



## Original Research Article

# Estimating the Stature of M.B.B.S. Students of a Medical College in Northern India from Foot Length

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## Abstract

**Introduction:** Identification is an important aspect of Forensic Medicine. It includes various parameters like determination of Age, Sex, Race, Stature etc. The Anthropometry of the individual helps a lot in the identification. The stature of an individual can be measured easily if whole of the body or skeleton is present. However, it becomes very difficult when fragmented bodies or some part of body or skeleton is brought for examination. The relation of foot length with the stature of the individual can be very helpful in such cases.

**Aim & Objectives:** To establish the relation between foot length and stature of an individual and to devise a regression equation for the same.

**Materials and Methods:** This study was carried out on 178 MBBS students of a Medical College of Northern India to determine the relationship of their foot length with the stature.

**Results:** There was significant positive correlation between foot length and stature ( $r=0.745$ ,  $p<0.01$ ) in our study group ( $N=178$ ). The correlation coefficient ( $r$ ) between left foot length and stature was found to be 0.521 ( $p<0.01$ ); between right foot length and stature was 0.521 ( $p<0.01$ ) for male participants ( $N=84$ ). Among female participants ( $N=94$ ) the correlation coefficient ( $r$ ) between left foot length and stature was calculated as 0.508; between right foot length and stature as 0.515 and both were found significant ( $p<0.01$ ).

**Conclusion:** A positive correlation exists between the foot length and stature of an individual. This study will help the forensic experts to estimate the stature of an individual in order to identify that individual even if only a foot is available for examination.

**Keywords:** Anthropometry, Skeleton, Stature, Foot length

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## 1. Introduction

The word Anthropometry is derived from ‘Anthrops’ means man and ‘metron’ means to measure. Anthropometry is one of the forensic investigation process and help in establishing identification of the individual.<sup>1</sup> Various parameters used for identification are determination of age, sex, race etc.<sup>2</sup> With the increasing frequency of mass disasters, homicides, air plane crashes, blasts train and road accidents etc., there is always need for such studies which help in identifying the deceased from fragmentary and dismembered human remains. The need to establish the identity of dismembered remains may arise in cases of mass disasters like terrorist attacks, mass murders, transport accidents, tsunamis, floods, and earthquakes.<sup>3</sup> In such a situation, measurements of hands

and feet provide good approximation about the height of a person.<sup>4</sup> Though a person could be identified by head relatively easier and convenient than any other body part, the role of the foot cannot be denied, especially in the case where it is the only source for identification.<sup>5</sup> Foot length possesses a biological correlation with stature and it has been shown that the foot measurement provided important predictive information about the individual’s stature.<sup>6</sup> Estimation of stature of an individual in India by using formulae given by western workers involves an error of 5-8%.<sup>7</sup> The aim of present study was to establish a relation between foot length with the height of the MBBS students of a Medical College of Northern India.

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## 2. Aims and Objectives

To establish the relation between foot length and stature of an individual and to devise a regression equation for the same.

## 3. Materials and Methods

This cross-sectional study is conducted on M.B.B.S. students of a Medical College of Northern India to establish a relationship between Stature and Foot length and to derive a regression equation between Stature and Foot length. This study was performed on 178 medical students (84 males & 94 females) of age group between 18-24 year.

The ethical permission was taken from the Institutional Ethics Committee and the consent of every student is taken before recording the data.

### 3.1. Stature measurement

The stature was measured as direct maximum distance from vertex to floor in the anatomical position using a measuring tape.

### 3.2. Foot length measurement

Foot length is the length measured from the most prominent part of the heel to the most distal part of the longest toe (1<sup>st</sup> or 2<sup>nd</sup>). The foot length is measured using a sliding caliper.

**Table 1:** Summary of study participants in terms of age, height, left foot length and right foot length

Indicator	Female (N=94)	Male (N=84)	Total (N=178)
Age in years (Range)	19-23	18-24	18-24
Mean Age (Standard Deviation)	20.81 (1.12)	20.85 (1.29)	20.83 (1.2)
Height in cm (Range)	134.6- 177.8	152.4- 190.5	134.6- 190.5
Mean Height (standard Deviation)	159.63 (6.40)	172.38 (7.14)	165.67 (9.28)
Left foot length in centimeters (Range)	21-26.5	21.5- 29.0	21-29
Mean Left foot length (Standard Deviation)	23.23 (1.27)	25.78 (1.43)	24.44 (1.85)
Right foot length in centimeters (Range)	20.5- 26.3	21.5- 29.0	20.5-29
Mean Right foot length (Standard Deviation)	23.25 (1.26)	25.76 (1.44)	24.44 (1.84)

### 3.3. Statistical analysis

The goal of this study is to establish a relation between foot length and height of an individual. The data is analysed using SPSS (version 16.0.2).

