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DIFFERENCES IN SOME ANTHROPOMETRIC CHARACTERISTICS AND SOMATOTYPE COMPONENTS BETWEEN TOP BOXERS, FREESTYLE WRESTLERS AND STUDENTS FROM THE REPUBLIC OF KOSOVO

(Original scientific paper)

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Abstract

This research studies the anthropometric and somatotype differences between top boxers, wrestlers and students. Specific measures were analysed, including body height, body mass, index of body mass (BMI), skin folds, upper arm and lower leg circumferences, as well as wrist diameters. The research is realised in a sample of 2018 participants from male gender of 18-33 years old, composed from 3 sub-samples of participants from a similar age. The first sub-sample consisted of 65 athletes-wrestlers in freestyle, the second sub-sample consisted of 60 athletes-boxers and the third sub-sample consisted of 93 respondents - non-athletes (students). The results show significant differences in the anthropometric characteristics between these three groups, where boxers and wrestlers show lower average height compared to students. Boxers have higher values in BMI compared with wrestlers and students, and are characterised with significant lower values of skin folds, indicating lower percentage of fat tissue. The anthropometric measurements show that wrestlers have larger advantages of elbow and knee joint diameter, which is an indicator of a developed muscular potential. In addition, wrestlers show lower values of endomorphic component in relation to boxers and students, while boxers show higher values in the mesomorphic component. These results confirm that anthropometric characteristics, body structure and the somatotype in athletes are adapted in the specific physical requirements of their sports, which is in accordance with previous research. The studies point to the importance of adaptation in body structure for optimal performances in the wrestling sports.

Key words: *Anthropometry, Somatotype, Boxing, Wrestling sports, Body structure*

Introduction

The success in wrestling sports, such as box and fighting in freestyle, is based on a complex combination from physical, physiological and psychological characteristics, where the anthropometric characteristics and the somatotype play an important role in reaching the higher results (Reilly et al., 2009; Ackland et al., 2012). The development of these capabilities and characteristics allows the athletes to overcome the challenges that are set from the specifics of the sports discipline and to optimize their performances. Although both disciplines are classified as fighting sports, the differences in competition structure, the needs for physical resistance and motoric capabilities reflect the different somatotype and body structure in athletes.

The specifics of boxing, which is a sport that requires dynamics, coordination and speed, as well as high lever of aerobic and anaerobic resistance, set different challenge compared to wrestling, where strength and resistance dominate during continuous physical contact (Giles et al., 2017). Boxers in general have the tendency to develop mesomorphic body type, which supports the fast and explosive movements needed for this sport, while wrestlers often have endomorphic or mixed type characteristics, which allows them higher level of stability and control in matches (Kale et al., 2019).

In studies where anthropometric characteristics were analysed, it is noticed that, despite the common requirements about strength and resistance, these two athletes' groups differ in the percentage of body fat, muscle mass and body structure (Franchini et al., 2011; Chaabène et al., 2015). For example, according to Franchini et al. (2011), in wrestlers is noticed an increased muscle mass and relatively higher percentage of

fat, which comes as a result of the long-term trainings to support body structure during contact movements. In contrast, boxers usually have lower percentage of fat and larger relative resistance in the upper part of the body, which is prerequisite for optimal punching performance (Ackland et al., 2012).

Multiple studies have examined the influence of the somatotype on performance in different sports and point that the differences in body structure influence over the specifics of the training and matching (Reilly et al., 2009). Each sport requires different way of anthropometric adaptations, so that's how in boxing is noticed larger strength of the upper extremities, which increases the efficiency of punches, whereas in wrestling there is a tendency for increased muscle mass in the trunk area, which is favourable for long-lasting stability (Giles et al., 2017).

Even though both boxing and wrestling are sports with high intensity, they have different dynamic needs which directly affect the development of specific anthropometric characteristics. In relation to boxing, where fast and coordinated movements are needed, punch efficiency is thought to be directly related to the distal length of upper limbs, while the lower percentage of fat is necessary for mobility and explosivity (Kale et al., 2019). In addition, boxers have significant degree of mesomorphic and ectomorphic components in the somatotype, which provides flexibility and the ability to make sudden changes in direction, as well as aerobic endurance that allows them to maintain an intense fight rhythm (Ackland et al., 2012).

