RESEARCH

ESTIMATION OF STATURE FROM ULNAR BONE: A CROSS-SECTIONAL STUDY ON FIFTY-SIX MALES IN INDIAN POPULATION

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Abstract

Background: It has been demonstrated that the length of an individual's ulna can reliably and accurately predict their height without the need for any other measurements. Anatomy, forensic medicine, and anthropometry require accurate height measurement. The purpose of this research was to investigate the anthropometric relationship between ulnar length and height, with the end goal of developing regression formulas that could be used to estimate height based on ulnar length alone. **Materials and Methods:** The study subjects were all medical and paramedical students of various batches in Index Medical College & Hospital of age group between 18 to 22 years who belonged to Indore population (Born & Brought up in Indore). **Result:** The height of the male subjects taken into considerations for present study was 168.1±10.1. The ulnar length of the right ulnar is slightly higher than on the left side. When compared between the two sides of the ulnar bone lengths, did not observe significant difference. The present study observed a stable incline, with a positive regression of Y=81.56+ 1.93X when compared between height and ulnar bone length of the male subjects. In addition, the present study also observed a positive Pearson correlation coefficient with a P value of <0.05. **Conclusion:** It is possible to estimate height in the Indore region by using the straightforward linear regression equation that has been developed thus far. A positive correlation was found between stature and length of ulna.

INTRODUCTION

The fields of anatomy, forensic medicine and anthropometry rely heavily on the ability to accurately measure height.[1,2] The expression of the dimensions of the human body and skeleton in a quantitative manner can be achieved with a series of methodically organized measuring techniques known as anthropometry. Establishing the identity of a person from mutilated, decomposed, and amputated body fragments has become increasingly important in recent years.[3,4] This is because natural disasters (such as earthquakes, tsunamis, cyclones, and floods) and man-made disasters (such as terrorist attacks, bomb blasts, wars, and plane crashes) have made this a necessity.[4,5] According to Chikhalkar et al. (2010),[7] it is necessary from both a legal and humanitarian point of view. The ulna is a long bone that can be found on the medial side of the forearm. Its proximal end is characterized by an olecranon process, and its distal end is characterized by a styloid process.[7,8,9,10] It is possible to feel the entire length of the ulnar subcutaneous border, all the way down to the styloid process.

It has been demonstrated that the length of an individual's ulna can reliably and accurately predict their height without the need for any other measurements. A review of the relevant literature unearthed the findings of the research conducted,[11] which made use of cadavers from World War II and the Terry Collection. The maximum length of each of the six long bones, as well as the maximum length of the femur and the distance between the upper and lower articulating surfaces of the tibia, were all measured. Also measured was the distance between the upper and lower articulating surfaces of the tibia.

When it comes to determining an individual's physical identity, stature, also known as body height, is one of the anthropometric parameters that is the most important and useful. The determination of a person's height is an essential component of anthropometric analysis.

One takes a person's height, which is comprised of the lengths of various bones and body parts that show a certain relationship with the body's overall shape, to get an idea of how much they have grown over time. Studies of the skeleton performed by

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anthropo-metrists can be used to calculate a person's height by measuring them at different points on the body.

An individual's anthropometric characteristics, which in turn have an impact on the internal structure and tissue components, which in turn are influenced by a person's genetic and environmental influences, are directly linked to a person's sex, shape, and form.

Anatomy, forensic medicine, and anthropometry require accurate height measurements. Montagu (1960).[6] Using methodically organized measuring techniques, anthropometry quantifies the human body and skeleton. Identifying mutilated, decomposed, and amputated body fragments has become more important.[4,5,6] Natural and man-made disasters (earthquakes, tsunamis, cyclones, floods) and terrorist attacks, bomb explosions, wars, and plane crashes require this.[12,13,14,15,16] The ulna is a forearm bone. It has olecranon and styloid processes, until the styloid process, the ulnar subcutaneous border is palpable.

