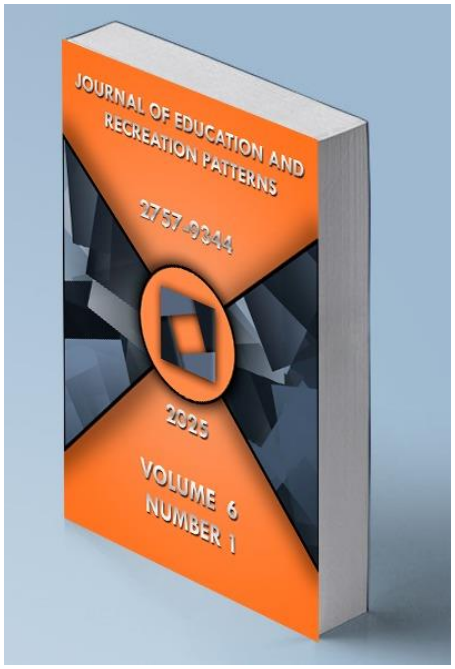

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Comparison of Endurance and Speed Performance of Soccer Players in Different Divisions

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ABSTRACT

This study aimed to profile the physical performance of soccer players from various competitive levels in Türkiye based on their 30-15 IFT and sprint test results. A total of 165 male players from different divisions and age categories voluntarily participated. The study included 165 male soccer players from seven competitive groups: 2nd Division (n=23), 3rd Division (n=38), RAD (n=40), U19 (n=18), U17 (n=16), U15 (n=14), and U13 (n=16). The mean (±SD) age, height, and body weight of the participants were as follows: 2nd Division players were 22.8 ± 3.7 years old, 1.81 ± 0.1 m tall, and weighed 73.5 ± 7.5 kg; 3rd Division: 25.2 ± 4.0 years, 1.79 ± 0.0 m, 72.8 ± 8.0 kg; RAD: 23.1 ± 4.8 years, 1.77 ± 0.2 m, 72.8 ± 8.2 kg; U19: 17.9 ± 0.2 years, 1.75 ± 0.0 m, 68.3 ± 6.6 kg; U17: 16.8 ± 0.4 years, 1.74 ± 0.1 m, 66.5 ± 5.6 kg; U15: 15.0 ± 0.0 years, 1.73 ± 0.1 m, 62.5 ± 7.1 kg; and U13: 13.0 ± 0.0 years, 1.58 ± 0.1 m, 50.0 ± 6.1 kg. The study assessed physical performance in soccer players using the 30-15 IFT and 30 m sprint tests. Results showed significantly higher 30-15 IFT performance in all groups except U13 ($p < 0.05$), with no significant differences among the remaining groups ($p > 0.05$). In the sprint test, senior-level players (2nd Division, 3rd Division, and RAD) outperformed younger groups, especially U13 ($p < 0.05$). Among youth players, U19, U17, and U15 performed better than U13, but showed no differences among themselves ($p > 0.05$). Overall, the 30-15 IFT is effective for evaluating aerobic and high-intensity running but limited for sprint-specific assessment, making it suitable for load monitoring in soccer training.

Keywords: Aerobic, Anaerobic, Endurance, Running Economy, Sprint.

INTRODUCTION

Soccer demands high-level performance attributes (Uzunhasan, et al., 2024) and a wide range of skills at different intensities to ensure success (Mainer-Pardos et al., 2021; Bangsbo et al., 2006). The ability to perform high-speed activities in soccer players is an important prerequisite for the successful performance of actions that need to be performed at different speed levels in soccer (Reilly et al., 2000; Nobari et al., 2021). Various studies have reported that positive acceleration and maximum running speed, which are components of high speed, are associated with match performance level in soccer players (Cometti et al., 2001; Reilly, 2005; Little and Williams 2005; Buchheit et al., 2010; Nobari et al., 2021).

