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ANTHROPOMETRIC CHARACTERISTICS AND BODY FAT MASS IN ELITE BASKETBALL PLAYERS

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Abstract
The present study was designed to evaluate the anthropometric parameters, body composition and anaerobic power components of elite male and female basketball players and compare them in relation to gender and specific sport demands. The study group consisted of 43 elite national level athletes: 22 male basketball players (aged 20.3±2.92) and 21 female players (aged 19.5±2.96). The significant differences were noted in fat body mass, triceps and lower body region skinfolds, wigh higher values in females, while higher values of forearm, upper arm and waist circumference were noted in males. Comparing Wingate test parameters, higher values of absolute anaerobic power, explosive power, and absolute anaerobic capacity were recorded in male players, while there was no significant difference in relative anaerobic power, and relative anaerobic capacity values between genders. Morphometric profile in elite sport should accompany physiological profile in order to monitor improvements during training process and sport performance.

Key words: body composition**,** physical activity, athletes, anthropometry, body mass index.

Introduction

Basketball is one of the most popular sports in the world, played at verying levels of competence among different nations. Sucesfull performance in basketaball, requires technical skills, energetic capacities, motivation, and specific anthropometric characteristics. During last decades there is growing interest among sports medicine scientists in assessing performance of elite athletes in relation to their body composition. The human body is composed of different tissues with more or less metabolic activity. Muscle mass is essential for optimum performance in all aspects of elite sport, and fat body mass is also needed for

optimal physiological function. Fat tissue is providing energy for long duration physical activities, but exceeding amount of body fat mass is associated with decrement in performance. Therefore optimal body composition with appropriate ratio of musce to fat mass in essential for achieving maximal performance in elite sport. Body composition assessment is part of total physiological profile of an athlete (Wilmore,1982), and it is widely accepted that adequate attributes are important in various sports (Carvajal, 2012). Morphometric characteristics are specific for each sport depending on the demands and type of the activity (aerobic, anaerobic).Basketball can be defined as an intermittent sport, requiring repeated bouts of intense actions followed by short periods of recovery (Ben Adbelkrim, 2007). It is also a game of continuously changing movements, needing explosive muscle power and developed both energetic capacities (Maud, 2006).

Elite athletes in this sport should have the ability to generate speed, but also high aerobic capacity and significant anaerobic power release during the game. Although aerobic capacity has been more extensively analyzed in literature, corresponding data for anaerobic profiles are still lacking, particularly in elite sport.

In order to obtain high level of physical performance, specific body composition should also be monitored and evaluated in basketball. There were several studies on the body composition and anthoropometric parameters on basketball players (Pelin, 2009, Sallet 2005, Gaurav 2010), indicating that the morphological characteristics in elite athletes in specific discipline differ from general population and other sport branches: for instance, basketball players are taller and heavier than players of other games, with longer limbs and relatively low values of body fat mass and high values of lean body mass.

Knowing the morphological profile of basketball players is very important for maximal performance, the aim of this study was to evaluate antropometric characteristics and anaerobic abilities of elite players and compared them according to gender. Data obtained could be used to help coaches and sports medicine specialists to monitor their physical performance and in the process od talent selection. Evalutation of anaerobic performance is also relevant to athletes since anaerobic parameters can be improved through specific conditioning regiments.

Methods

Forty three elute national level basketball players were enrolled in the study. They were divided into two groups: twenty-two male basketball players (20.30±2.92 yrs), and twenty one female basketball players (19.5±2.96 yrs). Anthropometric measurements (body mass, body height, skinfold thicknesses, body circumferences), were measured and calculated in all subjects. The nutritional level was defined according to the body mass index values (WHO, 2000), obtained by dividing a person's weight in kilograms by the square of the person's height in meters.

The anthropometric evaluation included 3 types of measurements: basic (body height, body mass, body mass index), body circumferences (chest, flexed and relaxed upper arm, forearm, waist, hip, mid-thigh, calf) and skinfold thickness (chest, subscapular,midaxillary, biceps, triceps, abdominal,suprailiac, supraspinal, front thigh, medial calf), according to the International Society for the Advancement of Kinanthropometry (International Society for the Advancement of Kinanthropometry, 2001).

