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Original article

ANALYSIS OF BODY COMPOSITION IN FOOTBALL ATHLETES AGED 6 TO 10

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Abstract

Objective. Establishment of body mass index of football athletes aged 6 - 10 by analyzing the differences and relation of body composition indicators.

Methods. The research entailed an ascertaining study conducted in Chiajna Medical Center, Ilfov, from January to March 2019, with 85 athletes aged 6 to 10 years, belonging to 6 sports clubs (Champion, Juniorul, Otopeni FOT, Argman, Marian Cristescu Academy and Concordia). The assessment of body composition was made with TANITA DC- 360 apparatus, monitoring the input data (gender, age, height and clothes weight), the results (weight, FAT %, Fat mass, FFM - Fat Free Mass, Muscle mass, TBW - Total Body Water Mass, TBW - Total Body Water %, BMI – body mass index), desired range (Fat % and Fat mass), indicator – Fat % and bioelectrical data. The results were calculated per each year of age; the indices were compared using nonparametric multiple comparison. The relation between the body composition indices for each studied age was analyzed using the Canonical Correlation Analysis for Two Groups of Variables.

Results. The comparative analysis of body composition, in the football athletes aged 6 to 10 years old, highlights differences of the indices in relation with the height, body weight, body total water and fat with reference to BMI. The correlative analysis results of body composition indices relation in the football players show significant strong connections with 44.4% at 6 years, 72.2% at 7 years, 50% connections at 8 years, 63.9% at 9 years and 61.1% at 10 years in $p<0.05$, $p<0.01$ and $p<0.001$.

Conclusions. Determining the body mass index in the 6-9 years old football players by means of a comparative and correlative analysis between the age groups and within the age groups contributed to a more efficient assessment of health status.

Key Words: football, body composition, body mass index, statistics, health status.

Introduction

Football is the most popular sport around the world and has been practiced by each nation without exception. In recent years there is an increasing interest from the part of the biological sciences to improve the knowledge related to football game through studies conducted in different fields (Najafi et al., 2015).

The measurements of body composition and food intake are important to assess the athletic condition and to help create the program of training and nutrition. The sports dietitians aim to help improving the performance by developing the nutrition and food intake knowledge in order to optimize the athletes' body composition (Devlin et al., 2017; Jenner et al., 2018).

A practical way to study the changes in body composition (particularly body fat) using the skinfolds has been demonstrated. The measurements of skinfolds, abdomen, chest and arm were taken on football players at the beginning and the end of the season (Thompson, 1959).

Body size is always a topic of discussion in the case of the professional football players as their weight increases or decreases depending on the size characteristics. Body mass index (BMI) and bioelectrical impedance are limited in their capacity to distinguish between lean and fat mass or to measure the regional composition (Bosch et al., 2014).

Due to the permanent interest in the relationship between body composition and performance in football, several technologies able to estimate the body composition were developed. The dual-energy X-ray absorptiometry is a well-accepted laboratory method that is often used as a reference for estimating the total and segmental body composition (Boykin et al., 2021). From this perspective, we decided to address this problem in the football players of 6 to 10 years old, both in terms of

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differences of body composition indices between the age categories, as well as their relationship.

The purpose of the research is the comparative and correlative analysis between the indices of body composition in football athletes aged 6-10.

Methods

The research refers to an ascertaining study within the Chiajna Medical Center, Ilfov, carried out from January to March 2019, on a number of 86 football players aged 6-10 years (6 years, n=9; 7, n=32; 8, n=21; 9, n=13; 10, n=11), members of 6 sports clubs (Champion, Juniorul, Otopeni FOT, Argman, Academia Marian Cristescu and Concordia Chiajna). The body composition was assessed using the TANITA DC- 360 analyzer, monitoring the data input (gender, age, height and clothes weight), results (weight, FAT %, Fat mass, FFM - Fat Free Mass, Muscle mass, TBW - Total Body Water Mass, TBW - Total Body Water %, BMI – body mass index), desired range (Fat % and Fat mass), Fat % index and bioelectrical data.

Statistical analysis was performed using the KyPlot 5.0 program, calculating the arithmetical mean (M) and standard deviation (±SD). The differences in the indices between the age groups were highlighted by means of the nonparametric multiple comparison, t-Table Upper Right: Test Statistics between i and j groups (6-10 years); Lower Left: P-Values (Studentized Range Distribution). The correlative analysis between the indices of body composition was performed using Canonical Correlation Analysis for Two Groups of Variables in each age category.

Results

Table 1 shows the mean and SD values of the body composition indices and the analysis of the differences between the means of 6-10 year groups.

