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Does Aerobic Capacity Change According to Position in Football Players?

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Research Article
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Abstract

Aerobic capacity plays an important role in football as it influences players' physical performance and long-lasting endurance levels. The aim of this study was to investigate the aerobic capacity levels of football players playing in different positions according to the positions they play. The study group consisted of 83 football players in super amateur league. Football players playing in 8 different positions voluntarily participated in the study (goalkeeper: n= 8, defender: n=13, left back: n=9, right back: n=7, midfield: n=24, left winger: n=7, right winger: n=7 striker: n=8). Yo-Yo Intermittent Recovery Test (YYIRT1) was applied to determine the aerobic endurance parameters of the players. One-way ANOVA analysis was used to compare the distance travelled, average speed (km/h) and maximum oxygen uptake (VO2max) values. It was determined that there was a significant difference between the test parameters of the players in different playing positions, and this difference was found to be between the left back players, goalkeepers, and stoppers ($p<0.05$). It was determined that goalkeepers had the lowest average aerobic capacity in the distances travelled by the players by position, while back players and wingers had high aerobic capacity averages. According to these results, we can say that the aerobic capacities of football players vary according to their positions, and the physiological demands of the position played by back players and wingers are effective in the distance travelled and the football players have different aerobic capacities.
Keywords: Football, Aerobic endurance, Position, Yo-Yo test

Futbolcularda Aerobik Kapasite Pozisyona Göre Değişir mi?

Öz

Futbolda aerobik kapasite, oyuncuların fiziksel performansını ve uzun süren dayanıklılık düzeylerini etkilediği için önemli bir rol oynar. Bu çalışmada farklı mevkilerde oynayan futbolcuların oynadıkları mevkilere göre aerobik kapasite seviyelerinin incelenmesi amaçlanmıştır. Araştırma grubu, süper amatör ligde mücadele eden 83 futbolcudan oluşmaktadır. Çalışmaya 8 farklı mevkide oynayan futbolcular gönüllü olarak katılmıştır (kaleci: n= 8, defans: n=13, sol bek: n=9, sağ bek: n=7, orta saha: n=24, sol kanat: n=7, sağ kanat: n=7 forvet: n=8). Oyuncuların aerobik dayanıklılık parametrelerini belirlemek için Yo-Yo Aralıklı Toparlanma Testi (YYIRT1) uygulanmıştır. Test kapsamında kat edilen mesafe, ortalama hız (km/s) ve maksimum oksijen alımı (VO2max) değerlerinin karşılaştırılması için tek yönlü ANOVA analizi kullanılmıştır. Farklı oyun pozisyonlarındaki oyuncuların test parametreleri arasındaki anlamlı fark olduğu, bu farkın sol bek oyuncuları ile kaleci ve stoperler arasında olduğu tespit edilmiştir ($p<0.05$). Oyuncuların mevkisel olarak kat ettikleri mesafelerde en düşük kaleciler yer alırken, bek ve kanat oyuncularının yüksek aerobik kapasite ortalamasına sahip olduğu belirlenmiştir. Bu sonuçlara göre, futbolcuların aerobik kapasitelerinin mevkilere göre değiştiğini, bek ve kanat oyuncularının oynadıkları pozisyonun fizyolojik taleplerinin kat ettikleri mesafede ve futbolcuların farklı aerobik kapasitelere sahip olmasında etkili olduğunu söyleyebiliriz.
Anahtar Kelimeler: Futbol, Aerobik dayanıklılık, Mevki, Yo-Yo test

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INTRODUCTION

Football is a dynamic and engaging game played on a pitch defined by specific rules and objectives. Football requires a combination of physical fitness, technical skills, tactical understanding, and teamwork. Football players should have good ball control, passing ability and spatial awareness to be successful. In addition, strategic elements such as formations, player positioning and set pieces also influence the outcome of matches. The fluidity, physical and technical demands and strategic nuances of football make it an engaging and widely played sport worldwide.

