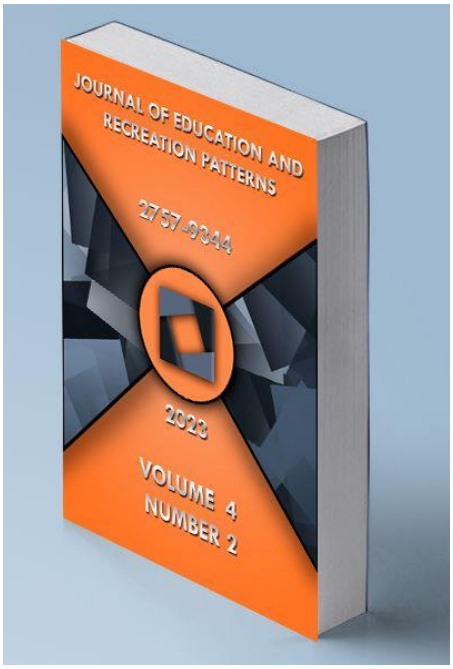

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Comparison of Maximal Sprint Speed, Maximal Aerobic Speed, Anaerobic Speed Reserve and Vo2max Results According to the Positions of Amateur Football Players: Experimental Study

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Comparison of Maximal Sprint Speed, Maximal Aerobic Speed, Anaerobic Speed Reserve and Vo2max Results According to the Positions of Amateur Football Players: Experimental Study

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ABSTRACT

Purpose: To compare the results of Maximum Sprint Speed(MSS), Maximum Aerobic Speed (MAS), Anaerobic Speed Reserve(ASR) and VO2max according to the positions of the players.

Methods: This study 5.34±1.44 years of sports history in the football branch, average age is 20.47±1.49 years, average height is 1.76±0.04 m, average weight is 74.41±45.59 kg, was conducted with a total of 91 volunteer male athletes. The study consisted of 2 sessions, 48 hours apart. In the first session, the 10 m speed test was applied, and in the second session, the Yo Yo-1 test was applied. Maximum Sprint speed, Maximal Aerobic Speed, Anaerobic Speed Reserve and VO2max results were calculated with 10 m and Yo Yo-1 test results. After descriptive statistics (Mean±Standard deviation) of all variables were made, One Way ANOVA test was applied to compare according to their positions and Bonferoni correction was applied to determine the difference between groups.

Results: There was no significant difference between the Maximum Aerobic Speed, Anaerobic Speed Reserve and VO2max results according to the positions of the players ($p>0.05$). However, a significant difference was found between the Left Wing and Center Defenders in the Maximal Sprint Speed results in favor of the Left-Wing players ($p<0.05$).

Conclusion: It was determined that the players had similar Maximal Aerobic Speed, Anaerobic Speed Reserve and VO2max performance outputs regardless of the positions they played, but Left-Wing players were faster than Central Defense players in Maximum Sprint Speed.

Keywords: Anaerobic Speed Reserve, Football, Maximum Aerobic Speed, Maximum Sprint Speed, VO2max

INTRODUCTION

Football has a very important position in terms of interest, demand and economy when compared to other sports branches. Football is a sport in which technical and tactical skills and the main physiological factors specific to football are very important, in which the exercises applied at different intensities in terms of its characteristic features are practiced at irregular intervals for a long time. In addition to the physical, mental, technical, and tactical skills that footballers gain with training, they also acquire physiological skills (İnal, 2004).

The conditional goal of the training methods and programs applied in football is to enable the players to perform high-intensity movements during the match without fatigue. From this point of view, it is very important to plan and implement a training method for the positions of the athletes, since applying a training method according to the positions of the players will increase the performance parameters of the athletes (Katis & Kellis, 2009).

Maximum aerobic speed (MAS), maximum sprint speed (MSS), anaerobic speed reserve (ASR) and maximum oxygen consumption (VO2max) constitute the basis of the performance indicators of the football players. Anaerobic speed reserve (ASR) is generally defined as the value between Maximal Aerobic Speed (MAS) and Maximal Sprint Speed (MSS) and is used to determine the intensity of the exercise applied.3 Maximum Sprint Speed means the highest speed that the athlete can reach in the 10-meter area during the 40-meter sprint test and is generally measured by radar speed gun or photocell. Maximal Aerobic Speed (MAS), another component of Anaerobic Speed Reserve (ASR), has taken its place in the literature as the speed at which maximum oxygen consumption is reached (Billat & Andkoralsztaın, 1996; Buchheit, 2008). Also in their 2023 study, Cirasun, V. & Baydemir, B. analyzed young athletes aged 14-15 and found key correlations between physical attributes and performance. Better dorsiflexion angles were linked to higher muscle volume and enhanced dynamic balance. Furthermore, athletes with larger calf volumes also demonstrated improved dynamic balance. A notable finding was the positive association between speed performance and change of direction abilities. This research underscores the influence of specific physical traits on athletic performance in youth football.

