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An examination of some physiological and anthropometric characteristics of 10-12 year-old soccer players*

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Abstract
Research aim: This study aimed to examine some physiological and anthropometric characteristics of 10-12 years old soccer players. Method: 20 subjects aged 11.05±0.94, who have been actively participating in Konya Besiktas Football Schools for 3 years, voluntarily participated in the study. These subjects' body weight, height, body fat percentage, arm span, leg length, bust length, back strength, leg strength, hand grip strength, anaerobic power, maximum oxygen consumption and 30 m sprint test measurements were made. Averages and standard deviations of the measured and calculated values were analysed using the "IBM SPSS Statistics Version v.21" statistical program. Results: As a result of the tests and measurements made, the subjects average body weight was 37.31±7.71 kg, height 147.66±9.25 cm, body fat percentage 17.99±3.92%, arm span 145.4±10,1 cm, leg length 69.62±6.57 cm, bust length 76.51±3.4 cm, back strength 51.95±12.86 kg, leg strength 52.77±14.36 kg, hand grip strength 17.67±5.34 kg, anaerobic power value 46.07±12.22 kgm/sec, maximum oxygen consumption (maxVO2) 44.61±3.23 ml/kg/min, and 30 m sprint test score 5.74±0.32 sec. Discussion and Conclusion: As a result of the literature review, it was determined that children in the same age group have similar physiological and anthropometric characteristics.
Keywords: Anthropometric Characteristics, Physiological Characteristics, Young footballers.

1. Introduction

Football is the most popular sport worldwide and is played in every country without exception (Thaller et al., 2018; Andrei, 2019; Rookwood, 2020) and is played by different categories of men and women, children and adults. Football performance depends on numerous factors such as technical/biomechanical, tactical, mental and target areas. Football is not a science, but science can help enhance performance (Stolen et al., 2005). In recent years, there has been a significant development in sports science. The subject area is now recognized as both an academic discipline and a valid area of professional practice Soccer players and Coaches are more open to contemporary scientific approximation preparing for competitions (Sporis et al., 2009).

Success in sports performance is closely related to the athlete's physical condition. In addition to physiological condition parameters, anthropometric parameters have an essential effect

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on the evaluation of the physical condition. The anthropometric characteristics of athletes can be an indicator of their physical readiness of the athlete. Therefore anthropometric examination is an important part of determining the physical characteristics of the athlete (Gontarev et al., 2016). Anthropometric measurements are important in determining physical and physiological performance. Body weight, body fat percentage, and muscle mass values of athletes are important factors that affect maximum oxygen consumption and jumping ability (Moncef et al., 2012). One of the preferred technical features when choosing successful athletes of the future is the calculation of anthropometric characteristics. Sports branches have their own anthropometric demands and characteristics (Revan 2003). Determining the anthropometric measurements of the individual in some sports branches provides an important advantage for that sport. For this reason, anthropometry has an important place among the talent selection criteria (Bompa 2001). During the selection of talented players in football, tests should be used to evaluate motor performance and physiological, along with somatotype and anthropometric research, and the improvement of players should be watched (Gjonbalaj et al., 2018).

Over the last decade, the identification and development of young football players have become increasingly important for elite football clubs and have made it mandatory to become elite at a very young age due to these increasing pressures on children. (Jones & Drust 2007). Football is a branch that requires an educational process. In this educational process, knowing the physical and physiological dimensions of football, providing young football players with the highest level in the training process, and following the development process will enable these children to show high success. Football schools have an important place in determining the talented children who have the requirements of this branch. In this process, it is essential to correctly plan the school, family, and club cooperation (Kurban & Kaya 2017).

This study has been designed to analyze some anthropometric and physiological characteristics of 10-12-year-old soccer players.

2. Method

The research protocol started after receiving ethics committee approval from Selçuk University Faculty of Sports Sciences dated 20.06.2018 and numbered 2018/42. This study was carried out by the 'Non-Invasive Clinical Research Ethics Committee Decision'.