In wrestling, the emphasis is on stability and resistance, especially in conditions of physical contact and control of the opponent. Studies show that wrestlers have larger muscle mass in the area of the trunk and lower limbs, which comes as a result of the intensive training in order to achieve stability and strong base to hold the opponent. (Chaabène et al., 2015). In relation to the somatotype, wrestlers have increased endomorphic components, which contribute to additional mass and stability, although the mesomorphic component is also important in the development of the muscle groups (Franchini et al., 2011). The research of differences in anthropometric and somatotype characteristics in elite athletes in these two disciplines shows an important segment of better understanding of the relationship between body attributes and sports success (Reilly et al., 2009).

The aim of this thesis is to analyse the differences in anthropometric and somatotype components in elite athletes of boxing and wrestling disciplines, the focus being on the adaptive physiological mechanisms that support the specific demands of each sport. Through compared analysis of anthropometric characteristics, the body structure and the somatotype, this research will provide development data of optimal training methodologies which will emphasize physical advantages and will minimize the weaknesses of the athletes. The results from this kind of research are especially useful for coaches and professional staff in the development of the individualized programs for each sport.

Work methods

The sample of the participants

The research was carried out on a sample of 218 male subjects aged 18-33, consisting of three subsamples of subjects of similar age. The first sub-sample consisted of 65 athletes-wrestlers in freestyle, the second sub-sample consisted of 60 athletes-boxers and the third sub-sample consisted of 93 respondents - non-athletes (students). Respondent athletes (wrestlers and boxers) were drawn from several wrestling and boxing clubs in R. Kosovo. The students were drawn from several faculties of the State University of Pristina.

The sub-samples of the participants athletes (wrestlers and boxers) were consisted based on the next criteriums: actively and continuously engaged in wrestling- boxing for at least two years, to have been included in the match system, to have trained minimum 4-5 times a week, on the day of the measurements, to have been healthy and without physical injuries.

Variable sample

For the assessment of anthropometric characteristics, the following variables will be applied, i.e. anthropometric measures: Body height (TV), Body weight (TM), Upper arm circumference (ONL), Knee circumference (OPK), Elbow joint diameter (DILZ)), Knee joint diameter (DIKZ), Triceps skinfold (KDTR), Suprailiac skinfold (KDSI), Subscapular skinfold (KDSS), Calf skinfold (KDPK) and body mass index (BMI) were calculated.

Based on the above-mentioned anthropometric measures, using the Heath-Carter method, the somatotype was calculated through three components: endomorphic, mesomorphic and ectomorphic. The

endomorphic component expresses the percentage of the body mass and fat in relation to the body structure, the mesomorphic represents the degree of muscle development and the density of body structure, while the ectomorphic component refers to the thinness and length of the body, which is characteristic for athletes with an easy and fast physical structure.

The measurement was realised in standard conditions in halls. The measurement was done by professionals from the field of kinesiology and medicine, who has previously been trained to measure a certain anthropometric measure. The instruments were standard and properly calibrated before they were used. All the anthropometric measurements are measured according to the International biological program (Lohman, Roche & Martorell, 1988). The instruments for measuring are of standard manufacture.

Data processing methods

For all variables, the basic statistical parameters were calculated: arithmetic mean (Mean), standard deviation (SD), coefficient of variability (KV%), the minimum score (MIN), the maximum score (MAX), and the normality of the distribution of the results was checked with the procedure of Kolmogorov and Smirnov (KS). Differences between wrestlers, boxers and students were determined by one-factor multivariate and univariate analysis of variance (MANOVA and ANOVA).

The statistical software program SPSS 26 (SPSS, v. 26.0 for Windows; SPSS Inc., Chicago, IL, USA) was used to process the obtained data. To determine the somatotype, the software program for somatotypes 1.2 was used, with this procedure, the somatotypes are actually determined for each respondent separately according to the Heath-Carter methodology.

Results

The result distribution in most anthropometric measures in three of the sub-samples is normal, which made it possible to carry out further processing of the basic data in a methodologically correct manner.

In order to determine whether there exist statistically significant differences in the anthropometric measures between boxers, wrestlers and students, multivariate and univariate analysis of variance (MANOVA and ANOVA) were applied.

By implementing the multivariate variance analysis (MANOVA), i.e. with testing the difference importance of arithmetic environments in the anthropometric measures, measures between boxers, wrestlers and students, a statistically significant difference is determined because Wilks' Lambda .06 and for degrees of freedom df =416/22, gives statistical significance at the Q < .000 level. The size of the partial effect of the determinants (partial n^2) shows high values of .75.

