# Cardiorespiratory Endurance Assessment of High School Futsal Players: A Case Study at SMAS Fatih Bilingual School, Banda Aceh

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**Abstract**

**Background** Futsal is a high-intensity sport that requires optimal cardiorespiratory endurance to maintain performance throughout a match. $VO_2$ Max is a key indicator of aerobic capacity and overall physical fitness in athletes.

**Objectives** This study aimed to evaluate the cardiovascular–respiratory endurance of SMAS Fatih Bilingual School futsal club players in Banda Aceh, Indonesia, and classify their $VO_2$ Max levels.

**Methods** A quantitative descriptive–evaluative design was used, involving all 15 active futsal players through a total sampling technique. Cardiorespiratory endurance was assessed using the Harvard Step Test, and results were classified according to $VO_2$ Max norms for males aged 13–19 years. Data were analyzed descriptively to determine mean values, frequency distribution, and percentage classification.

**Results** The mean $VO_2$ Max score was 62.78, categorized as "poor." Distribution analysis showed that 33.33% of players were in the "very poor" category, 26.66% in "poor," 26.66% in "moderate," and 13.33% in "good."

**Conclusion** Most futsal players at SMAS Fatih Bilingual School demonstrated suboptimal aerobic fitness, which may hinder competitive performance. Implementing structured training programs targeting aerobic endurance is recommended to enhance performance and reduce fatigue during matches.

**Keywords:** Cardiorespiratory Endurance, $VO_2$ Max, Futsal, Harvard Step Test

Received: June, 10 2025. Accepted: June, 25 2025

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How to Cite:. Azmi, F., Ifwandi, Masri, Zulfikar, Mualimin, A., & Ambia, F. (2025). Cardiorespiratory endurance assessment of high school futsal players: A case study at SMAS Fatih Bilingual School, Banda Aceh. *International Journal Emerging of Sport Science, 1*(2), 13-16

## INTRODUCTION

Futsal has become one of the most widely played sports in Indonesia, attracting participants across diverse age groups and genders. While it is often dominated by male players, futsal has also gained popularity among women, reflecting its inclusive nature and accessibility (Halim & Indiarsa, 2016). As a variant of football, futsal is played indoors on a smaller pitch, with teams consisting of five players each. This format emphasizes fast-paced gameplay, technical precision, tactical adaptability, and high-intensity physical effort (Supriady, 2021).

To sustain optimal performance in such a demanding sport, players must possess various components of physical fitness, including endurance, speed, explosive power, agility, strength, and coordination. Among these, cardiorespiratory endurance—often measured through maximal oxygen uptake ($VO_2$ Max)—is particularly crucial. $VO_2$ Max refers to the maximum rate at which oxygen can be consumed during intense exercise, reflecting the combined efficiency of the cardiovascular, respiratory, and muscular systems (Nasution, 2014; Zakiyuddin, 2016). Higher $VO_2$ Max values are strongly associated with prolonged high-intensity performance, reduced fatigue, and improved match outcomes (Tamara & Nurrocmah, 2019).

Several factors influence $VO_2$ Max, including age, sex, genetics, nutrition, training regimen, and environmental conditions such as altitude (Indrayana & Yuliawan, 2019). Furthermore, the status of the cardiovascular, respiratory, and hematological systems directly affects oxygen delivery and utilization during exercise. Effective physical training programs—designed with systematic and progressive overload—are essential to improve aerobic fitness, enhance recovery rates, and maintain competitive performance levels (Yanti & Marisa, 2021).

Fatih Bilingual School, located in Banda Aceh, Indonesia, is known for its commitment to high-quality education, interactive learning, and extracurricular excellence. Its futsal team regularly competes in regional tournaments, such as the *Pascal Cup* (2023 and 2024), and often represents the school in provincial-level

competitions. However, observational assessments during friendly matches have revealed signs of performance decline during the later stages of play. These include reduced ball control, inaccurate passing and shooting, diminished off-ball movement, and slower responses during counterattacks—symptoms typically associated with inadequate cardiorespiratory endurance.

Despite the recognized importance of aerobic fitness in futsal, there is limited empirical research assessing $VO_2$ Max levels among high school players, particularly within Fatih Bilingual School. Understanding the players' aerobic capacity is essential for designing targeted conditioning programs that can enhance performance and reduce fatigue. Therefore, this study aims to evaluate the cardiorespiratory endurance of SMAS Fatih Bilingual School futsal players using the Harvard Step Test and classify their $VO_2$ Max levels according to established norms.

## METHOD

### Participant

The study involved all 15 active members of the SMAS Fatih Bilingual School futsal club in Banda Aceh, Indonesia. Participants were male students aged 16–18 years, all of whom regularly participated in the school's futsal training sessions and competitions. Due to the relatively small number of players, a total sampling technique was employed, ensuring that every team member was included in the research.

### Research Design

This research employed a quantitative descriptive–evaluative design. Quantitative methods were used to obtain measurable data on the players' cardiorespiratory endurance, while the descriptive–evaluative approach aimed to profile their current fitness levels based on standardized assessment procedures (Sugiyono, 2012; Pratama & Nawawi, 2020). The Harvard Step Test served as the primary measurement tool, following standard protocols. Players stepped onto and off a bench at a set rhythm for a specified duration, after which heart rates were measured during recovery. Predicted $VO_2$ Max values were calculated and categorized according to norms for males aged 13–19 years (Parmar, 2013).

### Data Analysis

Data were processed using descriptive statistics. The mean $VO_2$ Max score was calculated to determine the overall aerobic fitness classification of the team. Additionally, frequency distribution and percentage analysis were applied to classify players into four categories: *very poor*, *poor*, *moderate*, and *good*. These results were then interpreted to provide insights into the team's current endurance capacity and to inform recommendations for training improvements.