2.1. Participants

20 male football players aged 11.05±0.94 years which are known as the pre-academy age group, who have been actively participating in Konya Besiktas Football Schools for 3 years, voluntarily participated in the study. Before the study, each of the subjects was given detailed information about the risks and inconvenient situations encountered in the study. Voluntary consent form approval was obtained from the parents of the subjects. Before the study, all subjects had a health check, and subjects who did not have any physical or cardiovascular disease were included in the study.

2.2. Age, Height, and Weight Measurement

The subject's body weights were measured with bare feet and shorts on a precision scale up to 20 grams. In height measurements, the sliding caliper was adjusted to touch the subject's head while the athletes were standing in an upright position. The recording was made while in this position and the length was measured with an accuracy of 1 mm. In the age calculation, the date of birth was taken as month and year.

2.3. Body Fat Percentage Calculation and Measurement

Subcutaneous fat was measured with a Holtain Brand Skinfold Caliper measuring device. It was performed by holding the skin and subcutaneous fat, pulling it away from the muscle tissue, and applying firm pressure with the tip of the instrument. The Durnin and Womersley Formula was used to calculate body density (BD). For this purpose, skinfold subcutaneous fat thickness of

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the Biceps, Triceps, Subscapular, and Suprailiac regions was measured. Body Densities were calculated by inserting the obtained values into the following formula (Durnin et al., 1974).

BY = X*1.1533-0.0643

logX = (the sums of Suprailiac, Biceps, Triceps, and Subscapular)

Calculated values for BD were inserted into the following Siri formula and body fat percentages were calculated (Siri 1961).

Body fat percentage (BFP) = (495 / Body Density) – 450

2.4. Anthropometric Measurements

Anthropometric measurements were made with a Holtain Brand anthropometric set. The subject laid back straight against the wall for the arm span and spread their hands parallel to the floor. The distance between the fingertips of the right and left hands were measured and recorded with the palms facing forward. The height of the leg between the coccyx and the floor was measured and recorded while the subject was standing. The bust-length was calculated by subtracting the leg length from the subject's height.

2.5. Physiological Measurement

A back and leg dynamometer (Takei brand) was used to measure back strength. The subject placed feet on the dynamo table with knees stretched, arms stretched, back straight, body slightly bent forward, and pulled up the dynamometer he gripped with his hand vertically as much as he could. This test was repeated three times with rest and the highest value was recorded. A back and leg dynamometer (Takei brand) was used to measure leg strength. After placing his feet on the dynamo table with his knees bent, the subject pulled the dynamometer bar, which was gripped with hands, vertically, using his legs as much as possible with arms were stretched, back straight, and body slightly bent. This test was repeated three times with rest and the highest value was recorded. A hand dynamometer (Takei brand) was used to measure hand grip strength. The subject, with his arm stretched at the elbow, squeezed the dynamometer with maximum effort without resting his arm on his body, and the value seen on the scale was recorded. The highest of the three trials was recorded as hand grip strength.

2.6. Field Measurement

2.6.1. Vertical Jump and Anaerobic Power Test

The distance that the subjects could reach by standing in front of the wall marked in centimetres, with their feet shoulder-width apart and their torso sideways to the marked wall was marked. Then, each subject was given three attempts in the same position and the best of them was evaluated. The range between the distance that the subjects could reach while standing and the distance they jumped and touched was determined in meters and converted to anaerobic power with the Lewis Nomogram formula (Fox et al., 1988).

Anaerobic Power=√4.9*VA*√DSM

2.6.2. 30 Meter Sprint Test

The 30-meter sprint was placed on the starting line of the track, and together with the exit sign, it started running through the starting photocell and the result obtained after passing through the finish photocell was recorded. The test was repeated twice and the best result was accepted.

2.6.3. 20 Meter Shuttle Run Test and Aerobic Capacity

The 20-meter test track was determined by measuring with a tape measure. The test started at a slow running speed (8 km/h) and the subject started running at the 1st signal tone he heard. He was told that he had to reach the line until the 2nd signal tone 2. Upon hearing the signal tone, he turned back to the starting line and continued this running speed with signals increasing 0.5 km/h every minute. When the subject heard the signal, he adjusted the tempo to be at the other end of the track once the second signal was given. The speed, which was slow at first, gradually increased every 10 seconds. If the subject missed a signal and caught the 2nd one, the test was continued. If the subject missed two signals in a row, the test was terminated. The subjects last run level and lap

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were recorded on the test paper, and the maximum oxygen consumption (maxVO2) was calculated.

