

# Correlation of Length of Ulna With Height to Estimate Stature in Female Tribal Population of Udaipur District: a Cross Sectional Study

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## ABSTRACT

**Introduction:** the uniqueness of human being physical and genetical characteristics helps in identification of individual. There are various methods and techniques, but the anthropometry is internationally recognized best systematic measuring method to determine age, sex, stature and race. The stature or height is estimated using dimension of various body parts using regression equation. Here in the present study the length of Ulna bone is selected for estimation of stature as it is easily and quickly measureable even in any compromised conditions.

**Objectives:** the objective of this study to derive regression equation for estimation of stature from the length of ulna in female tribal group of Udaipur region, Rajasthan.

**Material and Methods:** A cross sectional study was performed on 255 female of age group 20-40 years, who belongs to tribes of schedule caste community. Spreading caliper and stadiometer was used for the measurement of ulna length and for stature respectively.

**Results:** the mean age of studied females was 31.32 years with standard deviation of 6.58 years. The mean height of tribal females was 152.52 cms, the mean length of right ulna was 24.14 cms. and left ulna was 24.35 cms. The study showed that length of left ulna was slightly higher compared to length of right Ulna. The positive correlation between mean length of right ulna and left ulna with mean height of female population was observed with correlation coefficient of 0.50, and 0.53 respectively.

**Conclusion:** the relation between length of right and left ulna with stature of female belongs to schedule tribe community found positive. The difference between actual height and estimated height was very small. Hence this study has forensic and anthropometric implications in estimation of stature of an individual.

**Keywords:** Stature; Height; Ulna; Anthropometric; Estimation; Regression.

## Introduction

Human beings dwelling in this globe belong same species i.e. Homo sapiens but each individual has unique characteristic features which helps in identification<sup>1</sup>. The unique physical appearance and characteristics is due to various factors like geographical location, biological structure (offspring), environmental and psychological condition<sup>2,3</sup>. It is also established that the physical characteristics and appearance pass through the various degree of changes from birth to death<sup>4</sup>. The identification or recognition of individual human's physical, genetical characteristics is quite essential to solve various crime, medico legal cases and ethnicity verification<sup>5</sup>. There are several methods and techniques like DNA finger printing, postmortem reports, sex determination, dactyloscopy, handwriting, lip prints, blood groups, cephalometry, fingerprints and anthropometry to identify the individual<sup>4,6</sup>.

Anthropometry is a series of systematic measuring techniques/methods which measure the human body/

skeleton dimensions in quantitative form. In forensic anthropology age, sex, race and stature estimation is worldwide accepted in legal medicine<sup>7</sup>.

The determination of age, sex, stature and ethnicity of human beings and skeleton has been documented by several researchers in various studies done at different geographical zones of earth<sup>8-10</sup>. Still the measurement of individual height (stature) using the dimensions of various parts of the body, is an important research topic among many anatomists, anthropologists, and forensic experts. The relationship between the height (stature) of the person and various parts of the body like head, trunk, and lengths of upper and lower limbs, vertebral column, long and short bones has been well established with respect to different population group<sup>11,12</sup>. The length measurement of ulna is the simplest and most reliable as ulna has easily recognizable surface landmarks even in compromised positions<sup>13</sup>. Stature is the height of a person in an upright position i.e., top to bottom length. The stature

is not only used to identify the individual but also used in many clinical as well as nutrition research<sup>14</sup>.

There are two methods to measure the stature – (A) Anatomical and (B) Mathematical.<sup>15</sup> In mathematical method, relationship between stature of person and single bone or multiple bones are used to generate a formula to calculate the stature of that group. It is observed from various studies that the relationship equation between stature and dimension of any body part can be best estimated using regression analysis.<sup>16</sup> But there is variation in dimension of body part among population of different regions/zones so derived formulas of stature in various studies are population /group specific. Hence these formulas will give incorrect results if used in other population and there cannot be a universal formula for stature estimation.<sup>17-20</sup> There are few anthropometric studies reported on tribal group of Udaipur region (Rajasthan) for stature measurement<sup>21,22</sup>. But none of study used ulnar length to estimate the Stature/ height. Hence this study was conducted on female of tribal population to find the correlation between length of Ulna and stature using regression analysis. This study will also provide baseline data to correlate height with nutrition level, gestational parameters etc.