## RESULTS AND DISCUSSION

### Results

The results of the Harvard Step Test revealed the predicted $VO_2$ Max scores and corresponding fitness classifications of the 15 SMAS Fatih Bilingual School futsal players. The calculated mean $VO_2$ Max was **62.78**, which falls within the *poor* classification according to the $VO_2$ Max norms for males aged 13–19 years (Parmar, 2013).

### $VO_2$ Max Classification

The frequency distribution showed that:

a) **5 players (33.33%)** were classified as *very poor*
b) **4 players (26.66%)** were classified as *poor*
c) **4 players (26.66%)** were classified as *moderate*
d) **2 players (13.33%)** were classified as *good*

This distribution indicates that more than half of the players (60%) fall into the *very poor* or *poor* categories, suggesting a general lack of optimal aerobic capacity within the team.

**Table 1** presents the detailed $VO_2$ Max classification of the players.

**Table 1.** Predicted $VO_2$ Max classifications of SMAS Fatih Bilingual School futsal players

| Classification | Frequency | Percentage (%) |
|---|---|---|
| Very Poor | 5 | 33.33 |
| Poor | 4 | 26.66 |
| Moderate | 4 | 26.66 |
| Good | 2 | 13.33 |
| **Total** | **15** | **100** |

The high proportion of players in the lower fitness categories highlights the need for targeted aerobic conditioning programs. Players in the *moderate* and *good* categories generally demonstrated better performance consistency and quicker recovery during matches, whereas those in the *very poor* and *poor* categories exhibited earlier onset of fatigue, potentially compromising their tactical and technical execution.

**Discussion**

The results of this study indicate that the majority of SMAS Fatih Bilingual School futsal players have suboptimal cardiorespiratory endurance, as reflected by a mean $VO_2$ Max score of 62.78, which falls within the *poor* classification. More than half of the players (60%) were in either the *very poor* or *poor* categories, suggesting that their aerobic capacity is insufficient to sustain optimal performance throughout a full match.

Cardiorespiratory endurance plays a crucial role in futsal performance, as the sport is characterized by repeated high-intensity actions interspersed with brief recovery periods (Tamara & Nurrocmah, 2019). Players with low $VO_2$ Max levels are more likely to experience early fatigue, which can lead to reduced technical accuracy, slower decision-making, and diminished tactical discipline during later stages of play (Yanti & Marisa, 2021). This was consistent with observational reports during matches, where players displayed decreased ball control, inaccurate passing, and reduced off-ball movement after the midway point of the game.

Several factors may explain the low $VO_2$ Max values observed in this study. First, inconsistent participation in structured physical conditioning sessions was noted among some players, aligning with previous findings that training adherence significantly influences aerobic fitness development (Indrayana & Yuliawan, 2019). Second, lifestyle factors such as nutrition, rest, and recovery may not have been adequately optimized, which are known to affect cardiovascular efficiency (Zakiyuddin, 2016). Finally, differences in age and training experience could have contributed to the observed variation in $VO_2$ Max classifications, as younger and less experienced players often demonstrate lower endurance compared to senior players with longer training histories (Nasution, 2014).

The presence of players in the *moderate* and *good* categories suggests that improvement is achievable with appropriate interventions. Research has shown that targeted aerobic conditioning programs, including high-intensity interval training (HIIT) and small-sided games, can significantly improve $VO_2$ Max in futsal players within 6–8 weeks (Hadi, 2016). Additionally, integrating periodized training plans that combine aerobic, anaerobic, and strength components may further enhance endurance while supporting overall match performance.

From a practical standpoint, coaches at SMAS Fatih Bilingual School should consider implementing a structured preseason conditioning program, complemented by in-season maintenance sessions, to elevate the team's overall aerobic capacity. Emphasis should also be placed on player education regarding nutrition, hydration, and recovery strategies, as these factors can have cumulative effects on endurance and performance.

## CONCLUSION

This study found that the cardiorespiratory endurance of SMAS Fatih Bilingual School futsal players was generally low, with a mean $VO_2$ Max score of 62.78 (*poor* category) and 60% of players falling into the *very poor* or *poor* classifications. Such fitness limitations likely contribute to early fatigue and reduced performance during matches. To address this, coaches should implement structured aerobic conditioning programs—such as high-intensity interval training and small-sided games—while encouraging consistent training attendance, proper nutrition, adequate recovery, and regular $VO_2$ Max monitoring. These measures are expected to improve endurance capacity and enhance team competitiveness in future competitions.

## ACKNOWLEDGMENT

The author would like to express sincere gratitude to all those who contributed to the completion of this research. Special thanks are extended to the headmaster, teachers, and students of SMP Negeri 5 Kota Bima for their cooperation and participation throughout the study. The support and assistance provided during the data collection and training sessions were invaluable.

Appreciation is also extended to the supervisors and lecturers at the Physical Education Study Program, STKIP Taman Siswa Bima, for their continuous guidance, constructive feedback, and encouragement during the research process. Lastly, the author is deeply thankful to family and peers whose moral support and motivation made this study possible.

## AUTHOR CONTRIBUTION STATEMENT

Fachrul Azmi conceptualized the study, designed the research methodology, and supervised the overall project. Ifwandi contributed to data collection and field testing. Masri assisted in data analysis and interpretation. Zulfikar contributed to literature review and drafting of the manuscript. Ahmad Mualimin participated in data collection and coordinated with the research site. Fachrizal Ambia provided critical revisions and final approval of the manuscript. All authors read and approved the final version of the article.

## CONFLICT OF INTEREST AND FUNDING

There is no conflict of interest

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