



# AN ANTHROPOMETRIC STUDY OF STATURE ESTIMATION AMONG MALES FROM THE MEASUREMENTS OF FEET IN UDAIPUR DISTRICT OF RAJASTHAN

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## ABSTRACT

**Background:** Estimation of stature has a very significant role to play in forensic anthropometry for personal identification.

**Objective:** To discover out the correlation among proportions of feet with stature in tribals of Udaipur district in Rajasthan (India).

**Material and Methods:** The present study was conducted on a total number of 481 male tribals of Udaipur district by using standard anthropometric techniques.

**Results:** There was a high correlation between height and right (0.184) foot length & left (0.186) Foot Length in males.

**Conclusion:** Linear regression equations were deduced in males out of which lowest standard error of estimate was experienced in combined foot length of males.

**Key Words:** Stature, Foot length, Regression equations

## INTRODUCTION

Anthropometry is an important tool of physical anthropology for obtaining different measurements like stature on the living as well as dead (skeleton and skeletal remains) of man using scientific method. Physical anthropologists mainly deal with study of human origin and evolution of human beings. They also deal with study of different races in various parts of the world.

Stature estimation has a very important role to play in forensic anthropometry for personal identification. Even anatomists and anthropologists apart from forensic experts have shown keen interest in estimating the height of an individual by measuring different parts of body like hand length, foot length. Previous researchers have established a very well defined relationship between height of individual and different parts of body like head, trunk and lengths of upper and lower limb.

Important differences /variations between various ethnic groups have been studied in detail by comparing relation-

ship between body segments and this has also been shown to be related to life style and locomotion. Prediction of dimensions of body segments is useful in many areas of modern science. The relationship between body segments & height is used in assessing growth in normal individuals as well as in people suffering from specific syndromes. The relationships between proportions of various body segments especially of long bones of limb (femur) with height have been most widely studied.

It has been proved that stature can be estimated from a shoe left at the scene of a criminal offense. Similarly the stature of a victim can be estimated when a part of body, such as a long bone, or hand, is all that corpse. (Santosh K et al. ,2014)<sup>1</sup>

There is significant correlation between stature and foot length. If one is known, the other could be predicted and vice versa. This could be of help in medicolegal instances for recognition of body parts and also be of use in cosmetic surgery ( Oommen A et al., 2005)<sup>2</sup>

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## MATERIAL AND METHODS

### Methodology

#### Inclusion Criteria

Tribal males and females of age group 18-32 years who were born & brought up in the tribal community of Udaipur region.

#### Exclusion criteria

Males and females having physical deformity, injury, disease, fracture, amputation or record of any surgical procedures affecting stature, hands and feet were excluded from the study.

Nutrition and socioeconomic status were not assessed.

#### Statistical Analysis

The data obtained was subjected to statistical analysis to derive the mean, standard deviation, correlation coefficient, regression coefficient. For testing the significance level, t test was applied. The following dimensions were measured based on the specific anatomical landmarks and the values were measured in millimeters.

#### Stature

It is the vertical distance between the highest point on vertex and the floor. The subject was made to stand barefoot on the foot place of the stature meter in an erect posture with the hands hanging down on the sides with the palm facing the thighs. Subject was asked to maintain upright posture and the movable piece was kept on the vertex and the height was recorded in millimeter.

#### Foot Length

It is the distance between the most backward and prominent part of heel and most distal part of longest toe of the foot, when the foot was fully stretched.

The study design of the current study is **Cross-sectional descriptive** type.

## RESULT

We have come across that the mean **age** of males was 24.688 years and S.D. was 4.319.

The average **stature** of males was  $1613.457 \pm 72.096$  mm and ranged between 1426 to 1800 mm. In males the mean (mm) and S.D. of Foot Length measured of right side was  $225.75 \pm 19.299$  and left side was  $225.964 \pm 19.275$ . In males the Foot Length was highly significant of right and left sides ( $p < 0.05$ ). In males there was a high correlation between

right & left side Foot Length (1.000). In males there was a near to mild correlation between right (0.184) foot length & left (0.186) side Foot Length in males with the stature.

## DISCUSSION

### FOOT LENGTH

**In 1988 Philip TA**<sup>3</sup> studied correlation between height and foot length in Male students of Karnataka and found correlation coefficient(r) as 0.71.

**In 2007 Bhavna, Nath Surinder**<sup>4</sup> studied correlation between height and Foot length in male Shia Muslims of New Delhi and found correlation coefficient(r) to be 0.546. A significant correlation was observed between foot length and stature.

**In 2008 Krishan K**<sup>5</sup> studied correlation between height and Foot length in male Gujjars of North India and found correlation coefficient(r) as 0.86. The highest correlation coefficient was shown between stature and foot measurements.

**In 2011 Parash MTH et al.**<sup>6</sup> studied correlation between height and Foot length in students of Dhaka and found correlation coefficient(r) as 0.69 for right foot and r for left side was 0.70. Both the length of right and left foot showed significant positive correlation with the stature.

