International Journal of Anatomy and Research,
Int J Anat Res 2017, Vol 5(1):3350-53. ISSN 2321-4287
DOI: https://dx.doi.org/10.16965/ijar.2016.473

Original Research Article

ESTIMATION OF HUMAN STATURE FROM LENGTH OF ULNA IN INDIAN POPULATION

Ashish Pandey [1], Radhika P.M *[2], Shailaja Shetty [3].

[1] Intern , Department of Anatomy, M S Ramaiah Medical College, Bangalore

*[2] Assistant Professor, Department of Anatomy, M S Ramaiah Medical College, Bangalore.

[3] Professor & HOD, Department of Anatomy, M S Ramaiah Medical College, Bangalore.

ABSTRACT

Introduction: Estimation of stature from measurement of various body parts is of particular interest to forensic scientist as it is considered as one of the basic parameters of the investigation process in unknown human remains in medico-legal cases. The aim of the study was to find out the relationship between personal stature and length of ulna.

Materials and Methods: The present study was carried out on 300 (150 males and 150 females) students of M.S. Ramaiah Medical College of the age group of 18 – 28 years. The parameters studied were height, length of right and left ulna. The observations were analyzed by Pearson's correlation to examine the relationship between length of ulna and height according to gender for right and left ulna separately.

Results: The mean and standard deviation of stature and length of both ulnas was derived. There was statistical difference between right and left ulna in both the gender. A positive correlation was found in both the gender. The correlation of stature with ulnar length was observed which was found to be statistically significant. A linear regression formula was established for right and left ulna.

Conclusion: The estimation of stature from the length of ulna will be of practical use in Medico-legal investigations and in anthropometry.

KEY WORDS: Stature estimation, ulna, Bone length, Regression equation, Forensic Anthropology.

Address for Correspondence: Dr. Radhika P.M, Assistant Professor, Department of Anatomy, M. S. Ramaiah Medical College, MSRIT Post, Bangalore, 560054, India. Phone: 9035044023
E-Mail: parameshradhika@gmail.com

Access this Article online

Quick Response code

DOI: 10.16965/ijar.2016.473

Web site: International Journal of Anatomy and Research
ISSN 2321-4287
www.ijmhr.org/ijar.htm

Received: 10 Nov 2016
Peer Review: 10 Nov 2016
Revised: None
Accepted: 20 Dec 2016
Published (O): 31 Jan 2017
Published (P): 31 Jan 2017

INTRODUCTION

Stature or body height is one most important and useful anthropometric parameter that determines the physical identity of an individual. In anthropometric research, prediction of stature occupies relatively a central position. Estimation of stature of an individual from the skeletal remains or from the mutilated or amputated limbs or parts of limbs in the events of the murders, accidents or natural disasters like floods, tsunamis, earthquakes, plane crashes, train crashes, terrorist attacks usually requires the identification of victims which mainly concerns with the forensic identification analysis[1].

The most detailed description of stature estimation from skeletal remains was compiled by Krogman and Iscan[2]. The first serious research on estimation of length of long bones of 50 maleand 50 female corpses was conducted by Rolletin. Pearson estimated the stature from

long bones by formulating the regression equations. He also found that these formulae are population specific and should not be applied to individuals of different population groups. Later Dupertuis and Hadden estimated stature in cases where the racial roots of the individual are unknown by formulating general equation. Further it was also noted that discrepancies might occur between right and left parts when using these formulae. Trotter and Gleser made a contribution to setting and improving mathematical methods for determining stature [3]. Studies on the estimation of stature from various body parts such as upper and lower extremities including hand and foot dimensions has been reported[2-6].

The ulna is a long bone on the medial side of the forearm. Proximally the ulna has a bony process called the olecranon process which articulates with the humerus. Distally the ulna bears a styloid process. The olecranon is subcutaneous and easily palpable. The whole length of the subcutaneous border of the ulna is palpable down to the styloid process. The ulna has easily identifiable surface landmarks making the measurements possible even in compromised postures [7]. Therefore, formulae based on the ulna length provide an alternative stature predictor under such circumstances.

