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Comparative Study of Anthropometric Measurement and Body Composition between Elite Handball and Basketball Players

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A B S T R A C T

The purpose of this study was to describe anthropometric characteristics and body composition of elite handball and basketball players as well as to make comparisons between them. Fifty-nine males were enrolled in the study, divided into three groups: fifteen handball players, fourteen basketball players and thirty healthy sedentary subjects. The descriptive statistics were expressed as a mean (SD) for each variable, while the ANOVA and LSD Post Hoc tests were carried out to detect the effects of each type of sport. The results showed there was no significant difference in body mass index among the groups, while a significant difference was found for body height and body weight as well as for all three of the body contents measured (muscle, bone and fat) among the groups. These findings may give coaches from the region better working knowledge and suggest to them to follow recent selection process methods and to be more careful during the recruitment.

Key words: *Sport, Top-Level, Handball, Basket, Male.*

Introduction

Improvement of the athletes performance is relevant topic in wide scientific literature (cited in Popović, Akpinar, Jakšić, Matić, & Bjelica, 2013; Popović, Bjelica, Jakšić, & Hadžić, 2014) as well as identifying talent, strengths and weaknesses, assigning player positions and helping in the design of optimal training programmes (cited in Hadžić, Bjelica, & Popović, 2012). However, authors prefer to research the issues such as increasing the physical fitness of athletes than considering the assessment of their body composition and their nutritional status (Triki et al., 2012). The main goal of the modern scientific approach in the area of sport sciences is recognize the standard performance of elite players and recognize and utilize the talents as early as possible. However, this work is not quite easy; mostly due to the reason the various athletic events require differing body types to achieve maximum performance. From this reason, it is important to get to know the characteristics of the body composition of elite players well enough, due to the reason this is considered an essential part of the total management process (Wilmore, 1982). On the other hand, it is relevant to specify that young athletes grow in a manner similar to non-athletes (cited in Popovic et al., 2014), it is widely recognized in the scientific literature that adequate profiles are primarily important in various sports disciplines, mostly due to the reason that absolute size contributes a significant percentage of total variance associated with athletic success (Carvajal et al., 2012). Therefore, scientists all over the world are looking for a standard formula that can improve the performance of elite players and discover talents as early as possible.

The anthropometrical characteristics and body composition of athletes has been the subject of many investigations as many researchers hypothesized the practicing athletes might be expected to exhibited structural and functional characteristics that are specifically favorable for the sport (S. Singh, K. Singh, & M. Singh, 2010). According to Massuça & Fragoso (2011), body composition and body mass contribute among other factors to optimal exercise and performance, body mass can influence an athlete's speed, endurance, and power, whereas body composition can affect strength and agility. However, there is most of descriptive data concerning characteristics of handball and basketball players from America and Western Europe, although there is a lack of data from Eastern Europe and this study aims to check if this is true for Serbian athletes. Hence, many previous studies have evaluated ideal anthropometric profile of successful handball player (Srhoj, 2002; Chaouach et al., 2009) as well as basketball player (Gualdi-Russo & Zaccagni, 2001; Bayios, Bergeles, Apostolidis, Noutsos, & Koskolou, 2006; Hooper, 1997) that provide insights into the requirements for competing at top level in particular sports. Indeed, handball is team sport that is generally played in an indoor field and requires a high standard of aerobic and anaerobic fitness in order to complete 60 minutes of competitive play and to achieve success through an intermittent high intensity body-contact and well-coordinated activities (Buchheit, Lepretre, Behaegel, Millet, & Ahmaidi, 2009). Team handball is one of the fastest and the most endurance required team sports and is epitomized by special maneuvers such as jumping, shooting under the pressure, faking against hard defense players and attempting fast breaks despite all the fatigue (Bilge, 2013). On the other hand, basketball is a team sport that is generally also played in an indoor field that is smaller than that of a handball field, and it requires a high standard of preparation in order to complete for 40 minutes of competitive play and to achieve success. In this game, movement patterns differ from handball, as it requires different specific work/rest ratio and/or effort distributions during games.

Hence, the purpose of this study was to describe anthropometric characteristics and body composition profiles of elite handball and basketball players and to detect possible differences in relation to competition level.

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Methods

Participants

Fifty-nine males were enrolled in the study. They were divided into three groups: fifteen handball players (23.13±0.22 yrs.) from the handball premier league in Serbia, fourteen basketball players (23.50±2.77 yrs.) from the basketball premier league in Serbia and thirty healthy sedentary subjects from the same country (24.77±3.00 yrs.). The measurements were carried out in the first three months of 2007.

