



DESCRIPTIVE ANALYSIS OF VO2MAX IN YOUTH SOCCER ATHLETES USING THE BEEP TEST

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ABSTRACT

Introduction: Aerobic endurance is a key determinant of performance in youth soccer, particularly during athlete selection and preparation for competition. Objective and practical fitness assessments are therefore required to identify athletes' physiological readiness. This study aimed to describe the VO2Max profile of youth soccer athletes using the Multistage Fitness Test (MFT) or Beep Test. **Methods:** This quantitative descriptive study involved 65 male youth soccer athletes aged 15–17 years who participated in a regional selection program in Makassar, Indonesia, in September 2025. Aerobic endurance was measured using the Multistage Fitness Test. The validity of the MFT as a predictor of VO2Max has been widely reported in previous sports science studies. Data were analyzed descriptively using mean, median, standard deviation, minimum, maximum, and percentage distribution across fitness categories. **Results:** The descriptive statistical analysis showed that the athletes obtained a mean VO2Max score of 47.91 ± 4.89 ml/kg/min, with values ranging from 37.45 to 57.12 ml/kg/min. The highest predicted VO2Max value was 57.12 ml/kg/min, while the lowest was 37.45 ml/kg/min. Most athletes were classified in the "Good" category, indicating adequate aerobic readiness for youth-level competition. However, substantial variation was identified between athletes in the upper and lower performance groups, demonstrating unequal endurance capacity within the squad. **Conclusion:** The study confirms that the majority of athletes demonstrated adequate aerobic endurance, although several athletes remained below the expected competitive standard. The findings contribute practical baseline data for coaches in designing individualized endurance training programs, particularly High-Intensity Interval Training (HIIT), to reduce physical performance disparities within the team.

1. Introduction

Modern football requires athletes to perform repeated high-intensity movements continuously over 90 minutes. Youth athletes transitioning into competitive football therefore require strong aerobic endurance to maintain tactical performance, movement efficiency, and recovery capacity during matches. One of the most widely used indicators of cardiorespiratory fitness is maximal oxygen uptake (VO2Max), which reflects the body's ability to transport and utilize oxygen during physical activity.[1,2]

In Indonesia, objective physical assessment during youth athlete selection remains an important issue in football development. Variations in coaching quality, training exposure, and physical conditioning among soccer schools (SSB) often create unequal athlete readiness. As a result, selection decisions based solely on technical observations may overlook physiological limitations that influence match performance and injury risk.[1,3,4]

Several Indonesian studies have emphasized the importance of aerobic endurance in football performance. Research involving Indonesian youth and regional football players reported that higher VO₂Max values were associated with better match endurance, greater running distance, and faster recovery between high-intensity actions. These findings indicate that aerobic capacity should become a central component of athlete evaluation during selection processes.[5,6]

Among field-based endurance assessments, the Multistage Fitness Test (MFT) or Beep Test is frequently used because it is practical, economical, and capable of testing multiple athletes simultaneously.[5,7] Compared with continuous running tests such as the Cooper Test, the MFT better reflects the intermittent movement characteristics of football through repeated 20-meter shuttle runs with progressively increasing intensity. Previous studies also reported that the MFT demonstrates acceptable validity and reliability in predicting VO₂Max among adolescent athletes.[8,9]

Based on these considerations, this study aimed to describe the VO₂Max profile of youth soccer athletes participating in a regional selection process using the Beep Test. The results are expected to provide objective physiological baseline data for coaches and support evidence-based conditioning programs before competition.

2. Methods

This study employed a quantitative descriptive design with a survey approach. The study was conducted in September 2025 at a football training field in Makassar, Indonesia.

Participants

The participants consisted of 65 male youth soccer athletes aged 15–17 years who participated in a regional athlete selection program. All athletes were declared physically healthy and actively involved in routine football training before testing.

Instrument and Validity

Aerobic endurance was measured using the Multistage Fitness Test (MFT) or Beep Test. The MFT is widely recognized as a valid and reliable field test for estimating VO₂Max in adolescent athletes. Previous studies reported strong correlations between MFT performance and laboratory-based aerobic measurements.

Testing Procedure

Before testing, athletes completed a standardized warm-up for approximately 10–15 minutes consisting of light jogging, dynamic stretching, and mobility exercises. Athletes then performed repeated 20-meter shuttle runs following audio signals with progressively increasing speed. The test ended when the participant failed to reach the line for two consecutive shuttles. Level and shuttle scores were recorded and converted into predicted VO₂Max values using standard conversion tables.

Data Analysis

Data were analyzed descriptively using SPSS. Descriptive statistics included mean, median, standard deviation, minimum value, maximum value, and percentage distribution for each VO₂Max category. Results were presented in tables and graphs.

Ethical Clearance

All participants and guardians provided informed consent before data collection.

3. Results

A total of 65 male youth soccer athletes participated in the selection process. The evaluation of cardiorespiratory endurance through the Multistage Fitness Test (MFT) showed considerable variation in aerobic performance among participants. The VO₂Max results indicated differences in physiological readiness levels, reflecting heterogeneous fitness characteristics within the selection population.

The highest aerobic performance was observed in athletes categorized as having excellent cardiorespiratory endurance. The highest recorded value reached 57.12 ml/kg/min (Level 12 Shuttle 12), followed by values of 56.56 ml/kg/min and 55.99 ml/kg/min. Athletes in this category demonstrated superior aerobic capacity and greater physiological potential to sustain prolonged match intensity.

