aerobic endurance of soccer academy players.

Table 1. Norma bleep test.

Category	Man	Woman
Very Less	<35.0	<33.0
Not Enough	35.0-39.9	33.0-37.1
Enough	40.5-45.1	37.8-42.4
Good	45.2-50.9	43.3-46.8
Extraordinary	51.0-55.9	47.4-52.5
Superior	>55.9	>52.6

Table 1 presents the normative values for the bleep test, categorized by performance levels for men and women. The classifications range from "very less" to "superior," with higher VO2 max values indicating better aerobic endurance. Men with VO2 max below 35.0 and women below 33.0 fall into the "very less" category, while those exceeding 55.9 (men) and 52.6 (women) are classified as "superior." These norms provide a benchmark for assessing aerobic endurance in athletes.

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RESULT

The research results obtained from 24 players then resulted in statistical analysis related to aerobic endurance: a minimum score of 33.6, a maximum score of 52.5, an average of 40.6, a median of 37.8, a mode of 43.3, and a standard deviation of 5.6.

Table 2. Description of soccer academy aerobic endurance research results.

Category	Frequency	Percentage
Very Less	2	8%
Not Enough	12	50%
Enough	4	17%
Good	5	21%
Extraordinary	1	4%
Superior	0	0%
Total	24	100%

Based on the table 2. above, the aerobic endurance level of soccer academy players in the extraordinary category is 4%, the good category is 21%, the fair category is 17%, the poor category is 50%, and the very poor category is 8%. The highest frequency is in the less category, with a presentation of 50%. With these results, it can be interpreted that the aerobic endurance of the soccer academy players is mainly in the poor category.

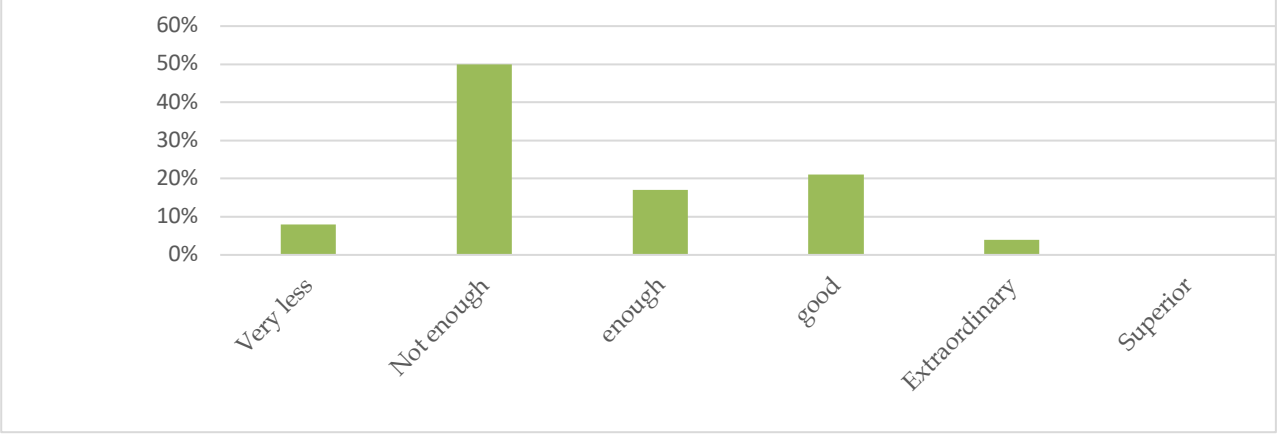

Figure 1. Frequency bar chart of endurance level of soccer academy

Figure 1 illustrates the frequency distribution of aerobic endurance levels among soccer academy players. The "not enough" category has the highest percentage at 50%, followed by "good" (21%) and "enough" (17%). A smaller proportion of players fall into the "very less" category (8%) and "extraordinary" category (4%), while none are classified as "superior." This distribution highlights the need for improved endurance training to enhance players' aerobic capacity.

