



## Review Article

# Stature and Its Estimation Utilizing Length of Hand Measurements of Both Gender Adolescents from Western region of Kosovo

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### Abstract

The purpose of this study was to examine the standing height of adolescents from district of Peja western region of Kosovo, as well relationship between the length of the hand and standing height from both gender adolescents. A total measured subject participated in this research was 457 students from high school graduates (232 boys and 225 girls) girls average of age is  $18.21 \pm 0.41$  years old [range 18-20 years] and for boys  $18.26 \pm 0.46$  years old (range 18-20 years). Measurements of standing height and the length of the hand were performed with reference to the ISAK protocol. The results for standing height and length of the hand were analyzed by means of the arithmetic mean (SD) and a simple correlation coefficient, while T-test analysis was used for differences between the two genders and linear regressive analysis assessed standing height based on length of hand measurements. The results obtained in this paper have shown that standing height can be estimated from the length of the hand, which reliably predicts standing height for both genders.

**Keywords:** Peja; Standing Height; Hand Length; Boys and Girls

### Introduction

Kosovo is located in the central part of the Western Balkans. Roads across Kosovo connect the Adriatic and the Aegean within the interior of the Balkan Peninsula. Its borders are shared with Albania (112 km), Macedonia (160 km), Montenegro (76 km) and Serbia (366 km). Kosovo's borders with neighboring countries mainly cross mountains and are of a natural character: to the west of Kosovo, the border is with Bjeshket e Nemuna; to the south, it is with Sharr Mountain and Pashtrik; and, to the north and north-east, it is with Kopaonik. The eastern perimeter of the Kosovo Basin is lower and thus waters flow into the South Morava Valley and Toplica. The south-western part of Dukagjini, between Pashtrik and Koritnik, is also lower and the White Drin flows there. Mountains make up about 63% of the territory of Kosovo and are divided into several groups: suburban and central, and high, middle and low mountains. The Dinaric Mountains belong to the western part of

Kosovo. The Inner Dinaric Mountains include Mount Mokna and the Mali i Thatë and the Bjeshket e Nemuna Mountains. Kosovo's climate is conditioned by geographical location. Extending through the medium latitude, Kosovo's climate is conditioned by the amount of sunshine, and its proximity to the Adriatic Sea, the Vardar Valley, and the opening to the north, where the altitude averages 400 m [1-6]. Based on the available data, Kosovo lies within several different geographical regions and its population belongs to the Central Dinaric Zone; thus, it is highly important to conduct a professional study that would provide a morphometric estimate of the entire population. With different geographical and administrative regions (Pristina, Mitrovica, Peja, Gjakova, Prizren, Ferizaj & Gjilan), Kosovo has a territory of 10,887 km<sup>2</sup> and 1,907,592 inhabitants (July 2018 estimate), whose average age is 29.6 years, while 50.34% are male and 49.66% female. There are some ethnic groups in Kosovo that are composed of: Albanians (92.9%), Bosnians (1.6%), Serbs (1.5%), Turks (1.1%), Ashkali (0.9%), Egyptian (0.7%), Gorani (0.6%) and Roma (0.5%), with other/unspecified at 0.2% (CIA, 2019). A map of Kosovo is shown

in Figure 1. This study analyzes the relationship between standing height and length of the hand measurements in adolescents in the western region of Kosovo. Within this region is administrative districts of Peja and three municipalities (Deçan, Istog and Klina). Territory of western Kosovo –Peja region (Figure 1).