## 4. Results

There was significant positive correlation between foot length and stature ( $r=0.745$ ,  $p<0.01$ ) in our study group (N=178). The correlation coefficient (r) between left foot

length and stature was found to be 0.521 ( $p<0.01$ ); between right foot length and stature was 0.521 ( $p<0.01$ ) for male participants (N=84). Among female participants (N=94) the correlation coefficient (r) between left foot length and stature was calculated as 0.508; between right foot length and stature as 0.515 and both were found significant ( $p<0.01$ ).

Regression equations to estimate stature in centimetres (y) given left foot length in centimetres (x) were calculated as follows:

1.  $y = 74.56 + 3.71 * x$ ; for all participants
2.  $y = 105.51 + 2.58 * x$ ; for male participants
3.  $y = 99.86 + 2.61 * x$ ; for female participants

Regression equations to estimate stature in centimetres (y) given right foot length in centimetres (x) were calculated as follows:

1.  $y = 73.84 + 3.74 * x$ ; for all participants
2.  $y = 105.82 + 2.60 * x$ ; for male participants
3.  $y = 98.78 + 2.64 * x$ ; for female participants

## 5. Discussion

There are many medicolegal cases in which we have to estimate the stature of an individual. The stature estimation is very easy part of anthropometry when the body is intact. However, if part of body or a fragmented body is brought for examination, the estimation of stature become a very difficult task. Many formulas has been derived to estimate stature from the length of long bones and different body parts. The present study establishes the statistically significant correlation between foot length and stature irrespective of gender where the coefficient is 0.745 for right foot and left foot length individually.

Mritunjay Singh et al. conducted a study and found that a significant positive correlation existed between right foot length with stature ( $r=+0.6092$ ) and left foot length with stature ( $r=+0.6001$ ). The difference in correlation is statistically significant by ANOVA test ( $P<0.01$ ). This is consistent with our study.<sup>8</sup> Sah SK et al. conducted a study and found that the correlation between foot length and stature, and foot breadth and stature were statistically significant in both gender ( $p<0.05$ ). Greater correlation coefficient between foot length and stature than that for foot breadth and stature indicated stronger correlation between foot length and stature, which is consistent with our study.<sup>9</sup> Mehul C Upadhyay et al conducted a study and found that the stature of males varied in range of 150 to 188 cm with mean of  $167 \pm 4.58$  cm and in females in the range of 139 to 171 cm with mean of  $154 \pm 4.7$  cm. Right foot length in males varied in range of 20.12 to 28.9 cm and in females 19.1 to 24.4 cm. Left foot length in males varied in range of 20.4 to 29.1 cm and in females 19 to 24.36 cm. Correlation coefficient for both foot in both males and females are  $>0.7$ , which is consistent with our study.<sup>10</sup>

The present study helped us to devise a regression equation which is beneficial for us to calculate the stature of an individual from his/her foot length. Our results are consistent with the study conducted by Kakkar. A et al where they have calculated the stature using foot length in female medical students.<sup>11</sup>

Similar study by Vidyullatha V. Shetty calculated correlation coefficient between height and foot length as + 0.688 for male and + 0.587 for female.<sup>12</sup> The correlation coefficient in present study was also similar to results of similar studies conducted in different regions of India.<sup>13</sup> K Srinivasulu et al. conducted a similar study and established a definite correlation between foot length and stature with p value <0.001.<sup>14</sup> A similar study by Kavyashree et al. established a strong positive correlation between height and foot length of an individual.<sup>15</sup>

## 6. Conclusion

Estimation of stature of an individual is an important part of identification. The estimation of stature can be done even if a part of body is recovered. In our study, we found that there is positive correlation between the foot length and stature of individual. The present study was conducted on 178 MBBS students. The correlation coefficient between left foot length and stature was found to be 0.521 (p<0.01). We have devised a regression equation from this study. It can be concluded that a positive correlation exists between the foot length and stature of an individual. This study will help the forensic experts to estimate the stature of an individual in order to identify that individual even if only a foot is available for examination.

## 7. Source of Funding

None.

## 8. Conflict of Interest

None.

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