ORIGINAL ARTICLE

Estimation of Stature from the Measurement of Forearm, Hand, Leg, and Foot Dimensions in Uttar Pradesh Region

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ABSTRACT

Introduction: Measurement of the human body and its different parts are used for various purposes such as industrial purpose for clothing design, medical, surgical, and dental purpose. It is used in the detection and correction of body defects, preparation for cosmetic surgeries, and estimation of general health. Criminal and other identification, anthropometry has a role in personal identification and hence is used into identify criminals.

Objectives: The objectives of this study were to provide correlation between lengths of forearm, hand, leg, and foot with stature.

Materials and Methods: The data were collected from students of age group between 17 and 21 years of both genders. Total sample size was 200 (100 male and 100 female) and parameters were measured using standard height measuring machine and tape.

Result: Of four parameters, leg length showed highest degree of correlation (r = 0.8847) and foot length showed least degree (r = 0.7664) of correlation with the stature.

Conclusion: This study data will help in medicolegal cases, among people of different regions, when only some parts of the body are found in cases such as bomb blast, mass disaster, and accident. Estimation of stature becomes more reliable and identification of individual is easily established.

Key words: Anthropometric, forearm, hand and foot, leg length, stature

INTRODUCTION

"Stature" is one of the most essential rudiments in the identification of an individual. Different parts of the body can be used in the estimation of stature. Like forearm, hand, leg, and foot can be used in the calculation of height of a person. Many studies have shown the correlation of stature with body appendages.

As the incidences of crime are going on increasing, the matter of identification of an individual is becoming prime importance nowadays. Estimation of stature forms important criteria for establishing individuality of the person and requires special attention in cases when bodies are found in mutilated state (only fragments are discovered).

For nearly 100 years, anthropologists and medical scientists are using skeletal and rudiments for the estimation of stature with great interest.[1] Anthropometric structures such as stature or body height have great importance to decide victims and criminals, which also includes age, sex, and race.[2,3] Natural calamities such as tsunami, earthquake, flow, and mass destruction such as plane crash has created problem in the identification of victims, where fragmented human remnants are mostly found.[4-7] Whenever forensic experts are in diligence, they prefer relatively less specific method of reconstruction, i.e., the mathematical method which works even if a part of the body is accessible.[8] Various researchers have developed mathematical procedures for the estimation of stature in skeletal remnants.[9-12] Regression equations have been developed recently by forensic experts for stature estimation using upper and lower extremity.[13,14] Body parts such as head, trunk, arm, and finger length are also used nowadays for the estimation of sex and correlated with height of individual. Stature has correlation with different parameters of the body but interracial and intergeographical differences occur.[15]

MATERIALS AND METHODS

The present study was conducted among 200 medical students which include 100 males and 100 females from the Teerthanker Mahaveer Medical College

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and Research Center, Moradabad, Uttar Pradesh. The students varied in age between 17 and 21 years. The main objectives of the research were explained to the participants and consent was taken before measurement of the parameters. 10 students were taken for measurement each day (except holiday) from 2 to 4 pm to avoid diurnal variations. The following parameters were measured.

Height

The height of the individual students was measured between the vertex and floor, with the participants standing erect, in anatomical position and the head in the Frankfort plane, using a standard height measuring machine as shown in Figure 1.

Measurement of various parameters in both side right as well as left was measured by measuring tape shown in Figure 2.

Forearm length

From the tip of olecranon process to ulnar styloid process using a measuring tape as shown in Figure 3.

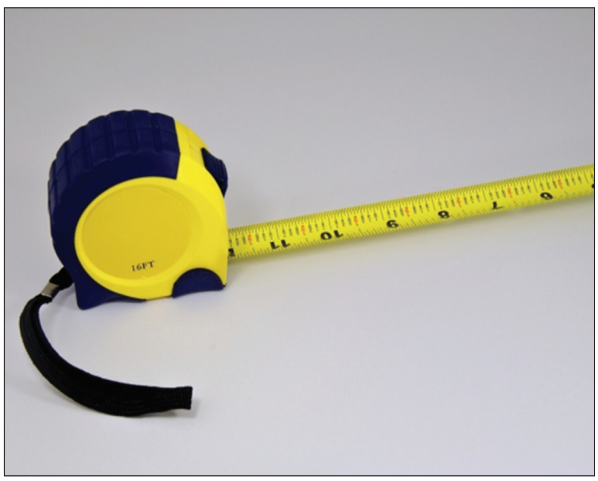

Figure 1: Standard measuring tape

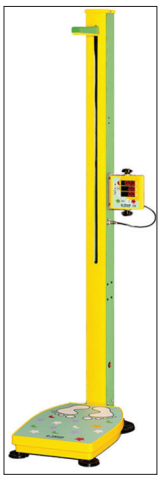

Figure 2: Standard measuring height machine

Hand length

From the distal wrist crease to tip of middle finger using a measuring tape (position: Supine) as shown in Figure 4.