**Figure 1:** Geographical Location District of the Peja.

The anthropometric dimensions of the human body and their inter-relationships have awakened the curiosity of many authors around the world undertaking research in this regard by comparing relations between different races, as well as within a population but from different geographical regions [5-10]. One of the dimensions of the body that has been most frequently addressed by research in relation to other anthropometric parameters is standing height, which is widely recognized as one of the most significant anthropometric measures whose values can be used for various purposes, such as assessing children's growth and development, nutrition, overweight, talent identification and energy consumption, thereby underlining the importance of accurately recognizing these values [11]. However, standing height is not always possible to measure in the traditional way, for example, in cases where an individual has some form of paralysis, fractures, amputations, scoliosis, kyphosis, osteoporosis, hormonal imbalances and various kinds of pain [30-38,22]. In such cases, we need to estimate relative stature using other anthropometric parameters as reliable predictors, such as arm span, which has been established by many authors to be one of the best predictors of standing height compared to, among others, sitting height, hand length, vertebral column length, tibia length, foot length and sternum length. Research indicates that the relationships between standing height and other anthropometric parameters are different and vary from race to race, ethnicity to ethnicity, and region to region [1,8-12,22,35,39]. According to a study conducted by [34], standing height relative to other anthropometric parameters varies

non-linearly, based on the age between males and females. It is especially interesting to note that a number of scientific studies has confirmed that people who are tall suffer more from heart disease, as well as some types of cancer, earlier damage to the joints and spine, etc. but, in other cases, tall people also enjoy more privileges in society, usually have higher social positions, are more successful at school and in a considerable range of sports and sports-related [4,31].

A large number of studies has been conducted worldwide on standing height to arm span ratios involving anthropometric parameters, using similar samples to the adolescent population of Kosovo in general [5-7], as well as on standing height to foot length ratios [3], standing height to sitting height ratios [33,14] and standing height to tibia length ratios [20]. Based on the above research, it is critical for the population of Kosovo to have accurate information as well as standing height to length of hand ratios, which are of great importance to medicine, sports, anthropology and other fields.

Therefore, the first aim of this research is to examine the average standing height of adolescents for both genders district of Peja, as the authors believe that Peja's population can reach full potential for the Dinaric race, while the second aim is to examine standing height for both genders in western region of Kosovo, district of Peja and its relationship to hand length [40].

## Method

This research on the population of Peja district western region of Kosovo included a sample of 457 high school graduates from, 232 are boys and 225 girls average of age is  $18.21 \pm 0.41$  years old [range 18-20 years] for boys and  $18.26 \pm 0.46$  years old [range 18-20 years]. We chose to obtain measurements from graduates because, being 18 years old, it was expected that, at the time of measurement, body growth and development had been completed for both genders and maximum standing height had been reached. It is also worth noting that the sampling criterion was random on the day the measurements were made, but all students were included, regardless of whether or not they had any physical disabilities and/or and were permanent residents of Peja district western region in Kosovo. The measurements were made by experts from the Institute of Sport Anthropology and the National Centre for Sport Medicine, both in Prishtina. Measurements of standing height and hand length were performed by reference to the protocol of the International Association for the Advancement of Kinanthropometry [19]. Whereas students' age data were obtained at the time of the measurements and each person's age was calculated from his/her date of birth and the date the measurements were made. The results for standing height and hand length were calculated using the SPSS version 25.0 mathematical package for each individual. The arithmetic mean [SD] was calculated for both

genders, while T-test analysis was performed with regard to the two anthropometric variables, differences between standing height and hand length for each sex group and between genders. The ratios between standing height and length of hand were determined via Pearson’s correlation coefficient with a 95 per cent confidence limit. Meanwhile, to determine the extent to which the length of the hand can predict body height, linear regressive analysis was employed. The significance of the statistical coefficient was set at the level of  $p < 0.05$ .

**Results**

A summary of the results for the anthropometric measurements of both genders are presented in Table 1. The arithmetic mean of standing height in boys is  $179.89 \pm 5.95$  centimeters and the length of the hand is  $19.15 \pm 0.89$  centimeters, while, in girls, the arithmetic mean is  $166.33 \pm 5.36$  centimeters for standing height and  $17.49 \pm 0.79$  centimeters for hand length. Differences between boys and girls in the case of anthropometric measurements of standing height and length of hand were statistically significant at [boys:  $t = 9.341$ ,  $p < 0.000$ ; girls:  $t = 9.325$ ,  $p < 0.000$ ].