Table 1. Comparative analysis of body composition indices between the age groups of football athletes aged 6-10 years (**M ± SD)**

	Age group (years)				
Variables	**6 (n = 9)**	**7 (n = 32)**	**8 (n = 21)**	**9 (n = 13)**	**10 (n = 11)**
Body height (cm)	127.4 ± 4.92	128.5 ± 6.16	133.0 ± 6.05	138.5 ± 5.66**	141.5 ± 3.90**
Body weight (kg)	24.35 ± 2.94	26.0 ± 4.41	29.2 ± 3.79*	34.3 ± 6.14**	33.7 ± 3.80**
Fat (%)	15.96 ± 3.78	15.9 ± 4.30	16.1 ± 5.48	16.5 ± 6.34	15.1 ± 3.67
Fat mass (kg)	3.84 ± 2.03	4.2 ± 1.81	5.8 ± 4.56	5.7 ± 3.07	5.2 ± 2.24
FFM (kg)	20.67 ± 19.47	21.7 ± 2.93	23.8 ± 2.74*	28.5 ± 3.93**	28.8 ± 2.11**
Muscle mass (kg)	19.47 ± 1.82	20.4 ± 2.79	22.4 ± 2.49*	26.9 ± 3.73**	27.06 ± 2.16**
TBW (kg)	15.13 ± 1.40	15.7 ± 2.22	17.5 ± 1.68*	21.1 ± 3.15**	20.8 ± 1.76**
TBW (%)	62.01 ± 4.34	62.7 ± 5.74	63.2 ± 6.32	61.9 ± 4.81	61.5 ± 4.69
BMI (kg/m^2)	15.02 ± 1.55	15.7 ± 1.94	16.2 ± 1.67	17.7 ± 1.99*	16.9 ± 1.27*

Nonparametric multiple comparison; differences between age, *p<0.05, **p<0.01, ***p<0.001

FFM, free fat mass; TBW, total body water; BMI, body mass index; M, mean; SD, standard deviation; n, number of subjects.

Comparative analysis highlights the increase of height related to body weight as follows: at 7 years by 1.1 cm and 1.65 kg; 8 years by 4.5 cm and 3.2 kg; 9 years by 5.5 cm and 5.1 kg; 10 years by 3 cm and 0.6 kg. There are significant differences at p<0.01 at 9 and 10 years (height) and 8-10 years (weight). Relation of fat indices: increase by 0.06% (Fat); 0.36 kg Fat mass (FM); 1.03 kg free fat mass (FFM) and 0.93 kg muscle mass (MM) at 7 years, decrease of fat by 1.4% and -0.5 kg and increase by 0.3 kg (FFM) and 0.16 kg (MM) at 10 years and significant differences at p<0.05 (FFM and MM) at 8 years and at p<0.01 (FFM and MM) at 9 years. Total body water (TBW) increases by 0.57 kg (0.69%) at 7 years and decreases by 0.3 kg (0.4%) at 10 years, with significant differences at p<0.05 at 8-10 years. BMI shows an increase of the value by 0.68 kg/m2 at 7 years and a decrease by 0.8 kg/m2 at 10 years and significant differences at p<0.05 at 9 and 10 years.

Table 2 presents the values of the mean and SD, the desired range, Fat % index and bioelectrical data of body composition indices between the age groups in football athletes aged 6-10 years.

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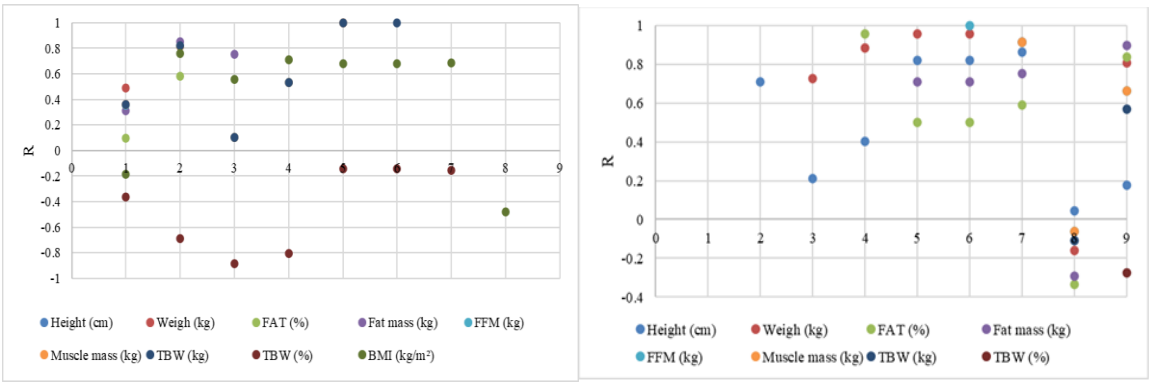
Table 2. Comparative analysis of the desired range, Fat % index and bioelectrical data of body composition indices between the age groups in football athletes aged 6-10 years (**M ± SD)**

