SPORMETRE
The Journal of Physical Education and Sport Sciences
Beden Eğitimi ve Spor Bilimleri Dergisi

DOI: 10.33689/spormetre.1436446
Research Article

Geliş Tarihi (Received): 13.02.2024 Kabul Tarihi (Accepted): 08.12.2024 Online Yayın Tarihi (Published): 30.12.2024

A COMPARISON OF PERFORMANCE PARAMETERS VARYING BY PLAYING POSITIONS OF U-18 FOOTBALL PLAYERS

Murat Koç[1*], Barışcan Öztürk[2], Osman Dişçeken[3], Hakan Engin[2], Caner Uzunca[2]
[1]Erciyes University, Faculty of Sport Sciences, Department of Coaching Education, KAYSERİ
[2]Cukurova University, School of Physical Education and Sports, Department of Coaching Education, ADANA
[3]Nevsehir Haci Bektas Veli University, Faculty of Sport Sciences, Department of Coaching Education, NEVSEHİR

Abstract: This study aims to determine the performances of U-18 football players in the Super Amateur League and compare some of their physical and physiological performances based on their positions. League and compare some selected physical and physiological performance parameters according to the positions they played. A total of 54 male soccer players with an age of 16.83±1.68 years and 7.14±3.16 years of sports experience participated in the study voluntarily. Performance criteria for the football players included Yo-Yo IR1 distance, VO_{2max}, and vVO_{2max}, as well as 10m, 30m, Illinois Agility Test, COD, CMJ, and RAST tests. A one-way ANOVA test was employed to compare the performances of football players according to their playing positions. Significant differences were found in favor of forwards in CMJ, average, and peak anaerobic power results ($p<0.05$). However, no significant differences were observed in Yo-Yo IR1, VO_{2max}, vVO_{2max}, 10m, 30m, Illinois and COD results ($p>0.05$). It was observed that peak and average anaerobic power and vertical jump results were significantly better in forwards compared to players in other positions. Strikers demonstrated superior peak and average anaerobic power as well as vertical jump performance compared to players in other positions.

Keywords: U-18 Football, Playing Positions, Athletic Performance

U-18 FUTBOLCULARIN OYUN POZİSYONLARINA GÖRE DEĞİŞEN PERFORMANS PARAMETRELERİNİN KARŞILAŞTIRILMASI

Öz: Bu çalışmanın amacı, Super Amatör Lig'inde yer alan U-18 futbolcuların performanslarını belirlemek ve oynadıkları pozisyonlara göre bazı fiziksel ve fizyolojik performanslarını karşılaştırmaktır. Çalışmaya yaşları 16.83±1.68 yıl ve spor deneyimleri 7.14±3.16 yıl olan toplam 54 erkek futbolcu gönüllü olarak katılmıştır. Futbolcuların performans kriterleri arasında Yo-Yo IR1 mesafesi, VO_{2max}, vVO_{2max}, 10m, 30m, Illinois Agility Testi, COD, CMJ ve RAST testleri bulunmaktadır. Futbolcuların performanslarını oyun pozisyonlarına göre karşılaştırmak için tek yönlü ANOVA testi kullanılmıştır. Futbolcuların oynadıkları pozisyonlara göre, CMJ, ortalama ve tepe anaerobik güç sonuçları lehine önemli bir fark bulunmuştur ($p<0.05$). Ancak, Yo-Yo IR1, VO_{2max} ve vVO_{2max}, 10m, 30m, Illinois ve COD sonuçlarında önemli bir fark saptanmamıştır ($p>0.05$). Zirve ve ortalama anaerobik güç ile dikey sıçrama sonuçlarının, diğer pozisyonlardaki oyunculara kıyasla, forvetlerde önemli ölçüde daha iyi olduğu gözlemlenmiştir. Forvetler, diğer pozisyonlardaki oyunculara kıyasla daha üstün zirve ve ortalama anaerobik güç ile dikey sıçrama performansını sergilemişlerdir.

