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The Evaluation of Anaerobic Power Values and Sprint Performances of Football Players Playing in Different Positions

M. Yalcin Tasmektepligil[1], Oguzhan Arslan[2] and Egemen Ermis[3]

[1]Ondokuz Mayis University, Yasar Dogu Faculty of Sports Sciences, Samsun, Turkey
Telephone: 90-362-3121919, E-mail: myalcint@gmail.com
[2]Bedriye Halil Naci Mihcioglu Secondary School, Ankara, Turkey
Telephone: 90-505-7037687, E-mail: oguzhanarslan140220001@hotmail.com
[3]Ondokuz Mayis University, Yasar Dogu Faculty of Sports Sciences, Samsun, Turkey
Telephone: 90-362-3121919, E-mail: egemenermis55@gmail.com

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ABSTRACT The purpose of this paper is to compare the anaerobic power values and sprint performances of football players playing in different positions and to evaluate the association between these. A total of 40 male football players participated in the study voluntarily. For this aim, 20, 30 and 45.72 m sprint tests, vertical jump and Wingate anaerobic power tests were performed on the football players. The results of this study showed that there were significant differences for all the sprint tests. Moreover, statistically significant positive correlation was found between all the sprint tests, while statistically significant negative correlation was found between sprint and vertical jump tests. In addition, a negative correlation was found between 30 m sprint and peak power values. Also, the negative correlation found between the sprint and vertical jump values brings to mind that vertical jump trainings can be used to improve the ability of speed.

INTRODUCTION

In football, success and increasing player performance is associated with finding players suitable for the game and giving training programs specific to these players. Today's football is a team sport that requires sportive performance such as high level endurance, power, flexibility, speed, agility and strategy and control (Bloomfield et al. 1994). Within this context, high level aerobic endurance and anaerobic power are important in football players (Reilly et al. 2000). Thus, football can be described as a sport which frequently has strong anaerobic cycles but which dominantly has aerobic energy system. However, although aerobic metabolism is used predominantly in football, anaerobic metabolism is the determinant. In short, football is an endurance sport that includes intense exercise periods with low level activities, spread within a period of 90 minutes (Reilly 1996). Within this context, it can be seen that both aerobic and anaerobic performance are a must in the game of football and this important combination is known to be specific to football (Boone et al. 2012). Indeed, blood lactate levels can vary between 2 and 10 mmol/L during a football game (Agnevik 1970; Ekblom 1986; Krustrup et al. 2006) and today's football requires a high level of aerobic endurance, as well as enough technique and tactical skills (Boone et al. 2012). On the other hand, different responsibilities of players in terms of their positions in the game field can cause them to become different in terms of physical and physiological characteristics and this situation causes variability in total energy use (Cerrah et al. 2011).

Football, as a representative of sports games, requires an intermittent performance with intertwining the aerobic and anaerobic exercises (Surwase et al. 2015). Game analyses report that elite athletes run between 9.500 and 12.000 meters during 90 minutes (Whitehead 1975; Bangsbo et al. 1991) and that 40 percent of this distance is made up of high intensity runs (≥14 km/h) (Rampinini et al. 2009). Other analyses report that when compared with backs and stoppers, midfielders cover between 5 to 15 percent more distance and strikers and backs make between 20-40 percent more sprints than midfielders and stoppers (Bangsbo et al. 1991; Mohr et al. 2003; Rampinini 2007; Dellal et al. 2010). When considered from this point of view, anaerobic power and sprint performances become important. What is more,

Address for correspondence:
Dr. Egemen Ermis
Ondokuz Mayis University
Yasar Dogu Faculty of Sports Sciences
Samsun, Turkey
Telephone: 0530 320 50 55
Fax: +90362 4576924
E-mail: egemenermis55@gmail.com

although low intensity activities are frequent in football; the quality of short but high intensity activities such as sprint, changing direction fast, fast speeding-up and slowing-down that require anaerobic power and capacity determine the result of the game (Bangsbo 2007). Thus, in order to carry out performances such as running, hitting and jumping in the best way possible, football players should have strong aerobic and anaerobic components made up of a combination of strength, speed and power (Bangsbo and Michalsic 2002). All this information bring forward the approach that requires specifying physical and physiological needs based on positions and planning training programs according to these elements.