In this study, the VO2max values of the athletes were calculated with the help of formulas by applying the Yo-Yo IR1 test. Obtained VO2max values were examined according to the positions of the players. It is thought that determining whether the positions played by the football players is related to the VO2max values will shed light on the training programs of trainers and conditioners or the researchers who will work in the field.

When we look at the above-mentioned concepts, it is clearly seen that there are many different elements that determine and change the performance of the football player. Knowing the level of performance parameters of football players for trainers or conditioners is the main guide in planning the training method to be applied.6 In this sense, determining the performances of maximal aerobic speed (MAS), maximal sprint speed (MSS), anaerobic speed reserve(ASR) and maximal oxygen consumption (VO2max) and revealing their relationships between them clearly demonstrates how important our study is. The fact that there is no research in the literature comparing the results of the MSS, MAS, ASR and VO2max according to the positions of the football players makes the research unique.

In this context, the aim of our study is to compare the results of maximal sprint speed, maximal aerobic speed, anaerobic speed reserve and maximal oxygen consumption according to the positions of the football players, to determine their levels and to reveal scientific data in order to increase their performance.

METHOD

Research Model

The research consisted of two sessions, 48 hours apart. 91 athletes participating in the study performed the 10 m speed test in the first session and the Yo Yo-1 test in the second session. Athletes tried the 10 m speed test twice, and the best time was recorded. A 3-5 minute rest was given between repetitions. The athletes applied the Yo Yo-1 test after 48 hours of rest, and MSS, MAS, ASR, and VO2max results were calculated with the 10m speed test and Yo Yo-1 test results. R and VO2max results were calculated with the 10m speed test and Yo Yo-1 test results.

Participants

Those who declared that they did not have any injuries playing in the Super Amateur League in Adana and that they volunteered to participate in the study, have 5.34±1.44 years of sports history in their branch, mean age 20.47±1.49 years, average height 1.76±0.04. m, with a mean weight of 74.41 ± 45.59 kg, a total of 91 volunteer male football players participated, and football players who declared that they were injured or were not willing to participate in the study were not included in the study. The athletes were informed about the study protocol, and the amateur football players who agreed to participate in the study signed a consent form stating the purpose and methods of the study.

Research Ethics

The procedures related to the study were prepared in accordance with the Helsinki Declaration Principles 2008 ethical standards and the ethics committee approval of the study was obtained from the Inonu University Health Sciences Non-Interventional Clinical Research Ethics Committee with the decision number 2022/3627 dated 21.06.2022.

Data Collection Tools

A questionnaire form prepared by the researchers was used for the demographic characteristics of the participants. The person in the form; age, height, weight, sports age and Body Mass Index (BMI) data were recorded. The presence of illness, injury, surgery, medications, allergies and nutritional status of the athletes were questioned, and the athletes who did not have any problems were measured between 15:00 and 17:00 on a day they did not train during the pre-competition preparation season.

10 Meter MSS Test: The maximum speed of the athletes was determined by the 10 m sprint test. The time of passing the last 10 meters was recorded with the photocell device placed between the 30th and 40th meters of the track, where the athlete will start running at maximum speed on a 40 m track. The speed per hour was calculated based on the time the athlete traveled 10 m (Al Haddad, 2015).

YoYo Level 1 (YIRT-1) Test: The aerobic endurance of the football players was determined with the YIRT-1 test. The test consists of a distance of 20+5 meters. Athletes ran the 20 m running area placed in the test area in a round-trip way according to the YIRT-1 signals. The test starts at 10 km/h and the athlete starts running with the first signal tone. The athlete performs the return with the second signal tone and makes the rest run in the 5-meter area. The test is continued by increasing the running speed at each level. The test of the athlete who missed the signal twice in a row was finished and the distance he ran was recorded.8,9 In addition, the MAS, ASR and VO2max values of the football players were calculated from the running distance in the YIRT-1 test and the results in the MSS using the equations in Figure 1.

