Innovations

Estimation of Stature from Upper Arm Length in Medical Students – An Anthropometric Study

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Abstract : Background : *Anthropometry is the best method of identifying the mortal remains and dismembered bodies in forensic and anatomy departments. It helps in the prediction of stature and built from the long bones. Upper arm length being the most accessible parameter and easy to measure, it is used in this study to prove the relation between height and upper arm length.* ***Objectives :*** *The objectives of the study are to investigate relationship between stature and upper arm length (UAL) and to formulate regression model for estimation of stature from upper arm length (UAL).* ***Methods: :*** *A cross-sectional study was performed on 265 students belonging to first and second MBBS from Konaseema Institute of Medical Sciences and Research Foundation (aged 18-21 years). Data was collected on anthropometric measurement like height of an individual and length of the upper arm by metallic and plastic tape.* ***Results:*** *All the measured parameters i.e. stature, right upper arm length (RUAL) and left upper arm length (LUAL) were higher in male participants (172.54+5.6, 34+1.4 and 34.06+1.39) compared to female (158.04+5.3, 32.48+1.5 and 32.35+1.49) which was statistically significant (p<0.05) Derived regression equation was stature (S) =3.981XRUAL+34.86 and 4.043xLUAL+30.05 for right and left upper arm respectively.* ***Conclusion:*** *Stature has showed statistically significant correlation with arm length in both sexes. Arm length highly correlates with height and regression equations fitted from arm length was found to be best estimator of height.*

Keywords: *Anthropometry, Upper arm length, Stature, Identification, Long bones*

Introduction:

Personal identification is an essential issue when mutilated and amputated limbs or parts of the body are found in mass disasters. Estimation of the stature from the size of different parts of the body is one of the most important items in personal identification .[1] Estimating stature and gender in the process of forming an individual's identity, various parts of the body are important for forming a biological profile, especially when damaged and amputated bodies are discovered. [2]Reconstruction of stature from long bones of the upper extremity is of great medico-legal relevance. Upper arm length (UAL) estimate stature with reasonable accuracy and is reliable factor for predicting stature. There is a strong relationship between stature and UAL and many sets of linear equation have been developed which are easiest and reliable methods for predicting relation between stature and body segments.[3]

Knowledge of stature is necessary for evaluating nutritional status and for correcting certain functional parameters.[4] The stature of a living human reflects the nutritional, genetic, and disease patterns of individual experiences.[5]

If UAL or stature measurements are known then other can be calculated fairly accurately. These are of considerable significance for forensic anthropometric and archaeological investigators in reconstruction of stature of an individual which can prove to be a useful tool for forensic scientists in medico legal investigation when only fragmentary remains of the body are available. It can also be of great help to anatomists, clinicians and anthropologists.[3]

Hence, present study is intended to investigate relationship between stature and upper arm length (UAL) and to formulate regression formula for estimation of stature from upper arm length (UAL) according to gender in medical students between ages 17-21 years. Knowing the relationship between stature and different anatomical anthropometric parameters help forensic scientists, anatomists and clinicians to estimate standing height from mutilated remains of body parts in clinical practices and forensic investigations. It is a necessity when measuring height is unenviable due to certain medical conditions and in field studies. Similar study was not conducted in the state of Andhra Pradesh.This study is intended to investigate relationship between stature and upper arm length (UAL) and to formulate regression model for estimation of stature from upper arm length (UAL).

Materials and methods:

Method: A cross-sectional study was performed on 265 students belonging to first and second MBBS from Konaseema Institute of Medical Sciences and Research Foundation (aged 18-21 years). Participants who do not have any physical deformities or any previous history of trauma were selected. Standing height (stature) and upper arm length (UAL) of both right and left upper limbs were measured for each subject. Measurements were taken in standard position.

Method of collection of data: Data was collected on anthropometric measurement like height of an individual and length of the upper arm by metallic and plastic tape. All the measurements were taken by single person.

Stature (Standing Height): For measurement of stature participants were asked to stand erect in anatomical position with bare feet flat on the platform and head in Frankfurt's plane. The weight of the participant was evenly distributed on both feet with heels of the feet placed together and length from vertex to heel was measured using stadiometer and recorded in centimetres to the nearest one decimal place.

Upper Arm Length : For measurement of upper arm length participants 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 measured using measuring tape and recorded in centimetres to the nearest one decimal place.

Study setting: This study was conducted in the KIMS and RF, Amalapuram after obtaining IEC (Institutional Ethical Committee) clearance.

The aim, objectives and method of collection of data were explained to all the participants.Informed consent was obtained from all medical students who were willing to participate in the study.

The study does not require any investigations or interventions to be conducted on any human participants.

Study duration: One month from approval from the IEC

Ethical issues: Informed consent was taken and confidentiality of data had been ensured. No issues of beneficence and maleficence.

