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Analysis of Body Mass Components in National Club Football Players in Republic of Macedonia

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ABSTRACT

Aim: This study aims to analyze body composition in adult male football players and its changes during adulthood. **Methods:** Adult male football players (n=942, mean age 24.11 ±4.69y), all members of national competitive clubs from Macedonia were included in the study. The absolute and the relative body components were calculated: lean body mass (LBMkg), muscle mass (MMkg; MM%), bone mass (BMkg; BM%) and fat components (FMkg; FM%), using the anthropometric protocol by Matiegka. **Results:** Mean values of anthropometric measures for all included participants were as follows: height=178.39±6.11cm; weight=77.02±7.57; LBM=65.65±6.38; MM%=53.23±2.78; BM%=17.05±1.27; FM%=14.58±1.48. Descriptive statistics for these parameters was made for age specific groups. **Conclusions:** The results obtained could be used as reference values for adult football players in Republic of Macedonia. In the examined age span (18-35 years) a slight increase of absolute values of all three body components has been registered with advancing age. The most significant increase in the absolute values was registered for the muscle component, followed by the fat and bone components, respectively. Regarding the relative values (%), the muscle and the fat components showed an equally slight positive correlation with the age increase of 1 year, whilst the bone component decreased with advancing age .

Key words: body composition, football player, muscle mass, body fat, anthropometry.

1. INTRODUCTION

It is very important to determine the body composition in football players since it is an essential evaluation factor of their sport-medicine status. All high demanding sports impose permanent need of monitoring of all parameters that are important for every sport performance (1, 2). In addition to the physiological, biomechanical, psychological and cognitive variables, all morphological variables are equally important. Anthropometry is a method that is used very often in evaluating of all morphological aspects of football players. This is a method which uses measurable values of the body surface that are applied in equations necessary for calculation of body composition (3, 4).

The body composition is divided into three components: muscle, bone and fat. It has become an important part of the assessment of football players. All body components are expressed as relative values (% of the whole body mass) as well as absolute ones (kg of the whole body mass). Body composition analysis is an ideal method of understanding the current status of individual's fat and muscle mass. It is necessary to have a baseline reference of body components that could be used as fitness markers and dietary goals. It might be hypothesized that an increase in body fat would have a negative impact on athletes' performance (5, 6). The body components in football players demonstrated better values than in the reference group; lean body mass was higher and body fat lower. An inverse correlation between general physical fitness and body fat has been found in high school athletes, where average performance in a battery of upper and lower body tests was impaired by excess fat, and endurance performance was poorer when the body fat in these young men exceeded 10% (7). It was concluded that the body composition is important for all elite football players, but that homogeneity between the players in top professional clubs resulted in small variations between individuals **(8).**

Morphological features and sport performances in football players are thoroughly studied, but in spite of the fact that there is a positive correlation between them, this association still remains speculative. In order to present more evidence on the association of the physical performance and the body composition, much research has been done in different sports (9, 10, 11). In one study, body mass and fat free mass (FFM) were related to the total distance covered in international players (12). Adult male players had a lower percentage of body fat (BF%) compared to the control group (10% vs. 16.7%) (13). Most of the relevant studies have included elite or professional football players and have examined the differences between elite and non-elite players. In a study conducted Hazir et al. it has been shown that all of the players from the First Turkish League possessed different body features compared to those who

played in the Second League (14). In another study a differences were found in the height and weight of football players in the First and the Third Serbian League, in favor of those playing in the higher league (15).

To our knowledge, earlier researches have evaluated anthropometric profile and fitness characteristics among elite football players mostly from Western Europe, while there is little published descriptive data concerning these characteristics in players from Eastern Europe. The aims of this study were to determine body composition in adult male football players and to find out the difference of body components among different age groups.

2. METHODS AND SUBJECTS

A non-experimental, cross sectional design was used in this research. A total of 942 football players underwent assessment of body components according Matiegka protocol during the regular check-ups in the Laboratory of Sports medicine at the Institute of Physiology, Medical Faculty, Skopje, in the period of 1999-2009.