Soccer is a highly intense and intermittent physical activity that is affected by multiple dynamic variables and involves aerobic and anaerobic endurance (Orendurff et al., 2010; Dolci et al., 2020; Kılcı et al., 2025). Optimum performance depends on the harmony and systematic functioning of these functions, like musculoskeletal, cardiovascular and respiratory systems (Ceviz, 2024). In addition to basic biomotor skills such as speed, strength and endurance, agility, coordination, flexibility and balance are the main factors affecting performance (Faigenbaum et al., 2024; Oztas et al., 2024). Various factors, including technical and tactical skills, league level, decision-making ability, and environmental conditions, influence high performance in soccer (Hughes & Franks, 2005; Nelson & Groom, 2012). During the match, it is known that aerobic energy systems are predominant, but anaerobic energy systems play an important role in high intensity sections during the match. High-intensity runs, sprinting, jumping, fast and rapid changes of direction, and dual challenges, which affect the score, are performed anaerobically (Silva et al., 2022; Baldi, 2017). It has been reported that VO2max is one of the most important determinants to evaluate aerobic capacity (Hoff et al., 2002; Wagner, 2023). A high VO2max level in players enables them to recover more quickly after sprint or high-intensity activities (Ma et al., 2023). Another component that determines the capacity of performance during high intensity activities is the amount of motor unit recruitment, intermuscular coordination, decreases in electromechanical delay time, speed of transmission in nerve impulses, and muscle stretch-shortening cycles (McKinlay et al., 2018; Sandford et al., 2019). In other words, in order to be ready for a successive exercise after a high intensity session, phosphocreatine stores need to be replenished rapidly and the muscle needs to be replenished with oxygen (Okut et al., 2025). The most important factors determining performance in soccer players are high-speed running, total distance covered and improved aerobic capacity (Buchheit and Ufland, 2011; Turner and Stewart, 2014).

The 30-15 Intermittent Fitness Test (IFT) has become popular in recent years in both applied research and athletic practice. The test requires a short time to complete (approximately 20-30 minutes) and allows large groups of athletes to be tested simultaneously. The test protocol includes 30 seconds of shuttle runs (between 2 lines 40 m apart) separated by 15 seconds of passive recovery started and terminated by audible beeps. The main purpose of using the test today is to determine the maximum aerobic speed and maximal heart rate of athletes (Bucheit et al., 2021; Grgic et al., 2021). Scott et al., (2017) reported in their study that 30-15 IFT has a positive correlation with 300m time shuttle run, repeated sprint time, 505 agility test. The maximal speed measured in the 30-15 IFT is widely used in the planning of high-intensity interval running training and is an important part of the test that is highly attractive to coaches (Viano-Santasmarinas et al., 2018). Performance of athletes is monitored and training programs are designed depending on the results of the tests (Castagna et al., 2010). It is reported that there is a relationship between physical performance and the competition status of soccer players. They report that emotional and physical factors also play a big role and can significantly affect performance levels. There are differences in VO2max levels between high-level professional soccer players and the players from lower competitive leagues and positions within the team (Yücel et al., 2018; Modric et al., 2020; Slimani and Nikolaidis, 2017). The number of

acceleration, sprint and change of direction is even greater in world-class players (Slimani and Nikolaidis, 2017). It was reported that performance during a match is related to the experience and age of the players (Lehance et al., 2009). However, many researchers have reported that some actions of performing during a match, including the motor characteristics of speed, strength, power and endurance (Stolen et al., 2005; Wisløff et al., 2004) are related to the experience and age of the players (Lehance et al., 2009). Mohr et al., (2003) found in their study that 'elite soccer players in the Italian league ranked 1 to 10 in the official FIFA list' performed ~28% more high-intensity running (2.43 km vs. 1.9 km) and ~58% more sprinting distance (650 m vs. 410 m) than lower-level soccer players, and ~28% more high-intensity running (2.43 km vs. 1.9 km) and ~58% more sprinting distance (650 m vs. 410 m) than soccer players in the Danish top league ranked higher than 20 in the official FIFA list'. Gissis et al., (2006) reported positive significant differences in 10m sprint time tests (1.95sec, 2.14sec, 2.21sec, respectively) in young soccer players (≅16 years), elite soccer players in the Greek National Youth Team, compared to sub-elite (participating in regional championships) and amateur soccer players. These findings indicate that the level of strength, especially muscle strength, plays an important role in the performance in soccer. Therefore, it can be suggested that experienced soccer players are able to perform strength-related motor skill tasks better than sub-elite and younger players. In this context, the purpose of the present study is to compare the physical performance profiles of soccer players from different competitive levels in Türkiye, focusing on their 30-15 Intermittent Fitness Test (30-15 IFT) and sprint performances. To the best of our knowledge, no previous study has simultaneously examined 30-15 IFT performance across such a wide range of competitive levels within Türkiye football.