The body height was measured by Harpender anthropometer (Holtain Ltd, Croswell, UK), with the precision of 0.1 cm. The body fat mass (FAT%) and total body mass were measured by Tanita bioimpedance analyzer TBF-310 (Tanita Corporation, Tokyo, Japan). The skinfold thicknesses were measured by using Harpenden caliper (Holtain Ltd, Croswell, UK) with the precision of 0.2 mm. All skinfold thicknesses were measured three times and the final value was the average between the three measurements.

All participants also performed Wingate Anaerobic Test, for assessment of anaerobic power components (Bar-Or 1987). The basic parameters were obtained: peak power, or anaerobic power (AP) is highest power output observed during the first few seconds of test; anaerobic capacity (AC); and explosive power (EP) as new parameter obtained in Laboratory, reflecting explosive component of muscle contraction. All parameters were recorded via software installed in PC, which was directly connected with the ergometer machine and then analysed, in absolute and relative values.

Results

Table 1 *Basic anthropometric characteristics of basketballball players and nonathletes*

Subjects	***Height (cm)***	***Body mass (kg)***	***Age (years)***	***Sport experience (years)***
Basketball players males (n=22)				
X	194*	90.1*	20.3	8.97
SD	6.46	11.8	2.92	3.0
MIN	184	73.0	18	3
MAX	208	127	27	14
Basketball players females (n=21)				
X	177	69.3	19.5	8.87
SD	5.41	6.08	2.96	2.73
MIN	168	58	18	6
MAX	189	78.0	25	15

Table 1 describes the basic anthropometric characteristics and sport experience of male and female basketball players. Males were taller and significantly heavier, and there was no difference in age and sport experience between genders.

Table 2 *Body mass index (BMI) references for adults (WHO, 2000*

BMI(kgm^{-2})	Nutrition level
< 18.5	Underweight
18.5-24.9	Normal weight
25-29.9	Overweight
>30	Obesity

Reference values of BMI are shown in Table 2 (WHO,2000).

Subjects with BMI <18.5kgm^{-2} were considered underweight, normal weight was defined as BMI between 18.5kgm^{-2} and 24.9 kgm^{-2}, and overweight was defined as values above 25kgm^{-2}. According to reference values for adults, BMI of volleyball players is above the values defined as normal weight.

Table 3. Body fat level, body mass index, and skinfold thickness values of basketball players

	Basketball players males	**Basketball players females**
	$\bar{X}$ SD	SD
BF (%)	12.3 ± 2. 84	15.2*±3.25
BMI (kg/m^2)	23.9 ± 2.50	21.4±3.22
Skinfold thickness (mm)		
Chest	8.70±2.32	10.4±3.64
Subscapular	10.9±4.88	12.1±5.36
Midaxillary	9.81±3.22	8.93±3.00
Biceps	6.02±2.35	8.05±3.18
Triceps	9.19±3.61	18.8*±6.94
Abdominal	16.0±6.67	24.5*±8.26
Suprailiac	10.1±5.50	18.0*±5.35
Supraspinal	7.04±3.32	9.51*±3.49
Front thigh	14.0±6.25	28.1*±8.95
Medial calf	8.60±3.55	15.4*±6.35

*p<0.05.

Body fat level, body mass index, and skinfold thickness values of basketball players were presented in Table 3.

The results indicated statistically significant ($p \leq 0.05$) differences between the male basketball players and female players in body fat mass.Significant ($p \leq 0.05$) gender differences were found in values of triceps, abdominal, supraspinal, suprailiac, thigh and calf skinfold.

Female basketball players in general are found to possess more deposition of subcutaneous fat in triceps area and in the lower regions of body (supraspinal, suprailiac, thigh and calf skinfold) as a sex specific distribution, while male players had greater value of midaxillary skinfold.

