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A comparative study of anthropometric measurements and body composition between junior football and basketball players from the Serbian National League

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A comparative study of anthropometric measurements and body composition between junior football and basketball players from the Serbian National League

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B Data Collection
C Statistical Analysis
D Data Interpretation
E Manuscript Preparation
F Literature Search
G Funds Collection

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abstract

Background: The purpose of this study was to describe anthropometric characteristics and body composition of junior football and basketball players as well as to make comparisons between them.

Material and methods: In this study 70 males were enrolled, divided into three groups: 25 football players, 13 basketball players and 32 healthy sedentary subjects. All subjects were assessed for the anthropometric measures required to calculate body composition variables, using the standardized procedures. Descriptive statistics were expressed as a mean (SD) for each variable. To detect the effects of each type of sport ANOVA and LSD Post Hoc tests were carried out.

Results: The results showed there was no significant difference in the body mass index and bone content in the body among the groups, while a significant difference was found for body height and body weight as well as for the other two body content variables measured (muscle and fat) among the groups.

Conclusions: These findings may give coaches from the region better working knowledge and advise them to follow recent selection process methods to be more successful during talent identification.

Key words: sport, youth, talent identification, males.

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INTRODUCTION

It is known that scientists all over the world are looking for a formula that can improve athletes' performance and discover talents as efficiently as possible [1]. The next important task is to identify strengths and weaknesses, assign player positions and help in the design of optimal training programs [2]. However, all of that is a very demanding process, as various athletic events require differing body types to achieve maximum performance [3].

Generally, it is accepted that practicing athletes could be expected to show structural and functional characteristics that are specifically favorable for their sport discipline [4]. Consequently, for all athletes involved in high professional competitive sports the body is required to perform at optimum capacity in terms of biomechanics [5]. In other words, every athlete should have specific anthropometrical characteristics and body composition figures convenient for his or her own sports discipline. Therefore, knowledge of the ideal values of athletes' body composition is considered an essential part of the total management process [6].

It is widely addressed in the scientific literature that adequate profiles are primarily important in various sports. There are several reasons for this. Frequently absolute size contributes a significant percentage of total variance associated with athletic success [7]. Strength, agility, speed, endurance, and power of an athlete depend on his/her body composition and body mass [8]. Excessive fat mass acts as a dead body mass in activities where the body must be repeatedly lifted during locomotion and jumping [9], thus, understandably, compromising the physical performance. Performance decreases and energy demands increase [10]. By contrast, muscle-skeletal mass is an indicator of sports performance [11]. It contributes to the energy production during high-intensity activities and provides absolute strength to athletes [12]. From this follows that a modern athlete should be fast, explosive and powerful. They should have more muscle mass and less fat tissue.

It is known, that body height cannot be much influenced, because it is a highly genetically conditioned dimension, while body weight, the percentage of fat and muscle can be changed a lot, and this fact should be used. Some sports require much more knowledge regarding this topic than others [13]. Competitors in wrestling, boxing, judo and female gymnasts want to lose weight quickly. On the other hand, competitors in shot put and weight lifting must have large muscle mass. However, the need to explore the anthropometrical characteristics and body composition of football and basketball players is also significant. Many previous studies have evaluated ideal anthropometric profiles of successful football and basketball players [14–18]. However, more data concerning characteristics of football and basketball players come from America and Western Europe and less from Eastern Europe. It allows an insight into the requirements for competing in their particular sports and informs about the competitive requirements of these sports. This study aims to assess anthropometrical characteristics and body composition of Western Balkan athletes, whose general population had specific measurement [19–21].

The training in football is usually based on movement expressed through endurance. It consists of a series of moderate activities, followed by alternating periods of high intensity, which leads to significant metabolic heat production [22]. Indeed, football requires a high standard of preparation through the

development of physical performance skills. However, the importance of tactical and technical expertise cannot be overlooked in order to withstand 90 minutes of competitive play during which the average intensity reaches about 75–90% of the maximum heart rate, respectively 70–85% of VO_2max [23]. On the other hand, basketball, which is an intermittent sport, is physically very demanding, but the regime is different. It constantly requires players to repeat intense actions (sprinting, shuffling, jumping) with jogging, walking, or short periods of recovery in between [24]. In this game, movement patterns significantly differ from football. It is imperative that the elements of the technique be applied quickly and explosively [25]. The average work intensity of a basketball game is above 85% of the maximal heart rate and above 80% of VO_2max [26].