### Materials and Methods

This study was carried out at Primary Health Centres (PHC) and Community Health Centres (CHC) of Jhadol, Kotra, Gogunda, and Sarada regions and a medical camp organized in American International Institute of Medical Sciences of Udaipur, Rajasthan during February 2019 to January 2020. Ethical clearance was obtained from the institutional ethical committee and written consent was taken from the subjects.

**Inclusion criteria** – Females aged 20-40 yrs belonging to schedule Tribe community (Bhil and Mina) were included in the study.

**Exclusion criteria** - Females with physical deformity, injury, skeletal abnormalities- like polio, previously fractured forearm, amputated upper limb, record of any surgical procedure affecting the stature were excluded from this study.

Total of 255 females as per inclusion criteria were selected from the specified communities from Udaipur district. The measurement of right and left ulna length was done by spreading caliper. And measurements were taken from the proximal end of the ulna to the tip of the styloid process with the elbow bent between 90 and 110 degrees<sup>23</sup> as shown in Figure 1. Standing metric height measuring stand (stadiometer) was used for vertical height measurements from crown to the heel in erect position with bare foot on the baseboard of stand and Frankfurt's plane parallel to the ground.

### Statistical Analysis

Data entry and analysis was done using Statistical Package for Social Sciences – Version 23. The mean and

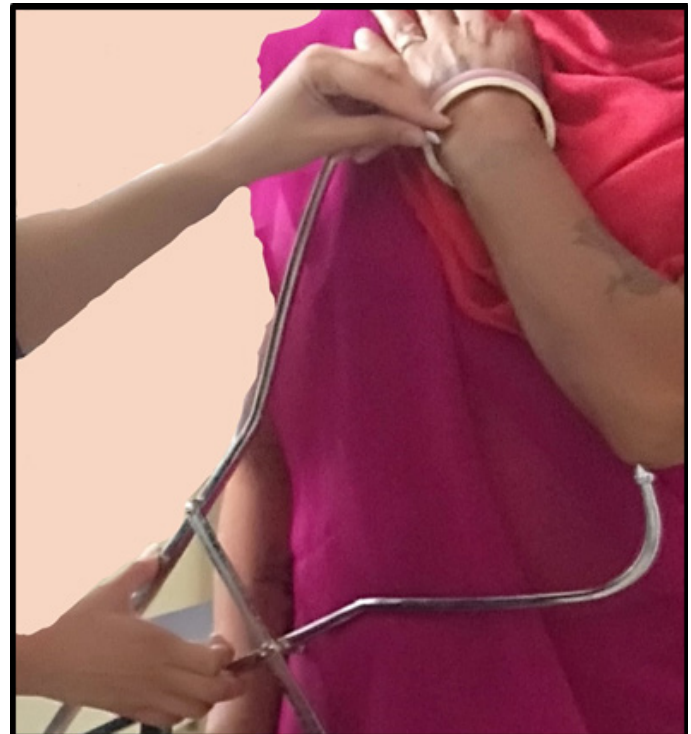


Figure 1. Showing measurement of ulnar length using spreading callipers.

standard deviation of age, height and ulna length was calculated. The regression equation was derived with correlation coefficient. P value <0.05 was considered as statistically significant.

### Results

The mean value of recorded data related to age, height and length of ulna is mentioned in Table 1. It is observed that mean age of 255 females was 31.32 years with standard deviation of 6.58 years. The Mean±SD of height of subjects was found to be 152.52 ± 9.63 cms. Similarly, mean±SD of length of right and left ulna was 24.14 ± 1.45 and 24.35 ± 1.49 respectively.

Table 1. Mean values of different variables

Variables	(Mean ± SD)
Age (years)	31.32 ± 6.58
Height (cm)	152.52 ± 9.63
Length of right ulna (cm)	24.14 ± 1.45
Length of left ulna (cm)	24.35 ± 1.49