Purpose of the Study

Within this framework, the purpose of the present study is to determine the sprint, vertical jump and anaerobic power values of amateur football players and to find out whether these performances cause a difference between positions.

MATERIAL AND METHODS

Research Group

A total of 40 male football players who were playing football in Samsunspor (n=20) and Kadiköyspor (n=20) football clubs and the mean of whose ages was 18.5±2.26 participated in the study voluntarily. Before the research, the participants were informed about the purpose of the study. Within the scope of the study, the football players were first grouped in four according to their positions as goalkeepers (n=5), defenders (n=10), midfielders (n=17) and forwards (n=8) and their ages, years in sport, weights and heights were found. Later, 20 m, 30 m and 45.72 m (50 yard) sprint tests, vertical jump and Wingate anaerobic power tests were performed on the football players. All the tests and measurements were made in Ondokuz Mayis University Faculty of Sport Sciences laboratory and athleticism track. At the time of the tests (July), there was no wind, the average temperature was 25.5 ^{0}C and the rate of humidity was 75.6 percent.

Data Collection

Heights and weights of each football player who participated in the study were measured and recorded respectively. The participants were taken in sprint tests, vertical jump tests and Wingate anaerobic power test respectively on four different days, and at the same period of time. Care was taken to perform all the tests under the same temperature and humidity conditions.

Height and Weight Measurements

Heights were measured with football players in upright position, with bare feet and soles touching with an accuracy of 0.1cm, while the weights were measured with 0.01 kg accurate Seca body mass and height meter again with bare feet and a short and t-shirt on.

20 m and 30 m Sprints

The start and finish points of the test were set on the athleticism track (20 and 30 meters). Two “Prosport tmr esc 2100 sb electronic chronograph” make photocell –one to the starting point and the other to the finishing point. These were pc-compatible with a feature of transferring wireless data and placed with an accuracy of 1/1000. Photocells had three ports each with two laser reflexive eyes. After two repetitive sprints with a recovery, the best value was recorded in seconds. Starts were done when the athletes felt ready and in high start position.

50 Yard (45.73 Meters) Sprint Test

A sprint distance of 45.73 meters (50 Yards) and a pre-sprint distance of 13.72 meters (15 Yards) were predetermined and signed. For the determination of the athletes’ anaerobic sprint times, Prosport tmr esc 2100 sb electronic chronograph” make photocell which was pc-compatible with a feature of transferring wireless data and 1/1000 accuracy. These had three ports each placed with two laser reflexive eyes. The athletes were made two run the same sprint distance twice with a recovery of three minutes and their best degrees were recorded in seconds. The participants were motivated verbally during the sprint. Starts were done when the athletes felt ready and in high start position without any command.

Vertical Jump Test (VJ)

Before the Vertical Jump Test, all the participants were made to perform a warming up program which contained very immediate and very short sprints. The athletes who were actively made to rest were taken in the test. Vertical jump test was monitored with the Takei Kiki Kogyo vertical jump meter (T.K.K.5406) which recorded the jump height. The participants performed 2 trials of each test with a recovery of 15 seconds between 2 successive jumps, and the best one was recorded.

Wingate Anaerobic Power Test (WAnT)

For the Wingate Anaerobic Power Test, Monark 824 model bicycle ergometer which was connected to a modified computer and that worked with compatible software was used. Before the tests, seat and handlebar adjustments were made for each athlete. For each athlete, the load that would be applied as outer pressure during the test was calculated as 75gr/kg for Monark ergometers.