Hence, the purpose of this study was to describe anthropometric characteristics and body composition profiles of junior football and basketball players from the Serbian national league as well to detect possible differences in relation to the competition level between them.

MATERIAL AND METHODS

Participants

70 males were enrolled in this study. They were divided into three groups: 25 football players (16.64 ±0.49 yrs.) from the junior premier league in Serbia, 13 basketball players (17.08 ±0.28 yrs.) from the junior premier league in Serbia and 32 healthy sedentary subjects from the same country (17.34 ±0.60 yrs.). The measurements were carried out in the winter preparation period.

Procedure

All subjects were clinically healthy and all of them give their written consent to participate in the experiment. The local ethics committee approved the protocol of the study. All subjects were assessed for the twenty anthropometric measures required for the calculation of body composition variables. The standardized procedure recommended by the International Biological Program (IBP) was used [27]. Height and weight were measured in the laboratory with the subject dressed in light clothing. Height was measured to the nearest 0.1 cm using a fixed stadiometer, and weight was measured to the nearest 0.1 kg with a standard scale utilizing a portable balance. Skinfolds (mm) were measured at six sites: triceps skinfold thickness, forearm skinfold thickness, thigh skinfold thickness, calf skinfold thickness, chest skinfold thickness and abdominal skinfold thickness (using a skinfold caliper). The circumferences (cm) were measured at eight sites: minimum and maximum circumference of the upper arm, minimum and maximum circumference of the forearm, minimum and maximum circumference of the upper leg, minimum and maximum circumference of the lower leg (using a anthropometric tape). At last the following diameters were measured to the nearest 0.1 cm: elbow diameter, wrist diameter, diameter of the knee, diameter of the ankle (using a small siding caliper). To reduce measurement variation, the same investigator examined all of the subjects. The body mass index (BMI) was calculated as body mass in kilograms divided by height in meters squared (kg/m^2). The values of bone, muscle, and fat content of the body composition were acquired by distributing all the measured variables in formulas by Mateigka [28].

STATISTICAL ANALYSIS

The data obtained in the research were processed using the application statistics program SPSS 20.0, adjusted for use on personal computers. The descriptive statistics were expressed as a mean (SD) for each variable. Analysis of the variance (ANOVA) and the LSD Post Hoc test were carried out to detect the effects for each type of sport (football or basketball) on each variable: body height, body weight, body mass index (BMI), and muscle, bone and fat content of the body, as well as to control it by sedentary subjects. The significance was set at an alpha level of 0.05.

RESULTS

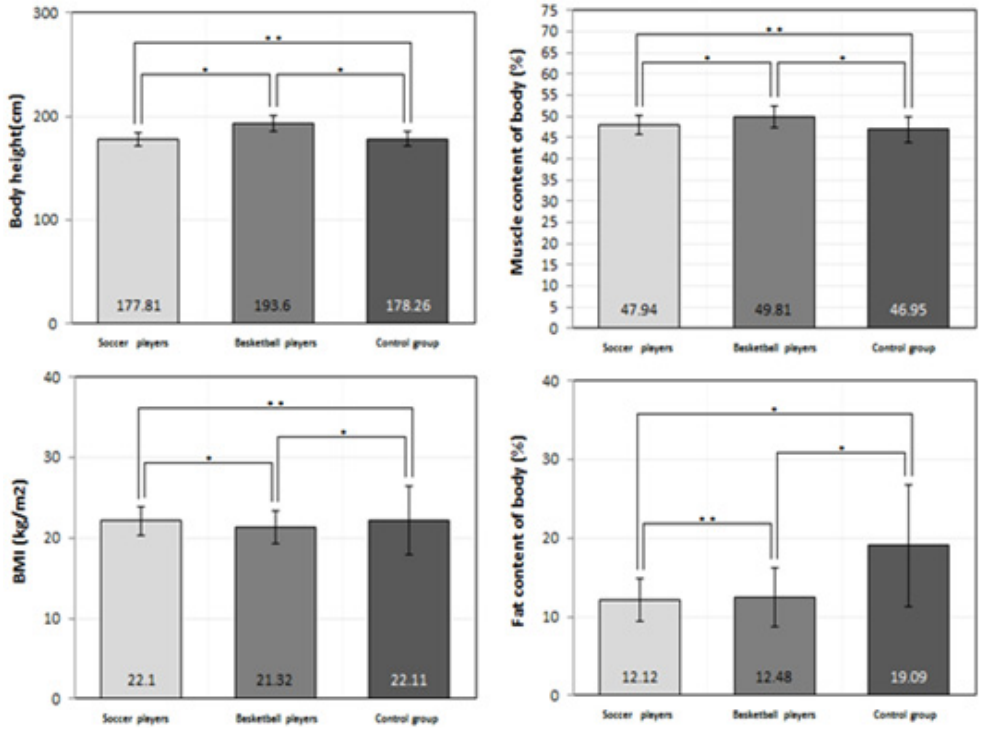
The anthropometric characteristics of subjects are shown in Table 1. There was no significant difference in the body mass index and bone content of body among the groups, while a significant difference was found for body height ($F = 25.19$), body weight ($F = 4.14$) and the other two body content variables among the groups: muscle ($F = 5.41$), and fat ($F = 12.31$).