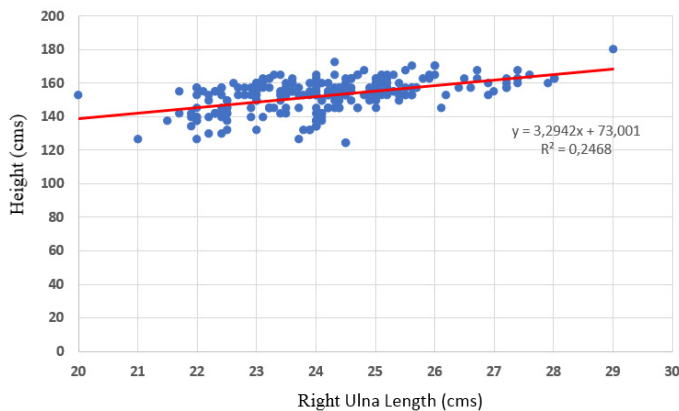
The relation between height and length of right ulna is shown in Table 2 and Figure 1. It is observed that there is positive linear relationship between height and length of right ulna when regression analysis is performed. Regression equation is mentioned in Table 2 with correlation coefficient (r) 0.50. Similarly, the positive linear relationship is observed from Table 2 and Figure 2, between height and length of left ulna from regression equation, 0.53 as a correlation coefficient. It is observed from Table 3 and Table 4 that

the difference between actual height and estimated height from regression equation is very small for both right and left ulna.

**Table 2.** Intercept, Regression coefficient, Correlation coefficient (r) and Coefficient of determination (r<sup>2</sup>) with Height.

Parameters	Length of right ulna (cm.)	Length of left ulna (cm.)
Regression equation	$y = 3.2942x + 73.001$	$a = 3.4391b + 68.764$
Intercept	73.001	68.764
Regression coefficient	3.2942	3.4391
Correlation coefficient (r)	0.50	0.53
Coefficient of determination (r <sup>2</sup> )	0.246	0.447

y = height and x = right hand ulna length, a = height and b = left hand ulna length.



**Figure 2.** Relation between right ulna length and height in females.

**Table 3.** Validity check of regression equation derived from length of right ulna for height measurement.

Sr. N <sup>o</sup> .	Right Ulna Length	Actual Height	Estimated Height	Differences
1	23.8	152.4	151.4	-1
2	23	149.8	148.7	-1.0
3	25.2	154.9	154.5	-0.4
4	24.2	152.4	152.7	0.3
5	28	164.5	165.5	1

**Table 4.** Validity check of regression equation derived from length of left ulna for height measurement.

Sr. N <sup>o</sup> .	Left Ulna Length	Actual Height	Estimated Height	Differences
1	25.1	154.9	155.0	0.1
2	24.5	152.04	153.02	0.9
3	25.3	154.94	155.77	0.8
4	23.8	152.4	150.6	-1
5	23	149.8	147.8	-2

## Discussion

The estimation of stature using ulnar length of tribal population of Udaipur region and especially females is of utmost importance to understand the variation in physical characteristics with normal females of same regions. In this study the length of left ulna (24.35cms) is found higher than the right ulna (24.14cms) of tribal females. This is contrary to most of the research study done on females of different part of India<sup>24,25</sup>. The study done by Mondal *et al* (2012), the mean length of right and left ulna in Bengali females was found 24.55cms and 24.46cms<sup>24</sup>. The study conducted by Atul Keche & Harsha Keche in year 2020, reported higher right ulnar (25.81cms) length than left ulna (25.58cms) length which is conflicting to present study<sup>25</sup>.

The correlation coefficient is positive but lies in medium to low range for right and left ulnar length with respect to height of tribal females. The positive correlation coefficient indicates that if the length of ulna increases or decreases, the height of subject also increases or decreases<sup>24</sup>. The difference in height estimated from regression equation and measured actual height is very small which validate the regression equation. The Study done by Thummar *et al* (2011) on population of Gujarat state found the difference in actual height and estimated height of same range<sup>26</sup>.

In another study on Vietnamese population, positive correlation was found between ulnar length and height in those aged 21-64 years,  $r=0.66$ ,  $p<0.0001$  in both males and females. The regression equations for females were, height = 85.80 + (2.97 x ulna length) and reported that regression equations calculated for women aged 21-64 showed good correlation and can be used to predict height of the individual<sup>13</sup>.

## Conclusion

From the present study, an interesting outcome is found that the length of left ulna is more than right ulna in tribal females. There is positive correlation between stature and length of ulna. This study would be useful for anthropologist, forensic experts. The finding of this study will instill the interest among the researchers to work on tribal population with special emphasis on females.

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