Figure 1. VO_2max, MAS and ASR Equations

VO_{2max}(ml/dk/kg) =Distance Run (m) × 0.0084 + 36.4 [9]
Maximal Aerobic Speed(km/h) = 0.456250 x (Distance Run (km) + 3.617444 x 3,6 [10]
Anaerobic Speed Reserve (km/h): MSS – MAS [11]

Statistical Analysis

Statistical analyzes were performed using the SPSS 26.0 program. The demographic characteristics of the subjects were analyzed with descriptive statistics. Results are given as arithmetic mean±standard deviation($\bar{x}$±ss). Kolmogorov Smirnov test was used to test whether the data obtained in our study showed normal distribution. It was determined that the data showed normal distribution and parametric tests were applied in the statistical analysis. Since our participant group was more than two, One Way ANOVA analysis was applied to determine the differences between the means. At the same time, Bonferroni correction was used to determine which group caused the difference between the means. Significance level was taken as $p<0.05$

FINDINGS

This section contains the results of an analysis comparing demographic characteristics, VO2max, Maximum Aerobic Speed (MAS), Anaerobic Speed Reserve (ASR), and Maximum Sprinting Speed (MSS) among football players across different playing positions.

Table 1. Demographic Characteristics of Football Players

		Age (year)	Weight (kg)	Height (m)	BMI (kg/m2)	Sport Age (year)
Center Defender	$\bar{x}$	20,50	74,76	1,79	23,06	5,41
	Sd	1,44	3,59	0,05	1,40	1,67
Right Back	$\bar{x}$	20,66	74,28	1,76	23,76	5,33
	Sd	1,22	4,90	0,06	1,78	1,73
Left Back	$\bar{x}$	20,22	76,29	1,75	24,39	4,80
	Sd	0,77	3,94	0,04	1,94	,86
Midfielder	$\bar{x}$	19,93	74,12	1,73	24,47	5,31
	Sd	0,77	2,18	0,02	1,11	1,62
Right Wing	$\bar{x}$	20,23	73,89	1,75	23,80	5,84
	Sd	0,92	3,38	0,03	1,62	1,34
Left Wing	$\bar{x}$	20,75	71,00	1,74	22,40	5,33
	Sd	1,05	5,49	0,03	3,06	1,43
Forward	$\bar{x}$	21,21	75,90	1,77	23,92	5,42
	Sd	2,93	6,68	0,05	2,17	1,55
Total	$\bar{x}$	20,47	74,41	1,76	23,75	5,34
	Sd	1,49	4,59	0,04	1,99	1,44

The mean age of the football players was 20.47±1.49 years, weight was 74.41±4.59 kg, height was 1.76±0.04 m, sports age was 5.34±1.44 years and BMI values were 23.75±1.99 kg/m2.

Table 2. Comparison of VO_2max Results by Position of Football Players

		Position	n	x̄	Sd	F	p	Dif.
VO_2max (ml/kg/dk.)	1	Center Back	12	50,10	2,08	1,42	0,22	
	2	Right Back	9	50,60	1,84			
	3	Left Back	15	51,98	2,53			
	4	Midfielder	16	52,67	2,50			
	5	Right Wing	13	51,90	3,37			
	6	Left Wing	12	50,34	3,37			
	7	Forward	14	50,89	4,25			
	8	Total	91	51,32	3,04			

No significant difference was found between the VO2 max results of the football players according to their positions (p>0.05). The findings from Table 2 suggest that midfielders exhibit the highest average VO2max values among football positions, indicating superior aerobic capacity, while other positions show relatively similar aerobic fitness levels with minor variations.

Table 3. Comparison of MAS (km·h–1) Results by Position of Football Players

		Position	n	x̄	Sd	F	p	Dif.
MAS (km·h–1)	1	Center Back	12	15,70	0,40	1,43	0,21	
	2	Right Back	9	15,80	0,35			
	3	Left Back	15	16,06	0,49			
	4	Midfielder	16	16,20	0,48			
	5	Right Wing	13	16,05	0,65			
	6	Left Wing	12	15,74	0,65			
	7	Forward	14	15,85	0,83			
	8	Total	91	15,94	0,59			

No significant difference was found between the MAS (km·h–1) results of the football players according to their positions (p>0.05). The data in Table 3 indicates that midfielders have the highest average Maximum Aerobic Speed (MAS) among football positions, suggesting superior aerobic endurance, while other positions demonstrate comparably close MAS values with slight variations.

