

ORIGINAL SCIENTIFIC PAPER

Somatotype Characteristics of Elite Young Athletes from the Republic of Kosovo

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Abstract

A large number of published studies have established the somatotype characteristics of athletes from different sports. The research goal is to establish and compare the anthropometric characteristics, body composition, and somatotype components of Kosovo's young elite athletes. The research was conducted on 255 young athletes aged 18, divided into 92 footballers, 83 basketball players, and 80 handball players. The obtained results show numerous relations and differences between the tested young athletes. The research results suggest that footballers are shorter and lighter than basketball and handball players; have lower BMI than handball players. Handball players are shorter than basketball players, and have greater BMI than basketball players and footballers. Footballers, compared to handball players have a greater bone-component and less fat-component percentage. Basketball players possess greater bone-component percentage values than handball players. Footballers have a dominant mesomorph component. Their somatotype category is balanced mesomorph. Handball players are established to have a common mesomorph athletic type with a characteristic skeleton's longitudinal dimension. The ectomorph body type is dominant in basketball players – a mesomorph- body type with a characteristic skeleton's longitudinal dimension and balanced correlation between the bone and muscle tissue. Therefore, these findings may give coaches from the region better working knowledge and suggest to them to follow recent selection process methods and be more diligent during the process of talent scouting.

Keywords: sport, youth, talent scouting, different sports activity, male athletes

Introduction

Amongst the important components of the anthropologic characteristics without a doubt are the anthropometric characteristics. They have been studied for a long time by sports scientists. It is a well-known fact that a large number of anthropometric characteristics are genetically determined. It is extremely difficult to influence by training the longitudinal and transversal measures (Norton & Olds, 2001). Nevertheless, it is the morphologic structure that directly influences the athlete's performance and they are very important in planning an effective training program.

Football is a team sport which is played on an open field of great dimensions, and therefore it requires a high standard of physical conditioning, it is also based on a large number

of movements, and a series of moderate activities that periodically replace high-intensity activities, leading towards significant metabolic heat production, and an intensity of 75-90% of the maximum heart rate, or 70-80% of the maximum oxygen consumption (Sæther, 2017; Amani, Sadeghi, & Afsharnejad, 2018). On the other hand, handball is played in the field of smaller dimensions, however, it is considered as one of the fastest team sports and also requires great durability and strength due to constant contact with the opponent's body and specific maneuvers such as jumping, pressurizing, blocking and shooting on goal (Bilge, 2013; Masanovic, Milosevic, & Corluka, 2018). The characteristics of the activities that volleyball players perform during training and matches are different from those of football and handball. There is no contact in



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volleyball because two teams of six players are separated by a net. In this game, movement patterns differ significantly from those in football and handball, as this game includes a large number of spiking, jumping, power hitting, blocking, and setting that is mainly based on a high level of strength and power (Marques & Marinho, 2009; Palao, Lopez-Martinez, Valades, & Hernandez, 2019).

Although there is a lot of research in the world in conjunction with the anthropometric characteristics and body composition of athletes, in the Republic of Kosovo there are few studies that deal with this issue. Therefore, this research was conducted in order to determine the anthropometric characteristics, body composition, and somatotypes components of young elite athletes from Kosovo who are involved in team sports, such as: football, basketball, and handball and to determine the differences between athletes.

Methods

Subjects

The research was conducted in the Laboratory of Functional Testing, Department of Physiology and Anthropology at the Medical Faculty in Kosovo, where all the athletes from the Republic of Kosovo are bound to have a regular medical-sports examination for two times a year at least. The current research involved an analytic-comparative design in order to evaluate the anthropometric characteristics of elite Kosovo athletes from several sports fields. The data extracted from the athletes who have played in the first national league and have been subject of routine sports medical examinations over the three-year period (2019–2021) were analyzed 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 was conducted on a sample of 255 young elite athletes aged 18. The sample was divided into three (3) groups as follows: 92 football players, 83 basketball players, and 80 handball players from the Kosovo Junior Premier League. The respondents were tackled according to the recommendations of the Declaration of Helsinki (revision of Edinburgh 2000). The protocols were approved by the Ethics Committee (Number 549, 10.05.2021) at the Ss. Cyril and Methodius University of Skopje.