Determination of stature of an individual from fragmented remains is still a very demanding assignment despite numerous studies carried out as formula derived in a particular population does not fit worldwide because of genetic, ethnic, dietary and climatic differences. Therefore regression formulae needs to formulated for each specific population. The aim of the study was to find out the relationship between personal stature and length of ulna and to derive linear regression equation to calculate height from length of ulna and vice-versa.

MATERIALS AND METHODS

The present study was carried out on 300 (150 males and 150 females) healthy medical students in the age group of 18 – 28 years who belonged to Indian population. Inclusion criteria include healthy individuals of Indian origin.Exclusion criteria include students with old fractures, orthopaedic deformity and metabolic or developmental disorders.

In each case, the height and length of right and left ulna were recorded. The measurements were always taken at a fixed time, between 16:00 - 17:00 pm, to eliminate discrepancies of diurnal variation. The ulna length was defined as the direct distance between the tip of the olecranon process and the styloid process while the elbow in full flexion. Ulna lengths were taken independently on left and right sides of each individual using a digital sliding caliper. The height of the individual was measured between vertex and the floor, when the person is standing erect, in anatomical position and the head in the Frankfort plane, using a standing height measuring instrument.

Data was analyzed using SPSS version 17. Data was summarized using descriptive statistics such as Mean, SD, and Range. Independent sample t-test was used to compare mean differences in height and length of ulna in males and females. Pearson's correlation was used to find the strength of linear relationship between stature and length of ulna. P value <0.05 was considered as statistically significant.

RESULTS

The statistical analysis was carried out the mean, standard deviation and range was tabulated in Table 1. The mean length of right and left ulna in males was 27.52 cms (SD±1.63) and 27.62 cms (SD±1.69) respectively. The mean length of right and left ulna in females was 26.22 cms (SD±1.61) and 26.03 cms (SD±1.61) respectively. The difference between mean length of right and left ulna of study group is statistically significant in male, female and both together is shown in table 2. Pearson's correlation coefficient was used determine the relation between length of ulna and height which is represented in table 3 and graph 1and 2. Correlation coefficient between total height and length of ulna was found to be statistically significant and positive in both males and females which suggests if length of ulna increases or decreases, the height of the subject also increase or decrease vice versa. The linearregression equation for estimation of height from right and left ulna was calculated

as Stature = 83.224 + 3.04 x length of right ulna and Stature = 81.06 + 3.14 x length of left ulna respectively.

Table 1: Mean, SD and Range for all parameters.

	Parameter (cms)	Mean (cms)	SD	Range
Both the sexes together	Height	164.7	7.96	140-190
	Length of ulna(right)	26.82	1.74	20-30
	Length of ulna(left)	26.76	1.82	20-30
Males	Height	169.46	6.53	150-184
	Length of ulna(right)	27.52	1.63	20-30
	Length of ulna(left)	27.62	1.69	20-30
Females	Height	164.07	7.9	140-180
	Length of ulna(right)	26.22	1.61	20-30
	Length of ulna(left)	26.03	1.61	20-30

Table 2: Comparison of length of right and left ulna.

Subjects	Length of Right ulna Mean ± SD (Range)	Length of left ulna Mean ± SD (Range)	P value
Both sexes together	26.82 ± 1.74 (20-30)	26.76 ± 1.82 (20-30)	P<0.01*
Males	27.52 ± 1.63 (20-30)	27.62 ± 1.69 (20-30)	P<0.01*
Females	26.22 ± 1.61 (20-30)	26.30 ± 1.61 (20-30)	P<0.01*

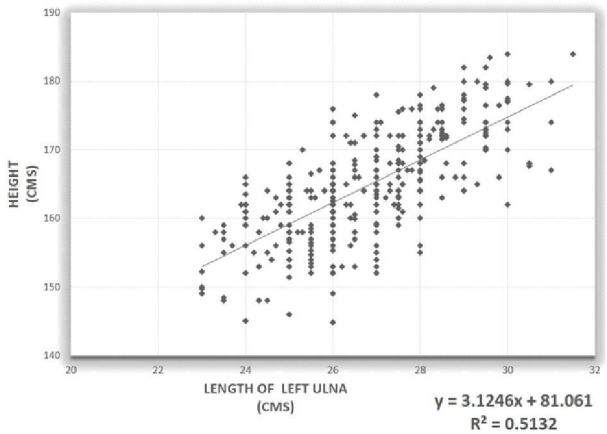
***P value is statistically significant**

Table 3: Correlation coefficient.

