Int. J. Morphol.,
37(3):1067-1072, 2019.

Anthropometric and Body Composition Differences Among Elite Kosovo Basketball, Handball and Soccer Players

Diferencias Antropométricas y de Composición Corporal entre Jugadores de Baloncesto, Balonmano y Fútbol de Élite de Kosovo

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PIREVA, A. Anthropometric and body composition differences among elite kosovo basketball, handball and soccer players. *Int. J. Morphol., 37(3)*:1067-1072, 2019.

SUMMARY: Comparative researches of athletes' anthropometric characteristics are undoubtedly of great importance in modern sport. But few researches deal with that issue, and the subject in question is examined on Kosovo athletes. The present research is conducted on a sample of 381 top athletes, divided into three groups, namely: 130 basketball, 133 handball, and 118 football players. The respondents were measured by their height, weight, breadth, girth and skin folds, whereas the following were indirectly calculated - body composition, somatotype components, and BMI index – aiming to establish their common morphologic characteristics and analyze the specific, i.e. the probable differences depending on the sport. Breadth and girth values were evaluated by ANCOVA and height and weight were used as co-variance factors. The other variables were evaluated by metric ANOVA. The research results indicate that football players are shorter and of less body weight compared to basketball and handball players. BMI of football players is statistically significantly lower compared to the handball players, whereas there is no difference in BMI between the football and basketball players. Handball players are shorter compared to the basketball players, and their BMI index is greater to the basketball and football players. Football players have greater relative transversal dimensions and girth, and lower values of all skin folds, and a lower percentage of fat component compared to the handball players. In football players dominates as a whole mesomorphic component, and their somatotype category is a balanced mesomorphy; with the handball players a mesomorphic type is obtained; whereas the basketball players have an ectomesomorphic body type.

KEY WORDS: Anthropometry; Physical differences; Somatotype; Sports.

INTRODUCTION

Team sports games are the ideal utility for satisfying the basic human need of motions, collaboration and competing. They require for the athletes to have a high level of physical, emotional and cognitive engagement to outplay and defeat the opponent. The so called defined success in collective sports depends on a great number of external and internal factors (regarding the individual person), among which the anthropologic characteristics of players are of a particularly great importance. Also one of the major components of anthropologic characteristics are, undoubtedly, anthropometric characteristics that are a subject of a long-term studies by the sports scientists. It is a well-known fact that a large number of anthropometric characteristics are genetically determined. Longitudinal and transversal measures are very difficult to be influenced through training (Norton & Olds, 2001). Morphological structure has a direct impact on the athletes' performance and, above all, it is important in planning an efficient training program. Along with the relation to the sports performances, the anthropometric status is important to the sports coaches in directing young athletes to sports best fitting their anthropologic profile. It is also known that with a number of sports ball games certain variations are present in the morphologic profile of the players keeping different team positions (football, basketball, handball, volleyball, rugby etc.) (Hoare, 2000).

Studies on the physical characteristics of the human body to-date indicate that the morphological characteristics of athletes successful in a specific sport differ in somatic characteristics from the general population. Tanner points that the absence of proper body composition is an objective obstacle in preventing an athlete from achieving top sports results. Carter, who used to study the body composition of

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elite athletes of different competitive rank, points at the similarities of body dimension and constitution, and the growth of the similarity proportionally to the increasing rank level of a competition. According to that "sports type" is simplest to be determined in a homogenous group of elite athletes of a particular sport (International Committee for the Standardization of Physical Fitness Tests & Larson, 1974). To be effective, training process must consider both the current and targeted anthropometric status of players, on the one hand, and the game specific demands and desirable results, on the other (Barr *et al*., 1994).

Although worldwide there is a big number of comparative researches studying athletes' anthropometric characteristics, in Republic of Macedonia there are few researches dealing with that subject. That is why the present research was organized in order to provide description of anthropometric characteristics, body composition and somatotype components of active elite Kosovo athletes from three topical sports (basketball, handball and football) and to investigate possible differences in relation to competition level.

MATERIAL AND METHOD

Subjects: The research is conducted in Medical Center in Pristine, where all athletes from the Kosovo are required to have regular sports medical control two times a year at least. The current research involved an analytic comparative design to evaluate the anthropometric characteristics of elite Kosovo athletes from more than one sports. The data from athletes who have played in the first national league and have undertaken routine sports medical examinations over the three year period (2015–2017) were analysed in this study. Prior to the initiation of the tests the purpose and procedures were explained to all the athletes. Data were confidential and data protection was observed.