2.7. Statistical Analysis

The 30-meter sprint was placed on the starting line of the track, and together with the exit sign, it started running through the starting photocell and the result obtained after passing through the finish photocell was recorded. The test was repeated twice and the best result was accepted.

3. Results

Tablo 1. Descriptive statistics of subjects

	(n=20) (Mean ± Sd.)
Age (year)	11,05± 0,94
Height (cm)	147,6 ± 9,25
Body Weight (kg)	37,31± 7,7

The average age of the subjects was 11.05±0.94 years, their average height was 147.66±9.25 cm, their average body weight was 37.31±7.7 kg, and their body fat percentage was 17.99±3.92%.

Tablo 2. Anthropometric measurements

	(n=20) (Mean ± Sd.)
Arm Span (cm)	145,4± 10,1
Leg Length (cm)	69,62± 6,57
Bust Length (cm)	76,51± 3,4

In this study, the footballers' arm span was 145.4±10.1 cm, their leg length was 69.62±6.57 cm, and their bust length was 76.51±3.4 cm.

Tablo 3. Physiological measurements.

	(n=20) (Mean ± Sd.)
Back Strength (kg)	51,95± 12,86
Leg Strength (kg)	52,77± 14,36
Hand grip strength (kg)	17,67± 5,34

The back strength of the athletes participating in this study was 51.95±12.86 kg, leg strength was 52.77±14.36 kg, hand grip strength was 17.67±5.34 kg.

Tablo 4. Field measurements.

	(n=20) (Mean ± Sd.)
Vertical Jump (m)	0,31± 0,05
Anaerobic Power (kgm/sec)	46,07 ± 12,22
30m Sprint (sec)	5,74± 0,32
MaxVO2 (ml/kg/min)	44,61±3,23

In the field measurements made, the subjects' vertical jump score was 0.31±0.05 m, anaerobic power value was 46.07±12.22 kgm/sec, 30m sprint score was 5.74±0.32 sec, and maxVO2 value was 44.61±3.23 ml/kg/min.

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4. Discussion and Conclusion

The average age of the subjects participating in this study was 11.05±0.94 years, their average height was 147.66±9.25 cm, their average body weight was 37.31±7.7 kg, and their body fat percentage was 17.99±3.92%. In the study conducted by (Ramírez-Campillo et al., 2015), it was reported that the average values of age, height, BFP, and body weight of 16 footballers were 11.6±1.7 years, 147±11.1 cm, 11.5±3.6%, and 45.0±9.3 kg respectively. In another study, the height, body weight, and BFP values of 163 footballers aged 9-11 were found to be 141.36±6.92 cm, 34.33±6.71 kg, and 16.71±5.80%, respectively (Opstoel et al., 2015). The average BFP of 14 footballers aged 12.2±0.6 years was calculated as 17.6±2.4 (Michailidis et al., 2019). In another study, it was reported that the average height of 11.8±0.5 years-old soccer players was 144.7±7.0 cm and their average body weight was 38.1±6.2 kg (Figueiredo et al., 2011). The body weight of 17 footballers with an average age of 11.12±0.86 was 39.59±8.07 kg and their height was 144.82±8.71 cm (Göksu et al., 2018). In another study, the average height of 26 male athletes with an average age of 11.6±0.7 years was 149.4±9.6 cm, their body weight was 38.3±8.9 kg, and their body fat percentage was 19.2±5,1% (Malina et al., 2011). In the study conducted by Baumgart et al., (2018) in Germany, the average height value of 15 footballers aged 11.6±0.3 years was calculated as 150±0.09 cm, and the average body weight as 39.2±9.1 kg. The BFP of 8 children aged 11.88±1.12 who received football training was calculated as 18.42±3.83% (Kaya et al., 2017). In the study conducted by Pérez-López et al. (2015) in Spain, the average height, body weight, and BFP values of 147 footballers aged 11.1±0.6 years were 144±7 cm, 37.1±6.4 kg, and 18.5±5.9%, respectively.

