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Physical and Physiological Characteristics of an Elite Soccer Team's Players According to Playing Positions

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ABSTRACT The purpose of this study was to evaluate and compare the positional physical and physiological characteristics of the elite soccer players based on anthropometric measurements, blood lactate, 5-10-20 m sprint, SJ, CMJ, Yo-Yo IR1 tests. For this purpose, measurements were taken from 29 professional soccer players (age: 23.38±3.42) during the competitive season of 2013/14. The ANOVA one way with Tukey's post hoc test was used to determine the differences of the players at different playing positions. Wingers were the youngest, shortest, lightest, and had less BMI and fat percentange than the players at the other playing positions. The wingers were the fastest and midfielders were the slowest group in the team in 5m and 10m. Forwards showed the best performance at SJ and CMJ in the team. The midfielders reached the highest and goalkeepers reached the lowest velocity at 2, 2.5, 3 and 4 mmol blood lactate levels. The wingers reached the best and the goalkeepers were/had the lowest distance at Yo-Yo IR1. Full backs reached a better distance than the midfielders, forwards and center backs respectively. The results clearly indicated that there are physical and physiological differences according to the playing position of soccer players.

INTRODUCTION

Soccer is primarily an aerobic-based sport but, to get result mostly, explosive activities are needed. Duration and intensity of these activities can be varied. Moreover, technical, tactical, physical, mental and physiological qualifications are needed to be succesfull as a soccer player so players must have high endurance capacity to give the best performance at these qualifications in the present soccer. In addition, soccer players have to be good at physical activities that require a high level of conditioning with repeated high intensity efforts (Boone et al. 2012). To determine the capacity of repeated high intensity efforts, specifically designed Yo-yo tests (IR1 and IR2) can be used because these tests aim to determine the ability of repeated high intensity efforts of players (Thomas et al. 2005).

Also, sprint tests (5-10-20 m) and jump tests (SJ and CMJ) can be used to evaluate the anaerobic capacity of players. The time at 5m can be used to determine the reaction time and explosiveness, and the time difference between the 5m and 10m can be used to determine the accelaration time, and the difference between the time at 5m and 20m can be used to determine the measure of speed. SJ and CMJ can be used to determine the anaerobic power of the players

Sport-specific performance capacity is considered reaching of lactic acid in the blood to 4 mmol. L^{-1} speed reached (Jensen 2001). This level is called the anaerobic threshold levels and it is important in determining the physical level and optimal training load of the players (Sporis et al. 2009). To determine anaerobic threshold level, blood lactate test (Incremental treadmill test) can be widely used to determine the aerobic capacity of players.

Scientific studies show that aerobic capacity of soccer players affected from the players' anthropometric values is developed rapidly as a result of development of scientific studies (Castagna et al. 2010). Also, physical and physiological capacities are affected by the playing position of players. Reilly et al. (2005) stated that the physiological demands of soccer were affected by playing positions and competition levels of players.

The aim of this study was to evaluate and compare the positional physical and physiological characteristics of players from an elite soccer team based on anthropometric measurements, blood lactate, 5-10-20 m sprint, SJ, CMJ, Yo-Yo IR1 tests.

METHODOLOGY

Subjects

Subjects consisted of 29 professional soccer players (age: 23.38±3.42 years, range 18–30

years; height 179.72±6.32, range 1.65-1.92 cm; weight 75.23±8.85, range 58.30-105.40 kg; BMI 23.33±2.11, range 20-29; skinfold body fat 8.86±2.24, range 6.35-15.20 and tanita body fat 8.74±2.17, range 5.00-13.70) from the Turkish Super League Team joining the UEFA league.

The subjects were divided into six groups according to their playing positions on the field: goalkeepers (n=3), center backs (n=4), full backs (n=4), midfielders (n=7), wingers (n=4) and strikers (n=7).

