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ESTIMATION OF STATURE;
UPPER ARM LENGTH – A RELIABLE PREDICTOR OF STATURE

1. MBBS, DMJ
Associate Professor
Department of Forensic Medicine & Toxicology
FMH College of Medicine and Dentistry, Lahore.
2. MBBS, FCPS (Gen Surgery)
Senior Registrar
Department of Surgical Unit III
Services Hospital, Lahore.
3. MBBS, DMJ,
Department of Forensic Medicine & Toxicology
FMH College of Medicine and Dentistry, Lahore.
4. Third Year MBBS Student,
FMH College of Medicine and Dentistry, Lahore.

Correspondence Address:
Dr. Mariam Arif
Department of Forensic Medicine & Toxicology
FMH College of Medicine and Dentistry, Lahore.
kemc51@yahoo.com

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Mariam Arif[1], Syed Hamad Rasool[2], Muhammad Khalid Chaudhary[3], Zunaira Shakeel[4]

ABSTRACT… Objectives: Estimation of height from upper arm length in healthy adult medical students in Lahore. **Design:** Cross sectional, observational. **Place and Duration of Study:** FMH College of Medicine & Dentistry, Lahore from November 2017 to January 2018. **Material and Methods:** This study included 100 healthy medical students (50 males and 50 females) aged 19-25 years. The stature and upper arm length were measured for each subject in anatomical position. The data was compiled on excel and then analyzed on SPSS version 11. **Results:** Stature in males was between 162 and 192 cm with the mean of 173.4 cm and standard deviation of 6.03 cm while the stature in females was from 147 to 169.5 cm with the mean of 159.9 cm and standard deviation of 5.39 cm. Overall, there was positive correlation between stature and UAL of subjects (r^2=0.86, p=2.85E-44). Also this correlation was evident for male cases (r^2=0.88, P=5.85E-24) as well as female cases (r=0.96, P=5.72E-35) when evaluated as separate entities. All these correlations were statistically significant. **Conclusion:** The study suggested that upper arm length is a reliable factor for predicting the stature in medical students in Lahore.

Key words: Stature, Identity, Anthropometry, Upper Arm Length, Regression Equation.

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INTRODUCTION

Determination of identity, both in the living and dead, is of paramount importance in medicolegal work. Forensic expert may come across numerous criminal and civil cases of establishing complete or partial identity in his career. Complete identification means absolute fixation of individuality whereas partial identification pertains to determination of only certain parameters of biometric profiling such as age, sex, race, stature etc.[1,2]

Identification can be a challenging task in cases of mutilated and fragmentary remains. This has become more significant in the past decade due to increase in the number of catastrophic events like floods, tsunamis, earthquakes, aircraft crashes, train accidents, terrorist attacks etc.[3] In these tragic events many precious lives are lost and there is dismemberment and intermingling of human body parts. Among various parameters then used for determination of identity, stature is a useful characteristic since it is genetically determined.[4] According to Roche[5], humans almost attain their adult stature by the age of 18 years. Forensic experts have been interested since ages in determining the height of individuals from measurements of long bones since they constitute specific proportion of the stature. Various studies with varying percentage of success have been conducted to estimate stature from upper arm length in different populations[6] but no data is available for Lahore region.

OBJECTIVE

The aim of the study is to find out height of an individual from upper arm length both in males and females separately in adult healthy medical students in Lahore.

MATERIALS & METHODS

One hundred healthy medical students (50 males and 50 females) between ages of 19-25 years were examined in the Forensic Medicine & Toxicology Department of FMH College of Medicine & Dentistry, Lahore. Participants were selected

randomly. Those having any physical deformity or previous history of trauma were excluded from study. Stadiometer and plastic measuring tapes were used for recording measurements. All the measurements were taken by the same person to ensure uniformity in measurements.

Height

Subjects were in erect position standing bare feet flat on the platform and head in Frankfurt's plane. Length from vertex to heel was measured using a standing height measuring instrument (stadiometer).