Anahtar Kelimeler: U-18 futbol, oyun pozisyonları, atletik performans

[*] *Corresponding Author: Murat KOÇ, Dr. Öğr. Üyesi, E-mail: muratkoc@erciyes.edu.tr*

INTRODUCTION

Football is known as a sport in which energy systems are used together and intertwined, directly or most directly affected by factors requiring both technical and physical abilities such as speed, agility, balance, strength, and the cardiovascular, nervous, and respiratory systems (Stolen et al., 2005; Taşkın, 2006). To possess these characteristics, good football players require long-lasting, quickly recoverable, and anaerobic power. In contemporary football, where modern players are compelled to cover approximately 12 km, endurance becomes an indispensable feature (Carling et al., 2008). A football match involves 1000-1200 movements, each lasting between approximately 4.5 and 6 seconds. Among these movements, movements such as acceleration and sudden changes of direction are high intensity and increase energy consumption. It can be observed that athletes with high endurance capacities and anaerobic thresholds can perform for long periods, even in high-intensity competitions (Di Salvo et al., 2009) Considering these performance situations, a fast athlete will have an advantage compared to the opposing team, maintaining speed in a small area and in positions that require sudden changes of direction, ultimately excelling in many positions (Sever & Zorba, 2018).

In examinations conducted based on playing positions, it has been determined that midfielders cover a greater distance than defenders and strikers, and that the duration of activities is longer at light and moderate intensity. On the other hand, it has been observed that strikers engage in more sprint runs over a more extended period compared to midfielders and defenders (Bloomfield et al., 2007). According to this data, the fact that modern football is played at a high level has increased performance expectations, making it progressively challenging to achieve the intended results in team sports. The benefits of advances in coaching science have been embraced by coaches and athletes, leading to innovative and diverse training methods. The results of these developments are being examined and interpreted, prompting a review of the applied training methods. Thanks to these situations, the positive change in the performances of football players has also reached a visible level with the advancement of science and technology (Turna & Kılınç, 2018).

This situation has also manifested in football regarding the positions played by athletes and their performance expectations. Consequently, to alter the outcome of competitions, it has become mandatory for players in all positions to exhibit the highest level of athletic performance. Numerous studies have been conducted in the literature considering age groups and positions in football (Aslan & Koç, 2015; Eyuboglu & Aslan, 2016; Yapıcı et al., 2016). Like almost all sports, individuals' maturation age and status impact their performance (Wattie et al., 2015). These differences reveal different physiological and physical demands for each position, emphasising the importance of position-specific training programmes. In Turkey, like global trends, there is a growing interest in understanding and optimising the performance parameters of young footballers. However, there is a gap in the literature on how these parameters differ according to the positions of Turkish U-18 players. Research in this field emphasises the role of maturation age and individual development on performance (Wattie et al., 2015). However, studies focusing on Turkish youth football are limited and questions about how young players' physical and physiological characteristics match their positions remain unanswered.

This study is one of the few studies examining the position-specific physical and physiological performances of 18-year-old young football players in Turkey. This deficiency in the literature points to the lack of playing young athletes in the correct positions and developing individual training programs. In this context, this study was conducted to determine the performance levels of young football players in different positions and to compare these performances based on their playing positions. The results of the study may provide important data on how to optimize the performance criteria specific to the position of young football players as they transition to the professional level (Dunn & Tamminen, 2023; Morris et al., 2017).

MATERIAL AND METHOD

This study employed a cross-sectional descriptive research design based on field tests, comparing the performance parameters of football players across their playing positions.

Participants

The study was conducted in September, the second annual training program preparation period. The study was conducted with a total of 54 volunteer male football players who play in the Super Amateur League in Adana, with no injury or illness, with 7.14 ± 3.16 years of experience in the sport, an average age of 16.03 ± 1.88 years, an average height of 1.76 ± 0.05 m, and an average body mass of 72.57 ± 8.50 kg. Athletes were informed about the study protocol, and those who agreed to participate were asked to sign a consent form stating the purpose and methods of the study. A questionnaire form prepared by the researchers was used to assess the demographic characteristics of the participants (age, height, body mass, years of experience in the sport, and body mass index (BMI).

The study was approved by the Cukurova University Faculty of Medicine Non-invasive Clinical Research Ethics Committee (Date: 03 November 2021, Number of meetings: 117 Decision no: 49) and was performed by the principles of the Declaration of Helsinki seventh revision.

Research Design

The research consisted of 3 sessions administered 48 hours apart. To eliminate the effect of biological rhythm on the athletes, the measurements were made by the same researcher at the same time of the day (17:00-19:00) (Turkeri et al., 2024). In the first session of the study, 10 m, 30 m, Illinois tests were applied. In the second session, Counter Movement Jump, COD (Zig-Zag test) and RAST tests were applied. In the last session, Yoyo IRT-1 test was applied. A 15-minute general warm-up protocol was applied to the athletes at the beginning of each session. Athletes applied general warm-up with 5 minutes of low-paced jogging and 10 minutes of stretching under the direction of their trainers.

