

## PREDICTION OF HEIGHT FROM FOOT LENGTH AMONG WESTERN UTTAR PRADESH POPULATION

Sandeep Kumar Sharma <sup>\*1</sup>, Sanjeev Kumar Jain <sup>2</sup>, Rohin Garg <sup>3</sup>, Nidhi Sharma <sup>4</sup>.

<sup>\*1</sup> PG student, Department of Anatomy, Teerthanker Mahaveer Medical College & Research Centre Moradabad, Teerthanker Mahaveer University, Moradabad, UP, India.

<sup>2</sup> Professor, Department of Anatomy, Teerthanker Mahaveer Medical College & Research Centre Moradabad, Teerthanker Mahaveer University, Moradabad, UP, India.

<sup>3</sup> Assistant Professor, Department of Anatomy, Teerthanker Mahaveer Medical College & Research Centre Moradabad, Teerthanker Mahaveer University, Moradabad, UP, India.

<sup>4</sup> Assistant Professor, Department of Anatomy, Teerthanker Mahaveer Medical College & Research Centre Moradabad, Teerthanker Mahaveer University, Moradabad, UP, India.

### ABSTRACT

**Back Ground:** Stature is the main Parameter for identification of any particular persons stature give a important indication for determination of any person among many people. Relationship between the different body part measurements with height is used to identify one to another in case of missing body parts.

**Objective:** The current study dealt with derived regression equation for height prediction from foot length. And got correlation between height and foot length in western up population.

**Materials and Methods:** Present study was conducted on 400 people (200 males & 200 females) of age between 18 to 30 years studying in Western Uttar Pradesh region.

**Results:** There was significant correlation (r) between height and foot length (for male right foot length is .71 & left foot length is .70 and female right foot length is .56 & left foot length is .98) and  $P < .05$ . The regression equation for height and foot length  $y = 73.99 + 3.65 \times \text{left foot length}$ , and for female right foot length  $y = 86.64 + 2.9 \times \text{right foot length}$ , for left foot length  $y = 85.01 + 3.01 \times \text{left foot length}$ .

**Conclusion:** The Present study is established definite correlation b/w stature and foot length and also regression equation have been established. In this study we have found the statistically moderate correlation b/w height and foot length and minimum standard error in estimation of stature.

**KEY WORD:** Age, body height, correlation coefficient, foot length, regression equation.

**Address for Correspondence:** Dr. Sandeep Kumar Sharma, PG student, Department of Anatomy, Teerthanker Mahaveer Medical College & Research Centre Moradabad, Teerthanker Mahaveer University, Moradabad, UP, India-244001 **E-Mail:** [dr.sandeep.anatomy@gmail.com](mailto:dr.sandeep.anatomy@gmail.com)

### Access this Article online

#### Quick Response code



DOI: 10.16965/ijar.2016.463

**Web site:** International Journal of Anatomy and Research  
ISSN 2321-4287  
[www.ijmhr.org/ijar.htm](http://www.ijmhr.org/ijar.htm)

Received: 01 Nov 2016  
Peer Review: 03 Nov 2016  
Revised: None

Accepted: 13 Dec 2016  
Published (O): 31 Dec 2016  
Published (P): 31 Dec 2016

### INTRODUCTION

Anthropology is the science of which deals with comparative study of Human, as a physical and culture being [1]. Anthropometry is one of the forensic investigation process and help in esta-

-blishing identification of the individual. Anthropometry is being widely used in Forensic investigations for identification of an individual which is an important step in crime investigation. Various parameters used for identification are

determination of age, sex, race etc. [1].

When a complete dead body is found, stature determination is rather an easy task but in case where only some parts of the body are available, the determination of stature of an individual from skeleton material or from the mutilated or from amputated limbs or from parts of limbs, has obvious significant in the personal identification in the events of murders, accidents or natural disasters as required in forensic identification analysis. The most of the workers on stature estimation have used the length of bones such as femur, tibia, humerus, radius etc. [2]. Anthropology is the science of which deals with comparative study of Human, as a physical and culture being [1]. Anthropometry is one of the forensic investigation process and help in establishing identification of the individual. Anthropometry is being widely used in Forensic investigations for identification of an individual which is an important step in crime investigation. Various parameters used for identification are determination of age, sex, race etc. [1].

