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Comparison of Cardiovascular Fitness using Two Different Measurement Instruments in U16 Soccer Players

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ABSTRACT

This study aims to compare the cardiovascular fitness of U16 soccer players using two measurement instruments: the Multi Fitness Test (MFT) and the Yo-Yo Intermittent Recovery Test (YYIR1). The research method used is a descriptive quantitative approach, which allows numerical analysis of participants' cardiovascular fitness characteristics. The analysis shows that the average MFT score was 44.2957, while the average YYIR1 score was 33.7477, indicating better cardiovascular fitness according to the MFT. In addition, the frequency distribution shows that 97% of participants were in the moderate category according to the MFT, while 93% were in the low category according to the YYIR1. This difference in results can be explained by the characteristics of each test, which measure different aspects of fitness; MFT focuses more on general endurance, while YYIR1 emphasizes aerobic capacity and recovery after intense activity. These findings highlight the importance of using multiple measurement instruments to evaluate cardiovascular fitness in young athletes. Thus, coaches can design more effective training programs tailored to the needs of U16 soccer players. The results of this study are expected to contribute to the development of more targeted training policies and help improve player performance and competitiveness on the field. This study also emphasizes the need to incorporate cardiovascular training into soccer programs to achieve optimal results.

1. Introduction

Cardiovascular fitness is an important component of soccer player performance [1], [2], especially among adolescent players, such as Under 16 (U16) players. At this stage, players are in a crucial phase of physical and fitness development that affects their ability to endure and adapt during matches. Good cardiovascular endurance not only helps players to continue playing at high intensity but also affects the quality of recovery after strenuous physical activity [3]. Therefore, coaches need to evaluate cardiovascular fitness using appropriate, accurate measurement tools.

In measuring cardiovascular fitness, two commonly used tests are the Multistage Fitness Test (MFT), also known as the Beep Test [4], [5], and the Yo-Yo Intermittent Recovery Test Level 1 (YYIR1)

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[6], [7]. Both tests are designed to measure aerobic capacity, but with different approaches. The MFT continuously measures players' aerobic endurance, with intensity increasing until they can no longer maintain their speed. In contrast, the YYIR1 emphasizes players' ability to run at high intensity repeatedly, which is more relevant to soccer's nature, which requires fast running followed by short recovery periods.

Previous research has discussed the significant differences between these two tests. Krustrup et al. found that YYIR1 is more accurate in reflecting the physical demands of soccer matches, mainly because this test measures players' capacity to recover after repeated sprints [8]. Conversely, Tumijan et al. noted that MFT is better at measuring general aerobic capacity [9], but may be less ideal for sports that demand rapid changes in intensity, such as soccer. Bangsbo also supports the use of YYIR1 in soccer because it better describes the physical conditions required during a match [10].

This study aims to compare the cardiovascular fitness of U16 soccer players using two different measurement instruments. The focus of this study is to determine whether one of these two instruments is more suitable for evaluating the fitness of 16-year-old soccer players, especially in the context of matches that demand endurance and rapid recovery. The results of this study will guide coaches in selecting the most appropriate test to evaluate cardiovascular fitness in U16 soccer players. By using the right measurement method, coaches can design more effective training programs, help players develop their aerobic capacity and recovery abilities, and maximize their performance during matches.

2. Method

This study used a quantitative descriptive approach to compare cardiovascular abilities between two measurement instruments, namely MFT and YYIR1, in under-16 soccer players. The quantitative descriptive method was chosen to provide a clear, objective picture of the results of cardiovascular fitness measurements for players based on the numerical data collected.

The sample in this study consisted of 30 U16 soccer players. The sample was selected purposively from the UNY Soccer School (SSB) to ensure representativeness and diversity in player characteristics. The inclusion criteria for sample selection included players aged 14-15 years who had been actively involved in soccer training for at least 1 year. All samples willingly agreed to undergo both tests in this study.