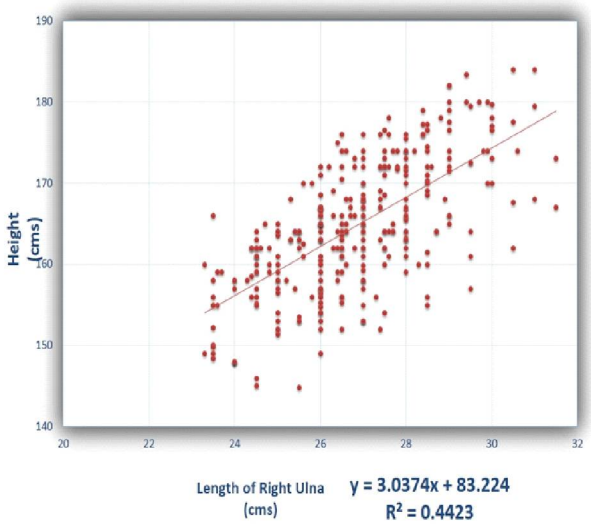
Subjects	Correlation coefficient [r] (Right ulna)	Correlation coefficient [r] (left ulna)	P-value
Both sexes together	0.44	0.51	P<0.01*
Males	0.45	0.51	P<0.01*
Females	0.27	0.32	P<0.01*

***P value is statistically significant**

Graph 1: Scatter plot showing the Correlation between the Height and length of Left Ulna.



Graph 2: Scatter plot showing the Correlation between the Height and length of Right Ulna.



DISCUSSION

Sex determination of an unknown individual and the estimation of stature is one of the most important aspects in forensic sciences and anthropological studies. Estimation of stature is essential for the calculation of body mass index, which is used for assessment of nutrition. However, its measurement is not always practical in old or frail bedridden patients who cannot stand or those who are suffering from vertebral column deformities. In such patients, formulae based on the ulna length provide an alternative stature predictor [8]. Pan worked on cadavers and derived relation between total ulnar length and total height of an individual [9]. According to Trotter M et al., there is an increase in the height of 2.5 cm after death [10]. Hence prediction of height using ulna in living has definitive advantage over the cadavers.

Various authors have observed that there is secular change and allometry between sexes among population. As the rate of skeletal maturity in males and females tend to vary during the course of development, gender specific formulae is required for the estimation of height [11]. In the present study, there was no statistical difference between the length of ulna between males and females. The Correlation coefficient between the total height and ulna length was found to positive indicating a strong relationship between the two parameters. The positive correlation suggests if length of ulna increases or decreases, the height of the subject also increases or decreases and vice versa.

In the present study the regression formulae for estimation of stature by both right and left ulna was derived and compared with the previous studies in the table given below. When compared with other studies it can be concluded that each population has a different regression formulae for calculating the stature.

Table 4: A comparison of linear regression equation of the present study with previous studies.

Authors	Place & year	Subjects	Linear regression equation
Allbrook [12]	Africa 1961	Males	Stature = 88.94 + 3.06 x ulna length ± 4.4 (Standard error)
Athwale [13]	Maharashtra 1963	Males	Stature = 56.97 + 3.96 x average length of right and left ulna ± 3.64
Maloy [5]	West Bengal 2009	Males	Stature =50.642+4.1896x right ulna± 7.7302. Stature = 76.289 + 3.256x left ulna ± 9.0826.
Thummer [14]	Gujarat 2011	Males	Stature = 81.11 + 3.12 x length of right ulna. Stature = 65.76+ 3.67 x length of left ulna
		Females	Stature = 17.10+ 5.34x length of right ulna. Stature = 18.95+ 5.33x length of left ulna
Anjali P. [15]	Marathwad 2012	Males	Stature = 93.45 + 2.92x length of ulna
		Females	Stature = 113.89 + 2.37X length of ulna
Present Study	Karnataka	Males & Females	Stature = 83.224 + 3.04 x length of right ulna Stature = 81.06 + 3.14 x length of left ulna