Full information about nature, demands and risk of study were explained to the all subjects before the test and each subject signed an informed consent document. First of all, all players joined the antropometric measurements (height, weight, fat) that used Seca (Seca Measuring Systems, Benson Avenue, Chino, USA), Tanita BF 350 (Tanita Cooperation, Tokyo, Japan), Holtain skinfold caliper (Holtain LTD., UK) before breakfast in the morning. Secondly, anaerobic capacity tests (Sprint tests 5-10-20 m, SJ and CMJ) were completed by using Powertimer (Newtest, OY, Koulukatu, Oulu, Finland). Sprint tests were applied on natural grass in the soccer field and jump tests were completed in the indoor sports hall. Thirdly, lactic asid test was completed on treadmill (Run Now 700 Unity, Technogym, Cesana, Italy) by using the Lactate Analyser (YSI 2300 STAT, Yellow Springs, Ohio, USA) in the indoor sports hall. And finally, aerobic capacity (Yo-Yo IR1) test was completed on natural grass in the soccer field.

Protocol

The tests were implemented in the middle of the season at the national team break and all of the measurements were carried out every other day. Physical measurements were carried out between the hours 16:00-20:00 of the day according to the recommendation of Reilly T et al. (2005). All of the measurements except for field tests were carried out in fitness center at 21 C - 24 C degree. Heart rate monitors and Professional training software (Polar S810 and Polar ProTrainer 5, Kempele, Finland) were used at training workouts, and subjects joined the all of the organizations together with a camp program so that resting time and nutrition program of subjects were organized, and they were prevented from taking extra things to increase their performance. The meal that was eaten by the subjects 3 hours 30 min before the performance measurements consisted of sixty percent carbonhydrate, twenty percent fat and twenty percent protein.

All of the measurements were carried out by the people who are expert in the field (doctor, physiotherapist, professional trainers graduated from physical education and sports departments).

Statistical Analysis

The statistical Package for Social Sciences SPSS 20 (SPSS Inc., Chicago, IL, USA) was used for statistical analysis. Descriptive statistics, mean values ± SD were calculated for age, height, weight, skinfold body fat percentage, tanita body fat percentage, SJ, CMJ, 5m, 10m and 20m times, HR levels (2, 2.5, 3 and 4 mmol) and running speeds (2, 2.5, 3 and 4 mmol), Yo-Yo IR1 running m and Yo-yo IR1 max HR for the six playing positions. The ANOVA one way with Tukey's post hoc test was used to compare the players at different playing positions. The level of significance was set at $p < 0.05$.

RESULTS

The overall mean age, height, weight, BMI, skinfold body fat and tanita body fat of subjects were 23.38±3.42, 179.72±6.32, 75.23±8.85, 23.33±2.11, 8.86±2.24 and 8.74±2.17 respectively.

Analysis of variance (ANOVA) was used to determine the differences between team positions. Goalkeepers were the tallest and the heaviest players in the team. They had also the biggest BMI and fat percentage in the team. The wingers were the youngest, shortest, lightest, and had less BMI and fat percentange than the players at the other playing positions. While the forwards were taller and heavier than the center backs, full backs, and midfielders; the center backs were taller and heavier than the full backs and midfielders. While the full backs had more BMI than the center backs and midfielders, the center backs had more BMI than the midfielders (Table 1).

The parameters of the sprint speed and jumping performance are presented in Table 2. The overall mean 5m, 10m, 20m, SJ and CMJ of subjects were 0.93±0.06, 1.72±0.66, 2.89±0,11, 41.77±4.23, and 44.73±4.42 respectively.