A five-minute long warming up protocol that included two or three sprints, of 4-8 seconds long with a pedal speed of 60-70 spin/minute with the 20 percent of their test load calculated in bicycle ergometer. Passive rest was given for 3-5 minutes following the warm-up (Inbar et al. 1996). The athletes were later asked to pedal the fastest way possible without decreasing the speed within a period of 30 seconds during the test. When it was made sure that the maximum speed was reached (approximately 3-4 seconds later), the load which was figured as 75gr/kg beforehand was dropped and the test measurement was started to be recorded automatically. The athletes were encouraged verbally during the test. In the recovery period, the athletes were made to return to normal by pedalling for 2-3 minutes against moderate resistance. The five-seconds that gave the maximum power output of the test was set as "peak power", average power output during the 30-minute long test was set as "average power" (AP) and the lowest five-seconds long power output recorded during the test was set as "minimum power". In addition, "fatigue index" (FI) was calculated with a mathematical correlation between peak power (PP) and minimum power (MP) (FI=PP – MP / PP x 100) (Aziz and Chuan 2004).

Data Analysis

The data was analyzed by using Statistical Package for Social Science (SPSS) 15.0 statistics program. Descriptive analyses were made for all groups. Kolmogorov-Smirnov test was used to test how normally the parameters tested were distributed and a decision was made concerning the parametric or nonparametric method, to be used in the analysis of differences between groups. One-Way Anova method was used in determining the difference between groups and Tukey multiple comparison was used to find out which group showed difference according to the results obtained. Pearson correlation analysis was used to analyze the association between the variables. The values of $p<0.05$ were accepted as the level of significance in statistical analyses.

RESULTS

While no statistically significant difference was found between the football players' ages, years in sport and heights in terms of their positions ($p>0.05$), a statistically significant difference was found in their weights ($p<0.05$). According to these results, the highest body weight was found in goalkeepers whereas forwards and midfielders were found to have lower body weights (Table 1).

When the players' vertical jump results were compared in terms of their positions, it was found that defenders had the highest levels of jump. However, no statistically significant difference was found ($p>0.05$). On the other hand, in the 50 yard anaerobic sprint test between positions, the average values of goalkeepers were found to be better than defenders and midfielders and this result was found to be statistically significant ($p<0.05$). Here, the sprint time of defenders were found to be lowest, while the values of midfielders were found to be close to the values of defenders. The players with the lowest sprint speed were goalkeepers (Table 2).

A statistically significant difference was found when the players' 20 and 30 m sprint values were compared in terms of their positions ($p<0.05$). The players who ran 20 and 30 m fastest were defenders, while those who ran the slowest were goalkeepers (Table 3).

When the Wingate anaerobic test parameters "peak power" and "average power" values were analyzed in terms of the players' positions, it was found that goalkeepers had the highest values while midfielders had the lowest. However, these values did not present a statistically significant difference ($p>0.05$) (Table 4).

Table 1: Distribution of age, years in sport, body height and body weight in terms of positions

Variables		*Goalkeeper (n=5)*	*Defense (n=10)*	*Midfield (n=17)*	*Forward (n=8)*	*Grand average (N=40)*	*P*
Age	Mean	18.4[a]	18.9[a]	18.35[a]	18.37[a]	18.50	0.942
	Sd	±2.70	±2.13	±2.29	±2.50	±2.26	
	Min.	15	15	15	15	15	
	Max.	22	22	23	23	23	
Year in Sport	Mean	7.80[a]	7.40[a]	7.52[a]	6.50[a]	7.32	0.781
	Sd	±2.59	±2.63	±2.79	±2.07	±2.53	
	Min.	5	5	1	4	1	
	Max.	10	13	13	10	13	
Body Height (cm)	Mean	181.80[a]	177.9[a]	176.29[a]	180.87[a]	178.3	0.125
	Sd	±5.93	±6.13	±5.09	±5.14	±5.70	
	Min.	172	166	162	173	162	
	Max.	187	189	184	188	189	
Body Weight (kg)	Mean	81[a]	72.60[ab]	71.82[b]	70.38[b]	72.88	0.054
	Sd	±11.11	±8.08	±5.43	±4.78	±7.36	
	Min.	65	58	58	61	58	
	Max.	96	83	83	77	96	

[*]Statistical differences were specified with letters on average values. Different letters show the difference between groups.