Upper Arm Length

Subjects were made to stand with the arm straight at the side of the body and bent at 90 degrees at the elbow joint. The distance from the acromion process to the olecranon process was then measured using plastic measuring tape.

Data Analysis

Data collected for both sexes was tabulated on excel and analyzed by SPSS version 11.0. Mean ±Standard Deviation (SD) was calculated. The correlation between height and arm length was evaluated by simple linear regression equation, standard error of estimate (SEE) and coefficient of determination (R^2). p- value was calculated to determine the significance.

RESULTS

Data was collected from 100 healthy adult medical students (50 males and 50 females) between ages of 19-25 years. Table-I compares stature and upper arm length measurements in males and females. Stature in males ranged from 162 to 192 cm with the mean of 173.4 cm and standard deviation of 6.03 cm while the stature in females was from 147 to 169.5 cm with the mean of 159.9 cm and standard deviation of 5.39 cm. It is evident that the mean values of stature and left upper limb measurements for males were significantly greater than females.

According to the linear regression, there was positive strong correlation between height and UAL of all cases (SEE=3.28, R^2=0.86). Males (SEE=2.08, R^2=0.88) and females (SEE=1.10, R^2=0.96) showed similar correlation which was statistically significant (Table-II Figure-1).

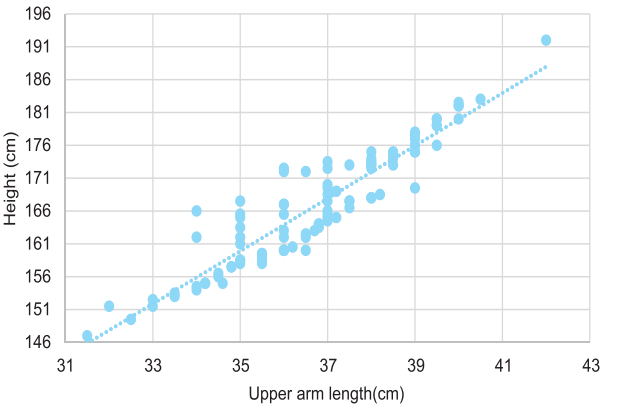

Fig.1. Correlation between Height and UAL

Gender	Male				Female			
	Mean	SD*	Maximum	Minimum	Mean	SD*	Maximum	Minimum
Height	173.4	6.03	192	162	159.9	5.39	169.5	147
UAL**	37.78	1.81	42	34	35.59	1.67	39.5	32

Table-I. Comparison of height and upper arm length in males and females
* Standard Deviation/ ** Upper Arm Length

Gender	Regression Equation	±SEE	R^2	p-value	Significance
Both	-19.55+4.01×UAL (cm)	3.28	0.86	2.85E-44	Significant
Male	55.45 +3.123×UAL (cm)	2.08	0.88	5.85E-24	Significant
Female	47.40+3.16×UAL (cm)	1.10	0.96	5.72E-35	Significant

Table-II. Linear regression equation for estimation of stature from upper arm length in cases

DISCUSSION

Estimation of stature from bones plays a vital role in the identification of fragmentary remains and dismembered bodies due to intermingling of body parts.[6-9] In this context, if only upper limb is found, stature can be estimated from upper arm length fairly accurately.[4,6,9] However, formulae calculated for one population cannot be applied to another population due to diachronic secular changes in limbs proportion.[7]

