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# The Relationship Between BMI and VO2max on the Football Skills of Athletes at the Safin Pati Football Academy

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**Abstract**

**Study purpose**. This study aims to analyse the relationship between body mass index and cardiovascular endurance on basic football skills in 17-year-old athletes at the Safin Pati Football School.

**Materials and methods**. This study used a quantitative approach with a correlational method. The study was conducted at the Safin Pati Football School, Pati Regency, Central Java. The research sample consisted of 18 active athletes who were members of the 2025 Pati Regency football team, aged 17 years. The research instruments included body mass index measurements, cardiovascular endurance tests using the bleep test, and basic football skill tests covering heading, passing, dribbling, and speed shooting. Data analysis was performed using Pearson's correlation test with the assistance of SPSS version 27 software.

**Results**. The results showed that both body mass index and cardiovascular endurance had a significant relationship with football skills. Body mass index contributed effectively by 14.9%, while cardiovascular endurance contributed effectively by 0.6%. The combined contribution of both to football skills was 15.5%, while the rest was influenced by other factors that were not studied. The novelty of this study lies in its focus on Safin Pati Football School, a football school that specifically focuses on coaching athletes to prepare them for careers in professional football.

**Conclusion.** Body mass index and cardiovascular endurance play a role in supporting basic football technical skills. These findings can serve as a basis for coaches to consider when designing physical training programmes and managing athletes' physical condition optimally.

**Keywords:** BMI, Cardiovascular, Football Skills

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## Introduction

Football is one of the most popular sports in the world and is growing rapidly. Football is a team game played by eleven people, with each player allowed to use all parts of their body except their arms and hands. Each team consists of one goalkeeper and ten other players with specific positions, such as defenders, attackers and midfielders (Suta et al., 2021). In other words, a football match is a game played by two opposing teams, each striving to score goals

against the other team, with each team consisting of eleven players (Sarwaki & Jatra, 2022). In Indonesia, according to Bima Pradiksa & David Agus Prianto (2022) 90,8% The majority of Indonesians are familiar with football, but not all of those who know about the sport actually play it; only 46.7% are football enthusiasts. These results show that Indonesians on average are fans of football because the culture of football originated in small areas throughout the country, where it is enjoyed by people from all walks of life, including men, women, adults and children.

Football is a game that involves dynamic movements and requires good physical condition, such as strength, speed, agility, endurance, flexibility, accuracy, power, reaction, and coordination (Ridwan, 2020). In football, there are basic things that must be mastered, namely football skills (Haskiya & Margaretha, 2023). Mastery of basic techniques such as dribbling, passing, shooting, and ball control are important indicators that determine a player's quality in a match (Kuswiranto et al., 2024). Therefore, in order to maintain the quality of athletes in football, physical fitness support is needed so that they can perform basic techniques efficiently and consistently in football matches.

One indicator of physical fitness that is closely related to the technical performance of football players is body mass index. Body mass index reflects the balance between weight and height, which indicates a person's body composition (Annisa, Ningrum, Dewangga, & Wanita, 2024). according to the Ginnannafsi et al., (2025) Athletes with an ideal body mass index have a more efficient body proportion in supporting technical movements, such as agility and good motor coordination when playing football. According to Ardianto & Andiana, (2024) Goalkeepers generally have the tallest body proportions and a higher percentage of body fat to support their reach and strength. Defenders have a similar posture to goalkeepers, with strong muscle mass for physical duels and heading to clear the ball (Eko Santoso & Rices Jatra, 2021). Midfielders tend to be proportionate with the lowest body fat to support mobility and agility. Forwards usually have relatively lower height and weight compared to goalkeepers and defenders, with strong leg muscles to support speed, acceleration, and the ability to change direction quickly. Excessive or insufficient body weight in football players can impair the effectiveness of basic techniques, as it can slow down reaction times and reduce body stability, ultimately affecting performance on the field (Raditya et al., 2024).

In addition to body mass index, cardiovascular endurance also plays an important role in supporting basic technical skills, especially in maintaining consistent performance throughout the match (Shodiqin, 2025). Players with good cardiovascular endurance have the ability to maintain technical stability, such as dribbling and defending, for long periods of time, and are able to perform repeated sprints with less fatigue (Hidayat, Sumantri, & Syahputra, 2025). Further (Muchtar et al., 2024) explains that football players with good endurance have a quick recovery ability, enabling them to perform optimally until the end of the football match.

