CALCULATION OF REGRESSION EQUATION FOR ESTIMATION OF STATURE FROM PERCUTANEOUS ULNA LENGTH

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Abstract

Many a times Forensic Experts are asked to identify the person from dismembered part of the body and skeletal remains by the Investigating Officer. If the whole skeleton is available it becomes easy for identification, but the problem arises when only dismembered part of the body, few bones or single bone is available. In identification, stature is primary characteristic along with age and sex. The present study is carried out in J. J. M. Medical College, Davangere, Karnataka. Total 100 students (50 males and 50 females) are randomly selected. The height of the students and length of both right and left Ulna of each student is measured by the same observer and with the same instrument. In this study we formulated the Regression Equation for estimation of stature from percutaneous length of right and left Ulna for males and females separately. Co-efficient correlation of height with percutaneous Ulna length is also calculated. The results of the present study indicate that the percutaneous length of ulna can be efficiently used for estimation of stature.

Key Words: Ulna length, Stature, Correlation coefficient, Regression Equation.

Introduction

Assessment of body height from different parts of body by anthropometric study of skeleton is an area of interest to Forensic Experts, Anatomists and Anthropologists. Many a times Forensic Experts are asked to identify the person from dismembered part of the body and skeletal remains by the Investigating Officer. If the whole skeleton is available it becomes easy for identification, but the problem arises when only dismembered part of the body, few bones or single bone is available.

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In ancient time physician and surgeon like Charaka and Sushruta were well acquainted with the relation of different parts of body and height. According to Charaka, the height of an average man should be 84 anguls, thigh - 21 anguls, leg - 19 anguls, forearm- 15 anguls and arm- 16 anguls[1].

In past many authors have studied on Stature estimation based on measurements of Ulna and other long bones. Several authors have offered regression equations based on the length of long bones; however it is well known that formulae that apply to one population do not always give accurate results for other populations. Pearson[2] stated that a regression formula derived for one population should be applied to other groups with caution. In 1929, Stevenson[3] confirmed the existence of inter population differences with respect to stature estimation.

And most studies have stressed that regression formula for stature estimation should be population specific. So there is a need to develop a separate regression formula for stature estimation from long bone measurement for a particular population.

Since Olecranon process and styloid process are easily felt through the skin, it becomes easy to measure the length of the Ulna bone. So the present study "Estimation of Stature from Percutaneous Ulna Length" is taken up.

Materials and Methods

The present study is carried out in J. J. M. Medical College, Davangere, Karnataka. Total 100 students (50 males and 50 females) are randomly selected. The height of the students and length of both right and left Ulna of each student is measured by the same observer and with the same instrument and during the time period of 2.00pm to 4.00pm to avoid diurnal variation of height. Inclusion criteria: Students between 19-22 years of age.

Exclusion criteria: Students having congenital limb deformities, old fracture of limbs, achondroplasia, hypochondroplasia & etc.

The ulna length is measured as a straight distance from the most proximal point of the Olecranon process to the most distal point of the Styloid process, with forearm flexed 90^0 angle at the elbow joint by using spreading caliper. Height of the student is measured in erect position with barefoot. After collection of data, it is subjected to statistical analysis. Mean, Standard Deviation, Standard Error of Estimate and Range for Height, Right Ulna length and Left Ulna length is calculated separately for males and females.

Correlation of Height with Right Ulna length and Correlation of Height with Left Ulna length is calculated for males and females.

Results

The statistical data which are extracted from calculation are tabulated as

Table-1: Shows Mean, Standard deviation and Range for Height, Right Ulna length and Left Ulna Length for male and female

All in centimeters	Mean		Standard Deviation		Range	
	Male	Female	Male	Female	Male	Female
Height	168.77	154.58	7.16	5.59	141-183	140-177
Rt Ulna Length	27.15	24.46	1.45	1.22	22-29.5	22.5-28
Lt Ulna Length	26.86	24.16	1.53	1.10	21.5-29.5	22.5-27.5

Table-2: Shows correlation co-efficient of Height with Right Ulna length and Left Ulna Length separately for male and female.

	Male	Female
Correlation of Height with Right Ulna length	0.79	0.71
Correlation of Height with Left Ulna length	0.79	0.70

For males, Correlation Co-efficient of Height with Right Ulna Length and Left Ulna Length are 0.79 and 0.79 respectively which show significant positive correlation. Similarly for females Correlation Co-efficient of Height with Right Ulna Length and Left Ulna Length are 0.71 and 0.70 respectively which also show significant positive correlation.