**In 2013 Singh JP et al.**<sup>7</sup> studied correlation between height and Foot length in Male Volunteers of New Delhi and found correlation coefficient(r) as 0.583 for foot length in males. The foot length exhibited statistically significant correlation with stature ( $p < 0.01$ ).

**In 2014 Dayananda R et al.**<sup>8</sup> studied correlation between height and Foot length in Medical Students of Kolar and found correlation coefficient(r) as 0.636 for foot length. The correlation between stature and foot length was found to be positive and statistically significant ( $p$  value  $< 0.001$ ).

**In the present study I noted** the correlation between height and foot length in Tribals of Udaipur and found correlation coefficient(r) as 0.184 for right foot and for left foot it was 0.186.

## SUMMARY

Present study is concerned with the dimensions of foot of the tribal males in Udaipur district.

Detail knowledge of the dimension is essential for artists, anatomists, forensic experts, scientists, reconstructive surgeons. It is also useful in anthropological research, orthopedic surgery, other allied clinical sciences and ergonomics.

In forensic investigation difficulties are being experienced in the stature and gender estimation of bodies dismembered in mass destruction. So as to eliminate these difficulties, new methods are being developed. This study was dedicated to the derivation of regression formulae for estimating stature from fragmentary remains of hands, foot whenever such a thing is recovered.

There are lot of variations in estimating stature from limb measurements among people of different region & race. It is, therefore, studies are required to collect the data from the different part of globe as the stature is the inherent characteristic of the individual, though influenced environmentally, therefore regional, simple and multiple regression equations can be of great value.

### CONCLUSION

In the present study “An Anthropometric Study of Stature Estimation among Males from the Measurements of Feet in Udaipur District of Rajasthan” following conclusions were derived these were:

1. Parameters studied in the male population highly correlated of the right and left sides of the foot. A perfect positive correlation was noticed between right and left foot length.
2. In the present study among males for the right and left foot length there was a positive and near to mild correlation.
3. Linear regression equations were considered in males out of which lowest standard error of estimate was experienced in combined foot length of males.

Thus, this study strengthens the

1. Identify victims and criminals from different body parts and skeletal remains.
2. In adults volumes of lung, strength of muscle, glomerular filtration, body mass index, metabolic rate and drug dosage adjustment can be assessed by the height.

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**Conflict of Interest:** None declared

Ethical Approval:

- Ethical clearance obtained from the ethical committee.
- Ref: GU/UEC/EC/2013/312

### REFERENCES

1. Santosh K, Garg R, Dagal N, Shekhawat S. Determination of human body height by the measurement of hand and foot length in population of Rajasthan. *Medico-Legal Update* 2014; 14(1):178-82.
2. Oommen A, Mainker A, Oommen T. A study of the correlation between hand length and foot length in humans. *Journal of the Anatomical Society of India* 2005; 54(2):1-9.
3. Philip TA. Foot size for predicting stature of males. *J.Ind.Acad. Forensic Sci* 1988; 27:30-9
4. Bhavna, Nath Surinder. Estimation of stature from measurements of lower limbs. *Anthropologist Special* 2007; 3: 219-22
5. Krishan K. Estimation of stature from foot print and foot outline dimensions in Gujjars of North India. *Forensic Science International* 2008; 175: 93-101.
6. Parash TH, Naushaba, Paul UK, Rahaman A, Farhat N, Tabriz SE. Estimation of stature of adult Bangladeshi male from the length of the foot. *Bangladesh Journal of Anatomy* 2011; 9(2):84-8
7. Singh JP, Meena MC, Rani Y, Sharma GK. Stature Estimation from the Dimensions of Foot in males. *Antrocom Online Journal of Anthropology* 2013; 9(2): 237 – 41.
8. Dayananda R, Babu U, Kiran J. Estimation of stature from dimensions of foot. *Medico- Legal Update* 2014; 14(1):6-9.

**Table I: Table showing distribution of age among study population in males**

	MALES
NUMBER	481
MEAN	24.688
MEDIAN	24.000
STD. DEVIATION	4.319
RANGE	14.000
MINIMUM	18.000
MAXIMUM	32.000

The age of the study population ranged between eighteen and thirty two years for males. Table I-shows the distribution of age among study population. The mean of age of males was 24.688 years.

**Table II: Descriptive Statistics of Height & Weight Studied in Males**

Column	Size	Mean	Std. Dev	Std. Error	Range	Max	Min	Median
Height	481	1613.457	72.096	3.287	374	1800	1426	1621
Weight	481	56.89	11.495	0.524	46.07	88.13	42.06	53.29

Table II Shows descriptive statistics for height and weight studied in males. The average stature of males was  $1613.457 \pm 72.096$  mm and ranged between 1426 to 1800 mm.