METHOD

Research Model

This study employed a cross-sectional and comparative research design to examine differences in endurance and sprint performance among male soccer players from various competitive divisions and age categories in Türkiye. The primary aim was to compare 30-15 Intermittent Fitness Test (IFT) and 30-meter sprint performances across different competitive levels.

Study Group

A total of 165 male soccer players voluntarily participated in the study. The sample distribution by group is presented in Table 1. Players were recruited from the following categories:

- 2nd Division (n = 23)
- 3rd Division (n = 38)
- Regional Amateur Division (RAD) (n = 40)
- U19 (n = 18)
- U17 (n = 16)
- U15 (n = 14)
- U13 (n = 16)

The inclusion criteria were as follows: (1) active participation in organized soccer competitions, (2) no musculoskeletal injuries within the past six months, and (3) provision of signed informed consent. Ethical approval for the study was obtained from the Bingöl University Health Sciences Scientific Research and Publication Ethics Committee (Decision No. 24/17, dated October 24, 2024).

Table 1

Frequency Distribution of Participants by Team Category

Group	*n*	%
Second Division	23	13.9%
Third Division	38	23.0%
Regional Amateur Division (RAD)	40	24.2%
U19	18	10.9%
U17	16	9.7%
U15	14	8.5%
U13	16	9.7%

Procedure for Data Collection

Testing was conducted on a natural grass field under standardized conditions. Players were familiarized with all procedures prior to data collection. The demographic characteristics of participants are provided in Table 2.

Table 2

Demographic Characteristics (Age, Height and Weight of the Groups (mean±sd)

Group	Age (years)	Height (m)	Body Weight (kg)
Second Division	22.83 ± 3.66	1.81 ± 0.10	73.52 ± 7.45
Third Division	25.21 ± 3.99	1.79 ± 0.04	72.84 ± 8.04
Regional Amateur Division (RAD)	23.05 ± 4.84	1.77 ± 0.20	72.81 ± 8.15
U19	17.94 ± 0.24	1.75 ± 0.04	68.25 ± 6.56
U17	16.81 ± 0.40	1.74 ± 0.07	66.47 ± 5.56
U15	15.00 ± 0.00	1.73 ± 0.06	62.49 ± 7.08
U13	13.00 ± 0.00	1.58 ± 0.08	49.99 ± 6.10

IFT 30-15 Intermittent Fitness Test (IFT)

Endurance performance was assessed using the 30-15 IFT, following the protocol by Buchheit et al., (2010). The test consists of 30-second shuttle runs between two lines 40 meters apart, interspersed with 15-second passive recovery periods. The initial speed was set at 8 km/h, increasing by 0.5 km/h every 30-second stage. Players were instructed to reach the lines in synchrony with auditory signals. The test was terminated when a player failed to reach the line for three consecutive intervals or voluntarily stopped. The final velocity (VIFT) and total distance covered were recorded.

30-Metre Sprint Test

Sprint performance was evaluated using a 30-meter linear sprint test. The timing was captured with precision photocells (±0.01 s accuracy) on a natural grass surface. Players started from 1 meter behind the timing gate. Each player performed two trials with a 3-minute passive recovery, and the best time was recorded (Mor et al., 2021).

Data Analysis

All statistical analyses were performed using IBM SPSS Statistics version 20.0. Descriptive statistics (mean, standard deviation, frequency, and percentage) were calculated for the participants' demographic characteristics and test scores. The normality of the data was assessed using the Shapiro-Wilk test, and homogeneity of variances was evaluated using Levene's test. When these assumptions were met, one-way analysis of variance (ANOVA) was used to compare the 30-15 Intermittent Fitness Test (IFT) and 30m sprint performance across different division levels. When ANOVA indicated a statistically significant difference, post hoc tests were conducted using Tukey's HSD test (for equal variances) or Games-Howell test (for unequal variances) to identify specific group differences. The significance level was set at $p < 0.05$ for all analyses.

FINDINGS

The IFT and sprint performance values of the groups included in our study are presented in Table 3. Statistical analyses of the IFT 30-15 test of players playing at different division levels were given in Graph 1. As a result of the statistical analysis, it was determined that the IFT 30-15 performance was statistically significantly higher in players playing in the 2nd Division and 3rd Division, RAD, U19, U17, U16 and U15 levels compared to the players in the U13 division ($p<0.05$). There was no significant difference between the other groups ($p>0,05$).

