Investigation of Body Composition of Footballers by Bioelectrical Impedance Method

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Abstract

Objective: This study aims at examining the body composition of male football players who perform regular football training by Bioelectrical Impedance (BIA) method and comparing it with a healthy control group and investigating the effect of regular exercise on body composition.

Materials and Methods: A total of 60 people participated in the study, including 30 volunteer male football players performing football trainings regularly from 11 Nisan Football Club playing in Turkey Football Federation Regional Amateur League (BAL) and 30 healthy volunteer control group consisting of male students from Harran University Medical Faculty. Both groups' ages and body mass indexes are similar to each other.   Bioelectrical Impedance (BIA) method was used for Osseosis, skeletal muscle weight (SMM), body mass index (BMI), body fat percentage (BFP), waist hip ratio (WHR), and basal metabolism parameters of the participants. The data obtained were evaluated with SPSS 23.0 statistical package program, and the significance level was evaluated as $p < 0.01$ and $p < 0.05$.

Findings: There was no statistically significant difference between the values of age, height, weight, intracellular fluid, extracellular fluid, protein, mineral, skeletal muscle weight (SMM), body mass index (BMI) and muscle ratios of the experimental and control groups ($p > 0.05$). When the parameters of basal metabolism, Osseosis and skeletal muscle weight of the

experimental group were discussed, no significant relationship was detected, although they were high numerically ($p > 0.05$). It was determined that the body fat percentage (BFP) of the experimental and control groups was correlated at $p < 0.01$ level and waist-hip ratio was correlated (WHR) at $p < 0.05$ level, which was statistically significant. As a result, although there was no significant difference between BMI values between the football players and the control group, the fact that the players' lower BMI values and lower waist-hip ratios showed that regular training reduces the risk of developing chronic diseases.

Keywords: Football, Bioelectrical impedance, Body composition

1. Introduction

In recent years, the physical inactivity caused by industrialization and sedentary lifestyle adversely affects individuals in every age group. A sedentary lifestyle brings serious health problems together with it (Çolakoğlu & Şenel, 2003). This sedentary lifestyle is a serious public health problem that occurs as a result of energy imbalance and decreases the quality of life and duration due to the fact that the energy consumed is less than the energy received (Şanlıer, 2005; Şanlı, 2008). Body mass index and body fat ratio measurements are among the most frequently used methods to gather information about the health status of individuals in medical fields, such as obesity and cardiology, sports science studies, and the fields related to public health (Dal Cin, Braga, Molinari, Cristallo, & Di Carlo, 1992; Erselcan, Candan, Saruhan, & Ayca 2000). Body mass index (BMI kg/m^2) is calculated for body weight assessment in sedentary individuals, and BMI classification determined by the World Health Organization (WHO, 2016) is examined. However, when BMI evaluation is carried out, the person can be evaluated as overweight because the muscular and bone mass of the individuals participating in sports is higher compared to sedentary individuals. Therefore, it is more accurate to evaluate body composition, especially body fat ratio in athletes (Şakar, 2010). Since abdominal lipoidosis is a greater risk factor for cardiovascular disease than peripheral lipoidosis, evaluation of regional lipoidosis is of great importance (Björntorp, 1997). Waist/hip ratio and waist circumference measurement is also important for the evaluation of abdominal obesity (Lean, Han, & Morrison 1995). There are different methods used to detect regional lipoidosis and to determine body composition. Of these, the bioelectrical impedance method is one of the most common because it tests body analysis accurately, quickly, and easily, and it tests many parameters together. Bioelectrical impedance method (BIA) has been seen as a suitable method for the determination of body composition and clinical epidemiological studies in recent years (Kaya & Özçelik, 2009). Bioelectrical impedance is based on the principle of determining the body composition by giving current to the body at low levels and at different frequencies (Canpolat, 2018).

A footballer is expected to have certain morphological and physiological attributes in order to make a continuous and successful career. A significant correlation between body mass, muscle mass and work-rate profile has been established (Rienzi, Drust, Reilly, Carter, & Martin, 2000). Body mass can affect the speed, durability and physical dominance of athletes, while the composition of the body inevitably affects the strength and agility, and for the successful of football individual requires a high level of athletic abilities and appropriate

atropometric characteristics and body composition, beside high level of technical and tactical skills (Popovic, Akpinar, Jaksic, Matic, & Bjelica, 2013).

There is abundant research available regarding the performance relationship of body composition, including football and many other branches (Mangine, Noyes, Mullen, & Barber-Westin, 1990; Ostojic, 2002). This study aims to examine the body composition of male football players who perform regular football training with Bioelectrical Impedance (BIA) method, and compare it with a healthy control group to investigate the effect of regular exercise on body composition.

2. Method

A total of 60 people participated in the study, including 30 male football players (experimental group) from Şanlıurfa 11 Nisan Football Club playing in Turkey Football Federation Regional Amateur League (BAL) performing football trainings regularly as five days a week, two hours a day, who have played sports for nine years. The control group consisted of 30 healthy male student volunteers from Harran University Medical Faculty, whose ages and body mass indexes are similar to the experimental group, and are not performing football trainings regularly. The age, height, and weight of the participants are shown in Table 1.