Adult male football players, age range 18–35 years (*N*=942; mean age=24.11 ±4.69y y), were classified into six two-year's age groups: group under twenty U20, (aged 18.27±0.68 y); under twenty-two U22 (aged 20.45±0.5); under twenty-four U24 (aged 22.57±0.5); under twenty-six U26 (aged 24.51±0.5); under twenty-eight U28 (aged 26.54±0.4); and over 28(aged 30.63±2.5), all being members of the national competitive football clubs. Participants were familiarized with the testing procedures used in this study. The Investigation was performed in accordance with the ethical standards of the Helsinki Declaration.

2.1. Protocols and equipment:

All measurements were made by highly trained and experienced technician. Height and body mass were measured using a stadiometer (SECA, Leicester, UK) and an electronic scale (HD-351, Tanita, Illinois, USA). Skinfolds were measured using John Bull calipers. Circumferences were measured with flexible standard measuring tape and diameters were measured using sliding Vernier outside calipers (GPMc). In addition to weight and height, the following parameters were also measured: four diameters (elbow, wrist, knee and ankle); five circumferences (upper arm, both relaxed and flexed, forearm, the calf and the thigh) as well as seven skin folds (biceps, triceps, forearm, thigh, calf, subscapular and supra-iliac).

Anthropometric parameters were analyzed by a special software program that utilizes all Mateigka's formulas intended for calculations of all body components (16).

3. STATISTICAL ANALYSIS

The mean, standard deviation (*s*), minimum and maximum values, and confident intervals were calculated for height, weight, lean body mass, relative and absolute body mass components. Data sets were checked for normality using the Shapiro-Wilks normality test and visual inspection. Association between body composition measures (BF, FM and FFM) and age was examined by Pearson's correlation coefficient (*r*). Differences between different age groups were assessed using one-way analysis of variance. The significance level was set at p=0.05. Statistical analysis was performed using Statistica 7 statistical software.

4. RESULTS

The descriptive statistics of the total sample (N=942) for general parameters (age, height and weight) and body mass components (lean body mass, muscle, bone and fat components) are shown in Table 1. The descriptive statistics of the same anthropometric variables for different age groups are shown in Table 2.

The absolute muscle mass (MM kg), which represents part of the body mass expressed in kg was substantially different between the age intervals of players, for F=17.24 and p<0.001 (p=0.000). In the group aged under 20 years there was a significantly lower absolute muscle mass compared to the rest of the older age groups. The analyses of the inter-class differences of the relative muscle mass (MM%) showed that there was a considerable distinction among the age intervals of the sport players, for F=2,71 and p<0.05 (p=0.02), but only the group aged up to 28 years (26-28 y) displayed a statistically significant relative muscle mass compared to the youngest examined group.

Concerning the absolute bone mass (BM kg), there was a significant difference between the age intervals for F=3.43 and p<0.01 (p=0.004). The examined individuals from the oldest group, over 28 years, showed a significantly higher absolute bone mass but only compared to the youngest examined group (under 20 years of age). Regarding the relative bone mass (BM%), there was a significant difference between the age groups, for F=11.86 and p<0.001 (p=0.000). The football players from the youngest

	Mean	Confidence -95,00%	Confidence +95,00%	Minimum	maximum	St dev
Age	24.11	23,77	24,38	17	38	4.69
Height (cm)	178,39	178,00	178,78	161,00	195,00	6,11
Weight (kg)	77.02	74,72	75,74	57,00	108,50	7,57
LBM	65.65	63,80	64,63	49.54	85,94	6,05
MM%	53,23	52,86	53,22	40.75	66,59	2,78
MMkg	39,94	39,62	40,25	22,79	55,48	4,93
BM%	17,05	17,21	17,38	13.65	21.71	1,27
BMkg	13.11	12,89	13,08	9.49	18,22	1,46
FM%	14,58	14,44	14,72	10.89	21.61	1.48
FMkg	11,37	10,87	11,17	6.75	22.56	1.95

Table 1. Physical characteristics and body mass components of Macedonian National League club footballers