The very good category consisted of athletes with VO2Max values ranging from 51.14–55.71 ml/kg/min. Several athletes achieved relatively stable values around 54.00 ml/kg/min, 55.14 ml/kg/min, and 55.71 ml/kg/min. These results indicate adequate physiological capacity to maintain competitive performance during high-intensity activities.

The good category represented the dominant performance classification among participants. Athletes in this category demonstrated VO2Max values ranging between 45.25–50.85 ml/kg/min, indicating sufficient physical readiness for youth-level regional competition. Although these athletes met general performance standards, further physiological improvement may enhance competitive performance.

Athletes categorized as adequate showed VO2Max values between 38.83–44.93 ml/kg/min. This group possessed acceptable baseline fitness characteristics; however, improvements in endurance training volume and intensity are required to achieve higher competitive standards.

Several athletes were identified in the very poor category, with the lowest values recorded at 38.14 ml/kg/min, 37.80 ml/kg/min, and 37.45 ml/kg/min. These findings suggest limited cardiorespiratory endurance capacity and indicate the need for structured intervention programs focusing on aerobic conditioning.

Table 1. Descriptive Statistics

Statistic	Value
N	64.0
Mean	47.91
Median	48.17
Std. Deviation	4.89
Minimum	37.45
Maximum	57.12

Table 2. Distribution of VO2Max Categories

Category	Frequency	Percentage (%)
Good	47	73.44
Fair	11	17.19
Very Poor	4	6.25
Very Good	2	3.12

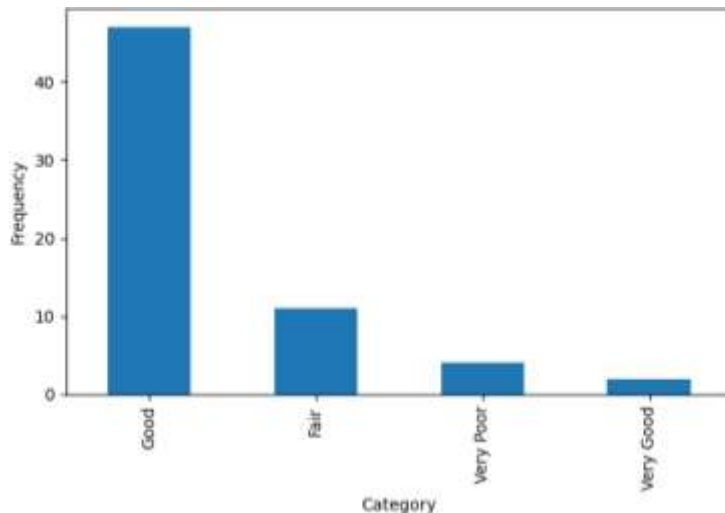


Figure 1. Distribution Graph

4. Discussion

The present study demonstrated that most youth soccer athletes were classified within the “Good” aerobic endurance category.[1,4] This finding indicates that the majority of participants possessed sufficient cardiorespiratory capacity to support the physical demands of youth football competition. Nevertheless, a considerable gap between the highest and lowest VO₂Max values suggests unequal conditioning levels among athletes.[10–13]

The highest VO₂Max score identified in this study (57.12 ml/kg/min) reflects strong aerobic adaptation and efficient oxygen utilization during exercise. Athletes with higher aerobic capacity generally demonstrate better recovery ability, greater running performance, and improved resistance to fatigue during repeated high-intensity activity.[2,4] These findings are consistent with previous studies reporting that soccer players with superior VO₂Max values tend to maintain performance intensity longer during matches.[9,14]

Conversely, athletes classified in the “Very Poor” category may experience earlier fatigue and reduced movement efficiency during competition. Low aerobic endurance may also negatively influence tactical decision-making and recovery between high-intensity actions.[15,16] Therefore, athletes in the lower categories require targeted conditioning interventions.

Compared with previous studies involving youth soccer athletes, the present findings show relatively similar aerobic profiles. Earlier Indonesian studies also reported that most regional youth players generally fall within moderate-to-good VO₂Max classifications, although performance disparities between athletes remain common due to differences in training background and coaching quality.[17–19]

This study has practical implications for coaches and sport scientists. The results may be used as baseline physiological data for individualized endurance training programs. High-Intensity Interval Training (HIIT) and small-sided game approaches may become effective methods for improving aerobic endurance in athletes with lower VO₂Max levels.[15,20]

Several limitations should be acknowledged. First, the study only used a descriptive design without comparing groups or examining training interventions. Second, VO₂Max values were estimated indirectly using the MFT rather than laboratory gas analysis. Third, the sample was limited to one regional selection program, reducing generalizability to broader athlete populations.[8,9,13]

5. Conclusion

This study showed that most youth soccer athletes participating in the selection process demonstrated “Good” aerobic endurance levels based on predicted VO₂Max values obtained through the Beep Test. However, large performance disparities remained between athletes in the highest and lowest fitness categories.

The findings provide practical scientific contributions by offering objective baseline data for evaluating physiological readiness during youth athlete selection. Coaches are recommended to implement individualized endurance training programs, particularly HIIT-based conditioning, for athletes with lower VO₂Max scores to improve team fitness uniformity before competition.

6. Author Contribution

Mariyal Qibtiyah dan Andi Ummul Hairi carried out the experiment and collected the data sample. Mariyal Qibtiyah wrote the manuscript with support from Andi Ummul Hairi, Irfan Yunus, Muhammad Naufal Ramadhansyah, Wiryana Dipo Utama.

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