Table 4. Comparison of ASR (km·h–1) Results by Position of Football Players

		Position	n	x̄	Sd	F	p	Dif.
ASR (km·h–1)	1	Center Back	12	9,93	0,57	1,84	0,10	
	2	Right Back	9	10,44	0,29			
	3	Left Back	15	9,67	1,92			
	4	Midfielder	16	10,14	0,64			
	5	Right Wing	13	10,17	0,77			
	6	Left Wing	12	9,13	0,50			
	7	Forward	14	9,95	1,31			
	8	Total	91	9,91	1,09			

No significant difference was found between the ASR (km·h–1) results of the football players according to their positions (p>0.05). The findings from Table 3 suggest that midfielders have the highest average Maximum Aerobic Speed (MAS) among football positions, indicating superior aerobic endurance, while other positions show relatively similar aerobic fitness levels with minor variations.

Table 5. Comparison of MSS (km·h–1) Results by Position of Football Players

		Position	n	x̄	Sd	F	p	Dif.
MSS (km·h–1)	1	Center Back	12	19,71*	,86	2,61	0,02*	1-5*
	2	Right Back	9	20,39	1,35			
	3	Left Back	15	23,23	6,00			
	4	Midfielder	16	21,35	2,11			
	5	Right Wing	13	21,16	2,37			
	6	Left Wing	12	23,80*	2,40			
	7	Forward	14	21,26	3,12			
	8	Total	91	21,63	3,35			

A significant difference was found between the MSS (km·h-1) results of the players according to their positions, between the Left-wing players and the Center back players ($p<0.05$). Findings in Table 5 indicate a statistically significant difference in Maximum Sprinting Speed (MSS) between the Center Back and Right-Wing positions in football players. The p-value of 0.02* suggests that this difference is not due to random chance but is statistically meaningful, with Right Wing players having higher MSS values compared to Center Backs players. This highlights the distinct physical demands and roles of these positions on the field, with Right Wingers players requiring potentially greater sprinting capabilities.

DISCUSSION

This study was carried out to compare the MAS, ASR, MSS and VO2max results of football players playing in different positions according to the positions. A total of 91 football players with a mean age of 20.47±1.49 years, a weight of 74.41±4.59 kg, a height of 1.76±0.04 m, and a sports age of 5.34±1.44 years participated in the study.

Comparison of ASR (km·h-1) Results by Position

There was no significant difference between the VO2max (ml/kg/min) results of the athletes participating in our study and the positions they played. When the VO2max performances of the players are examined, the central defenders are 50.10±2.08, the right wing defenders 50.60±1.84, the left wing defenders 51.98±2.53, the central midfielders 52.67±2.50, right wing players 51.90±3.37, left wing players 50.34±3.37 and strikers 50.89±4.25 ml/kg/min. It has been found that the players who have good VO2max values from the positions participating in our research are the players who play in the central midfield area. Tonnessen et al. (2013) examined the maximum aerobic capacity of professional football players and did not find a significant difference between the VO2max results of defender, midfielder and forward players and the positions they played (Tonnessen, 2013). Gil et al., (2007) found no significant difference between the VO2max results of strikers, midfielders and defenders in their study on football players (Gil et al., 2007). Metaxas et al. (2006) found no significant difference between the positions of the players and their VO2max results (Metaxas et al., 2006). In another study, Söyler (2020) could not find a significant difference between the positions of football players playing in the regional amateur league and their VO2max results (Söyler, 2020). In order to determine the aerobic capacity of the football players playing in the Italian and Danish leagues, Yo Yo-1 test was applied and it was stated that the players playing in the midfield covered more distance than the defense and forward players, and accordingly their VO2max results were higher (Mohr et al., 2003). Di Salvo et al., (2007) stated in their study that midfielders have higher VO2max results than attacking and defensive players (Mohr et al., 2003). He also found that midfielders have higher VO2max than other positions, noting that a player's role in the team is related to his physiological capacity (Reilly et al., 2000). When the studies in the literature are examined, the findings in our study are similar to each other. It was found that the players playing in the midfield have a higher oxygen consumption capacity than the players

playing in the defense and attack zones. Players playing in the midfield take an active role in both defense and offense, and more effort is required to control a wider area in the game. This situation is thought to be the reason why the VO2max values of the players playing in the midfield are better than the players playing in other positions.