Subjects	Standing Height Range [Mean $\pm$ SD]	Length of Hand Range [Mean $\pm$ SD]
Boys	163.5-196.4 [179.89 $\pm$ 5.95]	15.5-24.6 [19.15 $\pm$ 0.89]
Girls	153.3-181.8 [166.33 $\pm$ 5.36]	15.3-19.6 [17.49 $\pm$ 0.79]

**Table 1:** Anthropometric measurements for both genders.

Subjects	Regression Coefficient	Standard Error [SE]	R-square [%]	t-value	p-value
Boys	0.524	5.080	27.5	9.341	0.000
Girls	0.530	4.563	28.1	9.325	0.000

**Table 3:** Results of linear regression analysis where hand length predicts body height.

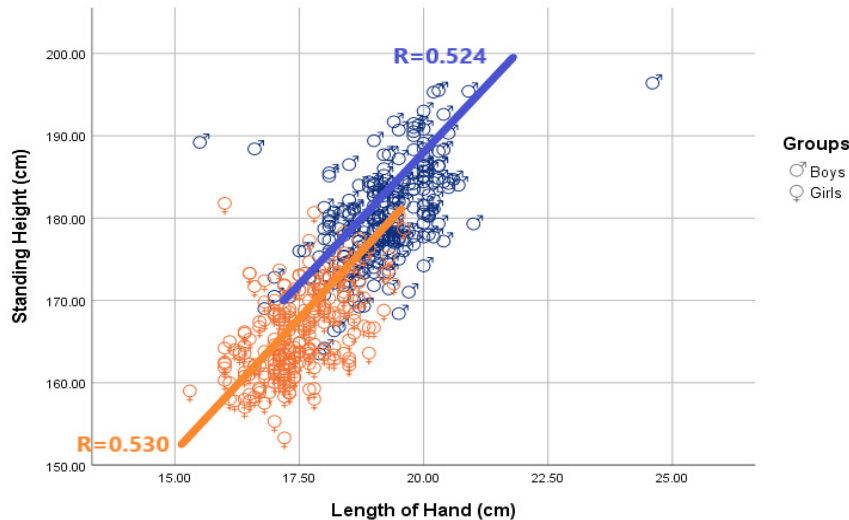
The associations between standing height measurements and length of the hand among the above models is sketched as a scatter diagrams [Figure 2].

The simple correlation coefficient and analysis of the 95 per cent confidence interval between anthropometric measurements are presented in Table 2. The correlations between standing height and the length of the hand are significant [ $p < 0.000$ ] and the correlations between the two anthropometric variables are good for both genders [boys: 0.524; girls: 0.530].

Subjects	Correlation Coefficient	95% confidence interval	Significance p-value
Boys	0.524	0.414–0.635	<0.000
Girls	0.530	0.418–0.642	<0.000

**Table 2:** Correlation between standing height and hand length of the study subjects.

The results of the linear regressive analysis are presented in Table 3. The results of the regression coefficient are high [boys: 0.524; girls: 0.530], while the results of standing height prediction for adolescents from the length of the hand for both genders are as follows: boys:  $t = 9.341$ ,  $p < 0.000$ ; girls:  $t = 9.325$ ,  $p < 0.000$ . These results are confirmed by the coefficient of determination, denoted as R-squared [%], for boys at 27.5 and for girls at 28.1.



**Figure 2:** Scatter Diagram and Relationship between Length of Hand Measurements and Standing height among Both Genders.

