

## STATURE AND ITS ESTIMATION UTILIZING ARM SPAN MEASUREMENTS OF BOTH GENDER ADOLESCENTS FROM NORTHERN REGION IN KOSOVO

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### Abstract

*This study is based on measurements of Northern region Kosovo adolescents. The aim of this study was to examine the stature of adolescents from Northern region as well relationship between arm span and stature in both Kosovo genders. A total measured subject participated in this research was 177 out of which (90 girls and 87 boys), females average of age is  $18.28 \pm 0.45$  years old (range 18-20 years) and for male  $18.25 \pm 0.46$  years old (range 18-20 years). The anthropometric measurements were done by trained people and were taken according to the ISAK manual. Relationship between stature 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 stature. Statistical importance was placed at level  $p < 0.05$ . As a result anthropometric measurements for both sexes showed that the average of stature for boys adolescents from Northern region are  $180.28 \pm 5.71$  centimeters and have the arm span average of  $180.96 \pm 6.53$  centimeters, while girls from Northern  $165.36 \pm 4.56$  centimeters tall, and have the arm span average of  $164.96 \pm 5.81$  centimeters. The results have shown that the arm span was estimated as a reliable indicator of stature assessment to the both gender adolescents from Northern region of Kosovo population. This study also confirms the necessity for developing separate height models for each region in Kosovo.*

**Key words:** stature, arm span, region, boys and girls, Kosovo

### Introduction

Kosovo is geographically clearly defined at the center of the Northern 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 Northern and interior part of the land. In central part of the land, such as Mokna Forest, Dry Forest (Mali & Thatë) and Cursed Mountains (Bjeshkët & 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 Northern Region of Kosovo, mostly due to the reason some regional differences were confirmed in Kosovo (Arifi, 2017) and 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 stature 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, Popovic, Kezunovic, Petkovic, Jurak, & Grasgruber, 2012; Gardasevic, Rasidagic, Krivokapic, Corluca, & 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, & Akusu, 2011). The Stature 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 Northern region, It can be as tall from other parts of Kosovo (Arifi, 2017) and might be equally tall or at least very close to Europe's top nations: (Popovic, 2016), Bosnian and Herzegovinians (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 Serbs (male 182.0 cm;

female 166.8 cm). Wherefore, the first purpose was to examine the stature in Kosovar adolescents from Northern region as the authors did believe this is the place where the population can reach the full potential of the Dinaric Alps, the second purpose of this research was to examine the stature in both Kosovo genders and its relationship with arm span.

## Materials & methods

The subject of this study was 177, students from high schools, in total there, Included are from Northern region of Kosovo, Mitrovica, 87 are male and 90 females average of age is  $18.21 \pm 0.41$  years old (range 18-20 years) and for male  $18.26 \pm 0.46$  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-Kosovan and non-Northern region.

Anthropometric measurements of stature 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 stature and arm span of Kosovars, the ratio between stature 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 stature. In the end, these relationships were plotted as scatter diagram for both genders. Statistical significance was set at  $p < 0.05$ .

## Results and discussion

A summary of the anthropometric measurements for both sexes is shown in Table 1. Arithmetic average of stature for boys is  $180.28 \pm 5.71$  centimeters, ranked with minimum and maximum results as 167.9-197.3 centimeters. For girls the average was  $165.36 \pm 4.56$  centimeters, ranked with minimum and maximum results as 158.70-182.0 centimeters. These are the results of the arm span for both sexes; the arm span arithmetic average length for boys is  $180.96 \pm 6.53$  centimeters, ranked with minimum and maximum results 167.5-196.8 centimeters. For girls this was  $164.96 \pm 5.81$  centimeters, ranked with minimum and maximum results 153.2-186.4 centimeters. 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 stature and arm span is significant ( $p < 0.000$ ), with these correlation coefficients (boys 0.781; girls 0.765).

Table 1. Anthropometric Measurements of the Adolescents

Subjects	Stature Range (Mean $\pm$ SD)	Arm Span Range (Mean $\pm$ SD)
Male	167.9-197.3 (180.28 $\pm$ 5.71)	167.5-196.8 (180.96 $\pm$ 6.53)
Female	158.70-182.0 (165.36 $\pm$ 4.56)	153.2-186.4 (164.96 $\pm$ 5.81)

Table 2. Correlation Between Stature and Arm Span of the Study Subjects

Subjects	Correlation Coefficient	95% confidence interval	Significance p-value
Male	0.781	0.565–0.800	<0.000
Female	0.765	0.494–0.708	<0.000

Table 3. shows the results of linear regression where high values of regression coefficient are shown suggesting a positive relation (boys 0.781; girls 0.765) which shows that arm span predicts stature for both Kosovar sexes (boys  $t=11.524$ ,  $p < 0.000$ , girls  $t=11.145$ ,  $p < 0.000$ ), which confirms the R-square (%) for boys (61.0), and for girls (58.5).