Comparison of MSS (km·h-1) Results by Position

Football is a sport in which there are intermittent linear, diagonal and change of direction runs at different speeds due to the nature of the game, and these runs are combined with technical and tactical skills. It is possible with a highly developed combination of anaerobic and aerobic properties of the football players, so that the specified features can be applied in the best way on the field (Rampinini et al., 2007; Stolen et al., 2005). Approximately 90% of the total energy used by a football player in the match comes from aerobic metabolism (Bangsbo, 1994). Aerobic capacity is an important factor in the recovery of athletes between high-intensity workouts and, accordingly, delaying the onset of fatigue (Tomlin & Wenger, 2001). Enhanced aerobic capacity is often defined as VO2max. This is very important for estimating aerobic capacity, but it may not be valid in sports where there is a continuous high tempo run alone, such as football. During the competition, players are required to perform higher intensity runs and sprints at a higher competitive level with a rapid recovery (Mendez-Villanueva et al., 2010; Dupont et al., 2004; Helgerud et. al., 2001; Helgerud et al., 2007). This depends on the athlete's speed at maximum oxygen consumption (MAS). MAS is known as running speed in VO2max (Berthoin et al., 1994)

There was no significant difference between the MAS (km·h-1) results of the athletes participating in our research and the positions they played. When the MAS performances of the football players are examined, it is seen that the central defenders are 15.70±0.40, the right-wing defenders 15.80±0.35, the left wing defenders 16.06±0.49, the central midfielders 16.20±0. 48, right wing players 16.05±0.65, left wing players 15.74±0.65 and strikers 15.85±0.83 km·h-1. When the literature was examined, studies examining the MAS values of football players according to positions could not be found. However, when studies with football players were examined, Rowan et al., (2019) found the average MAS values of young football players to be 4.38±0.26 m/s (13.14±0.93 km/h). Gonzalez-Badillo et al., (2015) found the MAS value of the football players in the Spanish youth team as 4.5 m/s (16.20 km/h). In another study, the MAS value of young Brazilian football players was found to be 4.6 m/s (16.56 km/h) (Teixeira, et. al., 2014). The values obtained in these studies and the values in our study are similar to each other. The fact that football players perform high-intensity repetitive runs can change the outcome of the match. Therefore, the runs that the athletes can maintain at maximum oxygen consumption levels will affect the level of efficiency in the field. In addition, in our research, the MAS values of the players playing in the midfield were found to be higher than the players playing in the defense and attack zones. Players playing in the midfield play the game in two ways (defense-offensive). In addition, when the field is parceled out, the largest area in terms of playing field falls to the midfielders. In this case, it requires the players playing in the midfield to run more. Activities such as starting attacks, overlapping, contributing to the attack, counter-attacking and concluding, etc. in offense, and catching with few people in defense, one-on-one combat, pressure level are possible with high-intensity runs. This can be considered as the reason why the players playing in the midfield have higher MAS values than the attacking and defensive players, since the display of these skills is realized by running continuously at the VO2max level.

Comparison of ASR (km·h-1) Results by Position

There was no significant difference between the ASR (km·h-1) results of the athletes participating in our research and the positions they played. When the ASR performances of the players were examined, the central defenders were 9.93±0.57, the right wing defenders

10.44±0.29, the left wing defenders 9.67±1.92, the central midfielders 10.14±0.64. , was found to be 10.17±0.77 for right wing players, 9.13± 0.50 for left wing players and 9.95±1.31 km·h-1 for strikers. The concept of ASR is defined as a new concept in sports sciences. The athlete's anaerobic speed reserve (ASR) is typically defined as the difference between Maximum sprint speed (MSS) and running speed (MAS) in VO2max. ASR can be broadly defined as a combination of both Maximum aerobic and anaerobic energy capacities (Bundle, et al., 2012). When we examine the ASR, it is seen in the activities that take place above the MAS value of the athlete. Accordingly, it can be said that the athlete appears in the activities performed in the supramaximal load in the MAS during the game (Bundle, et al., 2012). Changes in the game structure of football have increased the pace of the game. In the game, the athlete must perform activities at maximal load and above due to offense and defense. Research examining ASR is limited in the literature. In the only study in the literature, Ortiz et al. (2018) compared the ASRs of football players according to their positions According to the findings of the research, although there is no difference between the positions, the defensive players (12.7±1.4) attacking (12.6±1.5) and midfielders (12.4±1.3) with a slight difference. He stated that he had a higher level of ASR than players playing in his region. This finding is similar to the result of our study. Although there was no significant difference in this study, the ASR values of the right defenders were found to be higher than the players playing in other positions, albeit with a small difference. Our findings show that right wing defenders have a higher ASR than other players, but the tactical situations associated with different positions likely change the rate of ASR available to players.