## Discussion

Through this study, it can be established that adolescents from western region of Kosovo, district of Peja are ranked very high in the world, the boys with an average standing height of  $179.89 \pm 5.95$  centimeters, and are very closed to the data that was reached in the measurement of Kosovo males population with an average standing height of  $179.52 \pm 5.96$  centimeters [5]. Compared to countries in the region such as Macedonia, adolescents from district of Peja are taller than those with an average height of 178.10 centimeters [30], however, adolescents from Peja are not taller than Montenegrins, whose height is 183.36 centimeters on average [29], and from the population of the Dinaric Alps [28]. In addition, girls adolescents from district of Peja are among the world's tallest populations with an average height of  $166.33 \pm 5.36$  centimeters, are taller than to the data that was reached in the measurement of Kosovo females population with an average standing height of  $165 \pm 4.80$  centimeters [5]. Compared to countries in the region, such as Macedonia, female adolescents from district of Peja are taller than those in Macedonia with an average height of 164.58 centimeters [29]. But a slightly larger difference is found in the case of females from the Netherlands, having a height of 168.8 centimeters [38], or with females from Montenegro averaging 168.3 centimeters [8]. This study confirms the existence of differences in standing height and hand length which are statistically significant between boys and girls, where the mean length of hand was  $19.15 \pm 0.89$  centimeters for boys and  $17.49 \pm 0.79$  centimeters for girls, and the difference was significant at the  $p < 0.000$  level; this has also been validated by

other authors [1,15,25,36]. Relationships between body parameters have been the focus of years of research for many anthropologists, which is why we have also tried to validate the correlation between standing height and the length of the hand. The present study reports high values for the correlation coefficient between standing height and hand length measurements for both genders adolescents from district of Peja, while the correlation between body length and hand length for boys is [ $r = 0.524$ ] and for girls, it is [ $r = 0.530$ ]; these results are comparable to those found in the measurement of Kosovo males and females population in while the correlation between body length and hand length for males is [ $r = 0.587$ ] and, for females, it is [ $r = 0.552$ ]. Recent studies from Europe and the rest of the world have presented results similar to those in the study from [41-43]. Who found a high correlation between standing height and male hand length with a value of [ $r = 0.699$ ] and female hand length with a value of [ $r = 0.693$ ]. Similar correlation values between standing height and hand length in the Egyptian population have been found by [23]. who found a correlation between these two parameters of [ $r = 0.525$ ] for males and [ $r = 0.697$ ] for females. Comparable findings for stature and hand length have been reported by [24], with values of [ $r = 0.604$ ] for males and [ $r = 0.630$ ] for females [42], in her study on Slovak youth, observed a correlation between standing height and hand length of [ $r = 0.630$ ] for males and [ $r = 0.580$ ] for females, and [36], found a correlation between standing height and hand length of [ $r = 0.578$ ] for males and [ $r = 0.309$ ] for females, while [26], found higher values between standing height and the length of male hands [ $r = 0.806$ ].

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On account of the models applied in this paper, it is evident that standing height showed a high correlation with hand length and confirmed that standing height can be estimated from the length of the hand among Kosovan adolescents from western region, district of Peja. The limitation of this study is that the boys and girls adolescents from western region of Kosovo included in this study were born in 1998, which was a period of war in Kosovo, when the population from this region were displaced from their homes. Their lives have been lived under difficult socioeconomic conditions. As the authors of this paper, we conclude that the average stature of district Peja boys and girls has not yet reached its full maximum genetic potential and that it is expected that future generations will achieve greater standing height and be among the tallest populations the world. It is therefore necessary to consider different models for population research in Kosovo, based on each region and both genders.

#### Conflict of interest

The author declare no conflict of interest.