Data collection was conducted across two separate testing stages. First, participants will undergo the MFT, during which they are asked to run back and forth for 20 meters at increasing speeds in response to audio signals. The number of laps participants complete measures the results of the MFT. Second, participants underwent the YYIR1 test. In this test, participants ran back and forth for 20 meters at a specified speed, interspersed with 10-second rest periods between each run. The total distance covered during this test was recorded as the result.

After data collection, statistical analysis was performed using SPSS version 27. Data analysis in this study was conducted descriptively to provide a clear picture of the measurement results from both tests. Descriptive statistics, such as mean, median, standard deviation, minimum, and maximum values, will be calculated for each group. The results of the MFT and YYIR1 will be presented in tables and graphs to facilitate visualization and understanding.

3. Results and Discussion

3.1. Results

Before the results of this study were known, the researchers described the characteristics of the sample in Table 1.

Table 1. Characteristics of the research sample

N	Age	TB	BB
30	14.63±0.49	163.30±2.68	50.30±3.64

To provide a clearer understanding of the cardiovascular fitness results, the following descriptive statistics table is presented. This table includes various minimum, maximum, mean, and standard deviation values that can provide an overview of the distribution and variation of the data.

The research data on the cardiovascular fitness of soccer players, using the MFT measurement tool, can be presented in Table 2 below using statistical descriptions.

Table 2. Descriptive statistics of MFT data

Description data of MFT	
Mean	44.2957
Median	44.2950
Std. Deviation	2.68063
Minimum	40.43
Maximum	50.85

Meanwhile, if the data are displayed as a frequency distribution, the cardiovascular fitness of the U16 soccer players in this study is shown in the following figure. The VO2Max MFT norm refers to the norm adopted from [11]:

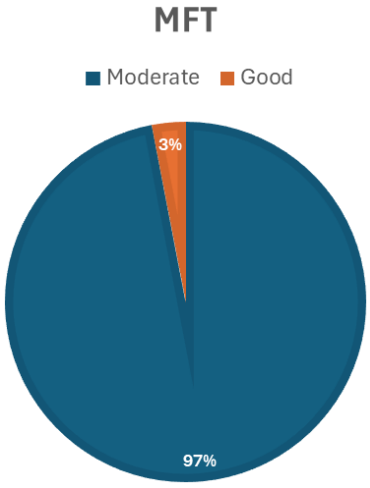

Fig. 1. MFT frequency data results

Based on the MFT diagram results, of the 30 participants, 29 (97%) were in the low category, 1 (3%) in the moderate category, and none in the good or very good categories.

Table 3. Descriptive data results for YYIR1

YYIR1 description data	
Mean	33.7477
Median	33.6800
Std. Deviation	3.28722
Minimum	28.02
Maximum	40.54

Meanwhile, if the data are displayed as a frequency distribution, the cardiovascular fitness of the U16 soccer players in this study is shown in the following figure. The VO2Max YYIR1 norm refers to the norm adopted from [8]:

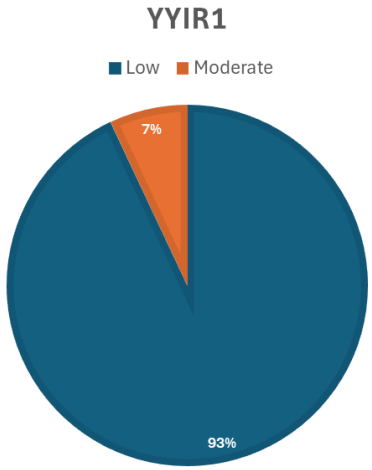

Fig. 2. Frequency data results for YYIR1

Based on the results of the YYIR1 table, 28 participants (93%) were in the low category, 2 (7%) in the moderate category, and none in the good or very good categories. Figure 3 below shows the comparison results based on the average scores obtained from the two tests conducted by this research sample.