Endurance plays a crucial role in football as it is a physically demanding sport that requires players to sustain prolonged periods of activity, including explosive movements such as jumping, sprinting, and changing tempo (Carvutto et al., 2021; Pérez et al., 2024; Stolen et al., 2005). The ability to maintain endurance is essential to sustain performance throughout a match, especially given the intermittent nature of football involving repeated changes of direction and short duration activities (Joo, 2018; Ramírez-Campillo et al., 2016). In addition, the physical development of football players, such as strength, endurance, and agility, is of great importance for their overall performance (Konrad & Tilp, 2018). The talent identification process in professional football clubs takes into account the total distance travelled by players during matches, indicating that endurance is an important trait for top-level football players (Gil et al., 2014**).** Elite football players need to adapt to the physical demands of the game and for this, high levels of speed, agility and aerobic endurance are defined as important physiological characteristics (Bebek, 2020; Rebelo et al., 2013). Furthermore, the importance of aerobic endurance performance in football players and need to develop endurance to maintain a high level of work throughout the match is increasing day by day (McMillan et al., 2005). In general, the literature underlines the critical role of endurance in football, emphasising its impact on physical performance and players' overall success in the sport (Dolci et al., 2018; Helgerud et al., 2001). Furthermore, aerobic endurance plays a key role in counteracting the fatigue-induced decline in running performance observed during football matches, emphasising its importance in sustaining match performance (Dolci et al., 2018). Athletes in team sports that involve intense training actions and endurance elements, such as football, can benefit from intensified training, emphasising the importance of endurance in football (Bangsbo, 2015). Research has shown significant improvements in aerobic fitness and match performance in football players, particularly in response to specific aerobic training methods (Impellizzeri et al., 2006; Marques et al., 2022) and it has been emphasised that it is crucial to define validated field tests that enable the assessment of football-specific endurance in young football players (Castagna et al., 2009; Michaelides et al., 2021). In another study small side games also have positive effect in aerobic capacity (Michailidis, 2024b).

The Yo-Yo intermittent recovery test is used to assess aerobic capacity and physical performance in various sports, especially football. It consists of two levels. Level 1 focuses on the capacity for intermittent exercise leading to maximal activation of the aerobic system, while level 2 determines the individual's ability to recover from repeated exercise with a high contribution of the anaerobic system (Bangsbo & Iaia, 2008). Furthermore, the test was found to be reproducible and could effectively assess an athlete's ability to perform intense

intermittent exercise with a high rate of aerobic and anaerobic energy conversion (Krustrup et al., 2006). The Yo-Yo intermittent recovery test has been widely used as an indicator of functional capacities in various sports (Carvalho et al., 2018; Castagna et al., 2019) including football, basketball, and recreational football (Datson et al., 2023). Coaches widely use the Yo-Yo intermittent recovery test as a valid assessment of aerobic endurance performance in football players (Deshak, 2019).

While there are many studies in the literature in which yo-yo test is used, studies in which football players are evaluated according to their positions or the positions they play are limited in the literature. In this context, the aim of the study was to investigate whether aerobic capacity in football players varies according to the positions they play.

METHOD

In this part of the study, information about the research group, research design, data collection process, data collection tools and data analysis are provided.

Research Model

In the study, experimental study model related to sportive performance was used as data collection method. The football players were informed before the measurements were made and asked to perform at maximum capacity. Football players were instructed not to train for 24 hours before the test, to avoid stimulant drinks and foods such as alcohol and caffeine, and to rest and eat at least 2-3 hours before the test. The measurements of the study were carried out on an artificial turf football pitch. Before the measurement, it was asked whether the athlete had any health condition that would prevent the athlete from working, and healthy players were included in the study. Firstly, physical measurements (height, weight, body mass index) of the athletes were taken, then Yo-Yo aerobic test was started after a 20-minute warm-up. The values of the players who finished the test were recorded.

Research Group

The study group of the research consists of 82 male football players who regularly train and compete in Sinop Super Amateur League. The primary challenge for managers and coaches is identifying the ideal players for each position. In our study we divided 8 different positions. Football players playing in 8 different positions voluntarily participated in the study (n=8 goalkeeper, n=13 defender, n=7 right back, n=9 left back, n=24 midfield, n=7 right wing, n=7 left wing and n=8 striker).

Ethical Approval

It was unanimously decided that Sinop University Human Research Ethics Committee is ethically appropriate as per the decision of 2024/73 dated 28.03.2024.

Data Collection Tools

Physical Measurements

Seca 213 brand height measuring device was used to measure the height of the football players participating in the study. Inbody 120 Bioimpedance body composition analyser was used to determine body weight and body weight values were recorded in kg. The formula "BMI (kg/m2) = Body Weight (kg) / Height2 (m2)" was used to determine the body mass index of football players.

Yo-Yo Intermittent Recovery Level 1 Test: "Yo-Yo 1 Intermittent Recovery Test" was used to determine the maximal oxygen utilisation capacity of the football players participating in the study. This test is an endurance test consisting of a 10-second active recovery period consisting of 2x5 metres in a 2x20-metre area with a gradual increase with a beep (Figure 1). The test starts at a speed of 10 km/h and increases steadily. The test is terminated when the subject reaches the exhaustion point and stops running or fails to reach the start and return lines three times in a row (Krustrup et al., 2006; Povoas et al., 2016; Stolen et al., 2005). The following formula was used to calculate the VO2max value of the athletes.

Yo-Yo IR1 Test: VO2max (ml/min/kg) = Distance run (m) x 0.0084 + 36.4 (Bangsbo et al., 2008).