#### References

1. Agnihotri AK, Purwar B, Googoolybe K, Agnihotri S, Jeebun N (2007) Estimation of stature by foot length. *J Forensic Leg Med* 14: 279-283.
2. Agnihotri AK, Agnihotri S, Jeebun N, Googoolybe K (2008) Prediction of stature using hand dimensions. *J Forensic Leg Med* 15: 479-482.
3. Arifi F (2020) Standing Height and Its Estimation Utilizing Length of Hand Measurements of Adolescents of Both Genders. *Biomed J Sci & Tech Res* 26: 20113-20118.
4. Arifi F (2018) Standing height of Adolescents in Kosovo and its relationship with other anthropometric measures as a potential predictors. PhD Dissertation, University of Montenegro.
5. Arifi F, Bjelica D, Sermaxhaj S, Gardasevic J, Kezunovic M, et al. (2017) Stature and its Estimation Utilizing Arm Span Measurements in Kosovan Adults: National Survey. *Int J Morphol* 35: 1161-1167.
6. Arifi F, Sermaxhaj S, Zejnullahu-Raçi P, Alaj I, Metaj Z (2017) Stature and its estimation utilizing arm span measurements of both gender adolescents from northern region in Kosovo. *Acta Kinesologica* 11: 49-52.
7. Arifi F (2017) Stature and its estimation utilizing arm span measurements of both gender adolescents from southeast region in Kosovo. *Sports Science* 10: 92-95.
8. Bjelica D, Popović S, Kezunovic M, Petković J, Jurak G, et al. (2012) Standing height and its estimation utilizing arm span measurements in Montenegro adults. *Anthropological Notebooks* 18: 69-83.
9. Brown JK, Feng JY, Knapp TR (2002) Is self-reported height or arm span a more accurate alternative measure of height. *Clin Nurs Res* 11: 417-432.
10. Campobasso C P, Di-Vella G, Introna F (1998) scapular measurements in regression formulae for the estimation of stature. *Boll Soc Ital Biol Sper* 74: 75-82.
11. Datta Banik S (2011) Arm span as a proxy measure for height and estimation of nutritional status: A study among Dhimals of Darjeeling in West Bengal India. *Ann Hum Biol* 38: 728 -735.
12. De Lucia E, Lemma F, Tesfaye F, Demisse T, Ismail S (2002) The use of arm span measurement to assess the nutritional status of adults in four Ethiopian ethnic groups. *Eur J Clin Nutr* 56: 91-95.
13. Dubois L, Ohm Kyrik, Girard M, Tatone-Tokuda F, Perusse D, et al. (2012) Genetic and environmental contributions to weight, height and BMI from birth to 19 yrs of age. An international study over 12,000 twin pairs. *PLoS One* 7: 30153.
14. Gardašević J, Masanović B, Arifi F (2018) Relationship between tibia length measurements and standing height: A prospective regional study among adolescents in southern region of Kosovo. *Sport Mont* 16: 51-55.
15. Ilayperuma I, Nanayakkara G, Palahepitiya NA, (2010) A Model for the Estimation of Personal Stature from the Length of Forearm. *Int J Morphol* 28: 1081-1086.
16. Çavolli R (1997) Gjeografia Regjionale e Kosovës. Enti i teksteve dhe i mjeteve mësimore i Kosovës, Prishtinë.
17. Lukpata P, Ojim UO, Esemonu U G, Okori SO, Egbu AO, et al. (2015) Stature estimation from hand dimensions in Bekwara ethnic group of cross River State, Nigeria. *Int J Sci Tec* 3: 267-270.
18. Krishan K, Sharma A (2007) Estimation of stature from dimensions of hands and fsst in a north Indian population. *J Forensic Leg Med* 14: 327-332.
19. Marfell-Jones M, Olds T, Stewart AD, Carter JEL (2006) International standards for anthropometric assessment. *Potchefstroom: International Society for the Advancement of Kinanthropometry*.
20. Masanović B, Gardašević J, Arifi F (2019) Relationship between foot length measurements and body height: A prospective regional study among adolescents in northern region of Kosovo. *Anthropologie* 57: 227-233.
21. Malina RM, Little BB, Stern MP, Gaskill SP, Hazuda HP (1983) Ethnic and social class differences in selected anthropometric characteristics of Mexican American and Anglo adults: The San Antonio heart study. *Hum Biol* 55: 867-883.
22. Mohanty SP, Babu SS, Nair NS (2001) The use of arm span as a predictor of height. A study of South Indian women. *J Orthop Surg* 9: 19-23.
23. Mohamed M H (2013) Measurement of Foot and Hand Dimensions and their Correlation with Height in Adult Upper Egyptians. *AAMJ* 11: 300-318.
24. Moorthy TN, Zulkifly NRB (2014) Regression Analysis for Stature Determination from Hand Anthropometry of Malaysian Malays for Forensic Investigation. *SLJFMSL* 5: 8-15.
25. Numan L, Idris J, Zirahei DS, Amaza M, Dalori L (2013) Prediction of stature from hand anthropometry: A Comparative study in the three major ethnic groups in Nigeria. *BJMM R* 3: 1062-1073.
26. Ozaslan A, Karadayi B, Kolusayin MO, Kaya1 A, Afsin H (2012) Predictive role of hand and foot dimensions in stature estimation. *Rom J Leg Med* 20: 41-46.