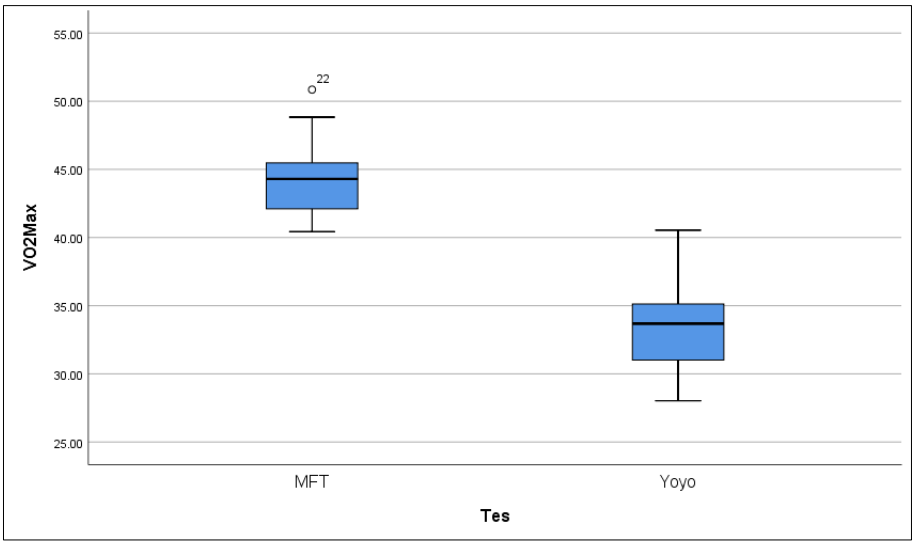

Fig. 3. Comparison results between MFT and YYIR1

In terms of average scores, the MFT results showed a score of 44.2957, higher than the YYIR1 average of 33.7477. This indicates that cardiovascular fitness assessed by the MFT was better than that measured by the YYIR1.

3.2. Discussion

Cardiovascular fitness is an important aspect of athletic performance, especially in endurance sports such as soccer [12], [13]. This study aims to compare the cardiovascular fitness of U16 soccer players using two measurement instruments: MFT and YYIR1.

Based on the results obtained, the average MFT score for participants was 44.2957, while the average YYIR1 score was 33.7477. These results indicate that cardiovascular fitness measured using the MFT is better than that measured using the YYIR1. This is in line with previous studies showing

that measurements obtained with different instruments can yield different pictures of an individual's cardiovascular capacity [14], [15].

In the frequency distribution analysis, 97% of participants were in the moderate category according to the MFT, while 93% were in the low category according to the YYIR1. These results indicate that despite differences in averages, both measurement instruments show that most U16 soccer players have cardiovascular abilities that need improvement. Research by Krustrup et al. indicates that more targeted, planned training can improve cardiovascular fitness in young athletes [8].

The differences in results between MFT and YYIR1 may be due to several factors, including the characteristics of the tests themselves and the types of training participants received. MFT emphasizes general endurance and physical strength, whereas YYIR1 focuses on aerobic capacity and recovery after intense activity [16]. Therefore, the results obtained from these two tests should be viewed as complementary, not as substitutes for one another.

The analysis results indicate that multiple measurement instruments are necessary to evaluate cardiovascular fitness in U16 soccer players. The use of various methods can provide more complete information about athletes' physical abilities, enabling coaches to design more effective training programs to improve their performance on the field. For further research, more in-depth data analysis can be conducted, including correlation and regression tests, as well as comparative tests using t-tests.

4. Conclusions

Based on the descriptive analysis, both tests provide distinct insights into the cardiovascular fitness of U16 soccer players. MFT highlights continuous aerobic endurance, while YYIR1 focuses more on recovery after intense activity. These results can help coaches adjust training programs to optimally improve players' cardiovascular fitness.

Conflict of interest

The authors declare no conflict of interest.

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