While the wingers were the fastest, and the midfielders were the slowest group in the team in

Table 1: Descriptive statistics (Mean ± SD of Age, Height, Mass, BMI, and Fat) of the six playing positions

	Overall	*Goalkeepers*	*Center backs*	*Full backs*	*Midfielders*	*Wingers*	*Forwards*
Age	23.38±3.42	22.67±2.52	24.5±3.11	21.75±2.97	23.71±4.31	22.50±3.70	24.14±3.72
Height	179.72±6.32	187.33±4.51	182±2.45	178,5±4.36	175.43±4.19	172.75±8.02	184.14±2.67
Mass	75.73±8.85	89.40±15.22	76.50±2.24	75.60±5.25	70.73±5.52	67.88±8.93	76.94±6.07
BMI	23.33±2.11	25.43±3.62	23.15±0.87	23.70±0.63	23.03±1.34	23.88±3.76	22.31±1.79
Skinfold body fat	8.86±2.24	12.13±3.80	7.96±2.43	8.85±1.77	9.32±1.86	7.63±0.92	8.20±1.60
Tanita body fat	8.74±2.17	11.07±3.50	8.48±2.29	8.56±1.44	8.37±1.98	8.05±2.56	8.77±1.97

Table 2. Descriptive statistics (Mean ± SD of 5m, 10m, 20m time, SJ, and CMJ) of the six playing positions

	Overall	*Goalkeepers*	*Center backs*	*Full backs*	*Midfielders*	*Wingers*	*Forwards*
5m	0.93±0.06	0.94±0.01	0.95±0.8	0.93±0.03	0.96±0.05	0.87±0.03	0.93±0.07
10m	1.72±0.66	1.74±0.05	1.75±0.06	1.70±0.04	1.76±0.04	1.64±0.05	1.73±0.08
20m	2.89±0.11	2.94±0.08	2.92±0.11	2.85±0.04	2.96±0.06	2.73±0.10	2.92±0.10
SJ	41.77±4.23	41.23±6.64	41.00±2.97	42.05±4.71	40.06±4.31	41.55±5.21	44.10±3.31
CMJ	44.73±4.42	44.00±5.07	44.12±2.69	43.52±5.24	44.44±5.40	45.70±6.61	45.81±3.23

5 and 10m; the forwards and full backs were faster than the center backs and goalkeepers for 5m. The full backs were faster than the forwards, goalkeepers and center backs in 10m. The wingers were the fastest and the goalkeepers were the slowest group in the team for 20m. The full backs were faster than the forward, center backs and goalkeepers. Forwards showed the best performance at SJ and CMJ in the team.

The parameters of the blood lactate HR and blood lactate threshold running velocities are presented in Table 3. The overall mean 2mmol HR, 2mmol mean running velocity, 2.5mmol HR, 2.5mmol mean running velocity, 3mmol HR, 3mmol mean running velocity, 4mmol HR and 4mmol mean running velocity of subjects were 159.52±9.94, 14.11±1.32, 166.17±7.58, 14.91±1.19, 170.31±7.70, 15.46±1.18, 176.28±7.46 and 16.32±1.15 respectively.

The midfielders reached the highest and the goalkeepers reached the lowest speed at 2, 2.5, 3 and 4mmol levels, and the goalkeepers' mean HRs were the lowest except for the 4mmol in the team and the full backs' mean HRs were the highest score in the team for 2, 2.5, 3 and 4mmol levels. The wingers reached the higher speed level than the full backs, center backs and forwards respectively at 2mmol level. The center backs

Table 3: Descriptive statistics (Mean ± SD of blood lactate HR and speed) of the six playing positions