Table-3: Shows standard error of estimate for right Ulna length left Ulna length in males and females.

	Male		Female	
	Right Ulna Length	Left Ulna Length	Right Ulna Length	Left Ulna Length
Standard Error of Estimate	4.38	4.36	3.94	4.01

Regression formulae for estimation of height;

In males

Height from Right Ulna Length;
$Y1 = 65.54 + 3.91X_1$

Height from Left Ulna Length;
$Y2 = 68.79 + 3.72X_2$

In Females

Height from Right Ulna Length;
$Y3 = 75.54 + 3.23X_3$

Height from Left Ulna Length;
$Y4 = 68.89 + 3.50X_4$

X_1 denotes right ulna length of male

X_2 denotes left ulna length of male

X_3 denotes right ulna length of female

X_4 denotes left ulna length of female

The standard error of estimate works out to be 4.38 for right ulna length and 4.36 for left ulna length in males, 3.94 for right ulna length and 4.01 for left ulna length in females.

Thus at 95% confidence level the estimated height of male and female are as follows:

In males

$Y1 = 65.54 + 3.91X_1 \pm 8.58$

$Y2 = 68.79 + 3.72X_2 \pm 8.54$

In Females

$Y3 = 75.54 + 3.23X_3 \pm 7.72$

$Y4 = 68.89 + 3.50X_4 \pm 7.85$

Discussion

Results of present study are in excellent agreement with study done by Mondal M.K. et. al.[1] (in his study correlation co-efficient (R) of Height with Right Ulna length and Left Ulna Length are 0.78 and 0.68 respectively), Umesh S. R.[4] (R = 0.79 for Male Rt Ulna Length, R = 0.77 for Male Lt Ulna Length, R = 0.74 for Female Rt Ulna Length, R = 0.83 for Female Lt Ulna Length.) and Sorojini Devi et. al.[5] (R = 0.619 for male and R = 0.584 for female).

Duyar I et. al.[6] mentioned in his study, a need for separate regression equation to estimate stature depending upon length of Ulna (short, medium and tall) to have accurate results.

Allbrook D.[7] derived regression equation formulae for height estimation from ulna length as, Stature = 88.94 + 3.06 (ulna length) ± 4.4 (S.E.). He had not derived regression equation separately for male and female.

Agnihotri A. et. al.[8] are of the opinion that there is no need of separate regression formulae for right and left ulna and also no need of separate equation for male and female, but Mohanty[9] suggested a need for gender based different regression equations to predict the height.

Athawale MC[10] showed that there is definite correlation between stature of an

individual and length of forearm bones. The regression equation derived for stature estimation from ulna length is; Stature = 56.97 + 3.96 x Length of ulna ± 3.64. Here the author has taken average length of right and left ulna length for estimation of stature.

Lal and Lala[11] estimated height from surface anatomy of long bones like tibia & ulna. The ulnar multiplication factor was comparable in all series. They have claimed that ulnar multiplication factor is better guide for calculation of height when it is not definitely known to which part of the country the individual belongs.

In this study we have derived a separate regression equations for both Right and Left Ulna Length for males and females to estimate accurate stature of individual.

Conclusion

The results of the present study indicate that the percutaneous length of ulna can be efficiently used for estimation of stature.

Most authors have underlined the need for population-specific stature estimation formulae. The main reason for this is, the ratio of various body parts differ from one population to another. In addition to ethnic differences, secular trend[12] and even environmental factors such as socioeconomic and nutritional status can influence body proportion[13]. So in this study we derived a separate regression equation to estimate stature from ulna length for Davangere region.