The data obtained from the literature review showed that the BW, average height values of the footballers participating in this study are similar to the footballers of the same age group, while there are similarities and differences in the BFP values. The reason for this is thought to be the training level, nutritional habits or the difference in the material, and the method used in the calculations.

As seen in Table 2, the footballers' arm spans were 145.4±10.1 cm, their leg lengths were 69.62±6.57 cm, and their bust lengths were 76.51±3.4 cm.

Bidaurrazaga-Letona et al., (2019) reported the bust length as 72.88±3.01 cm and the leg length as 76.52±3.59 cm in 29 soccer players with an average age of 11.41±0.29 years. In another study, the bust length of 16 footballers was 71.58±2.37 cm, and the leg length was 78.19±5.73 cm. (Makhlouf et al., 2018). The arm span of 24 footballers with an average age of 10.9±07 was measured as 153±0.2 cm (Michailidis et al., 2013). Perroni et al., (2015) reported the bust length of 20 footballers aged 11.95±0.21 years as 0.79±0.38 m in their study. In a study conducted in Portugal, the bust length and leg length of 87 footballers aged 11-12 years were measured as 73.0±3.1 cm and 71.7±4.5 cm, respectively (Figueiredo et al., 2009a). In another similar study conducted by Figueiredo et al., (2009b) in Portugal, the bust length and leg length values of 54 children aged 11.8±0.5 years were determined as 72.4±2.7 cm and 71.3±4.2 cm, respectively. Lloyd et al., (2015) calculated the bust length of 10 footballers aged 11.2±0.5 years as 72.0±2.9 in their study in the United Kingdom. As a result of the study, the bust lengths of 38 footballers in the 11-year-old group were determined as 69.86±4.25 cm and their arm spans as 139.23±8.81 cm. In the same study, these values were found to be 68.97±2.20 cm and 135.51±8.92 cm, respectively, in 35 children aged 10 years (Polat et al., 2009). In another study, the leg length of 14 children aged 12.3±0.7 years was reported as 71.7±3.9 cm (Mendez-Villanueva et al., 2010). The average leg length of 14 children aged 11.8±04 years was calculated as 0.85±0.03 m (Jlid et al., 2019).

When the values obtained in the research were compared with the literature values In terms of anthropometric characteristics, it was seen that there are similarities and differences. The reason for this could be the physical characteristics of the footballers. It is known that athletes in the same age group have different physical conditions at this stage of rapid physical development.

As seen in Table 3, the athletes' back strength was 51.95±12.86 kg, leg strength was 52.77±14.36 kg, and hand grip strength was 17.67±5.34 kg.

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Boyacı and Bıyıklı (2018) reported that the back strength of 20 footballers aged 11.80±1.30 was 51.76±18.86 kg, their leg strength was 89.56±17.56 kg, and the average value of right-left hand grip strength was 22,09±5.73 kg, and 21.47±4.99 kg, respectively. The leg strength value of 8 children aged 11.88±1.12 who received football training was determined as 75.68±6.16 kg (Kaya et al., 2017). In the study conducted in Belgium by Fransen et al., (2012), the hand grip strength value of 38 athlete children aged 10-12 years was calculated as 22.8±4.0 kg. In the same study, this value was 18.3±3.4 kg in 119 children aged 8-10 years. Ramírez-Vélez et al., (2017) reported the hand grip strength of 15.3±3.6 kg in 313 children with an average age of 10.0±0.08 years in their study in Colombia, while Kidokoro and Miyashita (2020) calculated the hand grip strength of 327 children aged 11,0±1.5 years in Japan as 20.6±7.6 kg. Bilgiç et al., (2016) reported the average values of back and leg strength of 94 children with an average age of 11.79±0.41 years as 53.51±11.25 kg and 50.54±10.73 kg, respectively. The average value of the hand grip strength was reported as 14.7±4.0 kg and back strength as 53.0±9.3 kg in 16 footballers aged 10-12 (Makhlouf et al., 2018). In another study, the leg strength of 10 athlete children aged 13.95±18.7 years was calculated as 43.53±4.1 kg and the back strength was 38.53±4.3 kg (Hamza 2013).