The research is conducted on a sample of 381 elite athletes aged between 19 and 35. The sample consists of three groups as follows: 130 basketball players, 133 handball players and 118 football players. The respondents were treated in accordance with the Declaration of Helsinki.

Protocols and equipment: All the measurements were conducted by highly professional educated and experienced persons. The height and weight are measured with a stadiometer (Seca, Leicester, UK) and electronic weighing machine (HD-351, Tanita, Illinois, USA). Skin folds are measured with John Bull calipers. Girths are measured with a usual elastic measuring tape, whereas diameters are taken by a caliper (GPMc).

Along with the height and weight the following anthropometric measures are taken: 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 skinfolds (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 (Cattrysse, *et al.*, 2002). Somatotyping components (endomorphy-mesomorphy-ectomorphy) were calculated according to Carter and Heath method (Carter & Heath, 1990), using the somatotype software (SomatotypeV.1_2_5).

Statistical analysis. The differences in body height, weight, BMI, skinfold thickness, body components, and somatotype components between the groups were tested by one way analysis of variance (ANOVA); and multiple comparisons between pairs of groups were carried out according to the LSD test. Breadth and girth measurements were compared by one way analysis of covariance (ANCOVA); and multiple comparisons between pairs of groups were carried out according to the LSD test. In this analysis, weight and height were controlled as covariates. Statistical analysis was performed using the SPSS 22.0 for Windows (Statistical Package for the Social Sciences, version 22.0, SSPS Inc, Chicago, IL, USA).

RESULTS

Table I shows that football players are shorter and have less body height compared to the basketball and handball players ($p<0.001$). Their BMI is statistically significantly lower compared to the handball players ($p<0.001$), whereas there is no statistically significant differences in BMI index between the football and basketball players. Handball players are shorter in favor of basketball players ($p<0.001$) and their BMI index is statistically significantly higher than that of the basketball and football players ($p<0.01$).

The review of Table II shows that when the body height and weight are controlled as co-variance the football players have statistically significantly bigger relative diameter of knee and ankle joint compared to the basketball and handball players ($p<0.05$). Handball players have statistically significantly bigger ankle joint diameter than the basketball players ($p<0.05$). The comparison between the basketball, handball and football players does not result in establishing statistically significant diameter differences in the area of elbow and wrist joints. The handball players

Table I. Descriptive statistics for stature, body weight, and BMI.

	Basketball X ± SD		Handball X ± SD		Soccer X ± SD	
Height	193.61	7.76	186.84	5.99	180.78	6.06
Weight	91.46	11.60	91.41	10.31	77.91	6.63
BMI	24.35	2.21	26.19	2.77	23.83	1.48

Table II. Diameters and circumferences (mm) (mean ± standard deviation) of athletes.

	Basketball X ± SD		Handball X ± SD		Soccer X ± SD	
Diameters						
Wrist	58.37	3.64	58.47	3.86	58.54	3.26
Elbow	85.51	5.61	85.71	6.13	85.21	4.88
Knee	103.78	5.80	104.48	6.25	105.80	4.29
Ankle	74.18	5.60	75.57	5.22	76.80	4.08
Circumferences						
Upper arm	311.29	26.30	315.74	25.99	307.47	19.47
Upper arm flex	343.06	29.52	350.02	27.85	341.68	21.36
Thigh	595.95	39.87	592.14	82.99	609.64	30.48
Forearm	278.88	22.06	289.23	20.21	280.65	15.50
Calf	385.90	33.44	390.63	27.64	395.84	23.09

have a bigger forearm girth compared to football and basketball players ($p<0.001$), a less relaxed arm girth compared to the football players ($p<0.01$). Football players have greater thigh girth than the handball players ($p<0.001$) and a greater calf girth than the basketball players ($p<0.01$).

