

Height Prediction Based On Foot Length among Western UP Population

Dr. Swati Yadav¹, Dr. Shweta Chaudhary^{2*}

¹ Assistant Professor, Department of Anatomy, Santosh Medical College & Hospital, Santosh Deemed to be University, Ghaziabad, Uttar Pradesh, India.

² Associate Professor, Department of Anatomy, Santosh Medical College Hospital, Santosh Deemed to be University, Ghaziabad, Uttar Pradesh, India.

ABSTRACT:

Background: The primary criterion for identifying any specific person is their stature, which provides a critical cue for picking out that person from a crowd. When a body part is missing, the relationship between its measurements and height is employed to match one body component to another.

Objectives: The goal of the current work was to develop a regression equation for estimating height from foot length. They discovered a relationship between foot length and height in the western up population.

Materials and Methods: This study involved 500 participants from Western Uttar Pradesh (250 men and 250 women), ranging in age from 18 to 25.

Results: There was a significant correlation (r) between height and foot length (males' right and left foot lengths is 0.73 and 0.72 respectively, and females' right and left foot lengths are .58 and .51, respectively, with a p value less than 0.05. In case of males, the regression equation for height and foot length is $Y=72.08+3.04(RFL)$, and $Y=75.97+3.6(LFL)$. For females, the regression equation is $Y=85.62+3.2(RFL)$, and $Y=83.02+3.11(LFL)$

Conclusion: The current study has revealed a clear correlation between stature and foot length as well as a regression equation. In this investigation, the minimum acceptable error in the assessment of stature and a statistically moderate association between height and foot length were discovered

Keywords: Regression equation, correlation coefficient, foot length, age, body height.

INTRODUCTION:

The science of anthropology is the study of humans as physical and cultural beings [1]. One of the forensic investigative processes, anthropometry aids in establishing a person's identity. Forensic investigations frequently employ anthropometry to identify individuals, which is a crucial first step in the investigation of crimes. Age, sex, race, and other characteristics are some of the elements used for identification [1].

When a dead body is found in its totality, determining an individual's stature is a relatively simple task. However, in situations where only some body parts are present, stature determination from skeleton material, mutilated or amputated limbs, or parts of limbs, has obvious significance in the personal identification in the events of murders, accidents, or natural disasters as required in forensic identification analysis. The majority of researchers who have studied how to estimate stature have relied on bone lengths like those of the femur, tibia, humerus, and radius [2]. The science of anthropology is the study of humans as physical and cultural beings. [1]. One of the forensic investigative processes, anthropometry aids in establishing a person's identity. Forensic investigations frequently employ anthropometry to identify individuals, which is a crucial first step in the investigation of crimes.

Age, sex, race, and other characteristics are some of the elements used for identification [1]. Long feet are necessary for a tall person's support and better balance. Height and foot size are both influenced by a variety of variables, including gender, genetics, health, and environment. To determine the height of a person whose body is no longer intact, forensic tests may employ foot size [3]. Along with other factors like age, sex, race, etc., estimation of stature becomes equally essential. The full skeleton is rarely present at the scene of the crime, as the forensic scientists are well aware of. Thus, the scientists may be forced to apply the mathematical way of reconstructing stature.

This has the benefit that it can still be used even if only a portion of the upper or lower extremities is available for evaluation [4]. Anthropologists have long been fascinated by the relationship that exists between certain body components and height. This is due to an increase in catastrophic occurrences that result in mass fatalities and need the identification of victims from human remains that have been dissected. In forensic investigations, the culprits' footprints are found [5]. The purpose of the current study was to determine the relationship between height and foot length and to predict height from foot length using a regression equation.

MATERIALS AND METHODS:

The current study, which looked at the association between stature and foot length in Western Uttar Pradesh residents, also came up with a regression equation connecting the two. This study involved 500 adult participants, 250 of whom were male and 250 female, and who ranged in age from 18 to 25 years.

While retaining the anatomical position and the head in Frankfurt posture, the stature was measured as the maximum direct distance from vertex to floor [6]. The individual was instructed to stand barefoot on the Stadiometer's baseboard using the typical standing position. The head is pointed toward Frankfurt's plane, while the two feet are in close proximity to one another. The height from the standing surface to the vertex in the foot's weight-bearing posture was then measured in centimeters.

Maximum distance between acropodion (most forward projection of the big toe or second toe) and the pternion (most backward projection of point of heel) was used to measure foot length. Subjects were instructed to stand on the paper with their feet relaxed but upright during the foot length measurement process to prevent excessive pressure on the feet. A pencil with a good, sharp tip was used to mark the heel's proximal point curve while being held perpendicular to the heel (fig 1). The proximal point was identified as the location with the greatest convexity. The great toe's distal tip was taken into account. With care to hold the pencil at a correct angle to the great toe, the curve of the measure toe was marked (Fig1). The distal point was determined to be the centre of the ensure toe's curve. A ruler was used to measure the distance between the proximal and distal points. In this investigation, any patient who had a foot defect or disease was excluded.