		Age group (years)				
Variables		**6 (n = 9)**	**7 (n = 32)**	**8 (n = 21)**	**9 (n = 13)**	**10 (n = 11)**
Fat (%)	a	12.1 ± 0.33	13.06 ± 0.35***	12.9 ± 0.21***	13.1 ± 0.55**	13.06 ± 0.00***
	b	19.9 ± 0.00	20.02 ± 0.72	20.8 ± 0.38***	22.2 ± 1.42***	22.8 ± 0.30***
Fat mass (kg)	a	2.8 ± 0.26	3.27 ± 0.45	3.57 ± 0.37**	4.3 ± 0.56**	4.29 ± 0.33**
	b	5.1 ± 0.49	5.51 ± 0.77	6.39 ± 0.93**	8.1 ± 1.06**	8.47 ± 0.74**
R (kHz)	6.25	645.1 ± 132.6	652.8 ± 58.7	658.6 ± 80.7	632.8 ± 111.9	646.2 ± 65.61
	50	558.1 ± 165.5	585.2 ± 79.6	582.1 ± 90.6	524.2 ± 111.6	526.6 ± 242.5
X (kHz)	6.25	-38.8 ± 31.9	-26.7 ± 18.4	-25.6 ± 17.9	-39.8 ± 41.1	-39.9 ± 50.57
	50	-89.5 ± 25.1	-76.4 ± 35.3	-72.08 ± 26.5	-66.6 ± 55.03	-89.6 ± 70.13

* differences between age, Nonparametric multiple comparison, *p<0.05; **p<0.01, ***p<0.001
M, mean; SD, standard deviation; n, number of subjects.

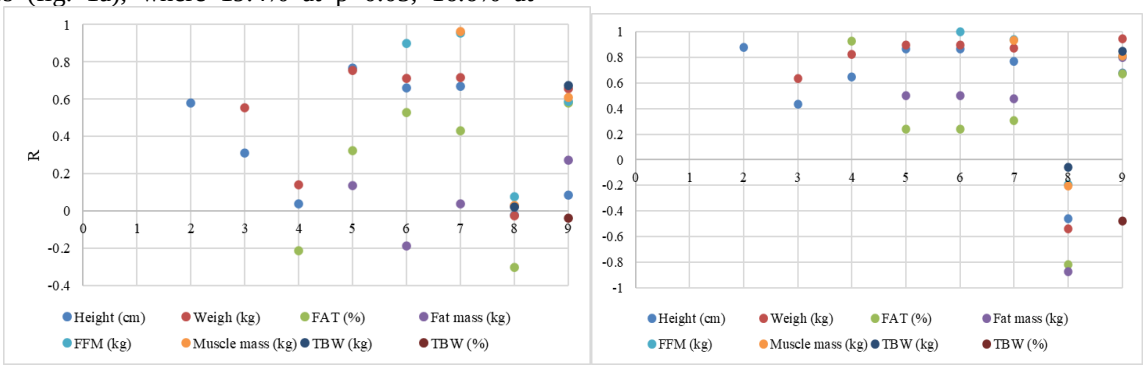
The comparative analysis results highlight the increase by 0.96% (Fat%) and 0.12 kg (Fat kg) and a value between 13.06 – 22.8% (Fat %) at p0,001 and 4.29 – 8.47 kg (Fat kg) at p0.01. As for the bioelectrical data R at 6.25kHz – 645.1 kHz and at 50 kHz – 558.1 kHz at 6 years and 646.2 (6.25 kHz) and 526.6 (50 kHz) at p>0.05. X at 5.25 kHz – 38.8 and at 50 kHz – 89.5 kH, while at 10 years the value is 39.9 (6.25 kHz) and 89.6 (50 kHz) at p>0.05.



a) b)

Figure 1. Correlation Matrix – Relation of body composition indices in football players of 6 (a) and 7 (b) years; R - Canonical Correlation Analysis; 6 years, n=11, p<0.05, R=0.666; p<0.01, R=0.797; p<0.001, R=0.898; 7 years, n=32, p<0.05, R=0.349; p<0.01, R=0.448; p<0.001, R=0.554

Figure 1 shows the results of the correlative analysis of the relation of body composition indices in the football players aged 6 years (a) and 7 years (b) revealing 44.4% significant strong connections at 6 years (fig. 1a), where 19.4% at p<0.05, 16.6% at p<0.01 and 8.3% at p<0.001. At 7 years (fig.1b) there are 72.2% significant strong connections, where 2.78% at p<0.05, 5.56% at p<0.01 and 63.8% at p<0.001.



a) b)