The review of Table III shows that football players have statistically significantly lower values of all skinfolds in comparison with the basketball and handball players ($p<0.001$). The handball players have a significantly bigger skinfold values of: the triceps, thigh, calf, suprascapular and suprailiac compared to the basketball players ($p<0.05$). The values of the arithmetic mean and the level of the statistical significance in Table IV represents that football players have statistically significantly less absolute values of muscle, bone and fat component in comparison with the basketball and handball players ($p<0.01$). There are not established statistically significant differences in the absolute values of body composition components between the basketball and handball players. As for the percentage differences of the body composition components (Table IV), it is obvious that football players have less percentage of fat component compared to basketball and handball players ($p<0.001$). Also, basketball players have a less percentage of a fat component compared to the handball players ($p<0.001$). There is not determined statistically significant differences in percentage values of bone and muscle component between the basketball, handball and football players.

Examination of Table V shows that the average values of mesomorphic and endomorphic components (components related to the total muscle and bone mass) are statistically significantly higher with the handball than those of football and basketball players ($p<0.001$). High values of the mesomorphic and endomorphic components reflect the big body composition of the handball players. The football players have statistically significantly higher average values of the mesomorphic component than that of the basketball players ($p<0.001$). Being expected, the average values of the ectomorphic component are significantly lower with the handball than those of the football and basketball players ($p<0.001$). Basketball players have statistically significantly higher average values of the ectomorphic and endomorphic components compared to the football players ($p<0.001$).

Table III. Individual skinfolds (mm) (mean ± standard deviation) of seven sites of athletes.

	Basketball X ± SD		Handball X ± SD		Soccer X ± SD	
Biceps	5.61	2.10	5.79	1.91	4.44	1.08
Forearm	7.20	2.44	7.54	2.45	5.65	1.29
Triceps	9.31	3.25	10.79	3.93	7.83	2.46
Thigh	15.09	5.80	17.43	6.52	11.97	5.47
Subscapular	12.49	4.18	13.67	5.26	9.76	2.91
Calf	11.39	4.32	12.95	4.33	8.98	3.27
Supra-iliac	10.09	4.10	11.50	5.58	7.71	2.75

Table IV. Body composition of athletes. The means and standard deviations of the fat. Bone and muscle weights (kg) and percentages are shown.

	Basketball X ± SD		Handball X ± SD		Soccer X ± SD	
MMA	65.78	12.53	67.83	10.51	57.65	8.97
MMkg	51.83	25.89	49.87	7.47	42.62	5.03
BMkg	15.61	2.01	16.11	12.45	13.48	1.53
MM%	56.77	29.51	54.56	5.40	54.62	3.38
BM%	17.11	1.30	17.70	13.56	17.33	1.61
FMkg	13.96	4.87	16.72	6.59	10.92	3.24
FM%	15.74	2.03	16.60	2.67	14.43	1.42
LBM	76.94	8.99	76.07	7.37	66.65	5.52

Table V. Scores (mean ± standard deviation) of the three components of the somatotype.

	Basketball X ± SD		Handball X ± SD		Soccer X ± SI	
Endomorphic	2.8	0.9	3.3	1.2	2.4	0.7
Mesomorphic	4.7	1.2	6.0	1.4	5.4	1.0
Ectomorphic	3.0	1.0	2.0	0.9	2.4	0.7

habits etc. Professional and/or elite football players in Europe, The Near East and in The South of America have the average of body height that varies from 176.0 to 183.0 cm, and the weight that is generally less than <80 kg (within the span of 65.6-78.7 kg.) and BMI index that varies between 23.00-24.45 kg/m^2. The average value of the body height, body mass and BMI index of Kosovo football players is higher to that of the players from Asian teams, and the values are similar to those of the players from European and South American teams (Bandiopadhyay, 2007). Comparing the morphological characteristics between Kosovo and neighbouring countries' football players (Croatia and Serbia), it is noticeable that Kosovo players have nearly identical height and weight with the football players playing in Croatia and Serbia – 77.6 and 77.4 kg. (Matkovic *et al*., 2003).

DISCUSSION

Hitherto researches suggest that morphologic characteristics and body composition can influence the athletes' selection in many sports (Ziv & Lidor, 2009). The research results point at the existence of differences in the anthropometric characteristics, body composition and somatotype components between athletes of different sports branches in the term of evaluating absolute values. But the authors of the present research think that the assessment of anthropometric characteristics (after checking the height and weight) provides more valid results in relation to the morphologic body structure (Pelin *et al*., 2009).

The present research investigates anthropometric characteristics, body composition and somatotype components of active Kosovo elite athletes of the sports: basketball, handball and football, and the obtained results are mutually compared.