When a complete dead body is found, stature determination is rather an easy task but in case where only some parts of the body are available, the determination of stature of an individual from skeleton material or from the mutilated or from amputated limbs or from parts of limbs, has obvious significant in the personal identification in the events of murders, accidents or natural disasters as required in forensic identification analysis. The most of the workers on stature estimation have used the length of bones such as femur, tibia, humerus, radius etc. [2].

A tall person needs long foot to support body and for increased balance. Foot size and height both based on many factor such as gender, genetics and health and environment. Foot size may be used in forensic test to estimate the height of a person whose body is no longer intact [3]. Estimation of stature becomes equally important along with other parameters like age, sex, race, etc. The forensic scientists are well aware of the fact that the complete skeleton is rarely available at the scene of crime. Thus the scientists may have no choice than to use mathematical method of stature reconstruction. This is of

obvious advantage that it is workable even if a part of upper or lower extremity is available for examination [4].

Relationship that exists between different parts of body and height has been of great interest to anthropologist, for many years. This is because of the increase in the number of catastrophic events causing mass deaths which require the identification of victim from dismembered human remain. Footprints are of the criminals in forensic examinations [5].

The aim of present study was to predict height from foot length with help of derive regression equation .and find out the correlation between height and foot length.

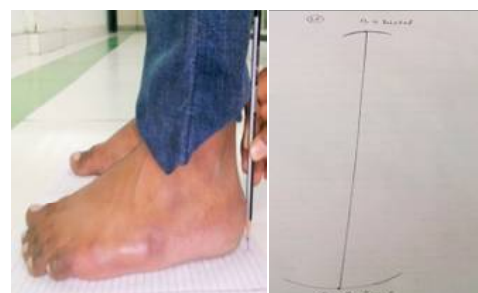
## MATERIALS AND METHODS

Present study was conduct in Western Uttar Pradesh Population, observed relationship between Stature and Foot length and also derived Regression equation between Stature and Foot length. This study was perform in 400 adult subject (200 males & 200 females) of age group between 18-25 year.

The staure was measured as direct maximum distance from vertex to floor, maintaining the anatomical position and head situated in Frankfurt position [6]. With used the Stadiometer, the subject was made to stand barefoot in the standard standing position on its baseboard. Both feet are in close contact with each other and head oriented in Frankfurt's plane. The height was then recorded in centimeter from the standing surface to the vertex in the weight bearing position of foot.

Foot length was measured as maximum distance between acropodion (most forward projection of big toe or second toe) the pternion (most back ward projection of point of heel) [7].

**Fig.1:** Shows measure of foot length.



During measurement of foot length, subjects were asked to stand on the paper in erect but relaxed position, avoiding undue pressure on the feet. For proximal point curve of the heel was marked by pencil with good sharp tip, holding it at right angles to heel (fig 1). The point of maximum convexity was marked as the proximal point. Distal point was considered on the great toe. Curve of measure toe was marked with pencil having good sharp tip taking care to hold it at right angle to the great toe (fig1). Mid-point of the curve of the ensure toe was taken as the distal point. Distance between the proximal and distal point was measured with a ruler. Which subject had any foot defomity or disease exclude in this study.

## RESULTS

Present study was conducted on 400 hundred subjects (200 males & 200 females) of Western Uttar Pradesh Region. The subjects of both sexes ages b/w 18-25 years were included in this study .The stature & foot length of subjects were measured to find out any correlation b/w study parameters. and regression equation was derived.

**Table 1:** Mean & Standerd deviation of height and foot length in total subject.

Parameter Subject	Mean	SD	Total
Male height	168.16	5.87	400
Female height	155.96	5.65	400
Male RFL	25.75	1.12	400
Male LFL	25.78	1.13	400
Female RFL	23.54	1.07	400
Female LFL	23.54	1.07	400

Table no. 1 shows descriptive statistics of various parameters studied in male subjects the average stature of Male subjects is  $183 \pm 5.87$ .and range b/w 183 to 152 cm. Standard deviation of stature ,right foot length & left foot length of male subject is 5.87,1.12 & 1.13 respectively. Ans also shows descriptive statistics of various parameters studied in female subjects the average stature of female subjects was  $184 \pm 5.64$ .and range b/w 184 to 143.05 cm. Standard deviation of stature, right foot length & left foot length of female subjects is 5.65, 1.07 & 1.07 respectively.