**Table III: Descriptive Statistics of Right & Left Foot Length Studied in Males**

COLUMN	Size	Mean	Std. Dev	Std. Error	Range	Max	Min	Median
MALE RFL	481	225.758	19.299	0.881	103.78	254.71	150.9	230.12
MALE LFL	481	225.964	19.275	0.879	103.19	254.19	151	230.45

Foot Length measured approximately 226 mm & ranged between 150.9 to 254.71 mm in males.

**Table IV: Paired Sample t-Test & Pearson Correlation showing statistical difference between Right and Left Foot Length in Males**

PAIRED SAMPLES	t	df	Sig.(2-tailed)	Pearson Correlation
MALE RIGHT FOOT LENGTH-MALE LEFT FOOT LENGTH	12.103	480	0.000**	1.000**

\*\* Statistically Highly Significant at the Level (0.01 & 0.05)

To assess the statistical differences between the observations of right and left Foot Length in males, paired sample t test was performed and thus null hypothesis was rejected. The Foot Length in males was highly significant of right and left sides. There was a high correlation between right & left side Foot Length of males as observed in Table IV

**Table V: Correlation between the Stature and Right & Left Foot Length Parameters studied in Males**

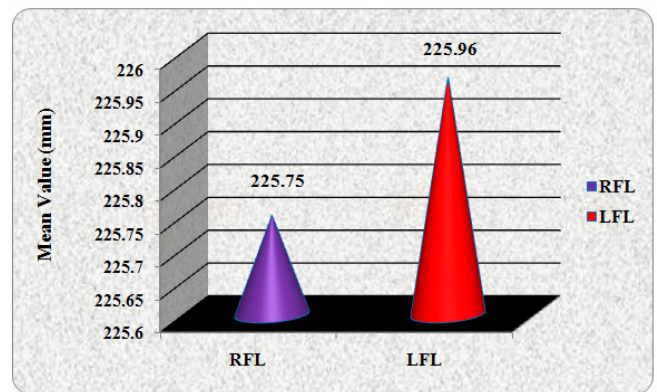
PARAMETERS	MALE RIGHT FOOT LENGTH	MALE LEFT FOOT LENGTH
PEARSON CORRELATION	0.184	0.186
Sig.(2-tailed)	0.000	0.000

To assess the statistical differences between the observations of right and left Foot length in males, Pearson Correlation was performed. There was a high correlation between foot length of males of right and left sides with the stature as observed in Table V.

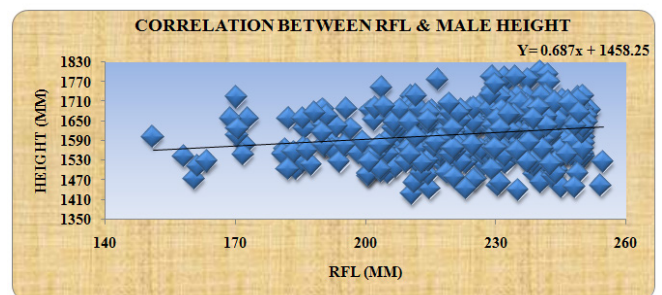
**Table VI: Linear regression equations for various parameters studied in Males**

$$\text{HEIGHT} = 1457.179 + 0.692 \times \text{Foot Length} \pm 70.924$$

TABLE VII: Table showing Linear Regression equations for various parameters studied in Males of both right and left sides.  
 HEIGHT =  $1458.259 + 0.687 \times \text{RFL} \pm 70.939$   
 HEIGHT =  $1456.126 + 0.696 \times \text{LFL} \pm 70.910$



**Figure 1: Descriptive Statistics (mean) of Right & Left Foot Length Studied in Males**



**Figure 2: Showing Correlation between Right Foot Length and Height in Male**

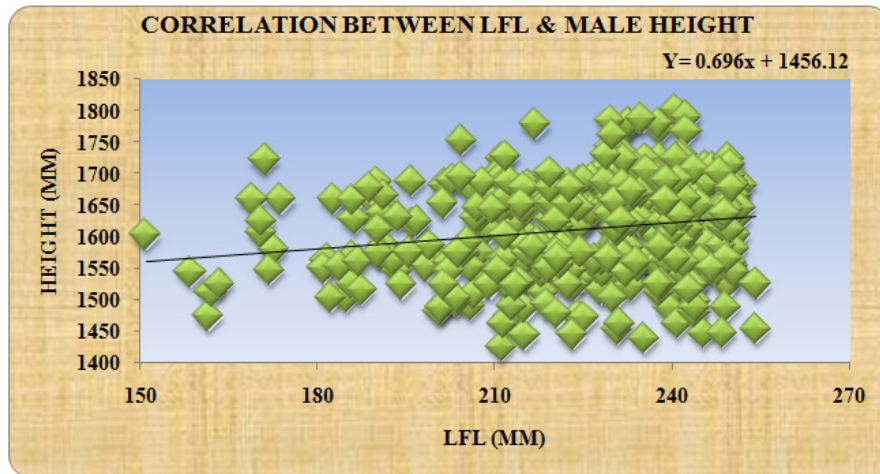


Figure 3: Showing Correlation between Left Foot Length and Height in Male.