Groups	Up to 20	Up to 22	Up to 24	Up to 26	Up to 28	Over 28
N	205	120	122	140	135	220
Age	18.27 (0.68)	20.45 (0.5)	22.57 (0.5)	24.51 (0.5)	26.54 (0.5)	30.63 (0.5)
Height (cm)	178.06 (6.2)	178.71 (5.85)	178.61 (6.15)	177.78 (5.81)	178.78 (5.79)	178.54 (6.42)
Weight (kg)	71.21 (7.73)	73.8£ (7.19)	75.88 £ (7.58)	76.25£ (7.56)	77.30£ (7.30)	77.79£ (7.64)
LBM	60.91 (6.76)	63.28 (5.8)	64.67 (6.00)	64.86 (5.99)	65.97 (5.66)	66.26 (6.16)
MM%	52.40 (3.23)	53.36 (1.88)	53.05 (2.5)	53.19 (2.84)	53.41 (3.33)	53.16 (2.37)
MMkg	37.34 (4.95)	39.4 (4.26)	40.30 (4.82)	40.51 (4.37)	41.32 (4.81)	41.37 (4.61)
BM%	17.84 (1.24)	17.42 (1.19)	17.23 (1.21)	17.06 (1.31)	17.02 (1.28)	17.05 (1.27)
BMkg	12.68 (1.53)	12.83 (1.38)	13.04 (1.28)	12.98 (1.44)	13.14 (1.12)	13.24 (1.19)
FM%	14.33 (3.72)	14.20 (1.41)	14.7 (1.66)	14.81 (1.56)	14.6 (1.19)	14.77 (1.44)
FMkg	10.25 (3.14)	10.52 (1.76)	11.21 (2.06)	11.33 (2.06)	11.34 (1.90)	11.53 (1.89)

Table 2. Comparison of physical characteristics and body mass components of Macedonian National League club footballers between age different groups. £ significantly higher than "up to 20"

group, under 20 years of age, displayed a notably higher relative bone mass compared to the remaining five older groups. The rest of inter-class differences were not significant ($p>0.05$).

The analyses of the absolute fat component (FM kg) showed a significant difference between the age intervals of the football players, for $F=9.01$ and $p<0.001$ ($p=0.000$). The analyses of the relative fat component (FM%) showed substantial difference among the age intervals of the athletes, $F=2.42$ and $p<0.05$ ($p=0.03$). As for absolute and relative fat components, both younger groups, the one aged up to 20 years and the one aged up to 22 years, showed significantly lesser amount of fat tissue. The rest of the inter-class differences were not significant ($p>0.05$).

The correlations between the body components and the age of the football players are shown on the Table 3.

	Scatter plot	Correlation	p
MMkg vs age	32.912 + 0.29188	r= 0.28	<0.001
MM% vs age	51.887 + 0.04795	r= 0.08	<0.05
BM kg vs age	11.896 + 0.04516	r= 0.15	<0.001
BM% vs age	18.625–0.0552	r=–0.20	<0.001
FMkg vs age	8. 7437 + 0.09457	r= 0.20	<0.001
FM% vs age	13.99 + 0.06928	r= 0.07	<0.05
LBM vs age	54.704 + 0.39491	r= 0.29	<0.001

Table 3. Pearson coefficient between body mass components and age of players

With an increase of the age for just one year, MMkg increased for 0.29 kg. For $r=0.28$ ($p<0.001$) in the examined relation there was mild and weak, but significant correlation. With an increase of the age for just one year, MM% increased for 0.05%. For $r=0.08$ ($p<0.05$) in the examined relation there was a mild and weak, but significant correlation. With an increase of the age for just one year, BMkg increased for 0.05 kilos. For $r=0.15$ ($p<0.001$) in the examined relation there was a mild and weak, but significant correlation. With an increase of the age for just one year, BM% decreased for 0.06%. For $r=0.20$ ($p<0.001$) in the examined relation there was a mild and weak, but significant correlation.

With an increase of the age for just one year, FMkg increased for 0.09 kilos. For $r=0.19$ ($p<0.001$) in the examined relation there was a mild and weak, but significant correlation.

With an increase of the age for just one year, FM% increased for 0.03%. For $r=0.07$ ($p<0.05$) in the examined relation there was a mild and weak, but significant correlation. With an increase of the age for just one year, LBM increased for 0.39 kilos. For $r=0.29$ ($p<0.001$) in the examined relation there was a mild and weak, but significant correlation.