Knee to ankle

From lateral condyle to lateral malleolus using a measuring tape (position: Knee flexed) as shown in Figure 5.

Foot length

From the tip of big toe to heel on the medial side using a measuring tape as shown in Figure 6.

Statistical 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. We analyzed our data using SPSS (version 16.0.2).

RESULT

Of four parameters, leg length showed higher (r = 0.8847) and foot length showed least degree (r = 0.7664) of correlation with the stature.

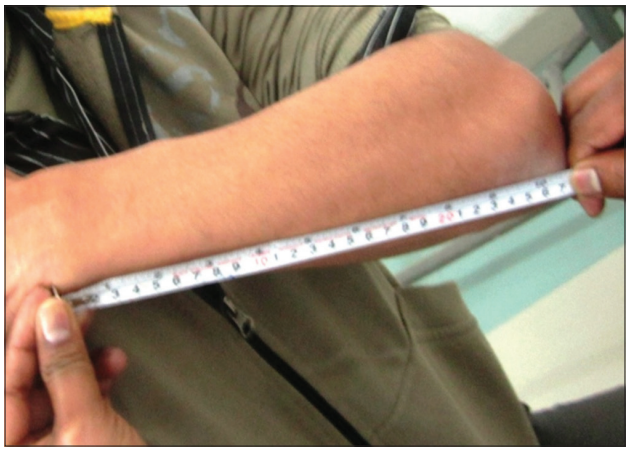

Figure 3: Forearm length

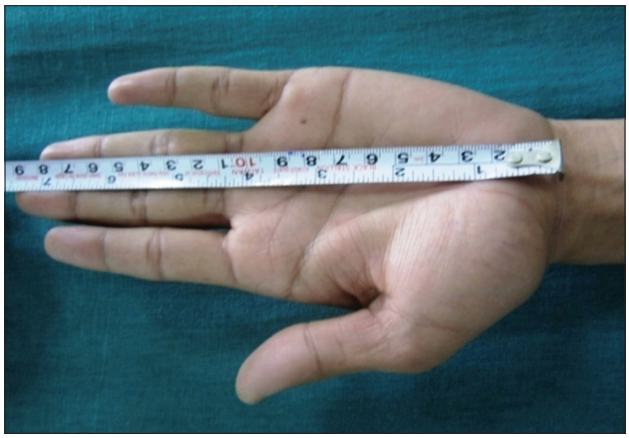

Figure 4: Hand length

The results are given below in the table and figure after the statistical analysis [Table 1 and Figures 7-10].

Table 1: Range, SD, correlation coefficient (r), and regression coefficient (b) values of the anthropometric measurements

Parameters assessed	Height range (cm)	Mean±SD	r	B
Height	148–185	163.725±8.370		
Forearm length (right)	23–30	26.162±1.833	0.8445	3.855
Forearm length (left)	23–30	26.131±1.831	0.8485	3.870
Hand length (right)	16–21	18.13±1.197	0.7885	5.510
Hand length (left)	16–21	18.124±1.186	0.7982	5.631
Leg length (right)	33–44	37.346±2.734	0.8847	2.706
Leg length (left)	33–44	37.346±2.734	0.8847	2.706
Foot length (right)	21–27	23.666±1.723	0.7664	3.721
Foot length (left)	21–27	23.666±1.723	0.7664	3.721