The purpose of this research was to investigate the anthropometric relationship between ulnar length and height, with the end goal of developing regression formulas that could be used to estimate height based on ulnar length alone. The subjects taken for study purpose belongs to Medical and Para-Medical students who are born and brought-up in Indore persuing their education in Index Medical College & Hospital, Indore. Age group between 18 to 22 years were only included in the study.

MATERIALS AND METHODS

The present study was carried out in Index Medical College &Hospital, Indore after obtaining permission from Ethics Committee of the Institution.

This study was a cross sectional one with both descriptive and analytical components. The descriptive component to find out mean height ulnar lengths of both hands of male and female study participants. The analytical component was used to evaluate the correlation between the height and length of ulna bone and to arrive at a regression equation for height with length of ulna in both sexes

Sample size: Based on the intense review of literature,[11,12,13,14,15,16,17,18,19,20] on estimation on estimation of human stature from length of ulna in Indian population 21, with a mean of 26.92, SD of 1.32 for males and with a mean of 21.75, SD of 0.92 with the limit of accuracy as 1% of the mean, the sample size was calculated to be 56.

N = 1.962x1.322 /0.2692 = 56 males

Present Study Population

The study subjects were all medical and paramedical students of various batches in Index Medical College & Hospital of age group between 18 to 22 years who belonged to Indore population (Born & Brought up in Indore).

Exclusion & Inclusion Criteria of the Present Study

Inclusion criteria was male or female healthy medical and paramedical students of age (18-22) years from Indore, subjects with skeletal abnormalities like achondroplasia, polio, scoliosis, previous fractured forearm, amputated upper limb and students from other than those not born and brought up in Indore will be excluded out from the study.

Methods

Written informed consents were obtained from the study participants prior to the interview. Measurements were taken using standard anthropometric instruments namely vernier calipers and stadiometer. Length of ulnar was measured with the help of Vernier caliper from tip of olecranon process to tip of styloid process with the forearm flexed 90* and hand touching the opposite shoulder for both sides. Height was measured in standing position with barefoot in the stadiometer with head oriented in Frankfurt plane. Measurements were taken by the sliding the horizontal part to the vertex in the sagittal line. All measurements taken around 2 to 4 PM to avoid diurnal variation.

Statistical Analysis

After collected data, statistical analysis was done for calculation of mean, standard deviation, standard error, correlation coefficient, regression coefficient, value of constant and t test for correlation coefficient applied to test the statistical significance using Microsoft excel file.

RESULTS

[Table 1] shows the mean and standard deviation of ulnar bone of male gender subjects. The height of the male subjects taken into considerations for present study was 168.1±10.1. The ulnar length of the right ulnar is slightly higher than on the left side. When compared between the two sides of the ulnar bone lengths, did not observe significant difference. The ulna lengths of the people in the study group are statistically significant at all ($P < 0.05$), when compared between right and left ulnar bones.The correlation coefficient of Pearson of the study subjects As ulna length increases or decreases, the subject's height also increases or decreases. This correlation is statistically significant (P 0.05) and positive in males. This positive and statistically significant correlation shows that if the ulna length increases or decreases, the subject's height also increases or decreases.

[Figure 1] shows the regression equation of height with ulnar bone length of the male study subjects. The present study observed a stable incline, with a

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positive regression of Y=81.56+ 1.93X when compared between height and ulnar bone length of the male subjects. In addition, the present study also observed a positive Pearson correlation coefficient with a P value of <0.05.