Statistical analysis: Data obtained was entered into MS Excel and statistical analysis is done using SPSS 22 version. Descriptive statistics , t-test and regression equation was calculated .

Results:

The mean age of the subjects is $19.38+1.162$. Descriptive statistics of age, stature, right upper arm andleft upper arm were shown in Table 1 All the measured parameters i.e. stature, right upper arm length (RUAL) and left upper arm length (LUAL) were higher in male participants ($172.54+5.6$, $34+1.4$ and $34.06+1.39$)compared to female ($158.04+5.3$, $32.48+1.5$ and $32.35+1.49$)which was statistically significant ($p<0.05$) as shown in table-2.

Table-1: Descriptive statistics of age, stature, right upper arm length and left upper arm length of total study population (n=265)

Variable	Mean	Std. Deviation
Age	19.38	1.162
Height	163.51	8.901
Right Arm Length	33.05	1.664
Left Arm Length	33	1.675

Table 2: Comparison of stature, right and left upper arm length among male and female participants

Measured parameters in cm	Male(mean ± SD)	Female (mean ± SD)	P value
Stature	172.54+5.6	158.04+5.3	<0.05
Right upper arm	34+1.4	32.48+1.5	<0.05
Left upper arm	34.06+1.39	32.35+1.49	<0.05

Table-3: Correlation between stature and upper arm length of both sides in male and female participants

Stature	Pearson's correlation coefficient (r)	Total (n=265)	
		RUAL	LUAL
		0.707**	0.749**
	P value	<0.001	<0.001

** Correlation is significant at the 0.01 level (2-tailed).

Table-4 Regression equation, Coefficient of determination (R2) and standard error of estimate (SEE)

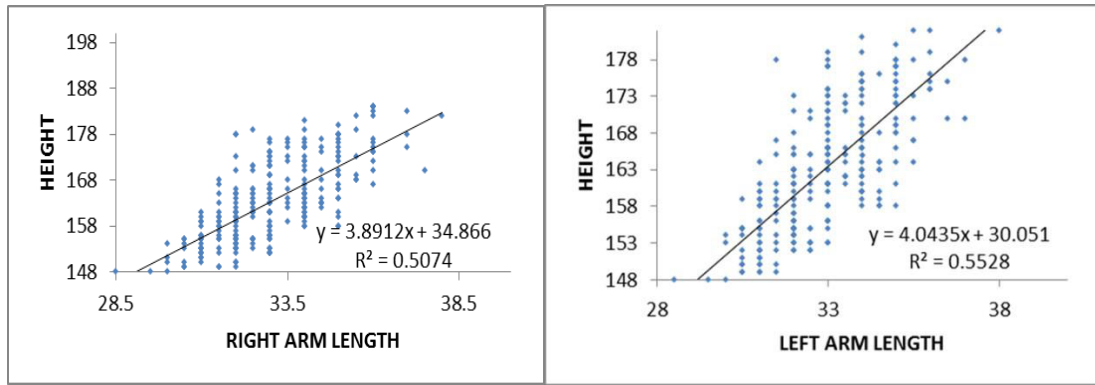| Stature	Rightupperarmlength	Leftupperarmlength
Regression equation	3.981XRUAL+34.86	4.043xLUAL+30.05
R^2	R 0.5528	0.5074
SEE	6.308	5.910

Fig 1 and 2 .Scatter plot with best fit line with stature in Y axis and right upper arm length and left upper arm length in X axis showing relationship between stature and upper arm length of both sides

Regression analysis was done and regression equation formulated for reconstruction of stature from length of upper arm of both sides for total study population.

Using regression formula $Y = A + BX$, stature can be calculated from length of right and left arm ofparticipants where Y= dependent variable (stature in cm), A= constant, B = Regression coefficient of variable and X= independent variable (upper arm length in cm)

In present study regression equation was formulated for estimation of stature from UAL of both sides for total study population. Derived regression equation was stature (S) =3.981XRUAL+34.86 and 4.043xLUAL+30.05 for right and left upper armrespectively.

Discussion:

Anthropometry is crucial entity in identification of human being in anatomy and also forensic department .With the skeletal remains of the human body, stature and structure of human body can be drawn to give idea about the identity of the person. Medico legally, it helps in identification of the mortal remains in disasters like earthquake, floods etc.

This study was conducted to prove stature of the human being can be estimated from the upper arm length of the both sides and to assess the height changes with upper arm length in human beings.