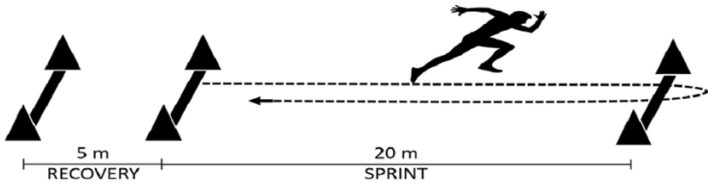

Figure 1. Yo-Yo Intermittent recovery level 1 test track

Analysis of Data

SPSS 21.0 package programme was used for all statistical analyses of the data obtained in the study. Descriptive statistics such as mean and standard deviation were used to evaluate the data. Shapiro-Wilk test was used to determine whether the data were normally distributed and the data found to be normally distributed were compared by One Way ANOVA. The pairwise comparisons were determined by Bonferroni test. Significance level was accepted as $p<0.05$ in statistical analyses.

FINDINGS

Table 1. Descriptive characteristics of football players

		Sport Age		Age (year)		Height Length (cm)		Body Weight (kg)		BMI (K/m²)	
Positions	**N**	**X̄**	**S**	**X̄**	**S**	**X̄**	**S**	**X̄**	**S**	**X̄**	**S**
Goalkeeper	8	9,87	1.64	21.37	1.68	181.62	2.06	73.25	5.70	22.17	1.42
Stopper	13	14.46	8.33	26.92	7.07	184.46	4.48	77.92	4.85	22.89	1.11
Left Back	9	15.00	9.24	24.44	4.85	172.22	1.39	71.11	2.57	23.96	0.85
Right Back	7	12.57	3.59	25.42	4.19	173.00	5.06	67.14	3.33	22.42	0.80
Midfield	24	11.54	5.65	24.50	4.35	177.20	3.97	75.25	5.95	23.97	1.89
Right Winger	7	12.14	3.38	23.57	1.90	172.42	3.15	69.00	3.82	23.18	0.87
Left Winger	7	10.57	3.82	22.28	2.92	174.57	3.64	71.14	4.48	23.34	1.53
Striker	8	10.00	6.39	25.50	5.34	183.75	6.88	79.37	7.83	23.48	1.13
Total	83	12.12	6.08	24.48	4.72	177.80	6.02	73.86	6.23	23.33	1.48

When Table 1 is analysed, the arithmetic means and standard deviations of the sports age, age, height, body weight and body mass index results of the football players participating in the study are seen.

Table 2. Yo-Yo IR1 test values of football players

		Distance				VO2max			
Positions	**N**	**X̄**	**S**	**Min.**	**Max.**	**X̄**	**S**	**Min.**	**Max.**
Goalkeeper	8	1215.00	649,19	520	2480	46,61	5.43	40.80	57.20
Stopper	13	1356,96	376.81	840	2320	47.80	3.16	43.50	55.90
Left Back	9	2547.77	893.78	880	3640	57.05	7.50	43.80	67.00
Right Back	7	1988.57	678.31	920	3160	53.10	5.69	44.10	62.90
Midfield	24	1865.00	729.38	760	3480	52.06	6.11	42.80	65.60
Right Winger	7	2045.71	507.24	1520	2800	53.58	4.26	49.20	59.90
Left Winger	7	1971.42	869.85	1160	3640	52.95	7.32	46.10	67.00
Striker	8	1442.50	457.37	540	2040	48.53	3.79	41.10	53.50
Total	83	1780.96	738.69	520	3640	51.36	6.19	40.80	67.00

When Table 2 is analysed, it is seen that the lowest value in distance travelled and VO2max variables is in goalkeepers and the highest value is in left back players.

Table 3. VO2max, distance travelled and running speed values of football players

		Distance					VO2max				
Positions	**N**	**X̄**	**S**	**f**	**p**	**Sig. Dif.**	**X̄**	**S**	**f**	**p**	**Sig Dif.**
1. Goalkeeper	8	1215.00	649.19	3.558	0.002*		46.61	5.43	3.564	0.002*	
2. Stopper	13	1356.96	376.81				47.80	3.16			
3. Left Back	9	2547.77	893.78				57.05	7.50			
4. Right Back	7	1988.57	678.31				53.10	5.69			
5. Midfield	24	1865.00	729.38			3>1-2	52.06	6.11			3>1-2
6. Right Winger	7	2045.71	507.24				53.58	4.26			
7. Left Winger	7	1971.42	869.85				52.95	7.32			
8. Striker	8	1442.50	457.37				48.53	3.79			
Total	83	1780.96	738.69				51.36	6.19			

*p<0.05

As a result of the analyses, there is a significant difference in aerobic capacity between left back players, goalkeepers and stopper among the players playing in different positions. In addition, the distance travelled and VO2max values of the back and winger players were higher than the players in other positions, although not significantly.