The average values of back, leg, and hand grip strength obtained in this study and the average values of similar studies in the literature are parallel.

As seen in Table 4, the vertical jump score of the subjects was 0.31±0.05 m. The anaerobic power value was 46.07±12.22 kgm/sec, 30m sprint score was 5.74±0.32 sec, and the maxVO2 value was 44.61±3.23 ml/kg/min in field measurements.

In their study, Torreblanca-Martínez et al., (2018) reported the average values of maxVO2 and 30-meter sprint in 86 footballers under the age of 11 as 49.78±5.08 ml/kg/min and 5.51±0.45 s, respectively. In the study conducted by Meckel et al., (2012), the max VO2 pre-test value of 13 footballers aged 14.3±0.5 years who received 7 weeks of special training was 44.9±5.2 ml/kg/min, and the post-test value was 49.5± 5.4 ml/kg/min, the 30 m sprint pre-test value was 4.82±0.23 m, and the post-test value was 4.74±0.22 m. In another study, the average values of vertical jump height, anaerobic power, 30 m sprint, and maxVO2 of 32 children aged 12.9±08 years playing football were 40.2±7.6 cm, 68.0±16.8 kgm/sec, 4.9±7.6sec, and 37.3±4.2 ml/kg/min, respectively. (Güler et al., 2010). The vertical jump value of 30 children receiving football training was determined as 25.80±6.23 cm and the anaerobic power value as 43.32±13.71 kg/m/sec (Kurban and Kaya 2017). In another study with 8 children aged 11.88±1.12 who received football training, the average values of vertical jump, anaerobic power, 30-meter sprint, and maxVO2 were 27.90±2.34 cm, 53.93±17.87 kgm/ sec, 5.27±0.34 sec, and 34.86±1.97 ml/kg/min, respectively. (Kaya et al 2017). In another study, the vertical jump value of 15 soccer players of the toddler football team (10-12 years old) of Akdeniz University was 21.4±4.33 cm (Kumartaşlı et al., 2014). While Deprez et al (2015) reported the 30-m sprint value of 343 footballers aged 11.8±0.7 years to be 5.11±0.24 m, in another similar study, they calculated the sprint value of 24 footballers aged 11.3±0.5 years as 5.27±0.17 seconds. Göksu et al,. (2018) measured the 30-m sprint average of 17 footballers in the 10-12 age groups as 5.78±0.35 seconds. Baumgart et al., (2018) reported a 30-meter sprint value of 5.17±0.23 s in 15 footballers aged 11.6±0.3 years in their study in Germany.

As a result of the literature review, while the 30-m sprint and maxVO2 values of the footballers participating in this study are similar to the footballers of the same age group, there are similarities and differences in vertical jump and anaerobic power values. The reason for this could be different physical and physiological characteristics, nutritional habits or differences in the materials and methods used in the calculations.

Physical and physiological parameters are two important characteristics that complement the performance of athletes. We recommend that children in the developmental age undergo anthropometric and physiological tests at regular intervals in order to determine the effect of training on their performance levels. However, the fact that these measurements are necessary in the regulation of the training to be applied in order to increase the performance level of children at this age survives in this study and other scientific studies. With the literature review and

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professional and academic experience, various physiological and anthropometric measurements to be made in the pre-adolescent period when children develop rapidly will affect the future sports performance of these children and their place in social life.

The findings of this study will help scientists, coaches and researchers during their studies in the research to be conducted with football player children. In addition, the tests applied can be compared with the characteristics of children playing football abroad again by using different age groups. For this reason, a training prescription can be written according to the results to be obtained and it can be acted in a more planned and programmed way according to the findings obtained. As a result, this study sheds light on an important area and issue in the preparation of training prescriptions that will allow young football players in Turkey to capture the characteristics of football player children in developed countries and rise above this level.

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