Table 4. Values of body circumferences

Circumference	Basketball players males $\bar{X}$ SD	Basketball players females
Circumferences (cm)		
Forearm	26.6*±2.25	23.4±1.70
Upper arm relaxed	30.2*±2.50	26.3±2.25
Upper arm flexed	34.1*±3.00	28.8±2.35
Chest	97.7±6.13	90.9±5.75
Waist	82.0*±5.92	73.4±4.26
Hips	101±5.99	97.7±5.29
Mid-thigh	55.0±4.29	54.9±2.90
Calf	39.0±2.83	39.1±3.22

Values of body circumferences were presented in Table 4. Significantly higher values were recorded in males in forearm, upper arm and waist circumference, compared to female basketball players.

Table 5. Values of Wingate test parameters in investigated groups

Subjects	Parameter	Anaerobic power (W)	Relative anaerobic power (W/kg)	Explosive power (W/s)	Relative explosive power (W/kg/s)	Anaerobic capacity (J)	Relative anaerobic capacity (J/kg)
Basketball players males	X	803*	8.83	126*	1.38*	16476*	181
	SD	177	1.81	37.3	0.38	3076	32.5
	min	492	4.94	58.6	0.41	10470	105
	max	1281	13.6	158	2,30	24750	258
Basketball players females	X	574	7.56	82.5	1.18	12288	178
	SD	104	1.49	14.3	0.18	2140	26.5
	min	233	3.74	37.8	0.37	7500	94.5
	max	740	11.42	122.8	1.53	14135	194

Values of Wingate test parameters in investigated groups are shown in Table 5. When analyzing the Wingate test parameters of examined athletes, we can observe significantly higher values of absolute anaerobic power, absolute and relative explosive power, and absolute anaerobic capacity, while there was no significant differences in relative anaerobic power, and relative anaerobic capacity between genders.

Discussion

Data of morphologic parameters in the field of sports medicine revealed that optimal body structure in athletes is associated with improvements in functional abilities and athletic performance (Kerr, 1995). In order to obtain informations of body composition parametes optimal for particular sport, anthropometric measurements are of great importance since the large amount of data can be collected with a non-invasive methodology and inexpensive equipments (Gaurav, 2010, Massuca, 2011).

Regular physical activitt leads to specific body composition changes, and individuals involved in programmed, dosed and continous physical activity (athletes) differ in athrompometric characteristics from general population. In elite athletes, these characteristics could be specially favorable for specific sport demands. In this terms, the anthropometric profile of basketball players is proved to be one of the crucial factors for maximal performance. As shown in previous studies, adequate body composition and body fat mass contribute to optimal performance in basketball (Carter, 2005, Gaurav 2010). Optimal body structure is needed for specific demands of this sport, with developed lean body mass and the least possible percentage of body fat. This is in accordance with our results, where basketball players are tall, relatively lean subjects with low fat mass percentage. When analyzing

anthromopometric parameters, the importance of body heigh is commonly accepted in team sports such is basketball. It is documented that specific morphological characteristics, such is body height and lean body mass have a positive influence on successful competition in basketball (Carter, 2005).

According to our results, male players are taller, heavier with higher BMI and significantly lower values of fat body mass, compared to females who in general are found to possess more deposition of subcutaneous fat in triceps area and in the lower body regions. Differences were also noticed in the values of waist, forearm and upper arm circumference, with significantly higher values in males. Our results also indicate greater lean body mass in male basketball players, contributing to higher values of BMI.

Although body composition assessment is of importance for general and athletic population, there are no adequate reference values for elite athletes (Ackland 2012, Rodriquez 2009, Malina 2007), especially in certain parameters such is BMI. The body mass index (BMI; weight/height^2) is parameter that is widely used in adult populations such as an internationally recognized definition of overweight and obesity (Kovač, 2012). Body mass index of our investigated groups is in the area of normal weight according to the established literature standards, and it did not show any significant differences among genders. Interestingly, females showed lower values of BMI compared to males, but higher body fat percentage than male players, greater lean body mass in males. Anthropometric characteristics of our selected athletes has been found to be similar to values previously investigated in our country and across top leagues in Europe (Vucković 2009, Cormery, 2008, Ostojić 2006, Sallet 2005).

