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Body Height and Its Estimation Utilizing Arm Span Measurements of both Gender Adolescents from Central Region in Kosovo

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A B S T R A C T

This study is based on measurements of Central region Kosovar adolescents. The aim of this study was to examine the Body Height of adolescents from Central region as well relationship between arm span and Body Height in both Kosovar genders. A total measured subject participated in this research was 193 out of which (93 girls and 100 boys), females average of age is 18.15±0.35 years old (range 18-20 years) and for male 18.26±0.44 years old (range 18-20 years). The anthropometric measurements were done by trained people and were taken according to the ISAK manual. Relationship between Body Height and arm span has been analyzed by the simple correlation coefficient at a 95% confidence interval. The linear regression analysis was carried out to examine extent to which arm span can reliably predict of Body Height. Statistical importance was placed at level p<0.05. As a result anthropometric measurements for both sexes showed that the average of Body Height for boys adolescents from Central region are 180.62±5.88 centimeters and have the arm span average of 181.36±7.08 centimeters, while girls from Central 166.77±4.71 centimeters tall, and have the arm span average of 167.08±5.03 centimeters. The results have shown that the arm span was estimated as a reliable indicator of Body Height assessment to the both genders adolescents from Central region of Kosovo population. This study also confirms the necessity for developing separate height models for each region in Kosovo.

Key words: *Body Height, armspan, region, boys and girls, Kosovo*

Introduction

Kosovo is geographically clearly defined at the center of the Central part of the Balkan Peninsula. Throughout Kosovo's territory pass roads, which connect Adriatic Sea, Aegean Sea with the center of Balkan Peninsula. Mountain ranges consist of about 63% of the Kosovo's territory. Sorted by their location or altitudes, they would be: peripheral and central mountains, high, average and low mountains. Dinaric Mountains extend in the western and interior part of the land. In central part of the land, such as Mokna Forest, Dry Forest (Mali i Thatë) and Cursed Mountains (Bjeshkët e Nemura), with their geographical position create special climate conditions in Kosovo. Considering that Kosovo's population is part of the central area of population from the Dinaric Race, it was of special significance to complete a professional study and a realistic assessment of morphometric evaluation adolescents from the Central Region of Kosovo, mostly due to the reason some regional differences were confirmed in Kosovo (Arifi, 2017) and in Montenegro (Bubanja, Vujovic, Tanase, Hadzic, & Milasinovic, 2015; Milasinovic, Popovic, Jaksic, Gardasevic, & Bjelica, 2016a; Milasinovic, Popovic, Matic, Gardasevic, & Bjelica, 2016b; Popovic, 2017; Popovic, Bjelica, Tanase, & Milasinovic, 2015; Vujovic, Bubanja, Tanase, & Milasinovic, 2015) as well as some socio-demographic characteristics (Quanjer et al., 2014).

In scientific literature is known that the measurement of Body Height is important in many settings: it is an important measure of body size and gives an assessment of nutritional status (cited in Datta Banik, 2011; Bjelica et al., 2012; Gardasevic, Rasidagic, Krivokapic, Corluka, & Bjelica, 2017), as well as in the determination of basic energy requirements, physical capacity abilities based on drugs quantity, as well as the evaluation of children growth, predicting and standardization of physiologic standards such as lungs capability, muscle strength, glomerular filtering, metabolism, etc (cited in Popovic, Bjelica, & Hadzic, 2014a; Golshan, Amra, & Hoghogi, 2003; M. Golshan, Crapo, Amra, Jensen, & R. Golshan, 2007; Mohanty, Babu, & Nair, 2001; Ter Goon, Toriola, Musa, &

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Akusu, 2011). The Body Height might also be a relevant factor that can success of some athletes in various sports (Popovic, Bjelica, Petkovic, & Muratovic, 2012; Popovic, Bjelica, Jaksic, & Hadzic, 2014b). The researches by European anthropologists a century ago, which have studied body height of the population living in the surrounding of Dinaric Alps (Pineau, Delamarche, & Bozinovic, 2005). As the modern Kosovars, belongs Dinaric racial classification, it is assumed by the authors of this study that adolescents that live in Central region, It can be as tall from other parts of Kosovo (Arifi, 2017) and might by equally tall or at least very close to Europe's top nations (Popovic, 2016; Popović et al., 2015), Bosnian and Hercegovinians (male 183.9 cm; female 171.8 cm) Dutch (male 183.8 cm; female 170.7 cm), Montenegrins (male 183.21 cm; female 168.37 cm) and Serbians (male 182.0 cm; female 166.8 cm). Wherefore, the first purpose was to examine the Body Height in Kosovar adolescents from Central region as the authors did believe this is the place where the population can reach the full potential of the Kosovo plain, while the second purpose of this research was to examine the Body Height in both Kosovar genders and its relationship between arm span.