In the present study the mean stature in males and females was 170.14 ± 6.03 cm and 157.55 ± 5.39 cm respectively. A study conducted on 500 healthy adult Arab Egyptians (250 males and 250 females), between ages of 25-40 years, at Benha Faculty of Medicine, Egypt reported that the mean stature is 174.59 ±4.13 cm in males and 163.02± 3.79 cm in females.[9] In a study by Ilayperuma et al.[10] on 258 medical students (140 males and 118 females) aged 20-23 years at University of Ruhana, Galle, Srilanka estimated the stature in males and females as 170.14 ± 5.22 cm and 157.55 ± 5.75 respectively. Similarly East Indian males and females' height was found to be 168.49 ± 5.1 cm and 156.54 ± 7.32 cm in study by Mohanty et al.[3] All these studies support our findings. However, the recorded stature in a study in Iran by Akhlaghi et al [11]was greater than the present study (males 180.52 ± 5.77 cm, females 162.92± 4.40 cm). The upper arm length measurements in both sexes in our study were greater than those recorded in Iranians[4] and Egyptians[9] but almost similar to those of Sikhs[5] and Turkish[12] subjects. These findings can be explained by the fact that there are variations in stature due to dietetic, geographic and ethnic factors.[2] Therefore formulae calculated for specific population cannot give accurate results when applied in another population for stature estimation. That's why Ross and Konigsberg reported that formulae for stature determination calculated for American Whites may not be applicable in Europeans.[13]

The present study showed that stature and upper limb measurements of males are greater than those of females which is statistically significant ($p < 0.001$). In Croatia, Petrovečki et al.[14] studied radiographic images of cadavers of 21 males and 19 females. They found out that there was difference in the stature and maximum length of long bones between males and females which was statistically significant. Similar observation has been made by other studies conducted in different populations.[8,9,11] This is because females stop growing 2 years earlier than males due to early onset of puberty in them and thus union of epiphysis in cartilaginous bones.[2] In addition, it is known that there is a relation between Y chromosome and stature.[9]

In our study correlation coefficient (R^2) between height and upper arm length was 0.88 in males and 0.96 in females which is highly significant indicating that the upper arm length can estimate stature in both sexes with reasonable accuracy. Similar positive correlation has been reported by other studies. Mumtaz[6] reported that correlation co-efficient was 0.94 in males and 0.95 in females among Indians. Moreover, Eldin[9] found that it was 0.84 and 0.80 for males and females in Egyptians respectively. Naveed et al[4] documented that though overall there was correlation between height and upper arm length (R^2=0.513) in Iranian population, this was significant only in males when considered separately for males and females. Contrary to our study, other studies have used other parameters for stature estimation. The arm length was the least (r=0.295) while hand length was the best (r=0.609) predictor in Efiks population in study by Ubgem.[14] According to another study from India, the most reliable parameter for stature estimation was foot length.[16] These variations can be attributed to the racial and ethnic differences.

Standard error of estimate (SEE) is a good parameter to evaluate the accuracy of the simple linear regression equations. SEE was low in both sexes (SEE = ± 2.08 for males; SEE = ± 1.10 for females). Eldin showed that SEE was least for arm length measurements (SEE = ± 2.24 for males; SEE = ± 2.30 for females) among various upper limb parameters studied in Egyptians.[9] Mumtaz[6] correlated right upper limb measurements with the stature among 150 (75 males & 75 females) students of Santosh Medical College, Ghaziabad

India. SEE was 2.02 in males and 2.13 in females. All these studies are in accordance with our results. In addition, several previous studies noted that all proximal limb bones are better predictors of stature than distal limb bones.[14.15] In contrast to our study, Ahmed[8] estimated stature from arm length of 376 Sudanese adults (187 males and 189 females) and calculated SEE as 4.40 cm for males and 4.48 cm for females. Moreover, in study on 400 cases for estimation of stature from upper arm length in North Indians, SEE was 5.621 for males and 5.326 for females.[17] Low values in our study suggest that stature can be determined from upper arm length.

CONCLUSION

From the above discussion it can be concluded that there exists a strong and significant correlation between stature and upper arm length. Therefore, if either of these measurements is known then other can be calculated fairly accurately which can prove to be a useful tool in medico-legal investigation and anthropometry.

Although this study included a smaller number of cases, it can still be beneficial for conducting researches including larger sample size at national level.