Protocols and equipment

All measures were undertaken by highly qualified and experienced persons. The height and weight were taken by a stadiometer (Seca, Leicester, UK) and electronic scale (HD-351, Tanita, Illinois, USA). Skinfolts were measured by John Bull calipers. The volumes were estimated with a standard elastic band, while the diameters – with a slide caliper (GPMC).

Besides the height and weight, the following anthropometric measures (Lohman et al., 1988) were estimated: 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, and 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 (endomorph – mesomorph – ectomorph) were calculated according to Carter and Heath method (1990), using the somatotype software (Somatotype V.1_2_5).

Statistical analysis

The players' anthropometric measures, body, and somatotype components were analyzed descriptively (i.e. mean and standard deviations). In addition, a one-way analysis of variance (ANOVA) was undertaken in order to evaluate the differences in the dependent measures based on played positions. In case the result was significant, Tukey HSD post hoc analysis was carried out to determine specific substantial differences among the groups. A probability level of 0.05 or less was taken in order to indicate statistical significance. All data were analyzed using the Statistical Package for the Social Sciences (SPSS, SPSS Inc., Chicago, IL, USA, version 22.0).

Results

The inspection of Table 1 shows that the football players are shorter and possess less body weight than basketball and handball players ($p < 0.001$). Their body mass index (BMI) is statistically significantly lesser than that of handball players ($p < 0.001$), but no statistically significant differences were established in the body mass index (BMI) between the football and basketball players. The handball players are statistically

Table 1. Descriptive statistics for height, body weight, and BMI

	Soccer $\bar{X} \pm SD$		Basketball $\bar{X} \pm SD$		Handball $\bar{X} \pm SD$		F	Sig
Height	178.42	5.98	192.10	8.82	182.50	6.81	80.31	.000
Weight	71.07	7.06	82.98	11.68	83.58	13.00	38.03	.000
BMI	22.29	1.49	22.43	1.90	25.09	3.61	26.50	.000

significantly shorter than the basketball players ($p < 0.001$), and their body mass index (BMI) is statistically and significantly greater than that of the basketball and football players ($p < 0.001$).

The inspection of Table 2 shows that the football players have statistically and significantly lower values of the diameters of the arm, elbow, and ankle in comparison with the basketball and handball players ($p < 0.01$). No significant and statistical presence of differences in the diameter of the knee joints in the football, basketball and handball players were established. In addition, no statistical and significant differences were es-

tablished in the diameter of the hand, knee, elbow and ankle joints during the comparison between basketball and handball players. The football players have statistically significantly less volume of the upper arm, upper arm flex, thigh, forearm, and calf compared to those of the basketball and handball players ($p < 0.01$). The basketball players have statistically significantly less volumes of the upper arm, upper arm flex and forearm as compared to those of the handball players ($p < 0.01$). No statistical and significant differences were established between the basketball and handball players in the volumes of their thighs and calves.

Table 2. Diameters and circumferences – mean (X) ± standard deviation (SD) of athletes

	Soccer X±SD		Basketball X±SD		Handball X±SD		F	Sig
DIAMETERS								
Wrist	55.46	3.21	57.83	4.14	57.18	3.68	9.82	.000
Knee	101.67	8.77	103.28	6.54	104.03	7.44	2.13	.121
Elbow	78.82	4.99	82.36	6.09	81.78	5.82	10.07	.000
Ankle	71.96	3.98	75.60	5.06	75.13	7.05	11.71	.000
CIRCUMFERENCES								
Upper arm	275.71	20.10	290.84	24.64	303.56	29.64	27.04	.000
Upper arm flex	306.03	21.52	322.59	24.09	335.75	30.19	29.77	.000
Thigh	553.04	37.61	576.51	41.27	590.75	51.67	16.51	.000
Forearm	258.53	16.13	270.78	18.17	281.10	22.21	30.85	.000
Calf	365.49	23.82	378.19	28.92	387.00	32.10	12.63	.000

The inspection of Table 3 shows that the football players have statistically significantly lower values of all skinfolds compared to those of the handball players ($p < 0.001$). The bas-

ketball players have statistically significantly lower values of the skinfolds of forearm, triceps, thigh, calf and supra-iliac than those of handball players ($p < 0.01$).