Methods

The subject of this study was 193, students from high schools, in total there, Included are from Central region of Kosovo, Prishtina, 100 are male and 93 females average of age is 18.15±0.35 years old (range 18-20 years) and for male 18.26±0.44 years old (range 18-20 years). The Criteria for the selection was that the researches have excluded from the data analysis the individuals with physical deformities as well as those without informed consent. The exclusion criterion was also being non-Kosovar and non–Central region. Anthropometric measurements of Body Height and arm span have been conducted according to the protocol of the International Society for the Advancement of Kinanthropometry (Marfell-Jones, Olds, Stewart, & Carter, 2006). The trained measures have measured selected anthropometric indicators (same measurer for each indicator), while the quality of their performance was evaluated against the prescribed "ISAK Manual".

The data was analyzed by Statistical Package for Social Sciences (SPSS) for Windows 23.00. The results obtained were analyzed through descriptive parameters: Means and standard deviation (SD) of the Body Height and arm span of Kosovars, the ratio between Body Height and arm span have been analyzed through correlation coefficient according to Pearson with reliability level of 95%. The linear regression analysis was carried out to examine extent to which arm span can reliably predict of Body Height. In the end, these relationships were plotted as scatter diagram for both genders. Statistical significance was set at $p<0.05$.

Results

A summary of the anthropometric measurements for both sexes is shown in Table 1. Arithmetic average sof Body Height for boys is 180.62±5.88 centimeters, ranked with minimum and maximum results as 170.3-198.8 centimeters. For girls the average was 166.77±4.71centimeters, ranked with minimum and maximum results as 157.3-185.0 centimeters. These are the results of the arm span for both sexes; the arm span arithmetic average length for boys is 181.36±7.08 centimeters, ranked with minimum and maximum results 162.4-197.7 centimeters. For girls this was 167.08±5.03 centimeters, ranked with minimum and maximum results 157.5-180.0 centimeters.

Table 1. Anthropometric Measurements of the Adolescents

Subjects	Body Height Range (Mean±SD)	Arm Span Range (Mean±SD)
Male	170.3-198.8 (180.62±5.88)	162.4-197.7 (181.36±7.08)
Female	157.3-185.0 (166.77±4.71)	157.5-180.0 (167.08±5.03)

The simple correlation coefficient and their 95% confidence interval analysis between the anthropometric measurements are presented in Table 2. For both sexes correlative relation between Body Height and arm span is significant ($p<0.000$), with these correlation coefficients (boys 0.812; girls 0.692).

Table 2. Correlation between Body Height and Arm Span of the Study Subjects

Subjects	Correlation Coefficient	95% confidence interval	Significance p-value
Male	0.812	0.577–0.771	<0.000
Female	0.692	0.507–0.788	<0.000

Table 3. shows the results of linear regression where high values of regression coefficient are shown suggesting a positive relation (boys 0.812; girls 0.692) which shows that arm span predicts Body Height for both Kosovar sexes (boys $t=13.792$, $p<0.000$, girls $t=9.139$, $p<0.000$), which confirms the R-square (%) for boys (66.0), and for girls (47.9).

Table 3. Results of Linear Regression Analysis Where the Arm Span Predicts the Body Height

Subjects	Regression Coefficient	Standard Error (SE)	R-square (%)	t-value	p-value
Male	0.812	3.448	66.0	13.792	0.000
Female	0.692	3.423	47.9	9.139	0.000

The relationships between armspan measurements and Body Height among the above models is plotted as a scatter diagram (Figure 1).