Comparison of MSS (km·h-1) Results by Position

According to the positions of the athletes participating in our research, a significant difference was found between the MSS (km·h-1) results between the left-wing players and the central defense players in favor of the Left-Wing players ($p<0.05$). While the MSS of the left-wing players was found to be 23.80±2.40 km·h-1, it was found to be 19.71±0.86 km·h-1 for the central defenders. In their study, Al Haddad et al., (2015) found that among all young football players between the ages of U13-U17, the players playing in the attack/wing area were faster than those playing in the defense and midfield areas. Malina et al., (2005) found in a study they conducted that attacking/wingers were faster than defensive players. In another study, Gil et al., (2007) similarly stated that attacking/wingers are faster than defensive players. In some other studies, it has been found that offensive/wingers are faster than defenders or midfielders (Mendez-Villanueva et al., 2013; Sporis et al., 2009; Boone et al., 2012) It can be said that the reason why the wingers in our research are faster than the defenders is due to the fact that fast players are involved due to the tactical expectations of the game, unlike other positions, especially in these regions.

Conclusion

When the MSS results of the football players playing in different positions were examined, a significant difference was found between the MSS values of the left-wing players and the defenders. However, although there was no significant difference in performance in MAS, ASR and VO2max results, it can be said that midfielders are better in MAS and VO2max results, and right-wing defenders are better in ASR. Depending on the development in football, the tactical needs associated with football players playing in different positions likely change the ratio of MAS, ASR, MSS and VO2max values available to players. The anaerobic and aerobic conditions that occur due to the nature of the game reveal the necessity of analyzing the running profiles of the football players in terms of ASR. Determining the ASR values of the players, determining the running profile and training them in line with this profile can be effective in increasing the competition level of the team and the players, and in the development of defense and attack techniques.

Recommendation

It is thought that the results obtained from the study will contribute to the literature. The differences in physical, physiological and motoric characteristics of athletes between positions can guide coaches in player selection. It is thought that similar studies can be conducted to evaluate the physical, physiological and motoric characteristics between positions in different team sports.

Limitations

This study is limited to football players between the ages of 19-22 who play football in the Super Amateur League in Adana. At the same time, male football players who had played football for at least 4 years, who declared that they did not have any injuries or health problems and agreed to participate in the study voluntarily, were included in the study.

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REFERENCES

Al Haddad, H., Simpson, B. M., Buchheit, M., Di Salvo, V., & Mendez-Villanueva, A. (2015). Peak match speed and maximal sprinting speed in young football players: effect of age and playing position. *International Journal of Sports Physiology & Performance,* 10(7). https://doi.org/ 10.1123/ijspp.2014-0539

Bangsbo J., Iaia F.M., & Krustrup P.(2008). The Yo-Yo intermittent recovery test: a useful tool for evaluation of physical performance in intermittent sports. *Sports Med*. 38:37–51. https://doi.org/10.2165/00007256-200838010-00004.

Bangsbo, J. (1994). Energy demands in competitive football. *Journal of sports sciences,* 12(sup1), S5-S12. https://doi.org/10.1080/02640414.1994.12059272

Berthoin, S., Gerbeaux, M., Turpin, E., Guerrin, F., Lensel-Corbeil, G., & Vandendorpe, F. (1994). Comparison of two field tests to estimate maximum aerobic speed. *Journal of sports sciences,* 12(4), 355-362. https://doi.org/10.1080/02640419408732181

Billat, V. L., Andkoralsztein, J. P. (1996). Significance of the velocity at VO2max and time to exhaustion at this velocity. *Sports Medicine*, 22:90–108. https://doi.org/ 10.2165/00007256-199622020-00004