Table 1. The mean age, height and body weights of the groups and their statistical comparison

Parameters	Experimental Group ($n = 30$) X±Ss	Control Group ($n = 30$) X±Ss
Year (year)	21.66±2.74	21.23± 1.19
Height (cm)	1.77±0.06	1.76±0.005
Weight (kg)	70.04±7.66	72.61±11.38

2.1 Data Collection

2.1.1 Measurements of Height and Body Weight

The height of the participants was measured using a wall-mounted stadiometer (Holtain Ltd., UK) with a precision of ±1 mm. Height measurements were taken with bare feet and with arms hanging freely from shoulders to sides. The measurements were taken with the head upright, the feet flatly stepped on the floor, the knees stretched, the heels adjacent, and the body upright. Body weights were measured with a BIA device with a precision of 0.1 with bare feet and minimal clothing.

2.1.2 Body Analysis

Body compositions, body weight, protein, mineral, BMI, right arm, left arm, right leg, left leg, right leg circumference and left leg circumference, basal metabolism, Osseosis, SMM, VYY

and WHR parameters of the participants were determined by Bioelectrical Impedance (In Body 720) method by printing out automatically. The participants were informed in advance about the rules to be considered in BIA measurement and they were asked not to participate in sports or drink alcohol in the 24 hours before the test, as well as not to consume food and drinks 3-4 hours before the test day. Participants were asked to stand on bare feet on the metal surface of the device, to hold the hand-held parts of the device with both hands, and to release their arms parallel to the body.

2.2 Data Analysis

Independent samples-t test analysis was used to compare the experimental and control groups. The data obtained were evaluated with SPSS 23.0 statistical package program, and the significance level was evaluated as $p < 0.01$ and $p < 0.05$.

3. Results

Table 2 shows the data of comparison of the body analyses of the experimental and control groups at the end of this study to examine the body composition of the football players who perform regular football training and the control group who do not train regularly.

Table 2. Bioelectrical impedance means and comparison results of groups

Parameters	Experimental Group (*n*= 30) X±S	Control Group (*n*= 30) X±S	*p*
Protein	12.68±1.38	12.04±1.52	0.117
Mineral	4.22±0.51	4.06±0.58	0.313
Osseosis	3.46±0.42	3.33±0.49	0.338
SMM (kg)	36.13±4.27	34.36±4.61	0.153
VKI (kg/height^2)	22.26±1.45	23.19±3.06	0.179
VYY %	9.75±3.97	16.11±6.21	**0.000**[**]
WHR	0.83±0.02	0.86±0.04	**0.011**[*]
Right arm (kg)	3.53±0.56	3.38±0.56	0.328
Left arm (kg)	3.47±0.53	3.34±0.54	0.412
Right Leg (kg)	10.09±1.15	9.61±1.08	0.120
Left Leg (kg)	9.99±1.17	9.51±1.15	0.141
Right Leg circumference (cm)	52.37±2.60	52.81±4.01	0.648
Left Leg circumference (cm)	50.60±8.40	52.52±3.95	0.273
Basal Metabolism	1733.12±150	1676.03±168	0.201

Note. [**]$p < 0.01$, [*]$p < 0.05$.

When Table 2 is examined, we can see in the body composition values of the experimental and control groups that protein was 12.68±1.38, 12.04±1.52; mineral was 4.22±0.51, 4.06±0.58; osseosis was 3.46±0.42, 3.33±0.49; SMM was 36.13±4.27, 34.36±4.61 and basal metabolism was 1733.12±150, 1676.03±168. From these parameters, we can conclude that parameters were found to be higher in favour of the experimental group; no significant relationship was detected between the groups ($p > 0.05$). When the BMI values of the experimental and control groups were examined, it was 22.26±1.45, 23.19±3.06, and although it was numerically low in favour of the experimental group, no significant relationship was found between the groups ($p > 0.05$).

The body fat percentage (BFP) of the experimental and control group was 9.75±3.97, 16.11±6.21 ($p < 0.01$) level respectively, and waist-hip ratio (WHR) was 0.83±0.02, 0.86±0.04 ($p < 0.05$) levels respectively, which was statistically significant.

4. Discussion

In our study, the mean age of the players was 21.66±2.74, the mean height was 1.77±0.06, and the mean body weight was 70.04±7.66. When we check the studies investigating the physical and motoric features of football players playing in the league, we can see that they show in approximate value with age, height and body weight averages in our study (Aslan & Ersöz, 2012; Bunc, Hrasky, & Skalska, 2015; Cossio-Bolanos, Portella, Hespanhol, Fraser, & Arruda, 2012; Gerosa-Neto, Rossi, Silva, Zapeterra, Fernandes, & Junior, 2014; Kashani, Khotbesara, Maskooni, & Djafarian, 2013; Zagatto, Miyagi, Brisola, Milioni, Silva, Santiago, & Papoti 2015).