Table 3. Individual skinfolds – mean (X) ± standard deviation (SD) of seven sites of athletes

	Soccer X±SD		Basketball X±SD		Handball X±SD		F	Sig
Biceps	4.60	1.15	5.44	4.63	6.09	2.37	5.23	.006
Forearm	6.17	1.55	6.34	1.82	7.84	2.43	18.40	.000
Triceps	8.43	2.60	9.30	3.10	11.08	4.00	14.60	.000
Thigh	12.46	4.33	14.02	4.92	17.61	6.69	20.46	.000
Subscapular	9.04	2.07	11.92	15.32	13.26	6.24	4.50	.012
Calf	9.94	3.63	10.96	3.09	13.52	4.97	18.36	.000
Supra-iliac	7.47	2.41	8.56	3.77	11.64	7.00	17.74	.000

According to the values of the arithmetic means and the level of statistical significance in Table 4, it is evident that the football players have statistically and significantly lower absolute values of the muscle, bone and fat components compared to the basketball and handball players ($p < 0.01$). The basketball players have statistically and significantly lower absolute values of the muscle and fat components, and greater absolute values of the bone component as compared to those of the handball players ($p < 0.01$). As for the percentage differences of the body composition component (Table 4), it can be established that the football players have a

greater percentage of the bone component, and lesser percentage of the fat component compared to those of the handball players ($p < 0.01$). No statistical and significant differences were established between the football and basketball players with regard to the percentage values of the muscle, bone and fat components. The basketball players have statistically and significantly greater percentage values of the bone component in comparison with those of the handball players. No statistical and significant differences were established between the basketball and handball players in the percentage values of the muscle and fat components.

Table 4. Body composition of athletes – the mean (X) ± standard deviation (SD) of the fat, bone and muscle weights (kg) and percentages are shown

	Soccer X±SD		Basketball X±SD		Handball X±SD		F	Sig
MMA	49.79	8.24	54.92	9.76	58.09	11.69	15.42	.000
MMkg	38.08	4.86	44.71	7.22	44.92	7.65	30.38	.000
MM%	53.52	3.50	53.80	2.91	53.70	2.98	30.38	.000
BMkg	12.74	1.56	14.75	2.03	13.92	1.87	26.97	.000
BM%	17.96	1.77	17.84	1.51	16.82	2.00	10.41	.000
FMkg	10.27	1.61	13.13	6.14	14.10	4.46	21.80	.000
FM%	14.40	1.30	15.63	5.81	16.58	2.92	17.85	.000
LBM	60.80	5.81	69.85	10.16	69.47	9.28	31.78	.000

The inspection of Table 5 shows that the average values of mesomorph and endomorph components (components that refer to the total muscle and bone mass) are statistically

greater with the handball players than those of football and basketball players ($p < 0.001$). The high values of endomorph and mesomorph components reflect the big body structure of

the handball players. The football players have statistically significantly higher average values of the mesomorph component in comparison with the basketball players ($p < 0.001$). As it was expected, the average values of the ectomorph component are

significantly lower with the handball players than with those of football and basketball players ($p < 0.001$). The basketball players have statistically significantly higher average values of ectomorph component than those of the football players ($p < 0.001$).

Table 5. Scores - mean (X) $\pm$ standard deviation (SD) of the three components of the somatotype

	Soccer X $\pm$ SD		Basketball X $\pm$ SD		Handball X $\pm$ SD		F	Sig
Endomorphic	2.3	0.6	2.5	1.2	3.3	1.4	18.51	.000
Mesomorphic	4.7	1.1	3.8	1.4	5.4	1.6	27.40	.000
Ectomorphic	3.0	0.7	3.7	1.1	2.2	1.3	44.75	.000