After recognising the importance of body mass index and cardiovascular endurance in supporting basic football skills, more contextual research is needed in the athlete training environment. The novelty of this research lies in its focus on the Safin Pati Football School, an institution that specifically prepares athletes through intensive, systematic, and professionally oriented training programmes. This differs from previous studies, which were generally conducted in the context of formal schools or extracurricular activities. This study focuses on the football academy environment, which has more targeted and competitive training standards. Based on this background, the researchers wanted to conduct research related to football school activities, reviewed from the analysis of body mass index and cardiovascular endurance in relation to football skills. This study was conducted on athletes from the Safin Pati Sport School (SPSS). Thus, this study will provide a new perspective on the relationship between body mass index and cardiovascular endurance and football skills in a training environment, which directly prepares athletes to join professional football clubs. The results of this study can also be useful for coaches in managing training programmes, diet, adequate nutrition and health for football

athletes, so that ultimately coaches can have targets for maintaining physical condition and playing skills for better athlete performance.

## Materials and Methods

### *Study participants*

The population of this study was all active athletes at Safin Pati Sport School who were members of the 2025 Pati Regency U17 football team. The sample consisted of 18 athletes selected using purposive sampling, all of whom were 17 years old. The location was chosen based on the relevance of Safin Pati Sport School to my research, as this football school has a diverse background of football players with a rigorous recruitment process, providing an opportunity to observe variations in BMI, VO2 max, and skills in real life. Furthermore, the structured training programme at Safin Pati Sport School, with its comprehensive facilities and certified coaches, allows for more valid measurements.

### *Study organization*

This study utilised a quantitative descriptive approach, employing an experimental research method with an experimental correlation type. According to Arikunto in (Khozim & Nugroho, 2022) Correlation research is research that aims to determine whether or not there is a relationship between independent variables and dependent variables. The instruments used in this study were body mass index measurements, bleep tests, and football skills. Data collection was carried out using tests and measurements.

### *Statistical analysis*

Data analysis was performed using SPSS version 27. The data analysis procedure was carried out using descriptive tests to describe the characteristics of the sample, with relatively homogeneous data distribution results. Normality tests were then performed, with the results showing that the data was normally distributed because the significance value of each variable was greater than 0.05. After the data was found to be normally distributed, a linearity test was conducted, which showed that the body mass index variable was linearly related to football skills, and the cardiovascular endurance variable was linearly related to football skills. Finally, a hypothesis test was conducted using the product moment correlation statistic to test the proposed research hypothesis. The results of the hypothesis test showed that there was a relationship between body mass index and cardiovascular endurance on football skills, so Ha was accepted. This study has two independent variables, namely: Body Mass Index, measured using calculations and analysis from the World Health Organisation (X1), and (X2) Cardiovascular Endurance, measured using calculations and analysis from sports testing and measurement books (Pasaribu, 2020), the dependent variable is football skill (Y).

## Results

### Descriptive Analysis

The respondents in this study consisted of 18 active athletes aged 17 years from Safin Pati Sport School. The following are the results of the descriptive analysis of BMI, cardiovascular endurance, and football skills. The results of the analysis can be seen in Table 1, Table 2, and Table 3.

**Table 1.** Descriptive Analysis of BMI

| | N | Min | Max | Mean | Standard Deviation | Categories |
|---|---|---|---|---|---|---|
| BMI | 18 | 14,9 | 26,8 | 21,6 | 2,4980 | Ideal |

**Table 2.** Descriptive Analysis of Cardiovascular Endurance

| | N | Min | Max | Mean | Standard Deviation | Categories |
|---|---|---|---|---|---|---|
| Vo2max | 18 | 29,7 | 50,8 | 38,9 | 5,9527 | Currently |

**Table 3.** Descriptive Analysis of Football Skills

| | N | Min | Max | Mean | Standard Deviation | Categories |
|---|---|---|---|---|---|---|
| Skills | 18 | 53,6 | 69,6 | 63,8 | 3,9999 | Good |

Based on the descriptive analysis in Tables 1, 2, and 3, it can be seen that the mean value of the Body Mass Index variable is 21.6, which is in the ideal category, with a standard deviation of 2.4980. Additionally, it can be seen that the body mass index of participants in the Safin Pati football school shows that 1 participant (5.6%) is underweight, 14 participants (77.8%) are of ideal weight, 2 participants (11.1%) are overweight, and 1 participant (5.6%) is obese. Furthermore, the mean value of the Cardiovascular Endurance variable was 50.8, which is in the moderate category, and the standard deviation of Cardiovascular Endurance was 5.9527. Additionally, it can be seen that the cardiovascular endurance of participants in the Safin Pati football school was in the very poor category for 4 participants (22.2%), poor category for 4 participants (22.2%), moderate category for 7 participants (38.9%), good category for 3 participants (16.7%), and no participants had cardiovascular endurance in the very good or excellent categories.