CONCLUSION

In the present study an attempt was made to documents a relationship between the ulna and height in Indian population. There was statistical difference between right and left ulna. A positive correlation was found between stature and length of ulna. Simple linear regression equation derived can be used for estimation of height from ulna and vice versa. Thus the data of this study will be of practical use in Medico legal investigations and in anthropometry. Hence the present study would be useful for Forensic Medicine experts and Anthropologist.

Conflicts of Interests: None

REFERENCES

[1]. Jasuja O.P, Singh G. Estimation of stature from Hand and Phalange length. Journal of Indian Academy of Forensic Medicine 2004;26(3): 100-106

[2]. W.M. Krogman, M.Y. Iÿs¸can, The Human Skeleton in Forensic Medicine, Charles C. Thomas, Springfield, IL, 1986.

[3]. O. Celbis, H. Agritmis Estimation of stature and determination of sex from radial and ulnar bone lengths in a Turkish corpse sample. Forensic Science International 2006; 158:135–139.

[4]. Meenakshi P. Borkar. Estimation of height from the length of humerus in western region of Maharashtra. Int J Res Med Sci. 2014; 2(2): 498-500.

[5]. Mondal M, Jana TK, Das J, Biswas S. Use of the length of the ulna in the estimation of stature in living adult males in the Burdwan district and in the adjacent areas of West Bengal. J Anat Soc Ind. 2009;58(1):16–19.

[6]. Khanapurkar S, Radke A. Estimation of stature from hand length, foot length and head length in Maharashtra region. Indian Journal of Basic & Applied Medical Research. 2012;1(2):77-85

[7]. L Ebite, T Ozoko, A Eweka, P Otuaga, A Oni, F Om'Iniabohs. Height: Ulna Ratio: A Method of Stature Estimation In A Rural Community in Edo State, Nigeria. The Internet Journal of Forensic Science. 2007;3:1-4.

[8]. Ilayperuma I, Nanayakkara, G, Palahepitiya N. A model for the estimation of personal stature from the length offorearm. Int. J. Morphol.2010; 28(4):1081-1086.

[9]. Pan N. Estimation of the height from different long bones in Bengalis. J Anat. Soc. Ind. 1924;58:3.74.

[10]. Trotter M and Gleser GC. Estimation of stature from long bones of American whites and Negros.Am.J.Phys.Anthropol1952;10:463-514.

[11]. Meadows, L. & Jantz, R. L. Secular changes in long bone length and proportion in the United States 1800-1970. Am. J. Phys. Anthropol. 1999;110:57-67.

[12]. Albrook D. The estimation of stature in British and East African males based on tibial and ulnar bone lengths, Journal of Forensic Medicine 1961;(8) 15-27.

[13]. Athwale MC. Anthropological study of height from length of forearm bones. A study of one hundred Maharashtrian make adults of ages between 25-30 years. American Journal of Physical Anthropology. 1963;21:105-12.

[14]. Thummar B, Patel Z, Patel S, Rathod SP. Measurement of Ulnar Length for estimation of Stature in Gujarat. NJIRM 2011;2(2):36-40.

[15]. Anjali Prasad, V B Bhagwat, Satish Porwal, D S Joshi. Estimation of Human Stature from length of ulna in Marathwada Region of Maharashtra Int J Biol Med Res. 2012;3(4):2337-234.

How to cite this article: Ashish Pandey, Radhika P.M, Shailaja Shetty. ESTIMATION OF HUMAN STATURE FROM LENGTH OF ULNA IN INDIAN POPULATION. Int J Anat Res 2017;5(1):3350-3353. **DOI:** 10.16965/ijar.2016.473