Discussion

The former research suggests that anthropometric characteristics and body composition can be taken into consideration during the selection of athletes in many sports (Hasan et al., 2007; Ziv & Lidor, 2009). The research results show the existence of differences in the anthropometric characteristics, body composition, and somatotype components between athletes of different sports fields (Hoare, 2000). In the current research, the subject of study was only the anthropometric characteristics, body composition, and somatotype components of young Kosovo elite athletes in the football, basketball, and handball sports games, and the obtained results were mutually compared. The results confirmed the recent studies that point the differences between the body height of football, basketball, and handball players (Jeukendrup & Gleeson, 2009; Ramos-Campo et al., 2014). So the selection criteria, the different types of games, and the game rules between these sports can explain the observed difference. If we analyze the official data, it is evident that the average height of the football players who took part in the Junior World football competition in India in year 2017 was 176.01 cm (Bjelica, Masanovic, & Krivokapic, 2000), while the average height of the representatives of Britain and Spain who played in the Final of the mentioned competition was 179.1 and 178.6 cm (Bjelica, Masanovic, & Krivokapic, 2000). Based on the mentioned data, it can be concluded that the young Kosovo football players have similar body height to the players of the European and South American teams (Chuman et al., 2013; Bjelica et al., 2019; Gardasevic et al., 2019). Different studies show that soccer players in national and international competitions vary in body weight, height, and BMI depending on the geographical location, ethnic and cultural influences or the different styles of the soccer game, diet habits, and similar. Professionals, namely elite football players in Europe, in Middle East, and South America have an average body height in the range of 176.0-183.0 cm., and a weight of generally less than <80 kg (within the range of 65.6-78.7 kg.) and BMI ranging between 23.00-24.45 kg/m² (Reeves et al., 1999; Bandyopadhyay, 2007).

On the other hand, the basketball players have the tendency to be tall athletes, since they manipulate with the ball above their heads (Gaurav & Singh, 2010), and their height helps them to reach the basket easier or to block the opposite player. The taller players in basketball are in advantage since their height works for them towards making a short shot (Rašidagić et al., 2020). For example, the average height of players who played in the World Competition of Basketball 2016 year in Saragossa, Spain, was 195.56 cm. Similarly, the average height of the basketball national representations which participated in the half-final were the following according to the accessible data: USA (198.17 cm), Turkey (195.75 cm), Latvia (198.17

cm) and Spain (195.92 cm) (Bjelica, Masanovic & Krivokapic, 2000). That proves that young Kosovo players have less body height than the best world's teams. The research results suggest that Kosovo coaches should be more diligent and keep pace with the contemporary selection methods while identifying talented basketball players. Namely, recent research points out that a great percentage (about 28%) of the total population of that area of Europe – the West Balkan – are tall 190 cm, and over. (Milašinović et al., 2017; Popovic, 2017; Čorluka et al., 2018). Likewise, it is expected for the basketball players to be heavier than the football players due to greater height, and the basketball players' height has increased over the last 20-30 years. It can be a result of an improved diet, especially in the professional basketball, as well as due to the diet supplements. The handball players have a greater BMI than the basketball, and football players, and have less body height than the basketball players. These differences can derive from the differences in the game structure and the rules that are specific for the handball game. The review of the obtained results shows that Kosovo young handball players have less body height than that of the European players in the World Championship held in Russia 2015 year. For example, the average height of the French representation, which won the Championship in Russia in year 2015 was 191.8 cm, while the Korean handball players, who took the 13th place, had the average height of 183.4 cm. The Polish handball players, who took 19th place, had the average height of 190.1 cm, and the Japanese representation, who were placed 20, had the average height of 181.7 cm (Bjelica, Masanovic, & Krivokapic, 2000). The representations from Africa and Asia have relatively shorter players than most of the European teams (Táborský, 2007), but none of these representations presented notable results. The former researches suggest that persons doing sports and those engaged in sports activities, have namely put their bones under pressure and hits, and have better health of the bones than the persons of sedentary life (Bedogni et al., 2002). Zouch et al. (2008) and its established that the bone mass was greater with those bones that had had greater loading as a result of direction changing, which takes place in such sports as football, handball and basketball. Ubago-Guisado et al. (2015) also describe soccer, basketball and handball as the sports of high impact, which demonstrate higher values of bone mass in comparison to other sports. Furthermore, the research results show that skinfolds and the mass component percentage of the handball players is higher in comparison with that of football players. No statistical and significant differences were established in the mass component percentage values between the basketball and handball players. These differences can be explained due to the specifics and structure of the handball game, which is performed with a number of contacts with the