Performance Tests

Illinois Test: For this test, a test track 5 m in width, 10 m in length, and consisting of three cones placed 3.3 m apart on a straight line in the center section was created for the test on the football pitch. After the test track was prepared, a photocell timer (Newtest Powertimer 300-series testing system, Finland) was placed at the start and finish points. Athletes began from the starting line of the test track by lying face down with their hands by their shoulders and in contact with the ground. Athletes completed the test, which consisted of a 40 m straight run and a 20 m slalom run between the cones, and which included 180º turns every 10 m. The measurements were repeated three times and the best time achieved by the athlete was recorded in seconds (Raya et al., 2013).

10 Meter and 30 Meter Speed Test: A three-gate photocell was used to determine the speed test of the athletes. Photocells were placed on the starting line, the 10 m line and the 30 m line.

Athletes were asked to run 30 meters at maximum speed. At the end of the test, 10 m and 30 m speed results were obtained (Muniroglu & Subak, 2018).

Countermovement Jump (CMJ) Test: This test was administered using the Newtest Powertimer 300 device (Newtest, Finland). Athletes attempted to jump to the highest point possible with the hands free, at the mid-point of the jump mat. During the measurement, the jump height of the athlete was recorded (Enoksen et al., 2009).

Running-Based Anaerobic Sprint Test (RAST): Athletes were asked to run the 35 m distance 6 times at maximum speed. A recovery period of 10 seconds was given between each 35 m sprint. Each 35 m sprint of the athletes was recorded in seconds (0.01). The anaerobic power of the athletes was found using the formula in Figure 1. With this formula, the athletes' average and peak anaerobic power was obtained (Burgess et al., 2016; Zagatto et al., 2009).

$$\textbf{Power (Watts)} = \textbf{Weight} \text{ (kg)} \times \text{Distance}^2 \text{ (m)} \div \text{Time}^3 \text{ (sec)}$$

Figure 1. Anaerobic Power and Fatigue Index (Burgess et al., 2016; Zagatto et al., 2009)

Yo-Yo Intermittent Recovery Test Level 1 (Yo-Yo IR1): The physical performance of football players in matches is based mostly on aerobic capacity and therefore the Yo-Yo IR1 test was used in this study (Bangsbo et al., 2008). This test consists of a 20+5 meter track and the athletes run along the 20 m running track placed in the test area in the form of a round trip according to the Yo-Yo IR1 signals. The test starts at 10 kph and the athlete starts running at the first signal tone. The athlete performs the return run at the second signal tone and then performs a recovery jog in the 5-meter area. The test is continued by increasing the running speed at each level. The test of an athlete who misses the signal twice in a row is terminated and the distance he/she has run is recorded (Krustrup et al., 2003).

Maximal Oxygen Consumption VO_{2max} (mL/kg/min): The VO_{2max} values of the athletes were calculated from the running distance in the Yo-Yo IR1 test using the equation in Figure 2 created by Bangsbo et al. (2008) (Bangsbo et al., 2008).

Maximal Aerobic Speed (vVO_{2max}): The vVO_{2max} values of the athletes were calculated from the running distance in the Yo-Yo IR1 test using the equation in Figure 2 (Heaney et al., 2009).

$$\textbf{VO}_{\textbf{2max}} \textbf{ (mL/kg/min)} = \text{Distance covered (m)} \times 0.0084 + 36.4 \text{ (Bangsbo et al., 2008)}$$

$$\textbf{Maximal Aerobic Speed (m/s)} = 0.456250 \times \text{distance covered (km)} + 3.617444 \text{ (Heaney et al., 2009)}$$

Figure 2. VO_{2max} and vVO_{2max} equations

Change of Direction Speed Test: This was carried out on a grass field using the Newtest Powertimer 300 device. The test consists of 3 slaloms placed as Zig-Zags 5 meters apart at an angle of 100° to each other over a distance of 20 meters. The athletes completed the test by passing between the 3 slaloms as fast as possible, starting 1 meter behind the starting line. The test was implemented three times for each athlete and the best time was recorded (Adıgüzel et al., 2024; Loturco et al., 2023).