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

Subjects	Regression Coefficient	Standard Error (SE)	R-square (%)	t-value	p-value
Male	0.781	3.592	61.0	11.524	.000
Female	0.765	2.955	58.5	11.145	.000

The relationships between arm span measurements and stature among the above models is plotted as a scatter diagram.

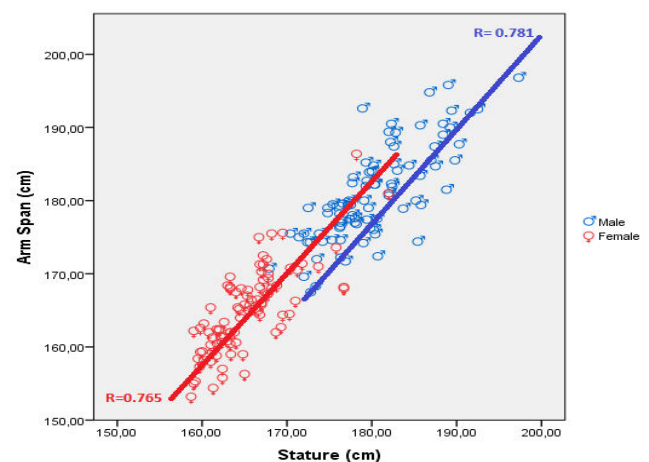


Figure 1. Scatter Diagram and Relationship between Arm Span Measurements and Stature among the Above Models

## Conclusion

Throughout this work we can prove that the adolescents from Northern region of Kosovo are very tall with an average of 180.28 centimeters for boys and 165.36 centimeters for girls. The results proved that the adolescents from Northern region are tall on average, taller than boys' population in Southeast region in Kosovo with 177.68 centimeters and taller than girls population 164.10, (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).

Data was close to the measurement of Serbian females - 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 Northern 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 stature will ascend in following two decades, comparing it to developed countries where this trend has already completed such as Dutch (Schonbeck et al., 2013). The results of this study confirm that the arm span reliably predicts stature, with significant ( $p$ -value 0.000) by linear regression analysis based on results achieved for male and female. The relationship between stature 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 (0.781 and 0.765) of correlations between them. The results of this study also confirm the necessity for developing height models for each region in Kosovo.

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## STATURA I PROCJENA KORIŠTENJEM MJERENJA RASPONA RUKU ADOLESCENATA OBA SPOLA IZ SJEVERNE REGIJE KOSOVA

### Sažetak

Ova studija temelji se na mjerenjima kosovskih adolescenata sjeverne regije. Cilj istraživanja bio je ispitati visinu adolescenata iz sjeverne regije, kao i odnos između raspona ruku i stature na Kosovu po spolu. U ovom istraživanju sudjelovalo je ukupno 177 ispitanika (90 djevojčica i 87 dječaka), djevojčice prosječne dobi  $18,28 \pm 0,45$  godina (raspon 18-20 godina) i dječaci  $18,25 \pm 0,46$  godina (raspon 18-20 godina). Antropometrijska mjerenja obavili su obučeni ljudi i uzimali su ih prema ISAK priručniku. Odnos između stava i raspona ruku analiziran je jednostavnim koeficijentom korelacije pri 95% pouzdanosti. Linearna regresijska analiza je provedena kako bi se utvrdilo u kojoj mjeri raspon raspona može pouzdano predvidjeti stas. Statistički značaj je postavljen na razini  $p < 0,05$ . Kao rezultat toga, antropometrijska mjerenja za oba spola pokazala su da je prosjek stasa kod dječaka adolescenata iz Sjeverne regije  $180,28 \pm 5,71$  centimetara i uz prosječni raspon od  $180,96 \pm 6,53$  centimetara, a djevojke  $165,36 \pm 4,56$  centimetara visoke i imaju prosječni raspon od  $164,96 \pm 5,81$  centimetara. Rezultati su pokazali da je raspoloživa tematika procijenjena kao pouzdan pokazatelj procjene stasa oba spola adolescenata iz sjeverne regije kosovske populacije. Ova studija također potvrđuje potrebu za razvijanjem odvojenih modela za svaku regiju na Kosovu.

**Ključne riječi:** stasa, raspon ruku, regije, dječaci i djevojčice, Kosovo.

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