According to the results of many studies in sports medicine, the body mass index has low level of validity when assessing body composition in athletes. This parameter only reflects ratio of body weight to height but does not discriminate body fat mass from lean body mass, which contributes significantly to body composition. There should be more population specific values, since higher BMI in athletes could lead to misinterpretation of this parameter in athletes.

On the other hand, body fat mass percentage is of the greater importance than body mass index, as excess adipose tissue acts as dead mass in activities where body mass must be lifted repeatedly against gravity (Reilly 2000). It is generally accepted that lower relative body fat is desirable for successful competition in most sports. Our results of fat body mass percentage in basketball players are in accordance for appropriate body fat range for both genders in this sport (Wilmore, 1983).

When comparing anthropometric characteristics to recent data on basketdball players from other countries, Kalinski (2002) showed similar values of anaerobic performance, and morphometric characteristics in Polland elite basketball player. In the study on morphometric profile of Bosnian elite basketball players, similar values of anthrompometric parameters were recorded (Poškić, 2014). These specific morphometric characteristics of basketball players have been linked with playing positions and individual player success (Angyan 2003, Coelho, 2008), team success (Carter 2005) and performances (Jakovljević, 2011).

When analyzing anaerobic profile of elite athletes, it has been suggested that success in many sport games relies on high anaerobic capacity, not only aerobic abilities (Hoffman, 1996) . Basketball is sport with specific demands at high level including intermittent bouts of high intensity interrupted with periods of submaximal effords. This type of activity requires both aerobic and anaerobic energetic systems. Also explosive power for jumps, kicking, runs at different intensities is of the great importance in basketball. When evaluating anaerobic profiles of investigated groups, differences were found in all Wingate parameters, with significant higher values in absolute anaerobic power and absolute explosive power and absolute anaerobic capacity for male basketball players, while there was no difference in the relative anaerobic power and relative anaerobic capacity. These discrepances are due to differences in anthropometric characteristics, since males are heavier, taller athletes with more active muscle mass and less fat body mass compared to females, as gender specific attributes.

In conclusion, body composition assessment in elite sport provides usefull information for creating conditioning programs throughout a season at all levels of competition. The amount of muscle, adipose tissue, fat-free component and their relationships could affect maximal performance, and evaluation of these parameters should accomplish physiological profile of athletes. Also, analysis of anaerobic abilities should be periodicaly applied to elite athletes in order to monitor improvements in training process.

References

Ackland, TR., Lohman, TG., Sundgot-Borgen, J., Maughan, RJ., Meyer, N.(2012). Current status of body composition assessment in sport: Review and position statement on behalf of the ad hoc research working group on body composition health and performance, under the auspices of the I. O. C. Medical Commission. Sports Med, 42(3):227-249.

Angyan, L., Teczel, T., Zalay, Z., Karsai I. (2003). Relationship of anthropometrical, physiological and motor attributes to sport-specific skills. Acta Physiologica Hungarica, 90, 225-231.

Bar-Or O. (1987).The Wingate anaerobic test: An update on methodology, reliability and validity. Sports Med, 4(6):381-394.

Ben Abdelkrim, N., El Fazaa, S., El Ati, J. (2007). Time-motion analysisand physiological data of elite under-19-year-old basketballplayers during competition. *Br. J. Sports Med, 41(2)*:69-75.

Carter ,JE., Ackland, TR., Kerr, DA., Stapff, AB. (2005). Somatotype and size of elite female basketball players. Journal of Sports Science, 23:1057-63

Carvajal, W., Betancourt, H., León, S.,Deturnel, Y., Martínez, M. (2012). Kinanthropometric Profile of Cuban Women Olympic Volleyball Champions. MEDICC Review, 14(2):16-22.

Coelho, E., Silva, MJ., Figueiredo, AJ., Moreira, CH., Malina RM. (2008). Functional capacities and sport-specific skills of 14 to 15-year-old male basketball players: Size and maturity effects. European Journal of Sport Science, 8:277-285.