RESULTS:

250 men and 250 women from Western Region of Uttar Pradesh made up the 500 subjects in the current study. The participants in this study ranged in age from 18 to 25. The subjects' height & foot length were measuring to determine any correlations between studies a regression equation was created using the parameters.

The descriptive statistics in Table No. 1 for the major parameters examined in male patients are shown. Male subjects' average height is 184 cm + 5.58, with a range of 184 to 154 cm. The male subject's right foot length, left foot length, and stature all had standard deviations of 5.67, 1.44, and 1.18, respectively.

Additionally, Ans displays statistical descriptions of many parameters examined in female patients. The female subjects average height was 154.76 cm. Female participants' stature, right foot length, and left foot length all have standard deviations of 5.42, 1.02, and 1.09, respectively. The following formulas were developed using the statistical equation separately for males and females: For males, the regression equation is $Y=72.08+3.04(RFL)$, and $Y=75.97+3.6(LFL)$ For females, the regression equation is $Y=85.62+3.2(RFL)$, and $Y=83.02+3.11(LFL)$

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

Parameters	Mean	SD	Total
Male height	169.16	5.67	500
Female height	154.76	5.42	500
Male RFL	25.95	1.44	500
Male LFL	24.72	1.18	500
Female RFL	23.43	1.02	500
Female LFL	25.34	1.09	500

Table 2: Regression between height and foot length.

Parameter	Male (250)		Female (250)	
	RFL	LFL	RFL	LFL
Correlation coefficient (r)	0.73	0.72	0.58	0.51
Regression coefficient (b)	3.04	3.6	3.2	3.11
Value of constant	72.08	75.97	85.62	83.02

* RFL-Right foot length * LFL-Left foot length

DISCUSSION:

In the current study, 500 participants- 250 men and 250 women in the age range of 18 to 25 years participated in the regression equation-based measurement of stature. Sutey Seema et al. [8] carried out similar age group studies.

To create independent formulas for each parameter, the measurements were taken on the right and left sides individually and statistical calculations were performed on the results. The length measures of the left and right feet did not differ significantly.

In the current study, males' right foot lengths ranged between 27.19 cm and 22.65 cm, while their left feet ranged between 27.18 cm and 22.68 cm. These ranges were similarly discovered in studies on the determination of stature from foot length by Mukta Rani et al. [9] and NardeArti et al. [1]. The foot length noted by various researchers, including Nath S et al. [10], Qamra SR et al. [11], and Ozaslan A et al. [12], does not coincide with our findings due to a number of variables, including racial, ethnic, nutritional, and geographic variations, all of which are significant in human development and growth. (Graph No. 1&2's range is shown.)

All of the cephalo-facial dimensions, according to research by Krishna K et al [13] on 252 Koli male adolescents from North India, are substantially linked with stature. Additionally, they published a regression equation for estimating stature in a population of North Indians based on hand and foot measurements. The researchers discovered that when males and females were combined, the correlation coefficient was +0.76. In the current study, the correlation between male and female foot length and stature is +0.73 and +0.58, respectively.

A regression formula between foot length and height of an individual was reported as $Y=75.45+3.64X$ for Males and $Y=75.41+ 3.43X$ for Females by Patel et al. [14] in their study on 502 medical students (278 male and 224 female) between 17 and 22 years of age belonging to various regions of Gujarat, India. In the current study, $Y=73.99+(3.65X)$ for males and $Y=85.64+(3.01X)$ for females, where X is foot length and Y is stature in centimetres, was derived as the regression formula. Thus, there is almost a correlation between this study and the one by Patel et al [14].

Mohnaty et al. [15] created a regression equation based on their study of the Odish people. In their study, 300 students were included. As long as height advances in both male and female foot length also goes up.

In the current study, the male and female correlation coefficients between height and foot length are + 0.73 and + 0.58, respectively, and these values are extremely significant. The aforementioned information makes it evident that if one measurement—foot length or stature—is known, the other may be determined. This information may be useful in anthropometric and medico legal investigations.

In the population of Western Uttar Pradesh, the mean height and foot length of men were found to be higher than those of women. Male foot length has a stronger correlation coefficient than female foot length.

People of different regions and races differ greatly when determining stature using limb measurements. In order to make stature estimate more accurate and identification verification easier, additional research needs to be done among people from various locations and ethnic groups.

This work will be useful in verifying a person's identity in medical and legal circumstances where just a few body parts have been discovered, like in mass disasters, bomb explosions, accidents, etc. Experts in forensic medicine and anthropology may both benefit from knowing one of the measurements—foot length or overall height—since this would allow for the calculation of the other. In some civil cases, it will also aid in establishing identification. The accuracy and reliability of stature prediction are higher for female students at TeethankerMahaveer University in Moradabad (U.P).

REFERENCES:

1. Arti L. Nardeet. 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 JpPhysAnthropol* 2009;16(42):140-135.
7. Agnihotri AK PurwarB, Googeoolye K , AgnihotriS, jeebum n. Estimation of stature by foot length. *J Forensic Leg Med* .2007;14(5):279-83.
8. SeemaSutay 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 SciInt* 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 AnatSoc 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.