The mean age of the subjects is 19.38+1.162. All the measured parameters i.e. stature, right upper arm length (RUAL) and left upper arm length (LUAL) were higher in male participants (172.54+5.6, 34+1.4 and 34.06+1.39) compared to female (158.04+5.3, 32.48+1.5 and 32.35+1.49) which was statistically significant ($p<0.05$). Because of the genetical constitution of the male and onset of the puberty later than that in the females ,the height and built of the male will be higher compared to females .In a study done byNavid et al[6], the mean age of cases was 21±1.32 years. Mean age of male cases was 20±1.2 years and female cases was 21±1.81 years. A significant differences were observed in

the height between the two sexes (P=0.0001). Also, there was a significant difference in the upper arm length of sex groups (P=0.0001).

Correlation coefficient (r) of height with upper arm length is 0.707 with right side and 0.749 with left side .It suggests the strong association of height with upper arm length both sides .It is in line with other studies .[5], [7]–[13]

In present study regression equation was formulated for estimation of stature from UAL of both sides for total study population. Derived regression equation was stature (S) =3.981XRUAL+34.86 and 4.043xLUAL+30.05 for right and left upper arm respectively.

Regression equation derived for different population is different which might be due to genetic, nutrition, geographical location, physical activity and various races which affect the anthropometric data.[1] So, population specific regression equation must be used for reconstruction of stature from upper arm length.

The studies by many researchers [5], [14] found out that the best stature predictor to be arm length , arm span and then tibial length. In the present study it was evident that simple linear regression equations derived from upper arm length was found to be the best predictor of standing height with the largest value of regression coefficient R2-0.5528 for right side and R2-0.5074 for left side.

Conclusion :

Stature has showed statistically significant correlation with arm length in both sexes. Arm length highly correlates with height and regression equations fitted from arm length was found to be best estimator of height. This proves upper arm length can be used to identify the mortal remains in forensic and anatomy. This study does not estimate height from other measures like arms pan, tibial length etc.

List of References:
1. *M. Akhlaghi, M. Hajibeygi, N. Zamani, and B. Moradi, "Estimation of stature from upper limb anthropometry in Iranian population," J. Forensic Leg. Med., 2012.*
2. *M. Arif, S. H. Rasool, M. K. Chaudhary, and Z. Shakeel, "ESTIMATION OF STATURE," Prof. Med. J., vol. 25, no. 11, pp. 1696–1700, Nov. 2018.*
3. *T. Shakya, D. Mishra, and P. Pandey, "Estimation of Stature from Upper Arm Length," Int. J. Heal. Sci. Res., 2021.*
4. *A. Canda, "Stature estimation from body segment lengths in young adults - application to people with physical disabilities-," J. Physiol. Anthropol., 2009.*
5. *M. T. Hossain Parash, M. M. Rahman, H. Naushaba, S. Haque, and S. C. Shimmi, "Simple linear regression approach for evaluating models to estimate stature based on upper limb dimensions of adult Bangladeshi males," Egypt. J. Forensic Sci., 2022.*
6. *S. Navid, T. Mokhtari, T. Alizamir, A. Arabkheradmand, and G. Hassanzadeh,*

"Determination of Stature from Upper Arm Length in Medical Students," Anat. Sci. J., vol. 11, no. 3, pp. 135–140, 2014.

7. *R. Lalhminghlua, M. Z. G. Saiyed, M. Nayak, and C. B. Jani, "Estimation of stature from outstretched arm span and measurement of component/s of upper limb in the natives of Gujarat," Indian J. Forensic Community Med., 2021.*

8. *S. D. Banik, H. Azcorra, G. Valentín, B. Bogin, and F. Dickinson, "Estimation of stature from upper arm length in children aged 4.0 to 6.92 y in merida, yucatan," Indian J. Pediatr., 2012.*

9. *K. Krishan, T. Kanchan, and J. A. DiMaggio, "A study of limb asymmetry and its effect on estimation of stature in forensic case work," Forensic Sci. Int., 2010.*

10. *S. N. A. Bakar et al., "Stature estimation by using upper limb measurements in the Malaysian population," Int. Med. J., 2018.*

11. *A. Datta, P. tiwari, C. P. Bhaisora, and D. K. Atal, "Estimation of stature by Measuring Upper Arm Length in Adolescence Age Group in Urban and Rural Population," Medico-Legal Updat., 2017.*

12. *S. Chandran, S. Manipady, M. Shetty, P. V. Tarvadi, and S. S. Shetty, "Estimation of stature by percutaneous measurement of upper arm length among native adult population of Dakshina Kannada District," Indian J. Forensic Med. Toxicol., 2016.*

13. *A. Özaslan, S. Koç, I. Özaslan, and H. Tuǧcu, "Estimation of stature from upper extremity," Mil. Med., 2006.*

14. *H. Mohite, S. Mohite, S. Kakade, S. Mane, and M. Ambali, "The Model for Stature and Gender Prediction in Indians Using Upper Limb Measurements," Online J. Heal. Allied Sci., 2021.*