SD: Standard deviation

Figure 5: Leg length

Figure 6: Foot length

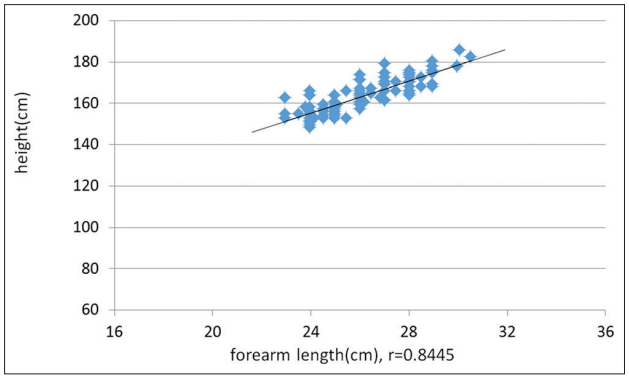

Figure 7: Correlation between height and forearm length

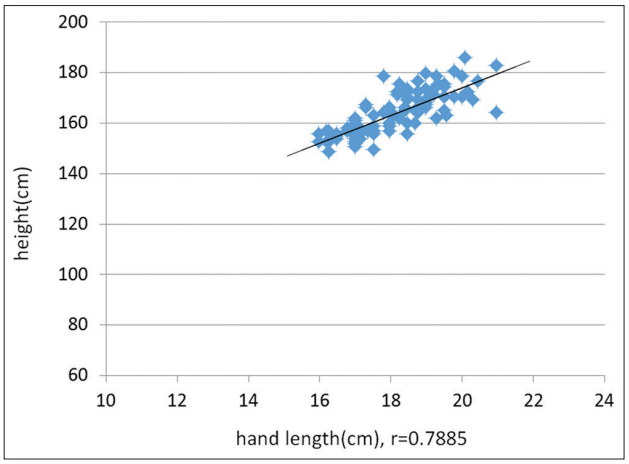

Figure 8: Correlation between height and hand length

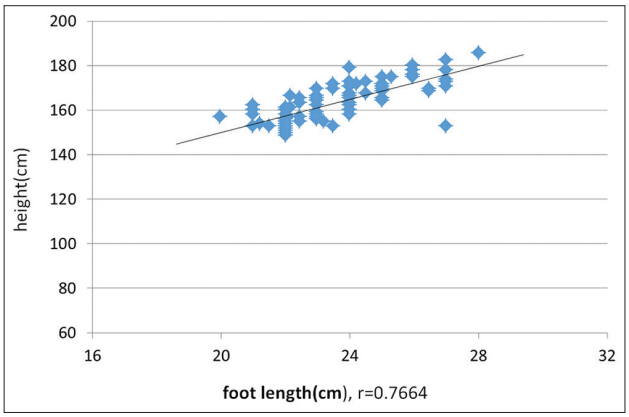

Figure 9: Correlation between height and foot length

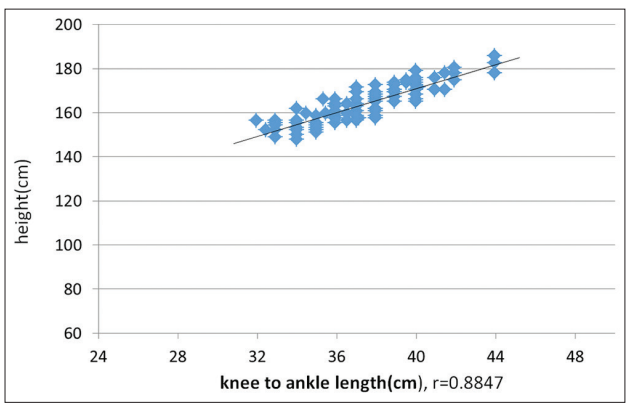

Figure 10: Correlation between height and leg length

Regression Equations

The regression equations derived for each of the parameters are as follows:

Estimation of stature from forearm length (right):
Y = 62.871+3.855*X (Y: Stature of individual, X: Forearm length)

Estimation of stature from forearm length (left):
Y = 62.59+3.87*X (Y: Stature of individual, X: Forearm length)

Estimation of stature from hand length (right):
Y = 63.835+5.51* X (Y: Stature of individual, X: Hand length)

Estimation of stature from hand length (left):
Y = 61.689+5.631* X (Y: Stature of individual, X: Hand length)

Estimation of stature from leg length (right):
Y = 62.667+2.706* X (Y: Stature of individual, X: Leg length)

Estimation of stature from leg length (left):
Y = 62.667+2.706*X (Y: Stature of individual, X: Leg length)

Estimation of stature from foot length (right):
Y = 75.664+3.721*X (Y: Stature, X: Foot length)

Estimation of stature from foot length (left):
Y = 75.664+3.721*X (Y: Stature, X: Foot length).

DISCUSSION

The cross-sectional descriptive study was conducted among 200 healthy medical students (100 male and 100 female) of age group 17–21 years of Teerthanker Mahaveer Medical College and Research Center (TMMC & RC), Moradabad, Uttar Pradesh.

The study showed that regression coefficient (0.8847) of leg length was found to be the best estimator of stature among other parameter such as foot length (0.7664), hand length (0.7982), and forearm length (0.8485). The study was similar to the finding of Bhavna and Nath[16] which revealed that tibial length was best estimator of stature among 503 Muslims of New Delhi. Finding also congruent with study of Chikhalkar *et al*.[15] who correctly estimated the stature from foot length (r = 0.6102) among 147 males and 153 female of age group 19–23 years in Mumbai.

In the present study, the foot length showed the regression coefficient of 0.7664, which is in contrast from the study of Patel *et al*.[17]. He showed the degree of correlation of foot length to be the least one (r = 0.6102) with height among 502 students of age group 17–22 years. Similar conclusion was also presented by Agnihotri *et al*.,[18] Sen and Ghosh,[19] and Kanchan *et al*.[14].

The present study showed that the second most highest degree of correlation was found for forearm length with regression coefficient (0.8485) which was agreed by Athwale[20] who conducted study on Maharastrian male of age group 25–30 years, Chikhalkar *et al*. (r = 0.6558).[15]

The regression coefficient (0.7982) for the present study showed stature and dimension of hand was the third most correlated value. The study contrast from the study of Krishna and Sharma,[21] who conducted study on north Indian Rajput's.

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