Table 1. Differences in anthropometric measures between boxers, wrestlers and students

	Value	F	Hypothesis df	df	Sig.	n^2
Wilks' lambda	0,06	56,70	22	414	,000	,751

	Boxers		Wrestlers		Students		F	Sig.	n^2
	Mean	SD	Mean	SD	Mean	SD			
TV	173,20	8,23	174,11	9,17	179,70	6,75	16,03	**0,000**	0,13
TM	77,85	13,43	73,24	14,73	76,28	11,13	2,05	0,131	0,02
BMI	25,84	3,39	23,91	2,67	23,60	3,05	10,63	**0,000**	0,09
KDTR	10,06	4,13	8,22	3,25	12,67	5,08	20,71	**0,000**	0,16
KDSS	13,57	4,54	7,88	2,60	11,82	3,86	37,59	**0,000**	0,26
KDSI	11,05	5,73	7,29	2,51	13,04	5,96	24,14	**0,000**	0,18
KDPK	11,62	5,25	7,09	1,86	10,85	4,45	22,03	**0,000**	0,17
ONL	34,27	3,15	34,32	2,64	37,13	3,18	23,90	**0,000**	0,18
OPK	37,28	3,19	36,46	2,72	31,56	3,45	75,95	**0,000**	0,41
DILZ	8,07	0,74	8,35	0,69	6,82	0,45	144,49	**0,000**	0,57
DIKZ	10,14	0,62	9,62	0,83	9,64	0,67	11,24	**0,000**	0,09
FAT%	16,94	6,21	12,25	3,44	18,28	6,55	21,93	**0,000**	0,17

In order to determine in which anthropometric measures exist statistically significant differences, were calculated also the one-factor univariate analysis for each anthropometric measure. From the review of table 1, it can be seen that the statistically significant differences are determined in the anthropometric measures: body height, upper arm circumference, lower leg circumference, diameter of the elbow joint, diameter of the knee joint, triceps skin fold, suprailiac skin fold subscapular skinfold, calf skinfold and

body mass index (sig< .000). Intergroup statistically significant differences were not determined only in the anthropometric measure of body weight (sig=0.131). The partial effect of the determinants partial - n2 is ranked between .09 and .57 and shows a small to large impact effect. The greatest effect in determining the differences is shown by the variables: elbow joint diameter (partial - n^2 =.57) and knee circumference (partial - n^2 =.41).

By applying a multivariate analysis of variance (MANOVA), i.e. testing the importance of the differences of arithmetic environments of the three somatotype components between boxers, wrestlers and students, a statistically significant difference is determined, because Wilks' Lambda .38 and for degrees of freedom df= 6/430, yields statistical significance at the Q < .000 level. The size of the partial effect of the determinants (partial n2), shows high values, 381.

Table 2. Differences in the somatotype components between boxers, wrestlers and students

	Value	F	Hypothesis df	df	Sig.	n^2
Wilks' lambda	,38	44,12	6	430	,000	,381

	Boxers		Wrestlers		Students		F	Sig.	n^2
	Mean	SD	Mean	SD	Mean	SD			
Endomorphy	3,41	1,23	2,29	0,85	3,56	1,26	25,28	**0,000**	0,19
Mesomorphy	7,43	1,37	6,68	0,86	4,98	1,45	75,27	**0,000**	0,41
Ectomorphy	1,43	1,05	2,07	0,87	2,60	1,22	21,52	**0,000**	0,17

In order to determine in which somatotype components, exist the statistically significant differences, also the univariate analysis of variance are calculated. From the review of chart 31, it can be seen that there are statistically significant differences in the three somatotype components: the endomorphic (F= 25.29; p= 0.000), the mesomorphic (F= 75.27; p= 0.000) and the ectomorphic (F= 721.52; p= 0.000). The partial effect of the determinants partial - n2 is ranked between .19 and .41 and shows a large impact effect. The greatest effect in determining the differences is shown by the somatotype component mesomorphy: (partial - n^2 =.41).