Statistical Analysis

The demographic characteristics of the subjects were analyzed using descriptive statistics. Results are given as arithmetic mean ± standard deviation ($\bar{X} \pm S$.). To decide on which test statistics were to be applied to the data obtained in the study, the Kolmogorov-Smirnov test, one of the tests for normal distribution, was applied to the data first. Since the data showed normal distribution (p>0.05), parametric tests were applied. One-way analysis of variance (ANOVA) was used in the analysis of the data. Bonferroni correction was used to identify the source of significant results. Statistical analyses were performed using SPSS 25.0 (IBM) software.

RESULTS

Table 1. Demographic characteristics of football players in general and according to playing position

n=54	Defenders (n=18)	Midfielders (n=17)	Strikers (n=19)	Total
	X (Mean) ± S.	X (Mean) ± S.	X (Mean) ± S.	X (Mean) ± S.
Age (year)	16.73±1.81	17.34±1.69	16.50±1.46	16.83±1.68
Height (m)	1.74±0.05	1.73±0.04	1.82±0.04	1.76±0.05
Body mass (kg)	72.96±7.27	70.70±6.78	75.55±12.35	72.57±8.50
BMI (kg/m^2)	23.83±1.94	23.44±1.81	22.75±3.80	23.42±2.41
Sport Age (year)	6.89±4.09	7.30±2.75	7.25±2.34	7.14±3.16

BMI (Body Mass Index) is calculated by dividing body mass (kg) by the square of height (m).

Table 2. Comparison of athletic performance values of footballers according to playing position

			n	X (Mean)	S.	f	p	Dif.
Illionis (sec)	1	Defenders	18	16.05	0.61	0.62	0.53	
	2	Midfielders	17	15.85	0.98			
	3	Strikers	19	15.80	0.38			
	4	Total	54	15.90	0.71			
30 m (sec)	1	Defenders	18	4.18	0.22	1.39	0.25	
	2	Midfielders	17	4.15	0.11			
	3	Strikers	19	4.08	0.18			
	4	Total	54	4.13	0.18			
10 m (sec)	1	Defenders	18	1.80	0.15	1.79	0.17	
	2	Midfielders	17	1.71	0.31			
	3	Strikers	19	1.65	0.22			
	4	Total	54	1.72	0.23			
COD (sec)	1	Defenders	18	6.28	0.20	2.28	0.11	
	2	Midfielders	17	6.13	0.23			
	3	Strikers	19	6.11	0.30			
	4	Total	54	6.17	0.26			
Yo-Yo-1 (m)	1	Defenders	18	1776.66	720.98	0.68	0.51	
	2	Midfielders	17	2017.64	420.52			
	3	Strikers	19	1833.89	707.73			
	4	Total	54	1872.66	632.96			
VO_{2max} (ml/kg/min.)	1	Defenders	18	51.32	6.05	0.67	0.50	
	2	Midfielders	17	53.34	3.53			
	3	Strikers	19	51.80	5.94			
	4	Total	54	52.13	5.31			
vVO_{2max} (m/sec)	1	Defenders	18	4.42	0.33	1.85	0.16	
	2	Midfielders	17	4.59	0.13			
	3	Strikers	19	4.45	0.32			
	4	Total	54	4.49	0.28			
CMJ (cm)	1	Defenders	18	33.01	7.27	11.59	**<0.001**	3-1,2
	2	Midfielders	17	33.58	5.26			
	3	Strikers	19	41.01	3.93			
	4	Total	54	36.00	6.67			
RAST Max Watt (W)	1	Defenders	18	849.74	273.31	7.12	**<0.001**	3-2
	2	Midfielders	17	691.90	128.54			
	3	Strikers	19	970.94	232.04			
	4	Total	54	842.70	245.85			
RAST Mean Watt (W)	1	Defenders	18	613.33	251.33	9.27	**<0.001**	3-2
	2	Midfielders	17	466.45	76.06			
	3	Strikers	19	718.94	151.33			
	4	Total	54	604.25	201.54			

No significant difference was found in the Illinois, 30m, 10m, COD, Yo-Yo IR1 distance, VO_{2max} or vVO_{2max} results according to the playing positions of the players. A significant difference was found in the CMJ, peak and average aerobic power values in favour of strikers ($p<0.001$) (Table 2).