Table 1: Mean and standard deviation of ulnar bone of male gender

Variables (cm)	Mean	Standard Deviation
Height	168.1	10.1
Length of ulna (right)	25.3	2.1
Length of ulna (left)	25.2	1.8

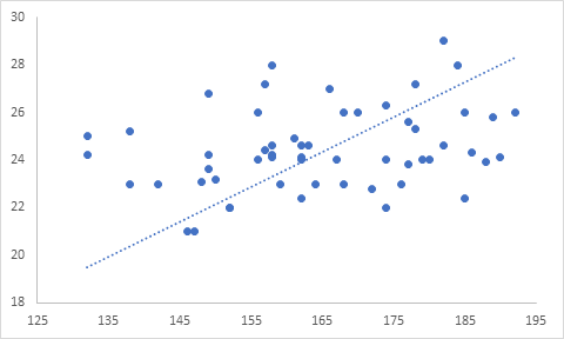

Figure 1: Correlation of height with ulnar bone length in male subjects (n =56)

DISCUSSION

The purpose of this study is to investigate whether there is a connection between total standing height and ulna length. When conducting anthropological research or conducting anatomical investigations, it is essential to be able to estimate a person's height from fragmentary and deteriorating skeletal remains to identify unidentified people.[21,22,23] The present study observed that the ulna lengths of the people in the study group are statistically significant at all (P < 0.05), when compared between right and left ulnar bones. In addition, the present study observed stable incline, with a positive regression of Y=81.56+ 1.93X when compared between height and ulnar bone length of the male subjects. In addition, the present study also observed a positive Pearson correlation coefficient with a P value of <0.05. Prasad et al., 2012,[24] conducted research on Maharastra population. The subjects belong to the age-group between 18-28 years. Male subjects showed a regression equation of stature S= 93.45 + 2.92 X1. Borhani-Haghighi et al, 2016,[25] conducted research in the Chabahar city which is located South-East of Iran. The subjects belong to the age-group between 20-50 years. Male subjects showed a correlation-coefficient of 0.59 with a regression equation of stature S= 81.89 + 3.13 left ulna ± 4.37, Saco-Ledo et al., 2019,[26] conducted research on 246 participants. The male subjects showed a correlation-coefficient of 0.22-0.57 with a standard error of 2.12. Paul et al., 2020,[27] conducted research on Maharastrian subjects of both the genders. The subjects belong to the age-group between 20-50 years. observed a mean height of 169.44 cm ± 6.82 SD in the range between 142-183 in their male subjects with a mean ulnar length of right is 27.02 ± 1.441 and left ulnar length is 26.95 ± 1.41. Kumar et al., 2020,[28] conducted research on Chennai subjects of both the genders. The subjects belong to the age-group between 18-22 years. Male subjects showed a regression equation of stature S= 68.23 + 4.71 x ulnar length. Gul et al., 2020,[29] conducted research in the state of Multan city in both the genders consisting of 100 subjects. The subjects belong to the age-group between 20-27 years. Male subjects showed a regression equation of stature S= 70.369 + 3.69 x ulnar length. Mitra et al, 2021,[30] conducted research in the state of Odisha in both the genders. The subjects belong to the age-group between 20-30 years. Male subjects showed a correlation-coefficient of 0.933 with a regression equation of stature S= 3.67 + 5.88 x ulnar length. Kachare et al, 2021,[31] conducted research on Central-Maharastra subjects of both the genders. The subjects belong to the age-group between 19-23 years. observed a mean height in the male subjects with a ulnar length of right-side is 25.98 ± 1.24 and left-de ulnar length is 25.63 ± 1.28, further reported a regression equation of S= 89.35 + 3.11 x ulnar length. Sarma et al., 2022,[32] conducted research in the North eastern region of India in both the genders. The subjects belong to the age-group between 25-45 years. Male subjects showed a correlation-coefficient of 0.955 with a regression equation of stature S= 160.85 + 6.34 x ulnar length. Banyeh et al 2022,[33] conducted research in the Ghanian country in both the genders. The subjects belong to the age-group between 18-30 years. Male subjects showed a regression equation of stature S= 108.02 + 2.094 x ulnar length.

CONCLUSION

According to the findings of this study, we conclude that both the ulnae of males are both longer and taller. This difference can be seen in both length and height. It is possible to estimate height in the Indore region by using the straightforward linear regression equation that has been developed thus far. A positive correlation was found between stature and length of ulna.

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