5. DISCUSSION

The results obtained for the height and weight in the present study were similar to those of football players in most European and American clubs, but different from Asian and elite European football players (3,17-20). It is important to underline which method has been applied when comparing the results obtained from body composition analyses and how the method itself corresponds with other available and known methodologies. According to Human Kinetics, body fat percentage for athletes, especially for male football players, is 10-18%, without specifying the applied method. Regarding the body fat percent, the value of 14.58% found in this study was similar to the value found by Matkovic et al. (21) in Croatian elite players (14.9%), but higher when compared to other studies (9,18,23). The average values of the body fat percentage in our study population were found at the higher zone of the optimal level (5–15%) delineated by Heyward and Wagner (22) for a physically active male population between the ages 18–34. Body fat in Portuguese junior football players calculated by Matiegka's method was 11.7±1.4 (23). An anthropometric profile of international players in Uruguay produced mean estimated body fat values of 11% (determined from summed skin folds) and muscle masses averaging at 62% (24). Young adult Czech players, U19, were taller than the youngest players in our study (180.57cm; 73.44kg) and showed very low body fat (7.3%) (BIA method) and higher skeletal muscle mass (39.3 kg) . Investigations of the body composition in young adult football players at the end of the adolescent period, in U20 and U21 groups, showed similar values as ours: for body fat 15.24% and 14.45%, and for LBM 61.9kg and 64.3kg, respectively (25).

Regarding the muscle body component, the football players from different age groups were homogeneous. The average adult football players, who belong to wide age span, from very young at the beginning of adulthood to

the upper limit of young adult age, had excellent amount of muscle mass, about 53%. The biggest muscle mass was registered in the group aged 26-28 years. Only the youngest group, under 20 years of age, showed insignificantly lower relative muscle component. With respect to this parameter, all different age groups older than 20 years showed MM% almost identical to the average value of the whole group.

The bone mass which, by the Matiegka's formula for adult individuals who have finished with their growth, is 15-18% or less, showed the value of 17.3% in the whole group of examined individuals. The absolute bone mass was statistically lower only in the youngest group compared to the oldest. Although the absolute bone mass (expressed in kg) increases with age, the relative bone mass decreases with age. The bone mass percent, which is a more representative indicator of the portion of bone mass in the whole body mass, was significantly higher in U20 and U22. The higher bone mass in younger examined individuals reflects their bigger capacity for growth, that is, their unfinished process of growing.

The mean value of the fat component (FM%) of the Macedonian football players was 14.58% (calculated by Matiegka's method), which is quite high value compared to the published results for the football players of other countries. This discrepancy in the proportional portion of the fat component might be due not to the fact that the Macedonian football players are fatter, but rather to the different method applied for its estimation. Younger groups, aged up to 20 years and up to 22 years, showed statistically significant lower amount of fat tissue, expressed as both, relative and absolute value.

In the examined age span (18-35 years), with the age increase (for only one year), a slight increase of all three body components was registered. The biggest increase from the absolute value was measured in the muscle mass, followed by the fat and the bone component. If seen as relative values, the muscle and fat components showed equally weak positive correlation as the age increased for one year, while the bone component was decreasing with age (negative correlation). The age of 20 years could be taken as the lower limit for anthropometric comparison of adult football players because subjects younger than 20 years did not match anthropometrically with their older team mates. They had lower muscle and higher bone mass, that could be considered as anthropometric indicators of active growing process.

6. CONCLUSION

In summary, in this research we determined the body mass components which could be used as reference values for adult football players in our country. By comparison of differences in body composition across young adulthood (18-35 years) we concluded that the youngest players (under 20 years of age) who played in senior league had larger percent of bone mass and lower percent of muscle and fat mass than the older ones. Although there were no differences between adult age groups in body components, BF and MM were slightly, but significantly, in positive correlation with age. The relative bone mass was in reversed correlation with the age, which is due to the fact that the bone mass is higher in younger subjects who are still growing.

CONFLICT OF INTEREST: NONE DECLARED

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