Assessment of Stature from the Percutaneous Measurement of Ulna in Healthy Volunteers

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ABSTRACT

Background: *Estimation of stature has a significant importance in the field of forensic medicine and anthropometry. For this purpose, an attempt has been made to derive regression equation formula to estimate stature from length of ulna, in the current study.*

Methods: *This study was carried out on 300 (150 male and 150 female) healthy subjects in a medical college, costal Andhra Pradesh with age between18 to 25 years. For every subject; the height and length of right and left ulna were recorded. The measurements were always taken at a fixed time between 2-4 pm to eliminate discrepancies of diurnal variation. The measurements were taken for stature from crown to heel in standing posture with head oriented in Frankfurt's plane with a standard height measuring instrument. The data was analysed statistically SPSS software version-21 for calculation of Mean, SD, Standard error, Correlation coefficient, Regression coefficient, value of constant and 't' test for correlation coefficient.*

Results: *The correlation coefficients for right and left ulnae in males are 0.835 and 0.837 whereas in females 0.772 and0.774 respectively. The difference in mean length of ulna in males and females was found to be statistically significant (P <0.001).*

Conclusion: *The lengths of ulna will aid better reliability in estimation of an individual stature in medico legal forensic examinations.*

Key Words: *Stature, Ulnar length, Anthropometry, Medico-legal*

INTRODUCTION

Establishing the identity of an individual from mutilated, decomposed and amputated body fragments due to natural disasters such as earth quakes, tsunamis, floods and man-made disasters like bomb blasts, plane crashes, and railway accidents is important for both medico legal and humanitarian grounds.[1] Stature is considered as one of the important parameters for personal identification and stature reconstruction plays a vital role in identification of individuals. There is an established relationship between stature and dimensions of various body parts which allows forensic experts to estimate stature.

The length of ulna is one such parameters shown to be a reliable and precise means in predicting stature of an individual.[2] The length of one of the forearm bones, ulna gives more accuracy in devising regression of persons height[3-4] rather than the length of the lower limb bones like tibia.[5]For this purpose we have analysed the anthropometric-relationship association between length of ulna and stature and to derive regression formula from it.

METHODS

The present study comprised of a total 300 (150 male and 150 female) healthy students of Narayana Medical College, Nellore, Andhra pradesh. Their ages ranged between 18 to 25 years. The institutional ethics committee permission and consent obtained from the subjects, were ensured before starting the study protocol. Subjects with history of old fractures, any significant systemic diseases, orthopaedic deformity, metabolic, developmental disorders which could have affected the general or bony growth were excluded from study. For every subject; the height and length of right and left ulna were recorded. The measurements were always taken at a fixed time between 2-4 p.m to eliminate discrepancies of diurnal variation. The measurements were taken for stature from crown to heel in standing posture with head oriented in Frankfurt's plane with a standard height measuring instrument. The height was recorded in centimetres. The length of ulna was measured with the help of spreading calliper from tip of olecranon process to tip of styloid process with elbow flexed and palm spread over opposite shoulder.

Measurements of length of right and left ulna were taken separately for calculation. The data was analysed statistically SPSS software version-21 for calculation of Mean, SD, Standard error, Correlation coefficient, Regression coefficient, value of constant and 't' test for correlation coefficient.

RESULTS

Table 1 shows that in male subjects, mean height is 168.93±6.73 cm, and mean length of right ulna is 27.84±1.45 cm, with range of 24.60 – 30.40 and mean length of left ulna is 27.75±1.44 cm with range of 24.50 – 30 cm and in the females, mean height is 156±4.96 cm, and mean length of right ulna is25.67±1.22 cm with range of 22.60 - 28.20 cm and mean length of left ulna is 25.60±1.23 cm with range of 22.50 - 28 cm.