**Table 2:** Shows regression value.

Parameter	Male (400)		Female (400)	
	For Right foot length	For left foot length	For Right foot length	For left foot length
Correlation coefficient (r)	0.71	0.71	0.56	0.48
Regression coefficient (b)	3.07	3.65	2.9	3.09
Value of constant	71.07	73.99	86.64	85.01

The formulae have been obtained by using the statistical equation in both male and female separately, and the formulae is:

Rgression Equation for male is  $Y=71.07+3.07(RFL)$ ,  $Y=73.99+3.65(LFL)$

Regression Equation for female is  $Y=86.64+2.9(RFL)$ ,  $Y=85.01+3.01(LFL)$

## DISCUSSION

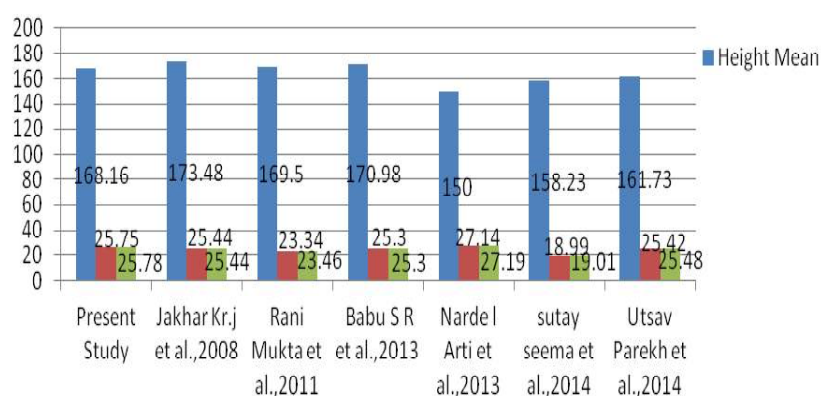
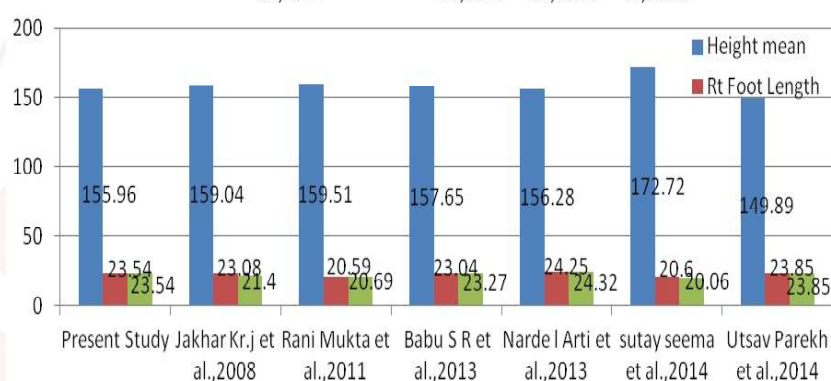
The present study was conducted in 400 subjects ( 200 males & 200 females) , in the age group 18-25 years for the measurement of stature from foot length by through regression equation. Similar age group studied were carried out by Sutey Seema et al. [8].

The measurement were taken right & left side separately and were subjected to statistically computation so as to derive independent formulae for the all the parameters. No significant difference was found in either left or right side of foot length measurements.

In present study , in males, the right foot length ranged b/w 28.06 cm to 22.03 cm and the left foot length ranged b/w 28.07 cm to 22.06 cm., Mukta Rani et al [9]., Narde Arti et al [1] studied on estimation of stature from foot length was also found these range. The foot length noticed by different workers such as Nath S et al [10], Qamra SR et al. [11] , and Ozaslan A et al. [12], do not tally with our findings because of many factors like racial, ethnic and nutritional factors and geographical variations, which play an important role in human development and growth. (shows range in Graph no.1&2).

Krishna K et al [13] have been studied on 252 Koli male adolescents from North India and suggested that all the cephalo-facial measurements are significantly correlated with stature. They also reported a regression equation for stature estimation from dimension of hand and feet in



**Graph 1:** Comparisons with available literature.**Graph 2:** Comparisons height and rt. Foot length with available literature.

a North Indian Population. They found the correlation coefficient to be +0.76 for males and females taken together. In the present study correlation coefficient between foot length and stature in males is +0.71 and in females is +0.56. Thus the present study correlates with this study. Patel et al. [14], in their study on 502 medical students (278 male and 224 female) between 17 to 22 years of age belonging to various region of Gujarat, India and reported a regression formula between foot length and height of an individual which was reported as  $Y=75.45+3.64X$  for Males and  $Y=75.41+3.43X$  for Females. In present study the regression formula derived is  $Y=73.99+(3.65X)$  for males and  $Y=85.64+(3.01X)$  for Females where X is foot length and Y is stature in centimeters. Thus the present study nearly correlates with the study of Patel et al [14].