Variables

All subjects were clinically healthy and had no recent history of infectious disease, asthma or cardio-respiratory disorders. All of them gave their written consent and the local ethics committee approved the protocol of the study. All subjects were assessed for the anthropometric measures required for the calculation of body composition variables, using the standardized procedure recommended by the International Biological Program (IBP) standards respecting the basic rules and principles related to the parameter choice, standard conditions and measurement techniques, as well as the standard measuring instruments adjusted before measurement was carried out. 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. Body mass index (BMI) was calculated as body mass in kilograms divided by height in meters squared (kg/m2). 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). Each individual measurement and the sum of the six measurements were used for analysis. The circumferences of the upper and lower arm and the upper and lower leg were measured in centimeters and the following diameters were measured to the nearest 0.1 cm: elbow diameter, wrist diameter, knee diameter, ankle diameter, upper arm diameter, forearm diameter, thigh diameter, and calf diameter. To reduce measurement variation, the same investigator examined all of the subjects.

Table 1. Anthropometric Measurement and Body Composition among the Subjects

Variables	Handball (N=26)	Basketball (N=14)	Control (N=31)	ANOVA
	Mean ± Standard Deviation			
Height (cm)	188.16±0.81	199.50±7.37	183.72±7.60	0.000*
Weight (kg)	86.63±0.87	99.57±11.60	86.74±14.68	0.007*
BMI (kg/m2)	24.47±0.65	24.94±1.40	25.61±3.49	0.330^
Muscle content of body (%)	52.85±0.80	51.26±1.99	48.32±3.27	0.000*
Bone content of body (%)	15.29±0.36	16.22±0.77	14.78±1.78	0.014*
Fat content of body (%)	12.41±0.08	11.54±1.97	18.51±5.89	0.000*

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

Statistical analyses

The data obtained in the research was 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 (handball 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 body mass index among the groups, while a significant difference was found for body height (F=22.22), body weight (F=5.37) and all contents of body among the groups: muscle (F=4.63), bone (F=6.75) and fat (F=16.96).

Table 2. Differences among the Subjects

Dependent Variable	(I) Group	(J) Group	Mean Difference (I-J)	Sig.
Height (cm)	Basketball	Handball	11.34	0.00*
	Basketball	Control	15.63	0.00*
	Handball	Control	4.29	0.07^
Weight (kg)	Basketball	Handball	12.94	0.01*
	Basketball	Control	12.34	0.00*
	Handball	Control	-0.60	0.88^
Muscle content of body (%)	Basketball	Handball	-1.59	0.16^
	Basketball	Control	3.00	0.03*
	Handball	Control	4.60	0.00*
Bone content of body (%)	Basketball	Handball	0.94	0.09^
	Basketball	Control	1.45	0.04*
	Handball	Control	0.51	0.27^
Fat content of body (%)	Basketball	Handball	-0.87	0.60^
	Basketball	Control	-7.23	0.00*
	Handball	Control	-6.36	0.00*

Note: ^ - non-significant; * - significant difference between groups.

The significant differences of anthropometric characteristics among particular sports are shown in Table 2. The LSD Post Hoc test indicates that basketball players were significantly taller than handball players and the subjects of control group, while there was no significant difference between the height of handball players and the height of the subjects in the control group. This test also indicates that basketball players were significantly heavier than handball players and the subjects of control group, while there was no significant difference between the weight of handball players and the subjects of the control group. The muscle contents of the bodies of the subjects in control group were significantly lower than that of all of the other subjects, while there was not any difference between handball and basketball players, while the bat contents of the bodies of the subjects in control group were significantly higher than that of all of the other subjects, while there was not any difference between handball and basketball players. Lastly, the bone content in the bodies of the subjects in the control group was significantly lower than the basketball players, while there was not found any other differences in this content.