27. Patel P N, Tanna JA, Kalele SD (2012) Correlation between hand length and various anthropometric parameters. *Int J Med Tox Fore Med* 2: 61-63.
28. Pineau JC, Delamarche P, Bozinovic S (2005) Average height of adolescents in the Dinaric Alps. *C R Bio* 328: 841-6.
29. Popovic S, Bjelica D, Tanase G D, Milasinovic R (2015) Standing height and its Estimation Utilizing Arm Span Measurements in Bosnian and Herzegovinian Adolescents. *Montenegrin Journal of Sports Science and Medicine* 4: 29-36.
30. Popović S, Bjelica D, Georgiev G, Krivokapic D, Milasinovic R (2016) Standing height and its Estimation Utilizing Arm Span Measurements in Macedonian Adults. *Anthropologist* 24: 737-745.
31. Popović S, Arifi F, Bjelica D (2017) standing Height and its Estimation Utilizing Foot Length Measurements in Kosovan Adults: National Survey. *Int J App Exer Phy* 6: 1-7.
32. Popović S, Gardasevic J, Masanovic B, Arifi F, Bjelica D (2017) Standing Height and its Estimation Utilizing Foot Length Measurements in Adolescents from Western Region in Kosovo. *Sport Mon Journal* 15: 3-7.
33. Popovic S (2018) Arm-span measurement as an alternative estimation of true height in Montenegrin young adults of both sexes: A national survey. *Anthropological Notebooks*, 4: 53–67.
34. Quanjer PH, Capderou A, Mazocioglu MM, Aggarwal A, Popovic S, et al. (2014) All-age relationship between arm span and height in different ethnic groups. *Eur Respir J* 44: 905-12.
35. Reeves SL, Varakamin C, Henry CJ (1996) The relationship between arm-span measurement and height with special reference to gender and ethnicity. *Eur J Clin Nutr* 50: 398-400.
36. Rastogi P, Nagesh K R, Yoganarasimha K (2008) Estimation of stature from hand dimensions of north and south Indians. *Leg Med (Tokyo)* 10: 185-189.
37. Rexhepi A, Brestovci B, Isufi I (2018) Normative Values of Some Morphometric Variables for Kosovo Albanian Population Aged 06 - >70 Years Old. *Int J Morphol* 36: 592-597.
38. Statistics Netherland (2015) Lifestyle, preventive screening; sex, age, 2015. Retrieved on March 15, 2016.
39. Steele M F, Chenier T C (2009) Arm-span, height and age in black and white women. *Ann Hum Biol*, 2009; 17: 533-541.
40. Silventoinen K, Bartels M, Posthuma D, Estourgie-Van B, Willem G, et al. (2007) Genetic regulation of growth in height and weight from 3 to 12 years of age: longitudinal study of dutch twin children. *Twin Res Hum Genet* 10: 354-363.
41. Ter Goon D, Toriola AT, Musa DI, Akusu S (2011) The relationship between arm span and stature in Nigerian adults. *Kinesiology* 43: 38-43.
42. Uhrova P, Benus R, Masnicova S, Obertova Z, Kramarova D, et al. (2015) Estimation of stature using hand and foot dimensions in Slovak adults. *Leg Med (Tokyo)* 17: 92-7.
43. Wakode NS, Wakode SL, Ksheersagar DD, Tajane VD, Jachak AN (2015) Prediction of Stature based on Measurement of Hand Length in Maharashtra Region. *Indian Journal of Clinical Anatomy and Physiology* 2: 131–135.