Table 2: Distribution of vertical jump and 50 yard anaerobic sprint test results in terms of positions

Tests		*Goalkeeper (n=5)*	*Defense (n=10)*	*Midfield (n=17)*	*Forward (n=8)*	*Grand average (N=40)*	*P*
Vertical Jump (cm)	Mean	50.16[a]	53.76[a]	51.08[a]	52.67[a]	51.96	0.102
	Sd	±2.36	±4.43	±2.30	±3.15	±3.28	
	Min.	48.4	48.7	48.4	47.5	47.5	
	Max.	54.3	59.6	56.1	56.4	59.6	
50 Yard (s)	Mean	50.16[a]	53.76[a]	51.08[a]	52.67[a]	51.96	0.010
	Sd	±2.36	±4.43	±2.30	±3.15	±3.28	
	Min.	48.4	48.7	48.4	47.5	47.5	
	Max.	54.3	59.6	56.1	56.4	59.6	

Table 3: Distribution of players' 20 m and 30 m sprint values in terms of their positions

Tests		*Goalkeeper (n=5)*	*Defense (n=10)*	*Midfield (n=17)*	*Forward (n=8)*	*Grand average (N=40)*	*P*
20 m (sn)	Mean	3.16[a]	2.97[b]	3.03[ab]	3.02[ab]	3.03	0.130
	Sd	±0.06	±0.18	±0.15	±0.12	±0.15	
	Min.	3.07	2.65	2.72	2.87	2.65	
	Max.	3.22	3.19	3.27	3.25	3.27	
30 m (sn)	Mean	4.30[a]	4.01[b]	4.13[ab]	4.14[ab]	4.15	0.052
	Sd	±0.07	±0.14	±0.12	±0.16	±0.14	
	Min.	4.18	3.91	3.91	3.95	3.91	
	Max.	4.37	4.37	4.32	4.42	4.42	

When the Wingate anaerobic test parameters "minimum power" and "fatigue index" values were analyzed in terms of the players' positions, no statistically significant difference was seen in both values ($p>0.05$); as for MP, defenders had the highest values while forwards had the lowest and as for FI, defenders had the lowest values while goalkeepers had the highest values (Table 5).

Statistically significant positive associations were found between sprints (20 m - 30 m; 20 m-50 yard; 30 m - 50 yard) (82%; 57%; 75%) while neg-

Table 4: Distribution of Wingate Anaerobic Power Test Parameters Peak power and average power values in terms of positions

Wingate Test Parameters		*Goalkeeper (n=5)*	*Defense (n=10)*	*Midfield (n=17)*	*Forward (n=8)*	*Grand average (N=40)*	*P*
Peak Power(W)	Mean	877.04^a	804.85^a	789.47^a	848.88^a	816.14	0.489
	Sd	±163.17	±96.17	±133.27	±128.55	±127.10	
	Min.	586.64	657.16	570.06	666.91	570.06	
	Max.	968.09	952.94	1114.19	1007	1114.19	
Average Power (W)	Mean	675.55^a	641.04^a	613.58^a	628.02^a	631.08	0.519
	Sd	±132.54	±86.98	±72.50	±65.45	±82.99	
	Min.	439.13	476.61	480.51	496.58	439.13	
	Max.	748.13	762.25	756.28	705.24	762.25	

Table 5: Distribution of Wingate Anaerobic Power Test Parameters Minimum Power and Fatigue Index values in terms of positions