Table 3

Intermittent Fitness Test (IFT) and Sprint Performance Values by Team Category (M ± SD)

Group	IFT (km/h)	Sprint (s)
Second Division (2ndDiv)	19.60 ± 1.37	4.00 ± 0.12
Third Division (3rdDiv)	19.88 ± 1.54	3.99 ± 0.16
Regional Amateur Division (RAD)	18.62 ± 1.40	4.02 ± 0.15
U13	16.50 ± 1.72	4.76 ± 0.26
U15	18.56 ± 1.22	4.28 ± 0.27
U17	19.19 ± 1.26	4.26 ± 0.12
U19	19.35 ± 1.90	4.16 ± 0.11

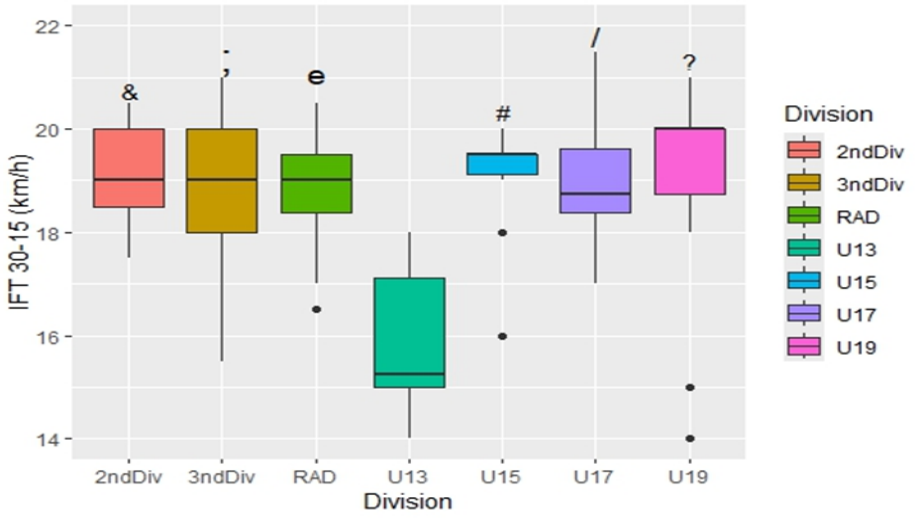

Figure 1

Comparison of 30–15 Intermittent Fitness Test (IFT) Performance Among Players from Different Divisions

Not:& indicates a statistically significant difference between 2nd Division and U13 ($p < 0.05$); **‘,’** indicates a difference between 3rd Division and U13 ($p < 0.05$); **e** indicates a difference between RAD and U13 ($p < 0.05$); **#** indicates a difference between U15 and U13 ($p < 0.05$); **/** indicates a difference between U17 and U13 ($p < 0.05$); **?** indicates a difference between U19 and U13 ($p < 0.05$).

According to Figure 1, statistical analyses of the 30m sprint tests of players competing in different divisions are presented in Figure 2. As a result of the statistical analysis, it is observed that the 30m sprint performance of the players in the 2nd Division is statistically different compared to the U13, U15, U17, and U19 players ($p < .05$). Regarding the 3rd Division players, their performance was statistically higher than that of the U13, U15, and U17 players ($p < .05$). For the RAD players, their performance was statistically higher compared to the U13, U15, U17, and U19 players ($p < .05$). On the other hand, while the sprint performances of the U19, U17, and U15 group players were statistically higher than those of the U13 players ($p < .05$), there was no statistically significant difference among themselves ($p > .05$).

