



## Estimation of Height of an Individual in Correlation with the Length of the Fibula

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### ABSTRACT

Establishment of an identity is very much important in both civil and criminal cases. Stature is one of the criteria of personal identification. Many studies have shown that limbs exhibit consistent ratios relative to the total height of a person. The present study is an attempt to evaluate a possible correlation between stature of an individual and the length of the fibula. A sample of 50 individuals was considered and the measurements were taken using standard tapes. It was found that the fibula length showed a correlation with the stature. It was concluded that the length of the fibula could be used in the estimation of stature among adults.

**Keywords:** Criminal cases, fibula.

### INTRODUCTION

Estimation of stature has a significant importance in the field of forensic anthropometry. To assess the height of an individual, from measurements of different parts of the body, has always been of immense interest to Anatomists, Anthropologists and Forensic experts. Physical anthropologists have been mainly concerned with the study of the human origin and human evolution as well as the varieties of mankind in different parts of the world.<sup>1, 2</sup> Estimation of stature of an individual from the skeletal material or from the mutilated or amputated limbs or parts of limbs has obvious significance in the personal identification in the events of the murders, accidents or natural disasters mainly concerns with the

forensic identification analysis.<sup>3</sup> Whenever case materials such as skeletal remains and body parts are discovered, a forensic examiner is asked to opine about recognition for deceased.<sup>4</sup> Stature along with age, race and gender, the big four parameters, are considered to develop the anthropometrical databases. These data can confirm the process of identification.

The relationship between specific body dimensions / proportions can be used to help solve crimes in the absence of complete evidence. For example, it has been proved that stature can be estimated from imprints of the hand, foot or footprints or from a shoe left at the scene of a crime. Similarly, the stature of a victim can be estimated when a part of body, such as a long bone, or hand, is all that remains.<sup>5</sup> Relationships between body parameters vary from population to population and ethnic origin to ethnic origin due to differences in nutrition and levels of physical activity.<sup>6</sup> Although several studies have been done for finding a relationship between stature and bone measurements, there are limited reports regarding present study population. Therefore, this study was

carried out to assess and correlate the length of fibula and the stature and to predict the stature of an individual.

### MATERIALS AND METHODS

This study was conducted on 50 individuals of age 18-45. The left foot was selected for measurement as per recommendation of the international agreement for paired measurements at Geneva (1912).<sup>7</sup> Cases were in standing position whereas back of the shoulders, buttocks, and heels were close to the wall without any rotation.

Fibula length was measured between the head of fibula to the<sup>8</sup> distal most point of lateral malleolus using a standard measuring tape. This is done by person sitting over the stool and knee joint flexed at 90 degrees.

Stature was measured in centimeter. Each subject was asked to stand barefoot on a flat surface. Upright height was taken from the vertex to the floor according to the anatomical position and Frankfurt Plane.<sup>9</sup> The measurements were taken at fixed time between 2 to 5 p.m. to eliminate the discrepancies due to diurnal variation and by the same person to avoid personal error in methodology.<sup>10</sup> To minimise subjective errors, all the measurements were taken three times and then mean was taken.

The obtained data was analyzed to find out mean, standard deviation (S.D.), coefficient of correlation. Regression equations were derived to calculate height of unknown individual from foot length and hand length.

### RESULTS AND ANALYSIS

The primary outcome was the regression equation for each parameter. Correlation coefficient (-1 to +1) was calculated for each parameter as were range, mean and standard deviation.

Analysis of data was done using SPSS.



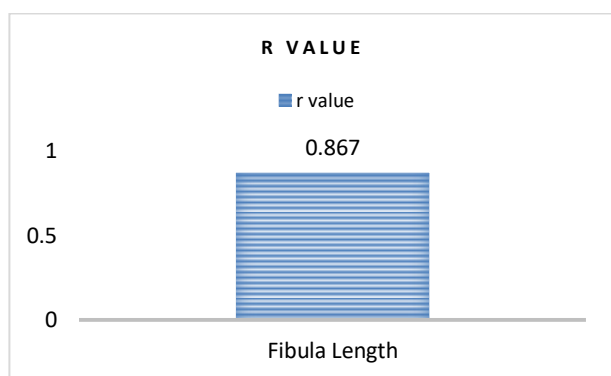
The stature ranged between 145, 0 to 188.0, the mean value of the stature was 160.328, the standard deviation was 8.4439.