	Overall	*Goalkeepers*	*Center backs*	*Full backs*	*Midfielders*	*Wingers*	*Forwards*
2 mmol HR	159.52± 9.94	154.33± 10.41	160.00± 7.12	163.00± 7.44	160.86± 8.78	157.75± 4.03	159.14±16.17
2 km speed	14.11± 1.32	12.53± 1.84	14.25± 1.08	14.30± 2.14	14.79± 1.11	14.46± 0.67	13.73± 0.77
2.5 km HR	166.17± 7.58	163.67± 6.35	167.00± 6.58	169.25± 5.74	165.57± 9.54	163.25± 4.50	167.29± 9.91
2.5 kms speed	14.91± 1.19	13.60± 1.47	15.27± 0.83	15.15± 2.02	15.46± 1.12	15.15± 0.57	14.44± 0.65
3 mmol HR	170.31± 7.70	168.00± 6.93	170.75± 6.85	173.75± 5.62	169.43±10.36	166.50± 5.26	172.14± 8.67
3 km speed	15.46± 1.18	14.10± 1.47	15.78± 0.75	15.73± 2.02	16.09± 1.00	15.66± 0.64	14.99± 0.69
4 mmol HR	176.28± 7.46	175.33± 5.78	176.00± 6.48	179.50± 3.70	174.43±10.61	172.00± 6.38	179.29± 7.32
4 km s speed	16.32± 1.15	15.03± 1.42	16.53± 0.67	16.58± 1.98	16.93± 0.91	16.50± 0.65	15.89± 0.83

Table 4: Descriptive statistics (Mean ± SD of Yo-yo IR1) of the six playing positions

	Overall	*Goalkeepers*	*Center backs*	*Full backs*	*Midfielders*	*Wingers*	*Forwards*
Yo-yo M	2330.34±236.98	1813.33±120.55	2195.00±161.97	2475.00± 138.92	2465.71± 162.77	2515.00± 19.149	2305.71± 56.23
Yo-yo HR	90.72± 4.37	190.00± 4.36	194.50± 2.38	188.75± 2.06	192.57± 3.41	192.75± 2.87	187.00± 5.161

reached the higher speed level than the full backs, wingers (they were at the same level) and forwards respectively at 2.5mmol level. At 3mmol level, the center backs reached the higher speed level than the full backs, wingers and forwards respectively. The full backs reached the higher speed level than the center backs, wingers and forwards respectively at 4mmol level.

The parameters of the Yo-Yo m and Yo-Yo HR are presented in Table 4. The overall mean Yo-Yo m, and Yo-Yo HR of subjects were 2330.34±236.98 and 190.72±4.37 bpm respectively. The wingers reached the best and the goalkeepers were/had the lowest distance. The full backs reached better distance than the midfielders, forwards and center backs respectively.

DISCUSSION

The aim of this study was to evaluate and compare the positional physical and physiological characteristics of the elite soccer players based on anthropometric measurements, blood lactate, 5-10-20 m sprint, SJ, CMJ, Yo-Yo IR1 tests.

The results of this study show that there are differences in the players' physical and physiological characteristics according to the playing positions on the field.

The full backs are the youngest, and the center backs are the oldest groups in the rest of the team. The midfielders are older than the goalkeepers and wingers. Sporis et al. (2009), who reached the similar results in their study, explained that the defenders were older and more experienced than both the midfielders and forwards. In this study, the mean height was 179.72±6.32, the same as the study of Muniroglu and Koz (2006), Metaxas et al. (2009) that explained the I. Division players' mean height as 1.79±0.06. And the goalkeepers were taller and heavier than the forwards, midfielders, wingers, center backs and full backs as in the study of Davis et al. (1992) and Sporis et al. (2009). The midfielders had the highest percentage of body fat in the team. There is no similarity between this study and the study of Sporis et al. (2009).

The wingers were the fastest and forwards were the second fastest group in the team. There is a similarity between this study and the study of Sporis et al. (2009). They stated that attackers were the fastest players in the team regarding sprint values for 5, 10 and 20 m. Also, there were similarites between the mean values of 10m in this study and some literature studies. Power et

al. (2005) explained the first team's 10 and 20 m sprint level as 1.74±0.07 and 3.01±0.10 respectively. And also, they explained the reserve team's 10 and 20 m sprint level as 1.73±0.06 and 2.98±0.09 respectively. Dunbar et al. (2005) explained the first team's 10 and 20 m sprint level as 1.73±0.08 and 2.98±0.10 respectively. And also, they explained the reserve team's 10 and 20 m sprint level as 1.71±0.06 and 2.97±0.09 respectively. The mean of 5, 10 and 20 m sprints emerged as 1.03±0.03 sec., 1.76±0.03 sec. and 3.01±0.05 sec. in the study of Brocherie et al. (2005).