Wingate Test Parameters		*Goalkeeper*	*Defense*	*Midfield*	*Forward*	*Grand average*	*P*
Minimum Power (W)	Mean	451.28^a	511.75^a	459.50^a	446.37^a	468.90	0.216
	Sd	±103.95	±96.22	±58.01	±47.05	±75.37	
	Min.	270.13	346.79	347.47	346.68	270.13	
	Max.	534.52	617.38	569.60	478.98	617.38	
Fatigue Index (%)	Mean	48.94^a	36.06^a	39.99^a	45.44^a	41.22	0.078
	Sd	±3.83	±11.46	±11.05	±7.29	±10.50	
	Min.	43.33	21.51	18.4	32.25	18.4	
	Max.	53.95	57.12	60.03	52.89	60.03	

ative associations were found between 20 m and 30 m sprints and vertical jump (-57%, -51%, respectively). On the other hand, a negative association was found between 30 m sprint and Wingate anaerobic power test parameter peak power (PP). In addition, statistically significant associations were found between Wingate anaerobic power test parameters (PP- AP); PP-FI; AP- MP)

Table 6: Correlation analyses between the results of Wingate Anaerobic Power and Vertical Jump Test and 20 m, 30 m and 50 Yard sprints

Tests and correlations		*20 m*	*30 m*	*50 Yard*	*VJ*	*PP*	*AP*	*MP*	*Fatigue index*
20 m	Pearson Corr.		**0.82****	**0.57****	**-0.57****	-0.28	-.13	-0.07	-0.10
	P		**<0.01**	**<0.01**	**<0.01**	0.08	0.42	0.66	0.51
30 m	Pearson Corr.			**0.75****	**-0.51****	**-0.33***	-0.14	-0.20	-0.01
	P			**<0.01**	**<0.01**	**0.04**	0.37	0.21	0.94
50 Yard.	Pearson Corr.				-0.27	-0.17	-0.20	-0.29	0.17
	P				0.09	0.30	0.21	0.07	0.30
Vertical Jump (VJ)	Pearson Corr.					0.29	0.17	0.15	0.06
	P					0.07	0.30	0.35	0.72
Peak Power (PP)	Pearson Corr.						**0.78****	0.31	**0.49****
	P						**<0.01**	0.05	**<0.01**
Average Power (AP)	Pearson Corr.							**0.68****	0.03
	P							**<0.01**	0.83
Min. Power (MP)	Pearson Corr.								**-0.64****
	P								**<0.01**

$^{**}p<0.01$, $^{*}p<0.05$

(78%, 49%, 68%) while a negative association was found between MP-FI (Table 6).

DISCUSSION

When the football players' ages, years in sport and average heights were analyzed, no statistically significant difference was found between positions ($p>0.05$). The fact that the difference between the variables of age and years in sport was meaningless, brings to mind that the definition and analysis of football players' physical, physiological and psychomotor characteristics in terms of positions can be made independent of these two variables. Body height and mass are the most obvious and observable physical qualifications, while choosing football players. Body mass and too much body fat tissue may affect physical performance negatively. Players with low body fat level show better performance when compared with those with high fat levels. In this study, a significant difference was found in favour of goalkeepers between the body mass averages of goalkeepers, forwards and midfielders ($p<0.05$). The fact that goalkeepers are not so much involved in aerobic trainings can be shown as the reason of this. Goalkeepers have high values of body mass index (BMI) but low aerobic capacity. Due to their positions, they need more anaerobic power during the game and they are good at explosive power (Boone et al. 2007).