Mohnaty et al. [15], studied on population of Odish has developed a regression equation, in 300 student were include in their study. As stature increases foot length of both male and female also increases.

In present study the correlation coefficient between height and foot length is + 0.71 in male and + 0.56 in female which is highly significant. From the above facts, it is clear that if either of the measurement (foot length or stature) is known the other can be calculated and this fact

may be of practical use in Medico-legal investigations and in Anthropometry.

## CONCLUSION

The mean value of stature, foot length was found to be greater for males than females in Western Uttar Pradesh Population. Correlation coefficient for male foot length is higher than female foot length.

There are lot of variations in estimating stature from limb measurements among people of different region & race. Hence there is a need to conduct more studies among people of different regions & ethnicity so that stature estimation becomes more reliable & identity of an individual is easily established.

This study will help in medico legal cases in establishing identity of an individual when only some remains of the body are found as in mass disasters, bomb explosions, accidents etc. If either of the measurement (foot length or total height) is known, the other can be calculated and this would be useful for Anthropologists and Forensic Medicine experts. It will also help in establishing identity in certain civil cases. Stature prediction is more accurate and reliable in case of female student of Teethanker Mahaveer University in Moradabad (U.P).

**Conflicts of Interests: None**

## REFERENCES

- [1]. Arti L.Narde et.al, Body Height Estimation Based On Foot Length And Foot Breadth J Indian Acad Forensic Med. July 2013; 3(3):245.
- [2]. Allbrook D. The estimation of stature in British and East African males based on tibial and ulnar bone lengths. J For Med 1961; 8: 15-28.
- [3]. Agnihotri AK Purwar B, Googeoolye K, Agnihotri S, jeebum n. Estimation of stature by foot length. J Forensic Leg Med. 2007; 14(5):279-83.
- [4]. Vercelloti G et al., Stature estimation in an early medieval (xi-xii) polish population: Am Jp Phys Anthropol 2009; 16(42):140-135.
- [5]. Qamra S, Jit I, Deodhar SD. A model for reconstruction of height from foot measurements in a adult population of Northwest India. Indian Journal of Medical Research. 1980; 71:77-83.
- [6]. Vercelloti G et al., Stature estimation in an early medieval (xi-xii) polish population: Am Jp Phys Anthropol 2009; 16(42):140-135.
- [7]. Agnihotri AK Purwar B, Googeoolye K, Agnihotri S, jeebum n. Estimation of stature by foot length. J Forensic Leg Med. 2007; 14(5):279-83.
- [8]. Seema Sutay et al., Study of stature by foot length measurement in Madhya Pradesh, Int. J. Bioassay 2014; 3(11):3441-3444.
- [9]. Rani M et al., Estimation of stature from percutaneous measurements of legs (1999-2000). J of For Sci Jan-June 2004; 21(1):12-14.
- [10]. Nath S, Chug D. determination of stature using hand and foot lengths among male and female Brahmins of Sundernagar, Himachal Pradesh. KRE Publishers; 2002. p.174-81.
- [11]. Qamra SR, Jit I, Deodhar SD. A model of reconstruction of height from foot measurement in an adult population of Northwest India. Indian J Med. Res. 1980; 71:77-83.
- [12]. Ozaslan A, Iscan MY, Ozaslan I, Tugcu H, Koc S: Estimation of stature from body parts Forensic Sci Int 2003; 132:40-45.
- [13]. Krishan K. estimation of stature from foot print and foot outline dimensions in Gujjars of North Indian Forensic Sci Int. 2008; 175:93-101.
- [14]. Patel SM, Shah GV, Patel SV. Estimation of height from measurements of foot length in Gujarat region. J Anat Soc India. 2007; 56(1):25-27.
- [15]. Mohanty BB, Agrawal D, Mishra K, Samantsinghar P, Chinara PK. Estimation of height of an individual from foot length: a study on the population of Odisha. Int J Rev Sci. 2012; 2:69-74.

### How to cite this article:

Sandeep Kumar Sharma, Sanjeev Kumar Jain, Rohin Garg, Nidhi Sharma. PREDICTION OF HEIGHT FROM FOOT LENGTH AMONG WESTERN UTTAR PRADESH POPULATION. Int J Anat Res 2016; 4(4):3289-3293. DOI: 10.16965/ijar.2016.463