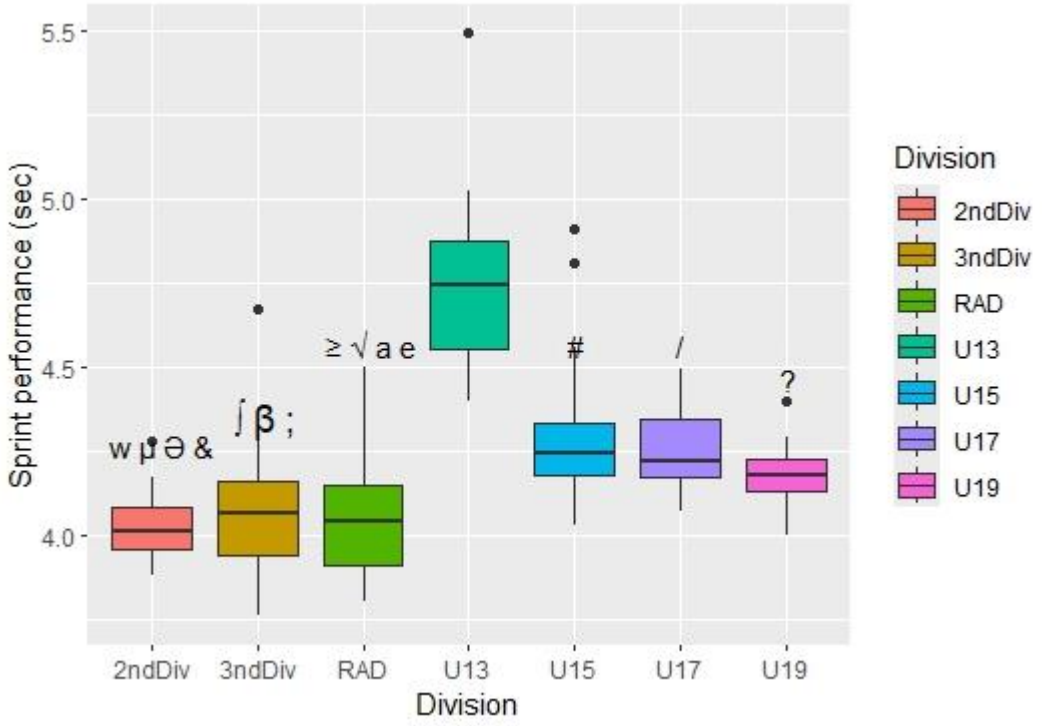

Figure 2

Comparison of 30m Sprint Performances of Players Playing at Different Division Levels

& indicates a statistically significant difference between 2nd Division and U13 ($p < 0.05$); **w** indicates a difference between 2nd Division and U15 ($p < 0.05$); **ə** indicates a difference between 2nd Division and U17 ($p < 0.05$); **µ** indicates a difference between 2nd Division and U19 ($p < 0.05$); ∫ indicates a difference between 3rd Division and U17 ($p < 0.05$); **β** indicates a difference between 3rd Division and U13 ($p < 0.05$); **;** indicates a difference between 3rd Division and U13 ($p < 0.05$); **≥** indicates a difference between RAD and U19 ($p < 0.05$); √ indicates a difference between RAD and U17 ($p < 0.05$); **a** indicates a difference between RAD and U15 ($p < 0.05$); **e** indicates a difference between RAD and U13 ($p < 0.05$); # indicates a difference between U15 and U13 ($p < 0.05$); / indicates a difference between U17 and U13 ($p < 0.05$); **?** indicates a difference between U19 and U13 ($p < 0.05$).

According to Figure 2, players in the 2nd Division demonstrated the fastest sprint

performance, with a median value lower than all other groups. A statistically significant difference was observed between the 2nd Division and the U13, U15, U17, and U19 players ($p < .05$), indicating that senior players perform better in short-distance sprints. Similarly, players in the 3rd Division and RAD had significantly faster times than U13, U15, and U17 players. Although U19, U17, and U15 players outperformed U13 players statistically, there were no significant differences among themselves ($p > .05$). These results suggest a performance hierarchy in sprinting ability aligned with age and competitive level.

DISCUSSION

The aim of this study is to compare the physical performance profiles of players competing in different division levels, especially in terms of 30-15 Interval Fitness Test (IFT) and sprint performances. In this context, the differences between high-intensity running and sprinting performances of high-level professional and playing in lower-level division players were analysed, and the effects of these characteristics on competition level and performance were evaluated. The main result of our study was that IFT 30-15 performance was found to be statistically significantly different ($p<0.05$) in players playing in the 2nd Division and 3rd Division, RAD, U19, U17, U16 and U15 levels compared to players in the U13 Division. There was no significant difference between the other groups ($p>0,05$).