The football players are shorter and have less body weight compared to the basketball and handball players. Their BMI index is less than that of the handball players. The average body height of Kosovo football players senior amounts to 181 cm, while body mass is 78 kg. Different studies show that football players in national and international competitions vary in their body weight, height and BMI index depending on the geographic situation, ethnic and cultural influences or different styles of football, diet

On the other hand, basketball players tend to be tall athletes, as they manipulate with the ball above the head (Gaurav *et al*., 2010) and their height gives them an advantage in scoring points or block the opponent player. The average height of professional basketball players in 2007 and 2008 years, according to the available data of NBA.com was 200.6 cm. On the other hand, the average height of the Olympic Games' basketball competitors in Peking 2008 according to the available data was: USA – 199.4 cm, Spain – 199.2 cm, Argentina – 199.6 cm, and Lithuania – 201.7 cm. It proves that Kosovo players are of lower average height than the world best teams. Kosovo coaches should have in mind that date when selecting players and follow the latest methods in the process of selection. Also it is likely for the basketball players to be heavier than the football players due mostly to the greater height. Handball players have greater BMI index compared to the basketball and football players, and less body height to the basketball players. These differences can be due to the different game structures and rules that are specific for the handball. The review of obtained data shows that Kosovo handball players have less body height compared to that of the European players in the World championship 2013 year. As comparison, the average height of Spanish champion team is 193 cm, Danish – 194 cm, Croatia – 194, whereas Korean players have 187 cm average height, and Kuwait – 184 cm. (Ghobadi *et al*., 2013). Africa and Asia teams have shorter players compared to those of European teams (Taborsky, 2007).

Football players have relatively bigger relative transverse dimensions of lower extremities (diameter of knee joint and diameter of ankle joint) compared to the basketball players and handball players (when the body weight and height are controlled). Football players also have a bigger relative girth of the thigh compared to the handball players and of the calf compared to the basketball players. This could be presumed considering the fact that football players use lower extremities only and they take the greatest load, whereas basketball and handball players use the upper and lower extremities.

Further, the research results point that football players have significantly lower values of all skin folds and lower percentage of fat component compared to the basketball and handball players. Between football, basketball and handball players there are no established differences in percentage values of bone and muscle component. That results are expected mainly due to the fact that the bigger number of hitherto researches determine that in football game dominant is the aerobic component in providing energy (Kemi *et al*., 2003). Anaerobic component in providing energy dominates in sprints, jumps and duel games. They are factors on which depends the successful result in the match (Sporis *et al*., 2008). On the other hand, in basketball and handball largely dominates the anaerobic component in providing energy - 20 % to 25 % aerobic activities and 75 % to 80 % anaerobic activities (Brittenham, 1996). These results are expected due to the fact that basketball match lasts 40 min, divide in 4 quarters of 10 min each, handball match takes 60 min, divided into two halftimes of 30 min, while football match takes 90 min, divided into two halves of 45 min. Within the match a basketball player runs a distance of about 5,000 to 7,000 meters (Dezman & Erculj, 2005; Erculj & Supej, 2006), handball players run a distance of 2.000 to approximately 6.000 meters (Popovic *et al*., 2012), whereas a football players covers a distance of 10,000 to 12,000 meters (Dellal *et al*., 2010). Also, handball players have a greater percentage of fat tissue compared to the basketball players. These differences can be explained with the specifics and structure of the handball game that involves a large amount of contacts with the opponents, the struggle for a better position, actions with pushing and jostling, opposing, swirling, namely heavy static tension in extremely short and dynamic actions, requiring a relatively big total body mass to enable handball players to accomplish these tasks.

The amount of fat body component is important from physiological point of view, the bigger percentage of body fat is correlated with the physical predispositions of the athlete, especially with the movements of sifting the body or individual body parts in the space (Gil *et al*., 2007). The percentage of fat component with Kosovo football players varies around 14 %, with the basketball players – 15 %, and with the handball players – around 16 %. 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 & Wagner (2004) for a physically active male population.