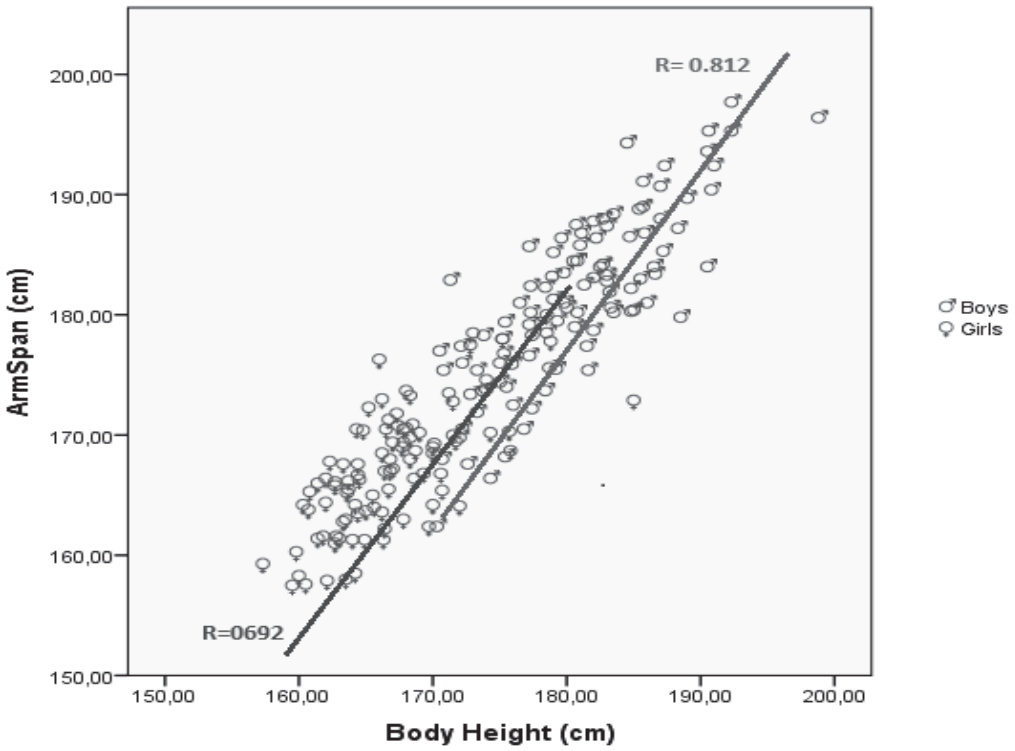

Figure 1. Scatter Diagram and Relationship between Arm Span Measurements and Body Height among the Above Models

Discussion

Throughout this work we can proved that the adolescents from Central region of Kosovo are very tall with an average of 180.62 centimeters for boys and 166.77 centimeters for girls. The results proved that the adolescents from Central region are tall on average, taller than boys population in Southeast region in Kosovo with 177.68 centimeters and taller than girls population 164.1 (Arifi, 2017), taller than male population in Macedonia with 178.10 centimeters and taller than female population in Macedonia with 164.58 centimeters (Popovic, Bjelica, Georgiev, Krivokapic, & Milasinovic, 2016), and is very closed to the data that was reached in the measurement of Serbians female 166.8 centimeters (Popovic, Bjelica, Molnar, Jaksic, & Akpinar, 2013), but not taller than male population.

However, there is a hypothesis that both sexes adolescents from Central region of Kosovo did not reach their full genetic potential yet, since they have been influenced by various environmental factors (wars, in the former Yugoslavia, poor economic situation, etc.) in the last few decades (Popovic et al., 2016). Wherefore, the authors believe that these circumstances had a negative bearing on the secular trend in Kosovo, while it is expected that the secular changes influencing Body Height will ascend in following two decades, comparing it to developed countries where this trend has already completed such as Dutch (Schönbeck et al., 2013).

The results of this study confirm that the arm span reliably predicts Body Height, with significant (p-value 0.000) by linear regression analysis based on results achieved for male and female. The relationship between Body Height and arm span we have been able to verify throughout Pearsons' correlation analysis with validity of 95% in male as well as female, which have given very high value (0.812 and 0.692) of correlations between them. The results of this study confirm the necessity for developing height models for each region in Kosovo.

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