A soccer player must have technical, tactical, physical, fitness, mental and psychological characteristics at a high level for his success in match performance. Although the player's technique, tactical understanding, strength, speed and quickness ability are at a high level, if he gets tired early and recovers late, he may not be able to use these important skills for soccer. Fatigue is one of the main factors that limit and affect the performance of the athlete. If an athlete does not get tired during training or can continue training even when tired, this is an indication that the athlete has endurance. The level of endurance in an athlete can be determined by examining various factors, including an individual's endurance, their basic motoric characteristics, their ability to perform a movement effectively, and their capacity to utilise functional abilities in an economical manner (Bompa, 2011). In this regard, Hoppe et al., (2013) demonstrated that performance in the Intermittent Shuttle Run Test —a test closely reflecting soccer-specific endurance—was significantly correlated with VO_2max and time to exhaustion in continuous endurance protocols, whereas no meaningful relationship was found with running economy or other physiological variables. Their findings emphasize that VO_2max is a key predictor of intermittent endurance capacity in soccer players.

Endurance is evaluated in two categories as aerobic and anaerobic endurance. Aerobic endurance is important in terms of performing low-intensity activities within the general structure of soccer (Bangsbo et al., 2006; Krustrup et al., 2005), performing high intensity movements repetitively and ensuring recovery in shorter times (Bishop et al., 2004, Bradley et al., 2013, Helgerud et al., 2001, McMillan et al., 2005, Mohr et al., 2003, Stølen et al., 2005). The most important indicators of aerobic capacity are maximum oxygen consumption (VO2max) capacity, anaerobic threshold (ANE) level and running economy. In the results of Helgerud et al., (2001) with 19 elite young male players, it was found that there was a direct relationship between VO2max level and characteristics such as total running distance, high intensity workload, number of sprints performed during the competition, and that athletes with high VO2max level during the competition had better performance during the competition compared to athletes with low VO2max level (Altmann et al., 2018).

Altmann et al., (2020) found significant differences in all endurance parameters—including fixed aerobic threshold (v2mmol/l), fixed anaerobic threshold (v4mmol/l), individual aerobic threshold, and individual anaerobic threshold—between goalkeepers and all other playing positions, while no significant differences were observed among wingers, central defenders, forwards, and central midfielders. The study revealed that goalkeepers had the lowest endurance capacity, whereas central midfielders demonstrated the highest aerobic

performance across all lactate-based thresholds, although the effect sizes were reported as small to moderate. Hermosilla-Palma et al., (2024) included a total of 84 male soccer players from 1st division teams A (1A) (n=21; age: 23.5±5.2), 1st division B (1B) (n=42; age: 23.0±5.0) and 2nd professional division (2nd) (n=21; age: 22.9±4.7). VIFT values were significantly higher in 1A teams compared to both 1B and 2nd division teams, and fullbacks showed significantly higher VIFT scores than central defenders. Silva et al., (2022) In the study, 124 young soccer players from different age groups (15, 16, 17, 18 and 19) were included, height and VKİ had high correlations with V IFT and low correlations with ASR (anaerobic speed reserve). CMJ (jump height) showed low correlations with ASR and high correlations with V IFT. Both V IFT and ASR showed moderate correlations with running time at different distances and very high correlations with MSS. COD (time, asymmetry index) time was highly correlated with V IFT and showed low to moderate correlations with ASR. It has been reported that locomotor skills performance at 30-15 V IFT is highly correlated with physical fitness and anthropometric characteristics; ASR is also correlated with these variables, but at a lower level of correlation. Therefore, IFT 30-15 Intermittent Fitness Test performance increased with increasing age, but there was no difference between the ages in our study, which suggests that it is related to the training age.

Scott et al., (2017) showed that V IFT was significantly associated with the 300 m shuttle, repeated sprint, 505 test and 40 m sprint, vertical jump and 10 m sprint tests. These findings demonstrate that different anaerobic properties contribute to intermittent fitness characteristics with V IFT. More specifically, this data suggest that V IFT is useful for monitoring performance on tasks largely determined by anaerobic capacity. Ingebrigtsen et al., (2014) reported that sprint speed at 20 and 35 m correlated with Yo-Yo IR1 test performance, but only 35 m correlated with IR2 test performance, and at 35 m, repeated sprint ability=RSA correlated with both levels of the Yo-Yo IR test, and submaximal HRs after 2 and 4 min were independently related to Yo-Yo IR1 and IR2 performance. Regarding anaerobic efforts, a relationship between repeated sprints, directional changes and anaerobic reserve speed and performance in the 30-15 IFT test has been observed (Ingebrigtsen et al., 2014; Scott et al., 2017; Silva et al., 2022). The IFT 30-15 Intermittent Fitness Test, which is one of the most important test methods among most measurement tests that can be applied in testing field performance and match performance in players, has become widespread today because it has the ability to measure endurance at the fitness level compared to other field tests.