Discussion

Based on the results it can be concluded that there are significant anthropometric and somatotype differences between boxers, wrestlers and students, which reflect the specific body structure needed for optimal performances in each sport. Boxers and wrestlers show lower average body height compared to students. According to the index of body mass, boxers have higher values than wrestlers and students, while between wrestlers and students are not determined statistically significant differences in this measure. Anthropometric skin fold measurements reveal that wrestlers have significantly lower triceps skinfold values compared to boxers and students, while boxers also show lower values than students in this measure. Also, in the subscapular skin fold, wrestlers have lower values compared to boxers and students, while boxers have lower values than students. For the skinfold of the suprailiac area, wrestlers show lower values compared to boxers and students, and boxers have lower values than students. In the skin fold of the lower leg, wrestlers have lower values compared to boxers and students, but no statistically significant differences were observed between boxers and students.

In terms of upper arm circumference, students have higher values compared to boxers and wrestlers, while between boxers and wrestlers are not determined statistically significant differences. Students also show lower knee girth values compared to boxers and wrestlers, whereas between boxers and wrestlers, no significant differences were recorded. Wrestlers have larger values of the diameter of the knee joint, while no statistically significant differences were determined between wrestlers and students.

The percentage of body mass is the lowest in wrestlers compared to boxers and students, while between boxers and students are not noticed statistically significant differences in this measure. In terms of the somatotype, wrestlers have lower values of endomorphic component compared to boxers and students, while no significant differences are determined between boxers and students. Boxers show the highest values in mesomorphic component compared to wrestlers and students, while wrestlers have higher values of this component compared to students. In terms of the ectomorphic component, students have higher values than boxers and wrestlers, while wrestlers show higher values compared to boxers.

The established differences in anthropometric and somatotype characteristics between boxers, wrestlers and students confirm the specific body structure needed for optimal performances in each sport, which is well documented in previous research. Martial arts athletes, as opposed to general population, show certain physical adaptations which are necessary to meet the unique demands of these sports, especially for developing strength, agility and resistance. The study of Wilmore and Costill (2004) shows that the increased muscle mass and the lowest body mass are crucial factors for increasing the physical power, which most often characterize the athletes in the contact sports.

Namely, Kale et al. (2019) indicate that professional wrestlers are characterized by a specific body composition with higher mesomorphic values compared to the general population, while the ectomorphic components, which are more common among students, are less present in athletes. The high mesomorphic component, which is the highest among boxers in this study, is closely related to the showed muscle mass and strength needed to generate explosiveness in punches (Chaabène et al., 2015). Additionally, Franchini et al. (2011) underline the importance of a reduced percentage of body fat in wrestlers, which positively affects their speed and agility, key factors in dynamic movements and quick reactions on the battlefield.

In the context of body height and mass, Ackland et al. (2012) point out that body height and the appropriate body structure are important for achieving ideal weight and balance in wrestling techniques, which is the reason why both boxers and wrestlers in general have lower body height compared to non-athletic populations. Studies by Katić и Blažević (2005) also support this thesis, showing the connection between the specific musculoskeletal structure and the needs for stability and mobility in martial arts sports.

Skinfold, which indicate the percentage of body mass, are found to be significantly lower in wrestlers, which is in accordance with the findings of Keogh et al (2007), who reported that wrestlers and other martial arts athletes have a reduces percentage of adipose tissue, which is associated with greater physical efficiency and reduced body weight.

In relation to the somatotype components, Chaabène et al. (2015) state that ectomorphic, which is characterized by a slender and longer body structure, is often less prevalent in wrestling athletes because it is not suitable for sports that require high level of muscular strength and resistance. The high values of ectomorphic component in students in this research are in accordance with previous findings, with the students showing a body structure that is not adapted to the demand of strength and explosiveness.

Additionally, the studies of Radu et al. (2017) indicate that the body structure and morphological characteristics of athletes, are significantly related to their choice of sport, with wrestlers generally having higher upper arm and lower leg circumference values, indicating greater muscular development, especially among boxers. These findings are fully compatible with the results of this research, with students showing lower values in these parameters, which suggests a body structure that is not correlated with the high physical intensity of martial arts.

Conclusion

Based on the obtained results it can be concluded that there are significant anthropometric and somatotype differences between boxers, wrestlers and students, which reflect the specific body structure needed for optimal performance in each sport. Boxers and wrestlers in general have lower body height compared to students, but they differ from each other in terms of body mass, body mass index, skinfolds and joint diameter. These variations suggest that the body structure and musculoskeletal structure are adapted to the specific physical demands of each sport, while students, who are not professional athletes, show anthropometric values which are not in accordance with the specific athletic needs of boxers and wrestlers.

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