References

1. Mondal MK, Jana TK, Das J et. al. Use of length of Ulna for estimation of Stature in living adult male in Burdwan District and adjacent areas of West Bengal. J Anat Soc India 2009;58(1):16-8.
2. Pearson K. Mathematical Contribution to the theory of Evolutions v on reconstruction of stature of the prehistoric races. London: Philos. Trans. R Soc; 1898. Series A 192: p. 169-244.
3. Lundy JK. The Mathematical verses Anatomical Methods of Stature Estimation from long Bones. Am J Forensic Med Pathol 1983;6(1):73-6.
4. S. R. Umesh. Estimation of Stature from Percutaneous Ulna Length. Medico-Legal Update, July-December 2011;11(2):9-96.
5. Sorojini Devi H., Das BK., Purnabati S., Singh D. and Yayashree Devi. Estimation of stature from upper arm length among the Marings of Manipur. Indian Med J August 2006;100(8):271-3.
6. Duyar I., Pelin C., Zagyapan R. A new method of stature estimation for Forensic Anthropological application. Anthropological Science 2006;114:23-7.
7. Allbrook D. The estimation of stature in British and East African males based on the tibial and ulnar bone length. J Forensic Med 1961;8:15-27.
8. Agnihothri AK, Kachhwaha S, Jowaheer V et. al. Estimating stature from percutaneous length of tibia and ulna in Indo-Mauritian population. Forensic Sci Int 2009; 187:109:e1-109.e3.
9. Mohanty MK. Prediction of height from percutaneous tibial length amongst Oriya population. Forensic Sci Int 1998;98:137-41.

10. Athawala MC. Estimation of height from the length of forearm bones. A study of 100 Maharastrain male adults of age between 25-30 years. American journal of Physical Anthropology 1963;21:105-12.

11. Lal CS and Lala JK. Estimation of height from tibial and ulnar length in North Bihar. Journal of Indian Medical Essentials 1972;58:4.

12. Meadows L., Jantz RL. Allometric secular change in the long bones from the 1800s to the present. J Forensic Sci 1995;40:762-7.

13. Malina RM. Ratios and derived indicators in the assessment of nutritional status. In: Himes JH, Editor Anthropometric assessment of nutrition status. New York: Wiley-Liss; 1991. p. 151-71.

Fig – 1

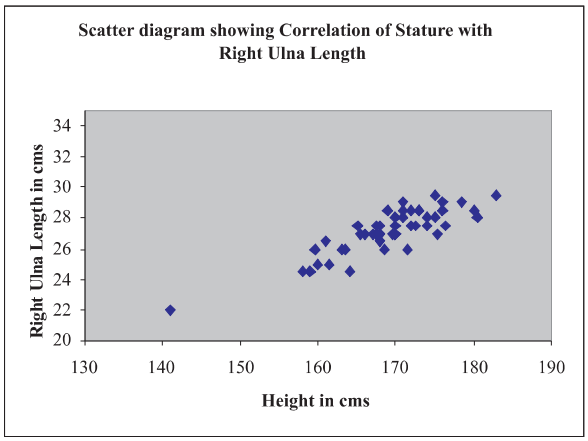

Fig – 2

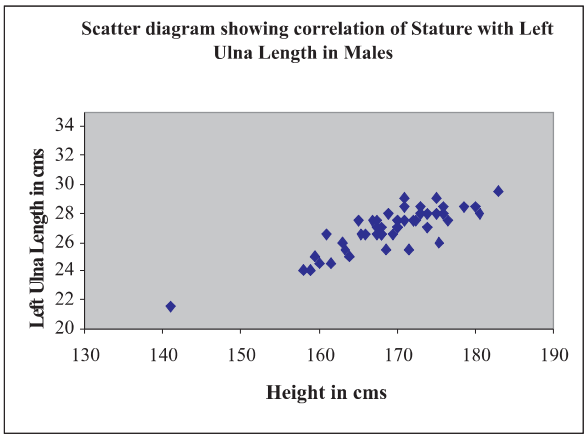

Fig – 3

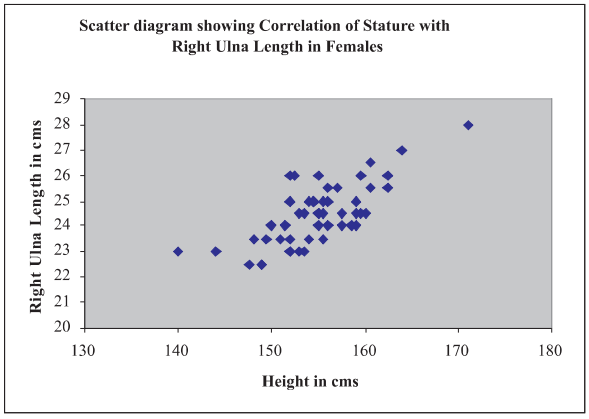

Fig – 4