Figure 2. Correlation Matrix – Relation of body composition indices in football players aged 8 (a) and 9 years (b); R - Canonical Correlation Analysis; 8 years, n=21, p<0.05, R=0.432; p<0.01, R=0.548, p<0.001, R=0.665; 9 years, n=13, p<0.05, R=0.552, p<0.01, R=0.683; p<0.001, R=0.801

Figure 2 presents the results of the correlative analysis of the relation between the body composition indices in the football players aged 8 (a) and 9 years (b), highlighting 50% significant strong connections at 8 years (fig. 2a), where 8,3% at p<0.05, 19.4% at p<0.01 and 22.2% at p<0.001. At 9 years (fig. 2b) there are 63.9% significant strong connections, where 8.3% at p<0.05, 8.3% at p<0.01 and 47.2% at p<0.001.

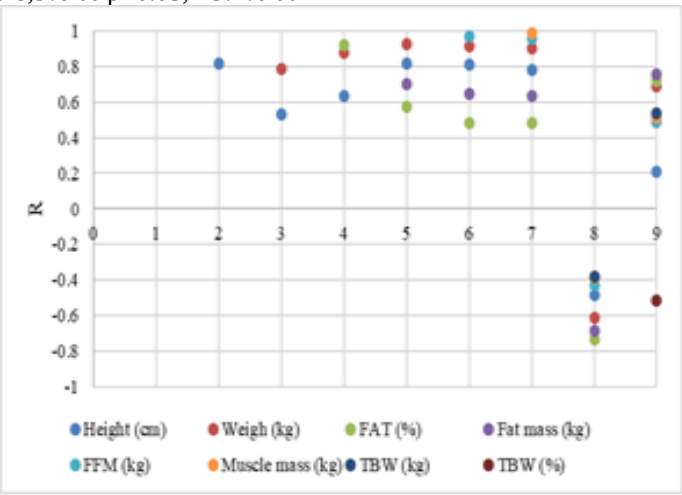


Figure 2. Correlation Matrix - Relation of body composition indices in football players aged 10 years; n=11, p<0.05, R=0.602; p<0.01, R=0.683; p<0.001, R=0.801

Figure 3 shows the correlative analysis results regarding the body composition indices in the football players aged 10, highlighting 61.1% significant strong connections, where 11.1% at p<0.05, 22.2% at p<0.01 and 27.7% at p<0.001.

Discussion

The use of BIA in sports is a non-invasive, rapid, easily accessible and comfortable way to continuously monitor body composition to determine the effects of short-term interventions on fitness training or injury recovery. But it is necessary to standardize the bioimpedance measuring conditions and to take into account the individual characteristics of the athletes (Malá, Zahálka & Maly, 2018).

Specialized literature highlights the seasonal changes of food intake and body composition in elite football players (Devlin et al., 2017). Effects of daily b-hydroxy b-metylbutyrate supplementation on the muscular strength and body composition in football athletes was evaluated (Ransone et al., 2003).

Visceral fat and abdominal body composition in National Football League players should be closely monitored, given that abdominal obesity entails the risk of lower limbs injury (Bosch et al., 2014).

Investigation of changes in body composition over a competitive football season, by dual energy X-ray absorptiometry, was made pre- and -post-season and in the following spring (Binkley et al., 2015).

Food intake of the Australian professional football players in a week of pre-season training did not meet the current recommendations. Elite athletes need support with the nutrition plans (Jenner et al., 2018). Also, the assessment of modifications in body composition during the seasonal phases of the training year in Canadian Inter-University Sport football players shows that body composition and central adiposity seem to change differentially between positional groups (Kim et al., 2018). Many athletes try to optimize their body composition for complying with the physical demands of their sport (Trexler et al., 2017).

Compared to other methods, the generation of normative data on total and regional body composition using the dual energy X-ray absorptiometry has higher accuracy and reliability and provides more information regarding the positional differences (Bosch et al., 2019).

Tracking changes in body composition can offer key information on the effectiveness of the training programs. It is possible to harmoniously use both the bioelectrical impedance analysis and the dual energy

X-ray absorptiometry to monitor the changes in body composition (Boykin et al., 2021).

Conclusions

The comparative analysis of body composition in football players aged 6-10 highlights differences in indices related to height, body weight, body fat and total water with reference to BMI.

The results of the correlative analysis of body composition indices in football players of 6-10 years old show significant strong connections as follows: 44.4% at 6 years; 72.2% at 7; 50% at 8; 63.9% at 9 and 61.1% at 10 years at $p<0.05$, $p<0.01$ and $p<0.00$.

Determining the body mass index in 6-10-year-old football players by comparative and correlative analysis between age groups and within these ones contributed to a more efficient assessment of health status, while providing important information on the athletes needing further tests and investigations.

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