Blondel, C., Delsart, C., & Goldfarb, F. (2001). Electron spectrometry at the μeV level and the electron affinities of Si and F. Journal of Physics B: Atomic, *Molecular and Optical Physics*, 34(9), L281. https://doi.org/ 10.1088/0953-4075/34/9/101

Boone, J., Vaeyens, R., Steyaert, A., Bossche, L. V., & Bourgois, J. (2012). Physical fitness of elite Belgian football players by player position. *The Journal of Strength & Conditioning Research*, 26(8), 2051-2057. https://doi.org/10.1519/JSC.0b013e318239f84f

Buchheit, M. (2008). The 30-15 intermittent fitness test: accuracy for individualizing interval training of young intermittent sport players. T*he Journal of Strength & Conditioning Research*, 22(2), 365- 374. https://doi.org/ 10.1519/JSC.0b013e3181635b2e

Bundle, M. W., & Weyand, P. G. (2012). Sprint exercise performance: does metabolic power matter?. *Exercise and sport sciences reviews*, 40(3), 174-182. https://doi.org/10.1097/JES.0b013e318258e1c1

Di Salvo, V., Baron, R., Tschan, H., Montero, F. C., Bachl, N., & Pigozzi, F. (2007). Performance characteristics according to playing position in elite football. *International journal of sports medicine*, 28(03), 222-227. https://doi.org/ 10.1055/s-2006-924294

Dupont, G., Akakpo, K., & Berthoin, S. (2004). The effect of in-season, high-intensity interval training in football players. The Journal of Strength & Conditioning Research, 18(3), 584-589.

Gil, S. M., Gil, J., Ruiz, F., Irazusta, A., & Irazusta, J. (2007). Physiological and anthropometric characteristics of young football players according to their playing position: relevance for the selection process. *The Journal of Strength & Conditioning Research*, 21(2), 438-445.

Cirasun, V.& Baydemir, B. (2023). The Relationship of Dorsiflexion Angle with Leg Volume, Balance, Speed, and Change of Direction Performance in Amateur Soccer Players.Journal of Education and Recreation Patterns (JERP), 4(1), 99-115. https://doi.org/10.53016/jerp.v4i1.83

Gonzalez-Badillo, J. J., Pareja-Blanco, F., Rodríguez-Rosell, D., Abad-Herencia, J. L., del Ojo-López, J. J., & Sánchez-Medina, L. (2015). Effects of velocity-based resistance training on young football players of different ages. *The Journal of Strength & Conditioning Research*, 29(5), 1329-1338. https://doi.org/ 10.1519/JSC.0000000000000764

Heaney, N., Williams, M., Lorenzen, C., & Kemp, J. (2009). Comparison of a YOYO IR1 test and a VO2max test as a determination of training speeds and evaluation of aerobic power. Australian Strength and Conditioning Association International Conference on Applied Strength and Conditioning, Australia. Poster Presentation 7;18:S1.

Helgerud, J., Engen, L. C., Wisloff, U., & Hoff, J. (2001). Aerobic endurance training improves football performance. *Medicine and science in sports and exercise*, 33(11), 1925-1931. https://doi.org/0195-9131/01/3311-1925

Helgerud, J., Høydal, K., Wang, E., Karlsen, T., Berg, P., Bjerkaas, M., ... & Hoff, J. (2007). Aerobic high-intensity intervals improve VO_2max more than moderate training. *Medicine & science in sports & exercise*, 39(4), 665-671. https://doi.org/0195-9131/01/3311-1925

İnal, A. N. (2004). Futbol'da eğitim öğretim. *Nobel Yayın Dağıtım*, 2, 15.

Katis, A. & Kellis, E. (2009). Effects Of Small-Sided Games On Physical Conditioning And Performance In Young Football Players. *Journal Of Sports Science And Medicine*. 8, 374- 380.

Kayhan, R. F., Çıkıkçı, A., & Gülez, O. (2021). Genç Futbolcularda Reaktif Kuvvet İndeksinin Bazı Parametreler Üzerine Etkisi. Uluslararası Spor, *Egzersiz & Antrenman Bilimi Dergisi*, 7(1), 31-39. https://doi.org/ 10.18826/useeabd.835723

Krustrup, P., Mohr, M., Amstrup, T., Rysgaard, T., Johansen, J., Steensberg, A., ... & Bangsbo, J. (2003). The yo-yo intermittent recovery test: physiological response, reliability, and validity. *Medicine & Science in Sports & Exercise*, 35(4), 697-705. https://doi.org/10.1249/01.MSS.0000058441.94520.32