Discusion

The results support previous investigations indicating a significant difference regarding the body height. Thus, selection criteria, different type of play and game rules between the basketball and handball game can explain the observed difference. However, our handball players are shorter than European players from the 2007 World Handball Championship. For example, the average height of Germany, the winning team was 194 centimeters, while the 15th Korea had an average of 187 centimeters and the 18th Kuwait had 184 centimeters. However, the teams from Africa and Asia are comparably shorter than the majority of European Teams (Taborsky, 2007). Therefore, this doubt may give coaches from Serbia better working knowledge of this particular group of athletes and suggest them to follow recent selection process methods and to be more careful during the recruitment as they have very tall population in general (Popović, Bjelica, Molnar, Jakšić, & Akpinar, 2013). On the other hand, the average height of professional basketball players in 2007 to 2008 season, according to available data from NBA.com, was 200.6 centimeters. From the other side, the average heights of the national basketball team's participants of the semi-finals in the 2012 Olympic Games in London, according to available data from official website, were following USA (200.1 cm), Spain (202.4 cm), Russia (201.2 cm) and Argentina (197.4 cm). This proves that the players from our basketball premier league are tall enough and they do not lag behind the top players in the world. However, this is not a surprise, as it is well known that the density of very tall subjects appears to be characteristic of the people from this area, since 28% of people from the general population were measured 190 centimeters or above in body height (Bjelica, Popović, Kezunović, Petković, Jurak, & Grasgruber, 2012). Therefore, this fact may give coaches from Dinaric Alps better working knowledge of this particular group of athletes and suggest to them to follow recent selection process methods and to be more careful during the recruitment, as they have a very tall population in general (Pineau, Delamarche, & Božinović, 2005) which confirms the high score of the subjects from control group (183.72 cm).

Furthermore, it was expected that basketball players were heavier than handball players and the subjects of the control group, mostly due to the reason they are significantly taller than both mentioned groups. However, the reason we have such heavier players in basketball has also to do with the fact that the average size of the basketball players has increased dramatically in the past decades. This could be a function of better nutrition, especially in professional basketball leagues, partly due to the use of nutritional supplements as well as anabolic steroids etc. If we compare our data to the average personal details of all participants in the 2012 Olympic Games in London by each sport: handball (82.5kg) and basketball (87.0kg), we can prove that the players from our premier leagues are much heavier.

The body mass index (BMI; weight/height2) is parameter that is widely used in adult populations such as an internationally recognized definition of overweight and obesity (cited in Kovač, Jurak, & Leskošek, 2012). Fortunately, the body mass index of all three groups is in the area of normal weight according to the established literature and it did not show any significant differences among the groups.

Indeed, we found that muscle content of handball and basketball players were significantly higher than control subjects, while bone content of basketball players were insignificantly higher than handball players and significantly higher than control subjects. These results may be explained by the fact that both, handball and basketball players have to use both, upper and lower extremities, and have higher percent of the muscle content than the players use just lower extremities (Popović, Bjelica, Petković, & Muratović, 2012). These results may be also explained by more demands to grow the muscle contents of the body in games that requires intermittent activities when high-intensity activities are followed by low-intensity intensity type of movements (Buchheit et al., 2009), such as handball, basketball etc. Moreover, it was expected that the percent of fat mass of the control group is significantly higher than the handball and basketball players and these results could be explained by less physical activity in controls (Popovic et al., 2014). However, it is interesting that the percent of fat content in the body of handball players are insignificantly higher than the percent of fat content in the body of basketball players. These results may be explained by an increased aerobic activity in basketball players, whereas handball trainings contains more anaerobic activity than basketball as this game requires higher intensity body-contact and well-coordinated activities (Buchheit et al., 2009). Although handball matches have duration of 60 minutes divided in two halves lasting 30 minutes each, handball players cover a total distance ranging approximately from 2,000 to 6,000 meters (Popovic et al, 2012). This is less shorter distance (5,000 to 7,000 meters) that basketball players cover (Dezman & Erculj, 2005; Erculj & Supej, 2006), although basketball matches have duration of 48 minutes divided in four parts lasting 12 minutes each. These distances are based upon different circumstances in each sport. The first of all it depends on position, then tactical defensive or offensive characteristics, or characteristics of the game.

This study suggests that handball and basketball decreased percent of fat content if we compare it to control group. On the other hand, this study also suggests that the muscle content of handball and basketball players seems to be explained by a greater percent compared to the subjects of control subjects, while the differences in the bone content are logical consequences. Lastly, the part attributed to the body height is the main causes of selection process.

Considering that the measurements were conducted in the middle of the season, this study is limited by the fact that changes in body composition and physical performance may occur from the start to the end of an athlete's training and competitive season (cited in Silvestre et al., 2006). Kraemer et al. (2004)

reported that athletes who enter a season with a high catabolic metabolic status could experience reductions in performance during a competitive season accompanied by detrimental changes in body composition. Accordingly, further studies should be very careful in projecting timelines for measuring anthropometric characteristics and body composition, mostly due to the fact that it has to be conducted either at the beginning or at the end of a season. It also has to be explicitly reported when the measurement was conducted.

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