Table 1: Range of all parameters in male and female subjects

parameter	Mean ±SD		Range (min – max)	
	Male (n=150)	Female(n= 150)	Male	Female
Height	168.93±6.73	156.94±4.96	160 – 186	145 – 167
Length of right ulna	27.84±1.45	25.67±1.22	24.60 – 30.40	22.60 – 28.20
Length of left ulna	27.75±1.44	25.60±1.23	24.50 – 30.00	22.50 – 28.00

Table 2 shows that there is no significant sidewise variation in ulnar length of males and females.

Table 2: comparison of length of right and left ulna

subjects	Mean Length of right ulna (cm)	Mean Length of left ulna (cm)	p-value
Male	27.84	27.75	>0.05
Female	25.67	25.60	>0.05
p-value	<0.001	<0.001	

Table 3 shows that the correlation coefficients for right and left ulnae are 0.835 and 0.837 respectively, in case of male subjects, and those for right and left ulnae of women are 0.772 and 0.774 respectively.

Table 3: Correlation of height with length of ulna in male and female subjects

subjects	Correlation coefficient (r)		Coefficient of determination(r2)		p-value
	right	left	right	Left	
Male	0.835	0.837	0.696	0.7	<0.0001
female	0.772	0.774	0.595	0.598	<0.0001

Table 4 shows regression equation for height with ulna length in males and females.

The equation is as follows:

Height(Y) = a (constant or intercept) + b (slope) × ulnar length.

Table 4: Regression equation formulae

parameter	sex	side	Regression equation
Ulnar length	Male	Right	Y = 61.57+3.81Xright ulnar length
		Left	Y = 60.91 + 3.89 X left ulnar length
	Female	Right	Y = 76.78 + 3.122 X right ulnar length
		Left	Y = 77.54 + 3.101 X left ulnar length

In men, 61.57 and 60.91 are intercept (constant or a) and 3.81 and 3.89 are regression coefficient (b) for right and left ulnae, respectively. In women, 76.78 and 77.54 are intercept (constant or a) and 3.122 and 3.101 are regression coefficient (b) for right and left ulnae, respectively.

Figures 1 and 2 show positive correlation between ulnar length and height of subjects, indicating that increase in length of ulna leads to increase in total height of male subjects. Figures 3 and 4 show positive correlation between ulnar length and height of subjects, indicating that increase in length of ulna leads to increase in total height of female subjects.
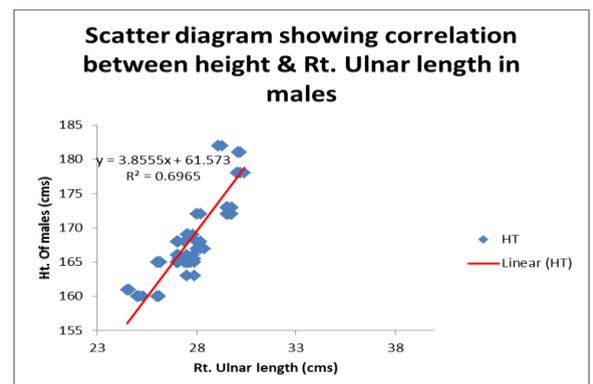