With the football players on the whole dominates mesomorphic component and their somatotype category is a balanced mesomorph (Apor, 1988; Casajus & Aragones; Ramadan & Byrd, 1991; Rienzi *et al*., 2000; Bandyopadhyay). In the present research Kosovo football players have somatotype characteristics similar to those of elite players from other countries. Portugal first league players' somatotype is 2.8-5.6-2.2. (Gomes *et al*., 1989), the Spanish National Team (1990 World Cup) 2.2-5.1-1.9 (Casajús & Aragonés, 1991), top level Hungarian 2.1-5.1-2.3 (Apor), and elite level South American players 2.2-5.4-2.2 (Rienzi *et al*.) were higher than the mesomorphy score obtained in the present study.

The result obtained with the handball players is a total mesomorphic athletic type with an emphasized longitudinal dimension of the skeleton, a constant relationship between the bone and muscle tissue and somewhat higher values of fat tissue and endomorphic component. Dominant with the basketball players is ecto-morphic type with an emphasized longitudinal dimension of the skeleton and constant relationship between the bone and muscle tissue.

CONCLUSION

In descriptive sports researches the body structure is mostly determined on the base of absolute anthropometric values. In the present research the height and weight are controlled with the support of a unidirectional analysis of covariance (ANCOVA) aiming to establish morphologic characteristics in a more reliable way. Results of the research suggest that the football players are shorter and have less body weight compared to the basketball and handball players, their BMI is statistically significantly lower than that of the handball players, whereas there is no differences in BMI between the football and basketball players. Handball players are shorter in comparison with the basketball players and their BMI index is greater compared to that of basketball and football players. Football players have greater relative transversal dimensions and girth of the lower extremities, and lower values of all skin folds and lower percentage of fat component compared to the basketball and handball players. Basketball players have lower values of more skin folds and lower percentage of fat component compared to the handball players. The dominant with the football players on the whole is the mesomorphic component and their somatotype category is a balanced mesomorph, with the handball players the mesomorphic type

is obtained, while the ecto-mesomorphic type is obtained with the basketball players.

Our results indicate that the selection of players in individual sports needs to be based on the players' morphologic characteristics. Coaches ought to be well informed about general and specific tasks that the player is to perform in the game. The obtained results can serve as normative anthropometric indexes of regular sports medical examinations of elite athletes in our country. The data can also be used as a norm of comparison between the anthropometric and somatotype data of elite athletes from different countries.

PIREVA, A. Diferencias antropométricas y de composición corporal entre jugadores de baloncesto, balonmano y fútbol de élite de Kosovo. *Int. J. Morphol., 37(3)*:1067-1072, 2019.

RESUMEN: Las investigaciones comparativas de las características antropométricas de los atletas son de gran importancia en el deporte moderno. Pocas investigaciones tratan el tema, el cual es abordado en los atletas de Kosovo. La presente investigación se realizó en una muestra de 381 atletas, divididos en tres grupos: 130 de baloncesto, 133 de balonmano y 118 jugadores de fútbol. Se midió la altura, peso, ancho, circunferencia y pliegues de la piel, y se calculó indirectamente: composición corporal, componentes del somatotipo e índice de IMC, con el objetivo de establecer sus características morfológicas y analizar las diferencias específicas y las probables diferencias. Dependiendo del deporte, los valores de amplitud y circunferencia se evaluaron mediante ANCOVA, y la altura y el peso se utilizaron como factores de covarianza. Las otras variables fueron evaluadas por ANOVA. Los resultados de la investigación indicaron que los jugadores de fútbol son más pequeños y tienen menos peso corporal en comparación con los jugadores de baloncesto y balonmano. El IMC de los jugadores de fútbol es más bajo respecto a los jugadores de balonmano, existiendo diferencia significativa, mientras que no existe diferencia en el IMC entre los jugadores de fútbol y baloncesto. Los jugadores de balonmano son más pequeños en comparación con los jugadores de baloncesto, y su IMC es mayor para los jugadores de baloncesto y fútbol. Los jugadores de fútbol tienen mayores dimensiones transversales relativas y circunferencia, y valores más bajos de todos los pliegues de la piel, y un menor porcentaje de componente de grasa en comparación con los jugadores de balonmano. En el fútbol, los jugadores presentan un componente mesomórfico completo, y su categoría de somatotipo es una mesomorfia equilibrada. Con los jugadores de balonmano se obtiene un tipo mesomorfo; mientras que los jugadores de baloncesto tienen una composición corporal ectomesomórfica.

PALABRAS CLAVE: Antropometría; Diferencias físicas; Somatotipo; Deportes.

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Received: 17-09-2018
Accepted: 25-02-2019