DISCUSSION AND CONCLUSION

No significant differences were found in the 10-meter and 30-meter speed results of the athletes participating in our study based on their playing positions ($p>0.05$). When examining the 10-meter acceleration performances, it was observed that strikers (1.65 ± 0.22 sec) outperformed midfielders (1.71 ± 0.31 sec), while midfielders outperformed defenders (1.80 ± 0.15 sec). Similarly, in the analysis of football players' 30-meter sprint performances, it was established that strikers (4.08 ± 0.18 sec) demonstrated better performance than midfielders (4.15 ± 0.11 sec), whereas midfielders performed better than defenders (4.18 ± 0.22 sec).

Previous research findings align with our results, as Taşkın (2006) found no significant differences in playing positions regarding the 30-meter sprint, and Cerrah et al. (2011) reported no disparities in 10-meter and 30-meter sprint results among amateur football players (Cerrah et al., 2011; Taşkın, 2006). Additionally, Aslan and Koç (2015) discovered no significant differences in acceleration and speed results based on playing positions (Aslan & Koç, 2015). While Malina et al. (2005) did not identify significant differences in football players' 30-meter sprint results, they did find that strikers exhibited higher average speeds compared to defenders and midfielders (Malina et al., 2005). Similarly, Gil et al. (2007) concluded that strikers displayed faster speeds than defenders and midfielders (Gil et al., 2007). The consistency in these findings across various studies and ours is attributed to the prevalent and comprehensive structure of contemporary football, contributing to an overall increase in the speed of the game.

Regarding the Change of Direction (COD) speed results, no significant differences were observed among the athletes based on their playing positions ($p> 0.05$). Examination of football players' COD performances indicated that strikers (6.11 ± 0.30 sec) outperformed midfielders (6.13 ± 0.23 sec), and midfielders (6.28 ± 0.20 sec) outperformed defenders. This is consistent with findings by Sariati et al. (2020) and Aktaş, Uçar, and Kaplan (2020), who reported no significant differences in change of direction ability across playing positions (Aktas et al., 2020; Sariati et al., 2020). Similarly, no significant differences were identified in agility results based on playing positions ($p>0.05$). Analysis of football players' agility performances revealed that strikers (15.80 ± 0.38 sec) exhibited better agility than midfielders (15.85 ± 0.98 sec), while midfielders performed better than defenders (16.05 ± 0.61 sec). These results indicate, as in other studies, that there are no significant correlations or differences in agility performances based on playing positions (Aktas et al., 2020; Aslan, 2015; Söyler & Kayantaş, 2020). In the study conducted by Barbero-Álvarez et al. in 2024, they evaluated the technical and physical load variables of semi-professional football players playing in the Spanish U18 National League in different positions. The results showed that there were significant differences between the first and second halves of the match according to positions (Barbero-Álvarez et al., 2024). In conclusion, our study, along with previous research, indicates that agility performances of football players in amateur leagues remain similar across all playing positions, emphasizing the universality of agility capabilities across different field positions

No statistically significant difference emerged in the VO_{2max} (mL/kg/min) results among the athletes participating in our study based on their playing positions ($p>0.05$). Upon scrutinizing the VO_{2max} performances of football players, it was observed that midfielders (53.34 ± 3.53

mL/kg/min) exhibited superior results compared to strikers (51.80 ± 5.94 mL/kg/min), while strikers outperformed defenders (51.32 ± 6.05 mL/kg/min). In a study by Tønnessen et al. (2013) investigating the maximum aerobic capacities of professional football players, no significant differences were identified in the VO_{2max} results among defenders, midfielders, and forwards (Tonnessen et al., 2013). Similarly, Gil et al. (2007), in their examination of football players, and Metaxas et al. (2006) found no significant disparities in VO_{2max} results based on playing positions (Gil et al., 2007; Metaxas et al., 2006). Consistent with these findings, Söyler (2020) reported no significant distinctions in the VO_{2max} results of football players participating in the regional amateur league according to their playing positions (Söyler & Kayantaş, 2020). In the Italian and Danish football leagues, midfielders covered more distance in the Yo-Yo IR1 test than defenders and forwards, resulting in higher VO_{2max} values. Di Salvo et al. (2007) observed that midfielders had superior VO_{2max} results compared to both strikers and defenders, highlighting the physiological differences among player positions (Di Salvo et al., 2007). In a study conducted by Bujnovsky et al. in 2019, the physical fitness characteristics of high-level young football players were evaluated according to their positions (Bujnovsky et al., 2019). Given that midfielders actively contribute to both defensive and offensive aspects of the game and require greater effort to control a larger area, their VO_{2max} values may exceed those of players in other positions. Furthermore, a 2022 study by Soós et al. examined the anthropometric and physiological profiles of young male football players in Hungary according to their positions. The results showed that forwards and wingers had the highest peak speeds and high-intensity action frequencies, while midfielders covered the most total distance (Soos et al., 2022). The results emphasize that there are significant differences according to positions and that these differences should be taken into account in the design of training programs (Ceylan, 2021). The congruence between the findings of studies in the literature and our investigation suggests that football players in midfield possess a greater oxygen consumption capacity compared to defenders and forwards. Given that midfielders actively contribute to both defensive and offensive aspects of the game, requiring more effort to control a broader area, it is plausible that their VO_{2max} values surpass those of players in other positions.