Currie, (2018) studied 93 elite youth soccer players (U11, U12, U13, U14, U15 and U17) with a mean age of (13.0 ± 1.9). Performance, speed (10m and 20m tests), agility (505 tests) and endurance (Yo-Yo IR1) tests 10m and 20m sprint and 505 tests (P>0.05) showed a significant difference between the U11, U12 and U13 teams. However, U14 to U17 had significantly better test results in all measurements compared to U11. Significant differences between all teams were only observed in the Yo-Yo IR1. This suggests that more mature players perform better than their younger competitors. To avoid bias in the physical structure, teams may consider comparing players according to their age of maturity rather than chronological age. Benitez Sillero et al., (2015) found that the endurance performance of 97 young players in the U14-U16-U19 age categories increased with age, but this difference was less in those who were close to each other. Tounsi et al (2021) found that speed performance (10-20-30m sprint) and endurance performance increased with age in young players aged 13-17 years (U13-U19, n=487). Huijgen et al., (2010) reported that sprint performance improved with age in a cohort of 267 young players aged between 12 and 19 years. Similarly, Buchheit et al., (2010) observed a linear increase in sprint performance across age categories (U13 to U18) in 99 youth players. In contrast, Miłek and Perkowski (2024) found no significant relationship between age and 5 m or 10 m sprint times in adult players but reported a weak positive correlation (r = 0.32) between age and 20 m sprint time, suggesting a slight decline in sprint performance with increasing age. Benitez Sillero et al., (2015) observed that aerobic endurance and sprint performance of 97 young players in U14-U16-U19 age categories

increased with age, but this difference was found to be less at ages close to each other. Baydemir and Aksoy (2017), In the study in which a total of 150 soccer players, 17 and 19 years old U17 (n=73) and U19 (n=77), were included, it was reported that the 30m sprint performance of soccer players (19 years old) was more improved than that of soccer players (17 years old). Buchheit (2008) emphasized in his study that individuals with higher VO2max, those with higher maximum sprint speed, have higher anaerobic speed reserve and therefore can reach higher V IFT at the same relative running speed. In order to support this situation, he reported that the 20 m sprint test is associated with high V IFT, while Scott et al., (2017) reported that the relationship between 20 m sprint times and V IFT in the current study indicates that anaerobic speed reserve potentially affects V IFT performance. When the literature is examined; the most important factor affecting endurance performance in soccer is aerobic endurance. During a match, it is necessary to have a good aerobic endurance in order to recover quickly and quickly after a high intensity effort and at the same time to delay fatigue. It is thought that aerobic endurance may be related to total running distances and aerobic endurance may be related with different positions in the match

Conclusion

As a result, it was concluded that the variables obtained from the 30-15 IFT are particularly useful for evaluating total distance and high-intensity movements but are not suitable for assessing sprint characteristics. From a practical perspective, the 30-15 IFT proves effective in monitoring endurance and high-intensity efforts. However, it is recommended to complement this test with additional assessments targeting sprint performance, such as short-distance sprint tests, to capture explosive power and acceleration. Periodic testing of these variables is essential to track player progress, adjust training plans accordingly, and ensure optimal physical preparation throughout the season. These inter-divisional differences or similarities in endurance and speed performance may be attributed to several factors, including variations in training load, tactical roles, and the players' stage of physical development, which are known to differ significantly between professional levels (Bradley et al., 2010).

Recommendations

Training programs should be adapted according to players' division and age levels, as higher-level and older players showed superior aerobic and sprint performance compared to U13 players. For younger age groups, greater emphasis should be placed on developing endurance and sprint capacity. The 30-15 IFT is effective for monitoring aerobic fitness but should be complemented with sprint tests to assess explosive performance. Future studies should include female athletes, increase sample sizes, and adopt longitudinal designs to enhance the validity and generalizability of the findings.

Limitations

This study has several limitations that should be acknowledged. First, the relatively small sample size within certain subgroups may limit the generalizability of the findings. Second, single-center design restricts the applicability of the results to broader populations or different training environments. Third, due to the cross-sectional nature of the study, causal relationships between variables cannot be established. Lastly, potential confounding factors such as playing position, training background, or surface conditions during testing were not controlled, which may have influenced performance outcomes.

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