According to the results of this study, although no statistically significant difference was found in vertical jump parameter in terms of positions ($p>0.05$), defenders were found to have the highest jump values, followed by forwards. Similarly, Ostojic (2000) reported that there was no statistically significant difference in terms of positions as a result of the vertical jump analyses of 16 football players playing in the Serbian Football League. The fact that stoppers rise for high balls frequently during a game has a positive effect on the high averages of defenders. High jumping averages of defenders and offenders may be because they are frequently exposed to jumping, as well as due to their individual skills. In their study, Gil et al. (2007) found that defenders and offenders were better than midfielders in squat jump. One of the desired specialties of defenders and offenders is their control of air balls. Stoppers generally make shorter distances (Mohr et al. 2003; Rampinini et al. 2007) and they need explosive power to rise for a high ball. Stopper position is also a position that has low VO_2max level, like the position of goalkeeper. They also have lower sprint and agility features when compared with other positions (Al-Hazza et al. 2001; Sporis et al. 2009). Midfielders and backs are similar in terms of physiological features and they make longer distances when compared with stoppers.

When the 50 Yard, 20 m and 30 m sprint characteristics were analyzed in this study, a statistically significant difference was found ($p<0.05$). According to the results of 50 Yard test, defenders were found to have the best values, while midfielders were found to have values close to defenders. Again in this test, goalkeepers were found to be the slowest. In sprint tests, the players who ran 20 m and 30 m best were the defenders, while the players who ran the slowest were the goalkeepers. In their study, Silvestre et al. (2006) found that goalkeepers were slower when compared with other positions. In another study conducted on the elite athletes of South America, forwards were reported to perform better when compared with defenders in terms of speed (Rienzi et al. 2000). Similarly, Gil et al. (2007) stated that young forwards were faster than midfielders and defenders. On the other hand, Mohr et al. (2003) found that the players in the center of defence ran more intensely in shorter distances when compared with players of other positions. In addition, they stated that forwards ran with less speed when compared with midfielders and defenders.

The results of this study showed that defenders were faster. This result can be explained by the growing importance of defence as well as offence. In addition, while defenders and midfielders need longer sprints in the game due to the width of the game field, forwards can need shorter sprints to strike a goal. Goalkeepers having the lowest sprint values of all the positions in this study, can be associated with the negative effect of body mass on speed and agility. Thus, it is an expected result for goalkeepers with more body mass to have less sprint values. In addition, goalkeepers may not need top levels of sprints due to their positions when compared with other players.

In this study, when Wingate Anaerobic Power Test values (PP, AP, MP FI) were compared between positions, no statistically significant difference was found ($p>0.05$). The highest PP value was found to be in goalkeepers. The fact that goalkeepers are continually trained with dynamic moves may have supported higher explosive powers, as a result of a drop in the myotatic reflex stimulus threshold. In their study they analyzed the physiological profiles of 120 football players based on their positions. They did not find a significant difference between defenders, forwards and midfielders in both absolute and relative power values. In football games, short term and high intensity moves such as sprints, changing direction, sudden hits, headers and jumps are thought to increase anaerobic capacity. In fact, all football players perform these basic activities in both trainings and competitions. Thus, the result that there was no statistically significant difference in Wingate test values in terms of positions can be explained by this reason. The differences between studies may be resulting from problems such as experimental procedures, also the time of the season measurements were made.

According to the results of this study, a significant correlation was found between 20 m and 30 m sprint values, vertical jump test and 50 yard sprint and between 30 m sprint and PP value; a Wingate Anaerobic Power Test parameter. In their study, Tharp et al. (1985) could not find a statistically significant association between sprint time and Wingate test performance. Aziz and Chuan (2004) reported a statistically significant association between Wingate test and repeated sprint test.

CONCLUSION

As a conclusion, the association found in the study between speed values and vertical jump brings to mind the idea that vertical jump training can be used to improve the speed. In addition, the significant association between PP and 30 m sprint value can be explained with the fact that the peak power in Wingate test is reached within the first five-seconds or before five-seconds and that 30 m sprint values are very close to 5 seconds.

RECOMMENDATIONS

Football is a sport that uses combination of both aerobic and anaerobic capacity. Players have different responsibilities in the game field depending on their positions. These differences require different physical and physiological characteristics. Thus, in order to be successful, physical and physiological needs should be specified based on the positions of the players and training programs should be planned according to these elements.

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