When the results of the vertical jump were examined, it revealed significant differences, favouring attacking players (strikers) ($p<0.001$). Strikers (41.01 ± 3.93 cm) outperformed midfielders, achieving 33.58 ± 5.26 cm, demonstrating superior performance. Söyler (2020) similarly ascertained a pronounced advantage for forwards in vertical jump performances (Söyler & Kayantaş, 2020). Existing research consistently indicates that forwards generally manifest superior vertical jumping capabilities in contrast to midfielders and defenders (Boone et al., 2012; Harry et al., 2018; Sporis et al., 2009). Moreover, a conspicuous discrepancy in favour of forwards was discerned in peak and mean anaerobic power values ($p<0.001$). Forwards outperformed defenders, and defenders surpassed midfielders. Strikers demonstrated elevated average anaerobic power compared to defenders, whereas defenders exceeded midfielders. Studies delving into anaerobic power across different player positions corroborate our findings, underscoring the proclivity for forwards to exhibit heightened levels compared to counterparts in alternative positions.

These revelations align seamlessly with match analyses, thereby accentuating the predilection for forwards in anaerobic-centric performance parameters. The congruence between these scholarly inquiries and our investigation augments the robustness of the delineated patterns.

Football, being dynamic, involves varied runs and technical skills, demanding a blend of anaerobic and aerobic fitness (Rampinini et al., 2006; Stolen et al., 2005). In a match, 70-90% of energy is aerobic (Hostrup & Bangsbo, 2023). Aerobic capacity, crucial for recovery and delaying fatigue (Tomlin & Wenger, 2001), is often measured as VO_{2max}. Yet, football's demands, featuring high-tempo runs, are better captured by maximal aerobic speed (MAS), defined as the speed at VO_{2max} (Öztürk et al., 2023). Our study found no significant difference in MAS among playing positions ($p > 0.05$). Midfielders (4.59 ± 0.13 m/s) outperformed strikers (4.45 ± 0.32 m/s), while strikers beat defenders (4.42 ± 0.33 m/s). Though no studies focus on MAS by playing position, Rowan et al. (2019) found young footballers' average MAS to be 4.38 ± 0.26 m/s (Rowan et al., 2019). Consistent studies reported MAS for young Spanish and Brazilian players as 4.5 m/s and 4.6 m/s, respectively (Gonzalez-Badillo et al., 2015; Teixeira et al., 2014). Our study aligns with these findings, suggesting uniform MAS values. Midfielders' higher MAS than strikers and defenders can be attributed to their dual-role involvement, covering more field area and engaging in diverse high-intensity activities.

In conclusion, the study revealed that U-18 strikers exhibited significantly superior peak and average anaerobic power as well as vertical jump results compared to players in other positions. While no significant differences were observed in 30m speed, 10m speed, Illinois, or change of direction speed, U-18 forwards demonstrated a better performance than players in other positions. Additionally, U-18 midfielders exhibited higher Yo-Yo IR1 running distance, VO_{2max}, and maximal aerobic speed (vVO_{2max}) results compared to players in other positions. Based on these findings, it can be concluded that the in-game anaerobic performance values of U-18 footballers in the forward position surpass those of players in other positions.

Recommendations

This study underscores significant findings regarding the performance differences among U-18 football players based on their playing positions. Future research could expand on these findings by exploring biomechanical, neuromuscular, and metabolic factors specific to each position to enhance performance optimization strategies. Moreover, studies including diverse age groups, genders, and competitive levels would enhance the generalizability of the results. Longitudinal research could offer deeper insights into the developmental dynamics of players' performance parameters. Additionally, investigating injury risks associated with position-specific demands and devising preventive measures would support player health and long-term performance sustainability

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