Malina, R. M., Cumming, S. P., Kontos, A. P., Eisenmann, J. C., Ribeiro, B., & Aroso, J. (2005). Maturity-associated variation in sport-specific skills of youth football players aged 13–15 years. *Journal of sports sciences*, 23(5), 515-522. https://doi.org/10.1080/02640410410001729928

Mendez-Villanueva, A., Buchheit, M., Kuitunen, S., Poon, T. K., Simpson, B., & Peltola, E. (2010). Is the relationship between sprinting and maximal aerobic speeds in young football players affected by maturation?. *Pediatric exercise science*, 22(4), 497-510. https://doi.org/10.1123/pes.22.4.497

Mendez-Villanueva, A., Buchheit, M., Simpson, B., & Bourdon, P. C. (2013). Match play intensity distribution in youth football. *International journal of sports medicine*, 34(02), 101-110. https://doi.org/10.1055/s-0032-1306323

Metaxas, T., Sendelides, T., Koutlianos, N., & Mandroukas, K. (2006). Seasonal variation of aerobic performance in football players according to positional role. *Journal of sports medicine and physical fitness*, 46(4), 520.

Mohr, M., Krustrup, P., & Bangsbo, J. (2003). Match performance of high standart football players with special reference to development of fatigue. J*ournal of Sports Sciences*, 21(7), 519-528. https://doi.org/10.1080/0264041031000071182

Ortiz, J. G., Teixeira, A. S., Mohr, P. A., Salvador, P. C. D. N., Cetolin, T., Guglielmo, L. G. A., & de Lucas, R. D. (2018). The anaerobic speed reserve of high-level football players: a comparison based on the running speed profile among and within playing positions. *Human Movement Special Issues*, 2018(5), 65-72.https://doi.org/10.5114/hm.2018.81287

Rampinini, E., Bishop, D., Marcora, S. M., Bravo, D. F., Sassi, R., & Impellizzeri, F. M. (2007). Validity of simple field tests as indicators of match-related physical performance in top-level professional football players. *International journal of sports medicine*, 28(03), 228-235. https://doi.org/ 10.1055/s-2006-924340.

Reilly, T., Bangsbo, J., & Franks, A. (2000). Anthropometric and physiological predispositions for elite football. *Journal of Sports Sciences*, 18, 669- 683. https://doi.org/10.1080/02640410050120050.

Rowan, A., Atkins, S., & Comfort, P. (2019). A comparison of maximal aerobic speed and maximal sprint speed in elite youth football players. *Prof. Strength Cond. J*, 53, 24-29.

Söyler M. (2020). *Bölgesel Amatör Lig Futbolcularının Mevkilerine Göre Bazı Fiziksel ve Teknik Parametrelerinin Sezonsal Değişimlerinin İncelenmesi.* Yüksek Lisans Tezi. Gazi Üniversitesi. Ankara.

Sporis, G., Jukic, I., Ostojic, S. M., & Milanovic, D. (2009). Fitness profiling in football: physical and physiologic characteristics of elite players. *The Journal of Strength & Conditioning Research*, 23(7), 1947-1953. https://doi.org/10.1519/JSC.0b013e3181b3e141

Stolen, T., Chamari, K., Castagna, C., & Wisloff, U. (2005). Futbol fizyolojisi: Bir güncelleme. Sports Med 35: 501–536, https://doi.org/10.2165 / 00007256-200535060-00004

Teixeira, A. S., da Silva, J. F., Carminatti, L. J., Dittrich, N., Castagna, C., & Guglielmo, L. G. (2014). Reliability and validity of the Carminatti's test for aerobic fitness in youth football players. *The Journal of Strength & Conditioning Research*, 28(11), 3264-3273. https://doi.org/10.1519/JSC.0000000000000534

Tomlin, D. L., & Wenger, H. A. (2001). The relationship between aerobic fitness and recovery from high intensity intermittent exercise. *Sports Medicine*, 31(1), 1-11. https://doi.org/10.2165/00007256-200131010-00001

Tonnessen, E., Hem, E., Leirstein, S., Haugen, T., & Seiler, S. (2013). Maximal aerobic power characteristics of male professional football players, 1989–2012. *International journal of sports physiology and performance*, 8(3), 323-329. https://doi.org/10.1123/ijspp.8.3.323

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