The forwards showed the best performance at jumping tests in the team. And the mean values of subjects at SJ and CMJ were 41.77±4.23, and 44.73±4.42 respectively. There were studies having different and similar results in literature. Dunbar et al. (2005) explained the first team's vertical jump level as 57.37±7.9 and the reserve team's vertical jump level as 54.74±7.2. Castagna et al. (2006) determined the CMJ in their study as 46.87±4.38 cm for amateur soccer players. Sporis et al. (2009) reached the mean values of SJ and CMJ as 44.1±1.3 and 45.1±1.7 respectively in their study.

The midfielders showed the best and the goalkeepers showed the worst performance in all the speed of blood lactate level. Also, Guner et al. (2005) explained a similar result related to goalkeepers. There were similarities between the 2mmol and 3mmol lactate levels of the present study and Dunbar's (2012) study that measured the 2-3 mmol lactate level of English professional players through the playing year. Also, there are similarities between the lactate threshold heart rate level of the present study (176.28±7.46) and heart rate level (178.7±7.6) of the study of Meckel et al. (2009). Kunduracioglu et al. (2007) determined the velocity of soccer players at 4mmol L^{-1} as 15.9+/-0.9 km/h^{-1}. Michele et al. (2007) carried out a study to compare the physiological responses to a running test frequently used to assess the lactate thresholds in soccer players at off season. They reached 3mmol-L^{-1} La velocity as 13.4±1.2 and 4mmol-L^{-1} La velocity as 14.4±1.3. Silva et al. (2007) explained in their study that the mean velocity of lactate thresholds for preseason as 14.94±0.21 and as 15.44±0.42 km/h^{-1} as a result of 8-week training program. Also, they explained the positional diversity of players, such as for the goalkeeper: 14.70 to 15.43, for the defender: 14.98 to 15.57, for the midfielder: 15.13 to 16.41 and for the forward: 15.23 to 15.53 km/h^{-1}.

In the present study, the mean of Yo-yo IR1 running capacity was determined as 2330.34± 236.98 m and the heart rate was 190.72±4.37 bpm. The heart rate level showed a similarity with the study of Kulkarni et al. (2013) and Krustrup et al. (2006) with the heart rate level as 190±3 and 187±2 bpm respectively. In the present study, the wingers, full backs and midfielders showed a better running capacity than the forwards, centerbacks and goalkeepers respectively. Also, Bangsbo (1994), Reinzi et al. (2000), Reilly and Thomas (1976) explained in their studies the midfield players had the most running and the center backs had the least running capacity in the team. In addition, Bangsbo et al. (2008) explained in their study top-elite male soccer players' results as 2420m, 2190m for moderate-elite, 2030m for sub-elite players and 1810m for moderately trained soccer players. In the other study, Castagna et al. (2006) determined the Yo-Yo IR1 running distance in their study as 2138±364 m for amateur soccer players.

CONCLUSION

As a result of the present study, the researcher suggests that training of soccer players can be specialized according to the playing positions and demands of the playing positions because there are differences in the physical and physiological characteristics of soccer players according to the playing positions. For instance, the wingers and midfielders are remarkably different in sprint performances. Furthermore, they have a difference in aerobic capacity level. For example, the wingers and full backs are totally different from the center backs in the aerobic capacities. Finally, there are remarkable differences in the jumping capacity of the forwards and milfielders.

RECOMMENDATIONS

The results clearly indicated that there are physical and physiological differences according to the playing position of soccer players. Therefore, as planning the training program of soccer players, managers, coaches and trainers have to think about the positional differences and demands of the playing positions to be succesful in the professional soccer.

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