Then, the mean value of the Skill variable was 63.8, which was categorized as good, and the standard deviation of Skill was 3.9999. Additionally, it was found that the football skills of participants at the Safin Pati football school were rated as adequate for 3 participants (16.7%), while the remaining 15 participants (83.3%) were rated as good. No participants were rated as very poor, poor, or average in football skills. Based on these results, it can be seen that the mean value is greater than the standard deviation value. Thus, this condition shows evidence of relatively homogeneous data distribution.

**Normality Test**

A normality test was conducted to determine whether the data was normally distributed or not. The data was declared normally distributed if the significance value was greater than 0.05; if it was less than 0.05, the data was declared not normally distributed. The results of the normality test can be seen in Table 4.

**Table 4.** Normality Test Results

| | N=18 | | |
|---|---|---|---|
| | **BMI** | **Vo2max** | **Skills** |
| Asymp. Sig (2 Taile d) | 0,295 | 0,200 | 0,096 |
| Decision | Normal | Normal | Normal |

Table 4 shows that the significance value of the Body Mass Index variable is 0.295. The Cardiovascular Endurance variable is 0.200, and the Skill variable is 0.096. It can therefore be concluded that the data is normally distributed because the significance value of each variable is greater than 0.05.

**Linearity Test**

A linearity test is conducted to ensure that the relationship between the independent and dependent variables is linear. Data is considered linear if the deviation from linearity value is greater than 0.05. If the deviation from linearity value is less than 0.05, the data is considered non-linear. The results of the linearity test can be seen in Table 5.

**Table 5.** Linearity Test

| Variable | Deviation from Linearity Value | Description |
|---|---|---|
| BMI with Football Skills | 0,276 | Linear |
| Vo2max with Football Skills | 0,914 | Linear |

Based on Table 5, it is known that the deviation from linearity value for the body mass index variable with football skills obtained a value of 0.276. Then, the deviation from linearity value for the cardiovascular endurance variable with football skills obtained a value of 0.914. The deviation from linearity values for both variables are greater than 0.05. Therefore, it can be concluded that the body mass index variable with football skills and the cardiovascular endurance variable with football skills have a linear relationship.

Hypothesis Testing

Hypothesis testing is conducted to examine the effect of independent variables on dependent variables. After conducting a Pearson product moment test, which states that the Rhitung value for the body mass index variable is 0.361 ($r \neq 0$), meaning that there is a relationship, H0 is rejected, and it can be concluded that there is a relationship between body mass index (X1) and football skills (Y). The Rhitung value for the cardiovascular endurance variable was 0.036 ($r \neq 0$), indicating a relationship, so H0 was rejected, and it can be concluded that there is a relationship between cardiovascular endurance (X2) and football skills (Y). In addition, the significance value of body mass index on football skills is $0.002 < 0.05$, and the significance value of cardiovascular endurance on football skills is $0.002 < 0.05$. Thus, there is a significant relationship between body mass index (X1) and basic futsal skills (Y), and cardiovascular endurance (X2) and basic futsal skills (Y).

Next, a correlation analysis was conducted to examine the relationship between body mass index and cardiovascular endurance with football skills. The results of the correlation analysis can be seen in Table 6.

**Table 6.** Correlation Analysis

| R | R *Square* | *Adjusted R Square* | *Std. Error* |
|---|---|---|---|
| 0,394[a] | 0,155 | 0,042 | 3,9140 |

Based on Table 6, the R-squared value of 0.155 indicates that Body Mass Index and Cardiovascular Endurance have a significant relationship with football skills of 15.5%, while 84.5% is influenced by other variables not examined in this study. Body Mass Index contributes effectively by 14.9% and relatively by 96%, which is the largest contribution. Cardiovascular Endurance contributes effectively by 0.6% and relatively by 4%, which is the smallest contribution to football skills.