Figure 1: scatter diagram showing correlation between stature and right ulnar length in males
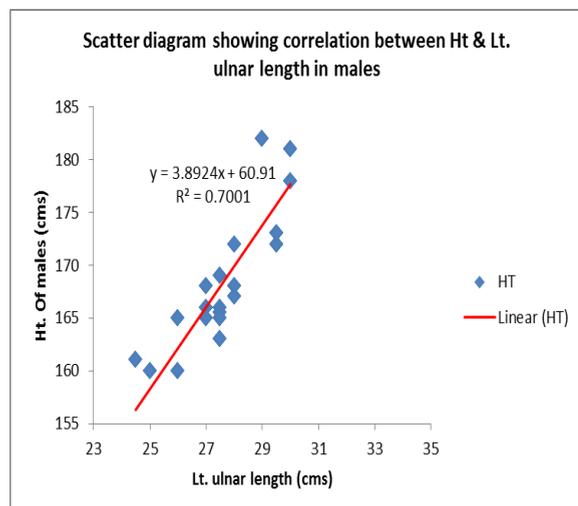
Figure 2: scatter diagram showing correlation between stature and left ulnar length in males
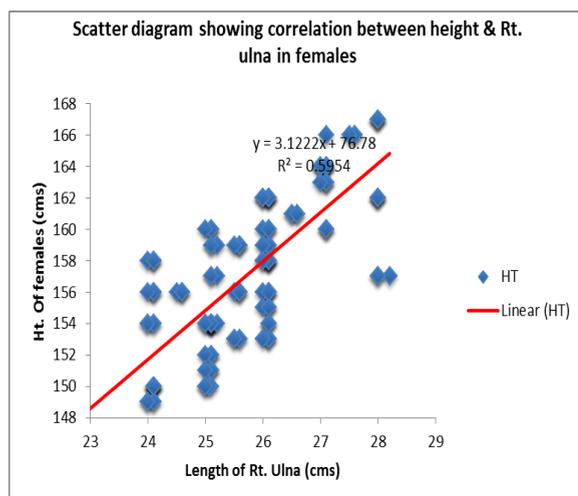

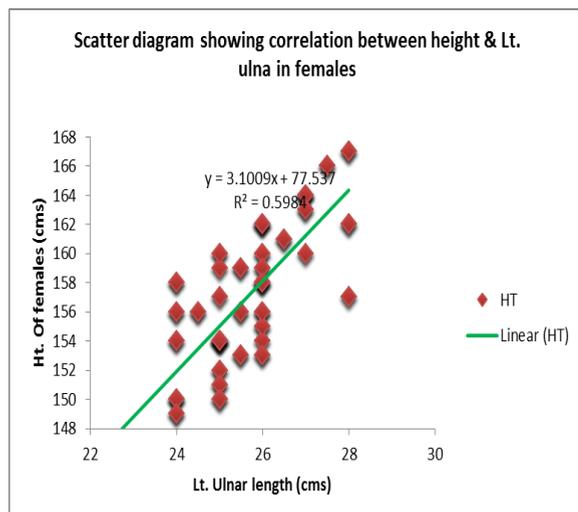**Figure 3: scatter diagram showing correlation between stature and right ulnar length in females**

Figure 4: scatter diagram showing correlation between stature and left ulnar length in females

DISCUSSION

Telkkä et al, Trotter et al Muñoz et al[6-8] have offered regression equations based on long bones. However it is well known that formulae that apply to one population do not always give accurate results for other population and each group needs a separate formula. In our study mean value of right ulnar length is 27.84 cmand that of left ulnar length is 27.75 in males. Our findings correlate with Bamne et al [9] findings. They studied 200 subjects (100 men, 100 women) and concluded that anthropometric measurement of ulna can estimate statue of a person with great accuracy. Our findings also correlated with Duyar et al[10] studied 254 healthy male subjects and derived new ulna-based height estimation formula. His study was based on the need for population-specific stature estimation in Turkish population. Our findings also correlate with those of Mondal et al[11] who studied 300 male subjects in Burdwan district of West Bengal, India.

In our study, mean value of right ulnar length is 25.67 cm and that of left ulnar length is 25.60 cm in females. Our findings correlate with those of Thummar et al[12]whom studied in female population and correlate in both sexes with Bamne et al[9] Illayperuma et al.[2]

CONCLUSION

From the present study, it has been concluded that the mean height and length of ulna is more in males than in females. The difference in mean length of ulna in males and females was found to be statistically significant (P <0.001).There is positive correlation between stature and length of ulna. Simple linear regression equation so far derived can be used for estimation of height in Nellore region of coastal Andhra Pradesh. If either of the measurements (length of ulna or total height) is known, the other can be calculated. This fact will be of practical use in all medico legal investigations and in anthropometry.

Conflict of Interest: None

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