The fibula length ranged between 33.1 to 48.0 the mean value was 39.852, and the standard deviation was 2.5718.

**Table 1:**

	Range		Mean	Standard Deviation
	Minimum	Maximum		
Height	144.0	188.0	160.328	8.4439
Fibula length	33.1	48.0	39.852	2.5718

Graph one



#### Height & Fibula length

Height = 46.881 + 2.847\*Fibula length (r=0.867, p<0.001, SEE= 4.2132)

#### DISCUSSION

In forensic examinations and anthropological studies, prediction of stature from incomplete and decomposing skeletal remains is vital in establishing the identity of unknown individual.<sup>11</sup> Height estimation by measurement of various long bones, head measurements, hand, foot length etc. has been attempted by several workers with variable degree of success. Between two basic methods of estimating stature, mathematician method is more available than anatomical method.<sup>12</sup> So, regression equations can be useful. Despite of the acceptable progression in different fields of forensic medicine, less attention has been paid to estimation of the body stature from the skeletal remains.<sup>13, 14</sup> so the present study, the linear regression was formulated for estimation of stature from lower limb length and foot length in the male subjects. It is worthy to note that there are some various factors such as genetic, nutrition, geographical location, physical activity and various races which affect the anthropometric data.<sup>15 16</sup>

In present study, the mean length of fibula was 39.528, the correlation coefficient (r) between stature and length of fibula was r=0.867 ad reported from the individuals.

Macdonnel (1901) studied English criminals and derived the regression formulae for estimation of height from foot length 166.457 +4.031 (foot 25.688 +/-2.9cms)

Qamra et al, (1980) computed linear regression equation for estimation of height from foot length and foot width in 1015 subjects between the ages of 17-35 years. It was concluded that foot length was a better tool for analysis of stature.

Ibinado et al., (2009) studied 477 subjects and found out that right foot length of male =26.92+/-1. 02 whereas right foot length of female =25.00+/-1.33. Mean value for left foot length of male = 26.92+/-0.13 cm and that for female =24.75+/-0.17 cm. In this study average length of foot was found to be 23.916 +/- 1.56.

Tung Wai Auyeung, J. S. W. Lee, T. Kwok, J. Leung, P. C. Leung, J. Woo et al., (2009) Estimated stature by measuring Fibula and Ulna Bone Length in 2443 Older Chinese Adults and the mean errors were +0.52 cm (over-estimation) in men and +0.45 cm (over-estimation) in women and the SDs were ± 3.5 cm in both genders.<sup>17</sup>

Hasegawa I, Uenishi K, Fukunaga T, Kimura R, Osawa M et al., worked on stature estimation formulae from radiographically determined limb bone length in a modern Japanese population.<sup>18</sup> Measurements were conducted on 434 living subjects (342 females and 92 males; 18-59years old). Regression formulae were constructed for females and males relative to the real body height measured in the erect position. Lower limbs of the femur and tibia were more accurate predictors (R=0.813-0.903) than the humerus was (R=0.670-0.708).<sup>19</sup>

#### CONCLUSION

The present study has established definite correlation between stature and fibula length. If the measurement of fibula is obtained the stature can be calculated respectively this would be useful for Anthropologists and Forensic Medicine experts. It will help in medico-legal cases in establishing the identity of an individual. The regression equation derived in the study can be used accurately and reliably for estimation of stature in a diverse population group. Hence, it is possible to determine the height of a person by using the data and the formulae derived from the present work fairly accurately within a standard error of the estimate which is acceptable from biological consideration in determining the height of known cross section of population.

As this study is done in living individuals so the results may not be applicable to the deceased individuals. In this study only healthy individuals are included so the results may not be applicable to persons having deformity or any congenital abnormality.

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