In their studies on football players and students from Nigde University who do not participate in regular sports by the skinfold method, Eker, Ağaoğlu, and Albay (2003) measured body fat percentages and stated that body fat percentages were significantly less. In their studies on students of Cumhuriyet University School of Physical Education and Sports and elite level athletes group consisting of active athletes, Sirtakavak et al. (2004) found that body fat percentages were 11.80%. Using BIA method, Karakaş, Taşer, Yıldız, and Köse (2005) measured body fat percentages of students at a school of physical education and medical school students and found that body fat percentages of students were 12.95%, and body fat percentages of medical school students were 15.40%, and they stated that the difference was statistically significant. In their studies examining the relationship between physical and motoric properties and technical capacities of players playing in the BAL league, Aslan and Ersöz (2012) determined that the average body fat ratio of the players was 7.70. Similarly, it has been determined that different activities involved in physical activity and applied for a certain period cause a decrease in body fat percentages of individuals (Gökdemir, Koç, & Yüksel, 2007; Orhan, Pulur, & Erol, 2008; Toraman, Yaman, Şahin, Ayçem, & Muratlı, 2002; Yüksel, Koç, Özdilek, & Gökdemir, 2007).

When the studies on footballers in different countries are examined, Cossio Bolanos et al. (2012) found that body fat ratio of Peruvian football players was 11.4±2.9%. In their study on Iranian football players, Kashani et al. (2013) found that body fat ratio of football players was 10.1±3.5%. In their studies on Brazilian football players, Gerosa-Neto et al. (2014), found

that body fat ratio was 14±5.2%. In their studies on Italian football players, Zagatto et al. (2015) found that body fat ratio of football players was 11.8±1%. In their studies on Czech football players, Bunc et al. (2015) found that body fat ratio of football players was 10.4±1.7%. The mean body fat ratio of the players participating in this study was 9.75±3.97, which is similar to the existing literature. The mean body fat ratio of the players and the control group was found to be statistically significant ($p < 0.01$), and it is similar to the aforementioned studies. As the percentage of body fat increases, the risk of developing chronic diseases increases. As is evidenced by the aforementioned studies, at the end of these studies, exercise and active life have positive effects on decreasing body fat percentage. In their studies examining the relationship between the physical and motoric characteristics and technical capacities of the players playing in the BAL league, Aslan and Ersöz (2012) determined that body mass index (kg/m^2) of the football players was 22.9±2.9. In their study on Iranian players, Kashani et al. (2013) found that the average BMI was 23.2±1.4 kg/m^2.

When previous studies are analysed, some studies show that there is a positive relationship between BMI and regular exercise (Bilim, Çetinkaya, & Dayı, 2016; Sarıta, Yıldız, & Hayta, 2017; Saygın, Polat, & Karacabey, 2005). In addition, there are some studies showing that regular exercise has no effect on BMI (Kurt et al., 2010; Poyraz et al., 2015; Selçuk & Karacan, 2017). Moreover, Bielec et al. (2013) reported that there was no significant difference between the body mass indexes of the swimmers they followed for two years and the control group. In another study, Sideraviciute et al. (2006) found that, although swimming exercise performed for 14 weeks and two days a week caused a decrease in body fat tissue in girls aged 14-19, there was no change in BMI.

It is expected that athletes have lower body weights with exercise. However, it is also expected that BMI will increase due to the fact that regular exercise increases muscle mass in the body. The mean BMI of the players participating in the current study was 22.26±1.45 kg/m2, which is in parallel with the existing literature. When the relationship between the mean BMI of the experimental and control groups in the study was examined, it was found that the skeletal muscle weights of the experimental group were higher, body fat ratio was lower, and the control group had no statistically significant relationship due to the excess of the body fat ratio. Çelik and Toksöz (1999) found that the average waist-hip ratio of male students studying at Dicle University physical education and sports department was 0.80±0.03 cm. Özder et al. (2003), in their study on 21 male footballers of Gençlerbirliği sports club, found that the average waist-hip ratio of the players was 0.90±0.01 cm. In the current study, the average waist-hip ratio of the players was 0.83±0.02 cm, and the average waist-hip ratio of the control group was 0.86±0.04 cm. In addition, it was seen that there was a statistically significant relationship between the waist-hip ratios of the football players and control group ($p < 0.05$).

As a result, previous research shows that increasing body fat percentage and waist-hip ratio increases the risk of cardiovascular diseases and triggers other chronic diseases. Although there was no significant difference between BMI values between the players and the control group, lower body fat percentage values and lower waist-hip ratios of the players showed that regular training reduced the risk of developing chronic diseases. In addition, as a result of the

data obtained from the study, it is thought that bioelectrical impedance method will be useful in the evaluation of body composition and body mass index, body fat percentage, and waist-hip ratio among disease risk factors.

Acknowledgements

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