Table 1. Descriptive data and ANOVA of 70 males enrolled in the study

Variables	Football (N = 25)	Basketball (N = 13)	Control (N = 32)	ANOVA
	Mean ±Standard Deviation			
Height (cm)	177.81 ±6.63	193.60 ±7.70	178.26 ±7.27	0.000*
Weight (kg)	69.90 ±6.78	80.00 ±9.76	70.27 ±14.09	0.020*
BMI (kg/m^2)	22.10 ±1.74	21.32 ±1.99	22.11 ±4.27	0.726^
Muscle content in the body (%)	47.94 ±2.12	49.81 ±2.58	46.95 ±3.02	0.007*
Bone content in the body (%)	16.76 ±1.48	16.95 ±1.15	17.34 ±2.47	0.532^
Fat content in the body (%)	12.12 ±2.78	12.48 ±3.67	19.09 ±7.77	0.000*

Note: N – number of subjects; BMI – body mass index; ^ – non-significant; * – significant difference between groups.

The significant differences of anthropometric characteristics among particular sports are shown in Figure 1. The LSD Post Hoc test shows a significant advantage in body height and body weight of basketball players compared to football players and the control group subjects. There is no significant difference in body height and body weight between football players and the subjects of the control group. This test also indicates that basketball players have a significantly lower body mass index (BMI) than football players and subjects in the control group, while there is no significant difference in the body mass index (BMI) between football players and the subjects of the control group. A significant advantage in the muscle content of the body in football and basketball players compared with subjects in the control group is noticeable, while there is no significant difference in the muscle content of the body between football and basketball players. Lastly, an increased and significantly higher value of the fat content is observed in subjects of the control group compared with football and basketball players, while there is no significant difference in this variable between football and basketball players.



Legend: * – significant; ** – non-significant.

Fig. 1. LSD Post Hoc test for the different parameters among the subjects

DISCUSSION

The results support previous investigations indicating a strong difference regarding the body height among basketball players on the one hand and football players and the subjects from the control group that represents general population on the other hand [8, 29]. Thus, selection criteria, different types of play and game rules between the football and basketball game can explain the observed difference. However, there has been a tendency to recruit taller and heavier football players [30]. And the absence of the differences between football players and subjects of the control group in this study raises doubt whether the selection process has been carried out correctly, especially because football players are shorter than subjects from the control group that represent the general population. Nevertheless, the official statistical data reveal that the average height of all the participants in the FIFA U-17 World Football Championship India 2017 was 176.01 centimeters, while the average height of representatives of England and Spain who played the finals of the aforementioned championship is 179.1cm and 178.6cm, respectively. On the other hand, representation of Mali, which is the shortest team in the mentioned FIFA U-17 World Football Championship with only 164.09 cm, has won fourth place. In a starting line-up, on the pitch in the battle for the third place there were players who mostly were not tall: Youssouf Koita (170 cm), Boubacar Haidara (160 cm), Djemoussa Traore (150 cm), Fode Konate (170 cm), Mamadi Fofana (175 cm), Mohamed Camara (150 cm), Hadji Drame (160 cm), Salam Giddou (170 cm), Mamadou Samake (180 cm), Ibrahiim Kane (150 cm) and Lassana Ndiaye (170 cm). Similarly, Philip Foden, the best young player in England and the best one of FIFA U-17 World Football Championship in India 2017, was 169 centimeters tall, while the most valuable Brazilian players, Paulinho and Brenner, were 174 and 175 centimeters tall, and another English

