



RESEARCH ARTICLE

HEIGHT PREDICTION BY MEASURING ULNAR LENGTH IN FEMALES

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ABSTRACT

Context: Stature estimation is frequently required by the Forensic Science experts which more often done on the skeletal remains. Since 1950's the long bones in the human body for eg Humerus, ulna, Femur and Tibia are used for stature identification. Arm Span, nose length have also been used for height prediction. A study was needed to find out such a correlation in females as few studies have been conducted.

Objective: To formulate an equation and relation for estimation of stature in living adult females by the measurement of their ulna bone.

Method: This study was conducted in Sri Ramchandra Medical College Chennai and Dubai medical college for girls. Female participants who were chosen from faculty and students. Crown to heel measurement and ulnar length measurements (From tip of olecranon process to tip of styloid process) were done.

Result: In the present study, the average height in 100 females was seen to be 162cm, the average length of right ulna was 25.7 and average length of left ulna was 25.4cm. The correlation coefficient(r) of the height and the length of the left ulna was (0.85) and that for the right ulna (0.81). Left side with height (0.85) The value of r implied that there was a positive correlation

Conclusion: Being a percutaneous bone Ulna can be easily palpated and measurements for length can be taken reliably. A relation between height and length can be studied easily which will be beneficial for Anatomist, Clinicians and anthropometry studies.

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INTRODUCTION

In order to discriminate the features and stature of different races and generations Anthropometry plays a vital and Key role in unfolding the mysteries of evolution. Evolution has modified and eliminated a variety of features and species regarding their stature and growth patterns. Not sparing the humans also. Pearson *et al.* (1898) first introduced the co-relational calculus into the field of work for the prediction of the stature from the measurement of the long bones. Height is one of the factors in the description of impressiveness of an individual and it varies with race, age sex, heredity, climate and nutritional status. Telekka *et al.* (1950) worked on the bones of the limbs and expressed the opinion that each racial group needs a separate formula for the estimation of stature. Many of the previous workers worked on cadavers or on skeletal remains (Mall *et al.*, 2012; Celbis and Agritmis, 2006). But cadavers cannot be the representatives of the population; because the cadavers are largely of persons who are aged, and they may have suffered

from chronic debilitating diseases. It may be likely that they had been lying in an abnormal posture and it may not have been possible to straighten the body to get the accurate stature measurement. Again, according to Trotter *et al.* (1952), there is an increase in the height of 2.5 cm after death, when the measurement is taken in the recumbent posture. Since over half of the century, the stature estimation has been linearly regretted with the length of the different long bones, especially for which the percutaneous measurement could be taken, like the ulna, the tibia, etc. The linear regression equation of the height on the ulna length has a definitive advantage over that of the tibial length, as it can be useful in the cases where the lower extremities are deformed, along with the deformities of the trunk (Lundy, 1985). Even the ulnar length was proven to be superior to the arm span measurement (Lal and Lala, 1972) and the hand length (Devi *et al.*, 2006) in predicting the height.

MATERIALS AND METHODS

This study was conducted in the Dubai medical College and Sri Ramchandra medical college on 100 females who were 19 to

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35 years of age. The females of 19-35 years age-group were approached, because the ulnar development and the ossifications complete by 19 years of age and as on the other hand, ladies who are above 40 years may have peri/post menopausal erosion in the bones.

An informed consent was taken from the participants.

Inclusion Criteria

Normal Females without any apparent deformity.

Exclusion Criteria

Stunted growth and deformed individuals.

The vertex to the heel height (in centimetre) was measured for each subject with them in the standing erect posture with bare feet .With help of a measuring tape the vertex to heel length was taking accurately by making the participant to stand against the wall and marking the wall.

The ulnar length was measured from the tip of the olecranon process to the tip of the styloid process, with the elbow flexed and the palm spread over the opposite shoulder with the help of the same tape; on the right and the left sides consecutively Fig. 4.

RESULTS

In the present study, the average height in 100 females was seen to be 162cm, the average length of right ulna was 25.7 and average length of left ulna was 25.4cm. The correlation coefficient(r) of the height and the length of the left ulna was (0.85) and that for the right ulna (0.81). Left side with height (0.85) The value of r implied that there was a positive correlation

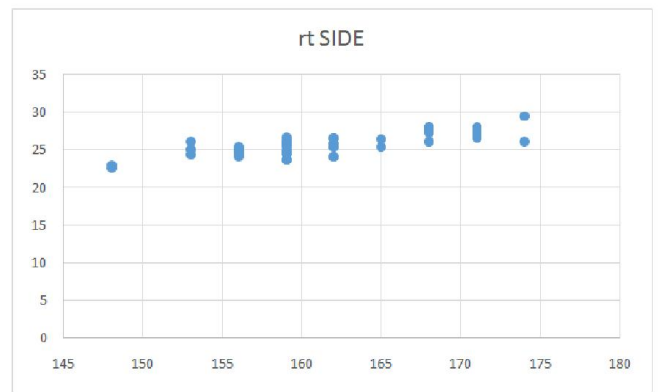


Fig. 2. Scatter diagram showing the length of right ulna as compared with the height