Cormery, B., Marcil, M., Bouvard, M.(2008). Rule change incidence on physiological characteristics of elite basketball players: a 10-year-period investigation. *Brit J Sport Med,* 42(1): 25-30

Gaurav, V., Singh, M., Singh S. (2010). Anthropometric characteristics, somatotyping and body composition of volleyball and basketball players. J PhysEdu Sport Man,1(3):28-32

Hoffman, JR., Tennenbaum, G., Maresh, CM., Kraemer WJ. (1996). Relationship between athletic performance tests and playing time in elite college basketball players. J Strength Conditioning Res, 10:67-71.

International Society for the Advancement of Kinanthropometry; The University of South Australia, School of Physical Education. Exercise and Sport Studies. International Standards for anthropometric assessment. Underdale, SA, Australia. 2001

Jakovljević, S., Karalejić, M., Pajić, Z., Gardašević, B., Mandić R. (2011). The influenc of anthropometric characteristics on the agility abilities of the 14-year old elite male basketball players.Physical Education and Sport, Vol. 9(2):141 – 149.

Kalinski, M., Norkowski, H., Kerner, M. (2002). Anaerobic Power Characteristics of Elite Athletes in National Level Team-Sport Games. Eur J Sport Sci, Vol 2:3.

Kerr, DA., Ackland, TR., Schreine,r AB.(1995). The elite athlete: Assessing body shape, size, proportion and composition. Asia Pac J Clin Nutr, 4(1):25-9.

Kovač, M., Jurak, G., Leskošek,B. (2012). The prevalence of excess weight and obesity in Slovenian children and adolescents from 1991 to 2011. Anthropological Notebooks, 18(1), 91–103

Malina, RM. (2007). Body composition in athletes: Assessment and estimated fatness. Clin Sports Med, 26(1):37-68.

Massuça, L., Fragoso, I. Study of Portuguese handball players of different playing status.(2011). A morphological and biosocial perspective. Biology of Sport, 28(1), 37-44.

Maud, P. J. & Foster, C. (2006). *Physiological Assessment of HumanFitness.*2nd ed. Champaign, Human Kinetics.

Ostojic, S., Mazic, S., Dikic, N. (2006). Profiling in basketball; Physical and physiological characteristics of elite players. J Strength Cond Res, 20(4): 740-744

Pelin, C., Kurkcuoglu, A., Ozener, B., Yazici, AC. (2009). Anthropometric characteristics of young Turkish male athletes. CollAntropol, 33: 1057-1063.

Pojskic H, Separovic V, Muratovic M Uzicanin S. Morphological Differences of Elite Bosnian Basketball Players According to Team Position Int. J. Morphol., 32(2):690-694, 2014.

Reilly, T., Bancsbo, J., Franks A.(2000). Anthropometric and physiological predispositions for elite soccer. *Journal of Sports Sciences,* 18:669-68

Rodriguez, NR., di Marco, NM., Langley, S. (2009). American College of Sports Medicine position stand. Nutrition and athletic performance. Med Sci Sports Exerc, 41(3):709-731.

Sallet, P., Perrier, D., Ferret, JM., Vitelli, V., Baverel, G. (2005). Physiological differences in professional basketball players as a function of playing position and level of play. J Sports Med Phys Fitness, 45: 291–294.

Vuckovic, I., Mekic, M. (2009). *Morfological characteristics of basketball players from playing position aspect.*In 1st International Scientific Conference.Exercise and Quality of Life.Proceedings book. Editor Mikalacki M. University of Novi Sad, 309-316

Wilmore, J. H. (1982). Body composition and athletic performance. In W. Haskell; J. Scala& J. Whittam (Eds.), Nutrition and Athletic Performance. California, USA, Bull Publishing, pp. 15875.

World Health Organization. (2000). Obesity: preventing and managing the global epidemic. Report of a WHO consultation. World Health Organ Tech Rep Ser,894:i-xii,1-253.