REFERENCES

1. Qayyum R, Arif M, Majeed AI. Pattern of anthropometric measurements in the population of Rawalpindi Ann. Pak. Inst. Med. Sci. 2016; 12 (4): 215-18.
2. **Parikh's Textbook of medical jurisprudence forensic medicine and toxicology.** 6th ed. CBS Publishers & Distributors Pvt Ltd; 2012.pp 2.1-2.8.
3. Mohanty BB, Agrawal D, Baisakh P, Samantsinghar et al. **A study of different parameters of human extremities and its relationship with human height in residents of Eastern India.** Tanta Medical Journal 2015;43(1):1–8gust 201
4. Navid S, Mokhtari T, Alizamir T, Arabkheradmand A, Hassanzadeh G. **Stature from arm length of medical students.** Anatomical Sciences 2014; 11(3):135-40.
5. Chauhan P, Singla A and Yadav B. **Estimation of stature from upper arm length among the Hindu and Sikh population of Lucknow region.** Int J Development Research2017; 7 (07): 13803-7.
6. Mumtaz SH, Sharma BR. **Estimation of Stature from Right Upper Limb Measurements.** Santosh University Journal of Health Sciences 2015; 1(2):53-6.
7. Salles AD, Carvalho CRF, Silva DM. et al **Reconstruction of humeral length from fragments.** Braz. J. Morphol. Sci. 2009; 26(2):55-61.
8. Ahmed AA. **Estimation of stature from the upper limb measurements of Sudanese adults.** Forensic Sci Int 2013; 228:178.e1-7.
9. El-Din S , Mohamed S, Elkholy S, Yousef MI et al. **Prediction of stature based on upper limb measurements.** Eur J Forensic Sci 2016; 3(2):1-7.
10. Ilayperuma I, Nanayakkara G and Palahepitiya N. **A model for the estimation of personal stature from the length of forearm.** Int Journal of Morphology 2010; 28:1081–6.
11. Akhlaghi M, Hajibeygi M, Zamani N, Moradi B. **Estimation of stature from upper limb anthropometry in Iranian population.** J Forensic Leg Med 2012; 19:280-4.
12. Uzun O, Yeginoğlu G, Kalkışım SN, Öksüz CE et al. **Evaluation of upper extremity anthropometric measurements in terms of sex estimation.** Int J Res Med Sci 2018; 6(1):42-50.
13. Ross AH and Konigsberg LW. **New formulae for estimating stature in the Balkans.** Journal of Forensic Sciences. 2002; 47(1):165-7.
14. Petrovečki V, Mayer D, Šlaus M, Strinović D, Škavić J. **Prediction of stature based on radiographic measurements of cadaver long bones: a study of the Croatian population.** Journal of Forensic Sciences 2007; 52(3):547-52.
15. Lukpata PU, Esomonu UG, Ewununu EO, Mba CE. **Correlation between height and selected anthropometric parameters of the upper limbs of the Efiks people in Cross River state, Nigeria.** J Pharm Biomed Sci 2016; 6(01):46-9.
16. Mukhta Rani, AK Tyagi, Vinod Kumar Ranga, Yashoda Rani, Atul Murari. **Stature estimation from foot dimensions.** J Punjab Acad Forensic Medicine Toxicology 2011; 11(1):5-7.
17. Batra APS. **Estimation of stature from upper arm length in north Indians–an anthropometric study.** Indian J Fundamental and Applied Life Sciences. 2011; 1(4):151-4.

It does not matter how slowly you go so long as you do not stop.

– Unknown –

AUTHORSHIP AND CONTRIBUTION DECLARATION

Sr. #	Author-s Full Name	Contribution to the paper	Author=s Signature
1	Mariam Arif	Prepared the proposal, data collection and compilation manuscript writing.	
2	Syed Hamad Rasool	Data collection and compilation manuscript writing.	
3	M. Khalid Chaudhary	Data collection and compilation manuscript writing.	
4	Zunaira Shakeel	Data collection and compilation.	