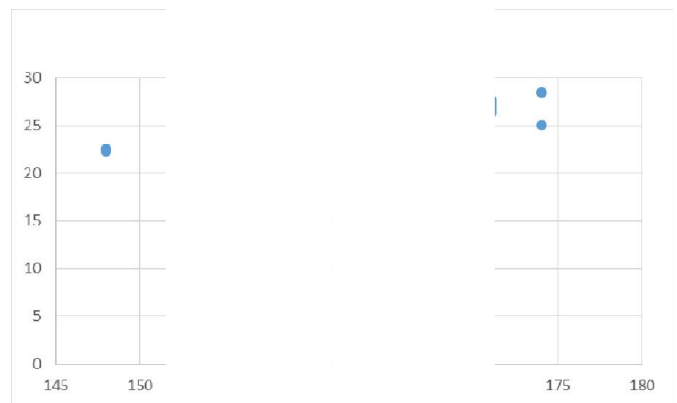


Fig. 3. Scatter diagram showing the length of left ulna as compared with the height

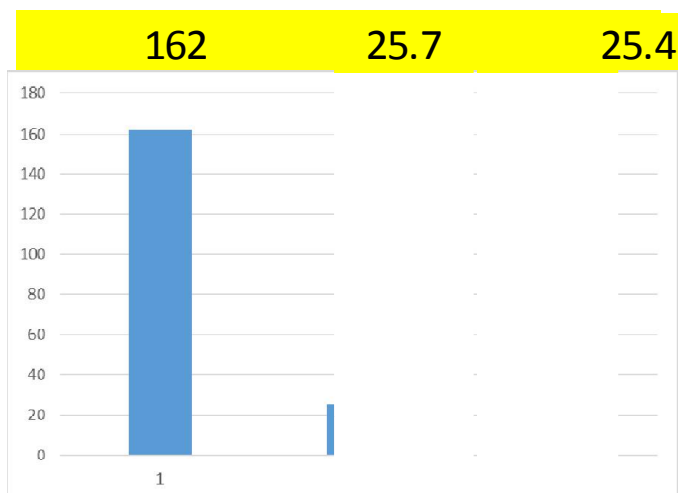


Fig. 1. Average of heights (1), Average of Length of Right ulna (2) and Left ulna (3)



Fig. 4. measuring the length of Ulna

A check was done on the formula for determination of stature $Stature = 6.46 \times \text{ulnar length} + 2$ which was found to be accurate in most of the observations.

DISCUSSION

In the present study, the correlation coefficient (r) of the height and the length of the left ulna was (0.85) and that for the right ulna (0.81). Left side with height (0.85) the value of r implied that there was a positive correlation. This implied a significant contribution of the length of the ulna towards the height. The simple linear regression equation which has so far been derived can be used for the estimation of the height. Our findings are at par with the findings of the previous researchers, as were reported in 1952. Trotter M *et al.*, (Trotter and Glessner, 1952) estimated the stature of American whites and Negroes from the ulna with linear regression equations. A study which was done by Lundy *et al.* (1985) discussed the regression equation and the mathematical and the anatomical method of estimating the living stature from the long limb bones in the south African population. The reports of Agnihotri *et al.* (2009) from Mauritius and those of Barbaosa *et al.* (2012) from Portugal also found the linear regression model to depict an individual's stature from the percutaneous ulnar length. In India, Lal *et al.* (1972) worked on a population of 258 in north Bihar, whose ages ranged from 12 to 21 years, for the estimation of the height from the surface anatomy of the long bones e.g. the tibia and the ulna. The ulnar mean multiplication factor was comparable in all the series. They claimed that the ulnar multiplication factor was a better guide for the calculation of the height, when it was not definitely known as to which part of the country the individual belonged. Devi *et al.* (2006) computed the correlation coefficient ($r = 0.619$ for males and 0.584 for females) and the regression equation formula for the estimation of stature by using the upper arm length among the living population of the Maring tribes of the Pallel area in the Chandel district, Manipur. In the Bengalee population, Mondal *et al.* (2009) postulated the height estimation in males from the ulna. The present study could highlight such a relationship in females. Since the height of an individual progressively increases up to a certain age (till adolescence) and then decreases after a certain age due to vertebral column erosion, so the inclusion of a wider range of age groups could overcome its limitation for its applicability of the regression model. But still the regression formulae which are proposed will be of immense practical use in the clinical practice and in medico-legal, anthropological and archeological studies, where the total height of a subject can be calculated if the ulnar length is known.

Conclusion

Being a percutaneous bone Ulna can be easily palpated and measurements for length can be taken reliably. A relation between height and length can be studied easily which will be beneficial for Anatomist, Clinicians and Anthropometry studies.

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