Paulinho and Brenner, were 174 and 175 centimeters tall, and another English player Rhian Brewster, the top goal scorer of the whole championship, was 177 centimeters tall. On the basis of the aforementioned data, we conclude that that football players from this study are tall enough. The aforementioned doubt may be quenched through new research that will cover a larger sample. The tendency to recruite taller players has not been confirmed in the literature [31–33]. On the other hand, there is a tendency for basketball players to be extremely tall athletes because players handle the ball above their heads [34]. Also, because their height helps them to reach toward the basket, as well as to defend the ball against opponents. Taller players in basketball have an advantage because their height enables their shot to travel a shorter distance [35]. They start out closer to rebounds, and their ability to jump higher than their opponents gives them a chance to block their shots [36]. For example, the average height of players in the 2016 FIBA U17 World Basketball Championship played in Zaragoza in Spain was 195.56 cm. Similarly, the average heights of the national basketball teams who played semifinals, according to available data from the official website, were as follows: USA (198.17 cm), Turkey (195.75 cm), Lithuania (198.17 cm) and Spain (195.92 cm). However, this is expected, since 28% of people from the general population have a body height of 190cm or more [37–39]. This will provide coaches from the region with new working knowledge on the basis of which they will successfully identify talent. Furthermore, it was expected that basketball players were heavier than football players and the subjects of the control group. The first reason is they are significantly taller than both of the other mentioned groups. The second reason is that the average height of basketball players in the past 20-30 years has increased dramatically. This could be a function of better nutrition, especially in professional basketball leagues, partly due to the use of nutritional supplements. On the other hand, the body mass index (BMI; weight/height2), parameter indicating overweight and obesity, fortunately, is in the area of normal weight according to the established literature for all three groups [40, 41]. The slightly lower values of for basketball players need not worry because the development process is still ongoing. Indeed, the authors found that the basketball players have significantly higher muscle content in the body than subjects of the control group. Unexpectedly, football players have a slightly higher percentage of muscle content than control subjects, which is clearly seen in the table overview. These results may be explained by more demands on sportsmen to grow the muscle content of the body. A slightly higher percentage of muscle content in basketball players was found as this game requires intermittent activities, when high-intensity activities are followed by low-intensity type of movements. It is also interesting to mention that basketball players have to use both upper and lower extremities, while football players use just lower extremities, possibly an additional reason why the authors reach these results. Regardless of lower values for football players, we should not doubt the selection process. It also corresponds to the fat content values we find in the established literature [42]. The bone content in the body of all groups of sportsmen is proportional to the longitudinal and transversal dimension of the skeleton, and it did not show any significant differences among the groups. In a gravitational sport like football and basketball, it is accepted that excessive fat mass compromises physical performance [43]. Therefore, the significantly lower percentage of fat content in the body of football and basketball players than in the control subjects showed that players from this study have high physical performance. Also, it is very important to remember that football and basketball players need a determined body fat percentage to perform well enough and achieve their full playing potential. A person who has too little fat tissue is exposed to certain risks [44]. A large decline of fat levels

can lead to complications and contraindications. Adipose tissue is a complex, essential, and highly active metabolic and endocrine organ which, through secreting adipokines, plays a very complex role [45]. The role of adipokines (leptin, adiponectin and interleukin 6) in proliferation, in hematopoiesis and reproduction is large just as in regulation of the immune function, angiogenesis, and bone development [45]. Since they have anti-diabetic, anti-inflammatory and anti-atherogenic properties, their lack would make the organism weak [46, 47], which means that a deficiency in the adipose tissue can have as harmful consequences as its excess.

CONCLUSIONS

The importance of body composition in sport performance is a primary concern in creating athlete profiles as well as conditioning programs throughout a season at all levels of competition [48]. This is mostly due to the fact that describing anthropometric characteristics and body compositions of athletes and detecting possible differences in relation to competition levels may give coaches a better working knowledge of the studied groups of athletes. Moreover, the results of this study suggest that playing football (slightly) and basketball (significantly) increased the percent of muscle content and significantly decreased the percentage of fat content (using the comparison of the control group whose participants had a higher percentage of body fat). The difference in body height is the result of the selection process. Hence, an increased focus on these variables is essential. On the other hand, the part attributed to body weight could be mainly caused by nutritional habits, lastly the differences in the bone content of the body is a logical consequence.

As this study was conducted in the middle of the season, it is limited by the fact that changes in body composition and physical performance can occur during the season [49]. It has been confirmed that athletes who start a season with a high catabolic status can expect reductions in performance during a competitive season [50], while detrimental changes in body composition are also probable [51]. Accordingly, subsequent studies should be designed more carefully to measure anthropometric characteristics and body composition, and it would be best to conduct them either at the beginning or at the end of a season.

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