DISCUSSION AND CONCLUSION

Aerobic endurance in football has been a topic of interest for people in sports from past to present. The Yo-Yo intermittent recovery test is actively used in football and is a valid measure of fitness performance, and there is a significant correlation between the test and the distance travelled at high intensity during the match (Aquino et al., 2018; Bok & Foster, 2021; Castagna et al., 2009; Krustrup et al., 2003). Endurance in football cannot be ignored as it significantly affects the physical performance of players and their overall success in the sport. Endurance is a critical factor in sustaining prolonged activities such as sprinting, changing pace, direction and maintaining strong contractions to control the ball against defensive pressure. Furthermore, intermittent, and repeated activities during football matches are closely related to the aerobic endurance and recovery capacity of players.

Studies have shown that there are differences in aerobic endurance capacity of football players depending on the positions they play. Considering the position-specific aerobic and anaerobic endurance demands during matches, Altmann et al., (2020) suggested that the endurance capacity of players may vary according to their position. Similarly, Bayrakdaroglu et al., (2020) found that the performance of intermittent and repetitive activities during a football match depends on the aerobic endurance and recovery capacities of the players and that this situation shows potential differences according to the playing positions. In the study by Yapici et al., (2016) it was observed that midfielders and strikers were at similar levels according to Yo-Yo 1 values, but midfielders were significantly higher than defenders. Akyildiz et al., (2022) reported that the CD had the lowest values for the overall metabolic power distances, while the CM had the greatest distances in the Turkish Super League. According to Koç (2021) found that in terms of running distances according to the positions played by football players, defense players created a significant difference compared to midfielders and goalkeepers, and the highest value in terms of VO2max levels was found in

defense players and the lowest value was found in goalkeepers. Concluded that there are anthropometric and physiological differences between football players in different positions and suggested that aerobic endurance may vary according to the roles of players on the field (Gil et al., 2007). Therefore, it is recommended that coaches consider the physical demands of the positions and seasonal variation when creating training programs for players (Aşçi et al., 2024). Another study showing that the endurance levels of football players vary according to different playing positions emphasises the importance of position-specific endurance assessment in football (Krustrup et al., 2003; Omar et al., 2024; Zhou et al., 2020). Castagna et al., (2009) found that specific endurance determined by Yo-Yo IR1 performance positively affected physical match performance in young male football players, emphasising the importance of position-specific endurance for on-field performance. In another study by Krustrup et al., (2006) the Yo-Yo IR2 test was shown to be a sensitive tool for discriminating between intermittent exercise performances of football players. This underlines the importance of the Yo-Yo test in the assessment of endurance levels in various competitive and positional contexts. In addition, Pivovarniček et al., (2013) reported significantly higher levels of endurance in the Yo-Yo test among elite international football players compared to those in lower leagues, indicating that endurance levels vary at different levels of football.

Ružbarský et al., (2017) reported a 25% improvement in Yo-Yo test performance at the beginning of the season, emphasising the dynamic nature of endurance levels throughout the annual training cycle. In contrast, Wong et al., (2009) reported that there was no positional difference in intermittent aerobic endurance among defenders, midfielders, and striker in elite youth football players (Michailidis, 2024a). Additionally, the lack of differences between playing positions may be due to the limited specialization of the training load received by the players until this age. According to Bicer (2021) reported that among defense, midfield and striker players, defense players had high running distance in his study on amateur football players.

As can be seen in the above literature examples, although some studies show that there are potential differences in aerobic endurance depending on playing positions, there are also contradictory studies in the existing literature. Endurance development has been identified as a key factor in preventing fatigue-related declines in running performance observed during football matches and reducing the effects of fatigue during the game. Extensive literature underlines the great importance of aerobic endurance capacity in football as it directly affects players' physical performance, match endurance, recovery capacity and overall success in the sport. The multifaceted nature of factors affecting endurance requires a holistic approach to optimise aerobic capacity in soccer players.

In our study, it was determined that football players playing in different playing positions had different Yo-Yo Intermittent Recovery Test performances, and the highest aerobic capacity value was found in back players and then in wingers. The reason for the different running speeds, running distances and VO2max levels in playing positions can be explained by the characteristics of the positions played by the football player, the fact that he is under more optimal load during the match and the distance to be travelled due to his position. It should be noted that more research is necessary to comprehensively understand the

relationship between positions and aerobic endurance in football and to develop new approaches to these positions, and new studies can be planned with a larger number of football players from teams in different league rankings.

Conflict of Interest: There is no personal or financial conflict of interest within the scope of the research.

Declaration of Contribution of Researchers: Research Design 1 and 2; Statistical Analysis 1; Preparation of the Manuscript and Collection of Data were carried out by 1, 2 and 3.

Information on Ethics Committee Permission

Board Name: Sinop University Human Research Ethics Committee

Date: 28.03.2024

Number/Decision No: 2024/73

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