opposite players – fighting for a better position, actions that involve pushing, opposing, and swirling – briefly, great static tensions in very short and dynamic actions, and the relatively great total body mass enables the handball players to perform these tasks (Buchheit et al., 2009). Consequently, it is now well established that elite handball players need to be tall and have body mass (Nikolaïdis & Ingebrigtsen, 2013). The quantity of body fat component is important from the point of the physiology, the greater percentage of the body fat is correlated with the physical characteristics of an athlete, especially in those of movements in which the body changes its place, or different body parts move in the space (Gil et al., 2007). The fat component percentage of Macedonian football players ranges from 14% of basketball players 15% and handball players about 16% (Gontarev et al., 2016; Gotarev et al., 2017). 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 (Heyward & Wagne, 2004) for a physically active male population. In addition, it is very important to remember that the football, basketball, and handball players need to have a certain percentage of body fat in order to perform well enough and achieve their full playing potential. The person with a little amount of body fat is endangered of having some risks (Milosevic et al., 2015). A greater drop of fat level can lead to some complications and contra-indications. Adipose tissue is a complex, essential, and highly active metabolic and endocrine organ that, through secreting adipokines, plays a very complex role (Kershaw & Flier, 2004). The role of adipokines (leptin, adiponectin, and interleukin 6) in proliferation, in hematopoiesis, and reproduction, is large just as in the regulation of immune function, angiogenesis, and bone development (Kershaw & Flier, 2004). Since they have anti-diabetic, anti-inflammatory and anti-atherogenic properties, their absence would make the organism weak (Fischer, 2006; Silva et al., 2016), which means that a deficiency in the adipose tissue can have as harmful consequences as its excess.

The mesomorph component dominates in football players and their somatotype category is the balanced mesomorph (Rienzi et al., 2000; Casajús, 2001). The obtained type with the handball players is the common mesomorph athletic type with an emphasized longitudinal dimension of the skeleton, a balanced correlation of the bone and muscle tissue, and somewhat higher values of the fat tissue and endomorphic component. The dominant component with the basketball players is the ecto-mesomorph type with an emphasized longitudinal dimension of the skeleton and balanced relation of the bone and muscle tissue. The data obtained in this research shows a high degree of similarity (results are very similar) with the research by Pireva (2019).

The limitation of this study consists in the fact that not all young football players, handball and basketball players who

play for Kosovo Junior Prime League were taken into consideration, which fact does not allow us to make an overall generalization in our conclusions. In addition, there was no consideration with regards to the specificities of the player's positions which are specific in each sport. In future research works, more sophisticated equipment could be used such as (DEXA and similar), which would provide more precise data about the body composition of young Kosovo athletes.

Conclusion

The importance of anthropometric characteristics and body composition has a direct influence on the athlete's performance, and above all, they are important in planning an effective training program during the whole season and at all levels of competition. 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. The obtained results can be used as a normative anthropometric index in the regular sports medical inspections of top young athletes. The data can also be used as a standard for comparison of anthropometric characteristics, body composition, and somatotype components of elite young athletes from different countries. The present research results show that football players are shorter and have less body weight than those of basketball and handball players. Their body mass index (BMI) is statistically and significantly lesser than that of the handball players. The handball players are statistically and significantly shorter than the basketball players, and their body mass index is statistically and significantly greater in comparison with that of the basketball and football players. Football players have a greater bone component percentage and less fat component percentage than handball players. The basketball players have statistically and significantly greater percentage values of the bone component than that of handball players. The dominant component of the football players is mesomorph, and their somatotype category is a balanced mesomorph. The handball players were established to obtain a common mesomorph athletic type with an emphasized longitudinal dimension of the skeleton. The dominant body type of the basketball players was obtained to be ectomorph with an emphasized longitudinal dimension of the skeleton, and balanced relation between the bone and muscle tissue.

The difference in body height is a result of the selection process. Hence, it is of great importance to have a particular focus on these variables. On the other hand, the part subscribed to the body weight can mainly be provoked by nutrition habits. Finally, the differences in bone content of the body is a logical consequence of the specific movement models of each sports discipline.

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Conflict of Interest

The authors declared that there no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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