DISCUSSION

Soccer is closely related to VO2Max and athlete performance (Muñoz-Martínez et al., 2017). A high VO2 max indicates that the athlete's body can efficiently supply more oxygen to the muscles during intense physical activity, which increases endurance. As a result, players can maintain their speed and the quality of their movements throughout the game (Kuswoyo et al., 2020). Strength qualities like muscle strength and explosive power are important in physical duels and hard kicks. Soccer players often sprint, run long distances, and participate in physical duels (Chmura et al., 2021). The ability to recover quickly between such activities is important for players to maintain performance throughout the match. High VO2 max is also associated with increased speed (Modric et al., 2019). Soccer players with good VO2 max tend to be able to move faster and chase the ball more effectively (Purnawan et al., 2022).

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According to Indrayana and Yuliawan (2019), the following variables affect VO2 max: gender, age, heredity, height, activity, and nutrition. A player's VO2 max capacity ultimately determines their performance in soccer; therefore, the higher the calibre of these criteria, the greater their VO2 max capacity. Proper training is needed to build VO2 max capacity and enhance athlete performance (Astorino et al., 2022). Overall, in individuals with average endurance, regular interval training sessions in soccer players can significantly increase VO2 max, which is also marked by increased cardiac output and stroke volume.

This study is limited to analyzing endurance and a limited number of samples. Aerobic endurance is also influenced by nutrition and motivation to exercise, since there is a positive and significant relationship between calorie intake, lifestyle, physical activity, and nutritional status on athlete stamina. In addition, other factors that influence aerobic endurance are work activities, rest time, lifestyle, environmental conditions, and lifestyle (Sepriadi, 2017). The study's results showed that the aerobic endurance level of students at Soccer Academy is mainly in the poor category. Twelve students are classified as poor: 5 are in the good category, four are in the sufficient category, two are in the inferior category, and one is in the extraordinary category. The highest frequency is in the poor category. With these results, it can be concluded that the VO2max level of soccer players in the academy is still primarily low and needs further improvement.

Various factors affect VO2max, including a nutritious diet, adequate rest time, and habits. Therefore, maintaining optimal physical fitness is important so players can perform their activities with maximum performance. In this case, regular physical exercise must be done to increase VO2max to a more optimal level. VO2max indicates the body's capacity to consume oxygen, expressed in litres per minute. A player's VO2max level is closely related to his physical ability to carry out activities or tasks. The higher the VO2max value of a player, the greater the capacity of activities that can be done more efficiently and the lower the level of fatigue the player feels. The study above shows the results of the VO2max of soccer players academy, which mostly gets the less good category. The results of the study above show that the majority of the physical players of soccer the academy need to be improved again to complete and carry out matches optimally and according to the instructions given by the coach. PSSI has made various achievements at the international level. Sports experts argue that one of the factors is VO2max (Sinurat, 2019).

To increase endurance, trainers can also implement several training programs in the form of interval training, cross-training, and endurance training country. Interval training is a training method that is done by combining periods of high-intensity activity and alternating rest periods (Kusuma et al., 2025). A simple application of this method can be seen in running training, where the running session is interrupted by a walking phase, then continued with running, and so on. Sprint training is carried out for 15 seconds, followed by a 45-second walk break, which is done in four sets (Firmansah, 2021). The equipment needed in this training method includes cones, stopwatches, and meters. The advantages of this training model lie in its simplicity in implementation and its ability to provide significant benefits in increasing the endurance capacity of players (Firmansah, 2021). Next, cross-country training is often referred to as cross-country running, which involves long-distance running activities carried out outdoors, generally through various terrains such as highways, trails, and mountains (Akbar et al., 2024). Cross Country training is an effective method for increasing VO2max. Cross Country is a long-distance running activity carried out in the open air, aiming to increase aerobic capacity and reduce training (Akbar et al., 2024). With these exercises, the coach can repeatedly provide the training program with the intensity of the training implementation at a high tempo so that the player's endurance increases,

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and the players are also accustomed to playing with high intensity and tempo during the match. Research Yamin & Gusril (2020) shows that intensive interval training increases VO2 max.

CONCLUSION

The research and analysis results indicate that the aerobic endurance level of soccer academy players, as measured by the Multi-stage Fitness Test, varies across different categories. Most players fall into the lower endurance levels, while only a tiny number achieve higher categories, indicating a need for improved aerobic conditioning. This suggests that the players' overall VO2Max levels still require improvement to achieve optimal physical conditioning.

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CONFLICT OF INTEREST

The authors have no conflict of interest to declare.

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