**Discussion**

The Relationship Between Body Mass Index and Football Skills

Body mass index has a close relationship with football skills. Based on the results of the study, body mass index is one of the factors that contributes effectively to football skills by 14.9% with a positive relationship. Based on these results, body mass index is related to football skills. Therefore, to improve football skills, the body mass index of Safin Pati football school participants must also be improved. This is very possible to do, considering that Safin Pati football is one of the football schools with the most complete facilities in the world, where there are 7 football fields and a gym, which will certainly make it easier to improve and maintain BMI so that it can contribute more to the football skills of athletes.

The ideal body mass index is closely related to basic skill performance in sports, including football Research conducted by Hafizhudin & Iwandana (2024) shows that students with a body mass index in the normal category tend to have better motor coordination when playing football. This is because a proportionate body allows for more efficient muscle movement, thereby facilitating the execution of basic football techniques. In addition, according to Pradana & Sugiharto (2023) Being overweight or underweight affects speed and agility when dribbling the ball. Therefore, maintaining a normal body mass index not only supports players' physical health, but also improves the effectiveness of basic football skills at football schools.

**The Relationship Between Cardiovascular Endurance and Football Skills**

Cardiovascular endurance variables are also related to football skills. Based on the research results, cardiovascular endurance variables contribute only 0.6%, which is not as significant as body mass index variables. Therefore, cardiovascular endurance must be further improved so that football skills can also improve and stabilise, considering that football is a high-intensity sport that requires excellent physical endurance to support player performance. To support this improvement, the Safin Pati Football School can utilise its comprehensive facilities to conduct physical training such as interval running, small-sided games, and circuit training on the field, which can be integrated with a strengthening programme in the gym to optimise lung capacity and heart efficiency. This will enable cardiovascular endurance to contribute more significantly to the football skills of athletes.

Cardiovascular endurance plays an important role in supporting the performance of football players, especially in maintaining the intensity of play throughout the duration of the match. Research conducted by Jati et al., (2025) shows that cardiovascular endurance affects muscle efficiency when performing repetitive movements such as sprinting, dribbling, and defending for long periods of time. Although its contribution to football skills is not as significant as body mass index, cardiovascular endurance remains an important foundation for athletes, especially in supporting overall physical ability. Furthermore, research Hernawan, Rohendi, & Kardani (2021) emphasises that players with high cardiovascular endurance have a faster recovery ability after activity. Therefore, physical training programmes at football schools should include regular and structured cardiovascular exercises so that players' endurance can improve and contribute positively to their mastery of football skills.

**The Relationship between Body Mass Index and Cardiovascular Endurance with Football Skills**

Based on the results of the study, body mass index and cardiovascular endurance have a significant relationship with football skills and contribute 15.5%. Therefore, body mass index and cardiovascular endurance need to be considered by individuals, parents, and coaches. This is because body mass index and cardiovascular endurance are factors that support football players in performing basic skills.

Body mass index and cardiovascular fitness are closely related to football skill quality. Research conducted by Syarif, Imanudin, Zaky, & Fadli (2025) shows that players with an ideal body mass index and good cardiopulmonary endurance capacity tend to be able to maintain their performance throughout a football match. Furthermore, research Raditya et al., (2024) mentions that being overweight can cause a decrease in movement efficiency and increase muscle fatigue, which has a negative impact on motor skills in football. On the other hand, low cardiovascular endurance can also reduce consistency in decision-making as the intensity of the match increases (Rubiyatno, Supriatna, Suryadi, Haetami, & Firsta Yosika, 2023). Therefore, the role of the coach in designing training that balances physical and technical aspects is very important. High-intensity interval training (HIIT) and regular monitoring of body composition can be effective strategies for maintaining optimal player performance (Suliarno., 2024). By paying attention to and maintaining these two factors, young football players are expected to develop their basic skills to the fullest and in a sustainable manner.

## Conclusions

This study shows that body mass index and cardiovascular endurance are related to football skills, with body mass index being the more dominant factor. These findings imply that body composition and physical fitness management need to be considered in an integrated manner to improve playing skills. The novelty of this study lies in its focus on SSB Safin Pati, which has an intensive and structured training system aimed at preparing athletes for careers in professional football, as well as complete facilities. However, this study still has limitations in terms of the small sample size and homogeneous age range, so the results cannot be generalised widely.

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## Conflict of interest

There is no conflict of interest in the research.

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