Original Research Article

Correlation of Stature and Hand Dimension Among Medical Students of South Tamil Nadu, India

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Abstract

Background & Objectives: Estimation of stature from the incomplete skeletal remains have importance in personal identification in the events of murders, accidents or natural disasters and considered as one of the biggest challenges of forensic science.Objectives: To study the relationship of stature in relation with hand dimensions and to derive a mathematical model to predict the stature from hand dimensions.

Methods: This cross-sectional study was done among 50 medical students studying at a medical college in South Tamilnadu. Age, gender, hand dimensions and height of all the subjects were noted. Pearson correlation was done to find the correlation between hand dimensions and height. Linear regression was used to derive the equations to predict the stature of an individual using various dimensions of hands.

Results: The mean age of the study population was 20.06 ± 1.28 years. Regression equations were derived to predict the stature of an individual with length and breadth of right and left hand. There was statistically significant positive correlation between stature and dimensions of both right and left hand. Linear regression equations were derived to predict the stature of an individual with any of the hand dimensions.

Interpretation & Conclusion: Hand dimensions have statistically significant positive correlation with the stature. The length or breadth of the right or left hand can be used to predict the stature of an individual.

Keywords: Breadth of hand, Height, Identification, Length of hand, Linear regression, Prediction, Stature.

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Introduction

Estimation of stature from the incomplete skeletal remains or from mutilated, amputated limbs,parts of limbs or highly decomposed, fragmented human remains has obvious importance in personal identification in the events of murders, accidents or natural disasters are considered as one of the biggest aspects of forensic science. Anthropometric techniques have been used for stature and bone length estimation from unknown body parts and skeletal remains by anthropologists, medical scientists, and anatomists for over a hundred years[1-3].

Stature estimation is one of the four attributes of the biological profile. The hand and foot remain intact in mass disasters many a times and their anthropometric measurements help in estimation of stature. The hand and foot prints also provide valuable information in scene of crimes and contribute in identifying the criminal. The estimation of stature from long bones may not be feasible with fresh or decomposed mutilated remains. In such situations it can be done from hand length and prints or from foot length and prints[4]. Hand length has been documented as significant predictor of body surface area and body mass[5].

The dimensional relationship between body segments and stature has been the focus of scientist, anatomist, and anthropologist for many years[6]. For this purpose, many sets of regression equation have been developed, and the better known are Karl Pearson from Western countries and Singh and Sohal (1952) from India[7]. Previous studies have reported the effectiveness of using hand length and hand breadth in estimating stature[6,7]. However, estimation of stature from these formulae in all population are not appropriate; as climate, heredity, nutritional status of the population has been reported to influence stature.

To counter this problem, we must have regression equation of different bones from representatives of same populations. Many studies have been done for stature estimation using long bones[8], foot dimensions[9], hand measurements[10], Radius Ulna Bone measurements [11] and Head measurements[12].

In this paper, an attempt had been made to study the relationship of stature in relation with hand dimensions and to derive a mathematical model to predict the stature from hand dimensions in healthy adult individuals in the age group of 18-25 years in medical students of south Indian population of Kerala and Tamil Nadu. No specific ethnic group had been included in the study but combinations of variegated ethnic groups were considered. This information will be highly important to Forensic experts, human biologists, and physical anthropologists for determination of stature from the fragmentary remains of upper limb.

Material & Methods

Study Design: Cross-Sectional study

Study setting: Tertiary care teaching hospital in Kanyakumari District, Tamil Nadu.

Duration of study: 2 months (1/8/2019 to 30/9/2019)

Study participants:

a. Inclusion criteria: Medical students aged 18 to 25 years

b. Exclusion criteria: Those who did not give consent for the study, those with congenital abnormality, past history of injuries, fracture and surgeries of hand affecting the palm.

Sample size was calculated, using the formula $[(Z\alpha+Z\beta)/C]2 + 3$, based on the study by MS Supare, SV Pandit and AS Bagul, where the correlation coefficient was 0.45 for right hand breadth and stature in male[21]. With Zα, standard normal deviate for $\alpha = 1.96$;Zβ, the standard normal deviate for $\beta = 1.28$; $r = 0.45$ and $C = 0.5 \times \ln [(1+r)/(1-r)] = 0.485$.Calculated sample was 48 and a total of 50 subjects were studied. To have equal representation from all the batches, 10 students from each batch (I year MBBS to internship) were selected by simple random sampling technique. The students' list in the attendance register was used as the sampling frame.

Study procedure:

The study was commenced after obtaining Institutional Human Ethics Committee clearance (IHEC No.2/Protocol no.1/2019). Informed written consent was obtained from all the selected study subjects. Study variables included age, gender, bilateral hand length, bilateral hand breadth and

stature. Each participant was instructed to place their hands supine on a flat hard horizontal surface with fingers extended and adducted, with no adduction or abduction at wrist joint and forearm in line with the middle finger. Hand length was measured using a sliding vernier callipers with the sensitivity of 0.02mm. Later the subject was asked to place the hand prone on the flat hard table with the fingers together and the thumb out to the side, the breadth of the hand was measured at the level of the knuckles, with the vernier calliper. The hand breadth was measured as a distance between the radial side of 2nd metacarpophalangeal joint to the ulnar side of 5th metacarpophalangeal joint. The height of the participant was measured using stadiometer with sensitivity of 1mm. Weight was measured using a weighing scale with sensitivity of 500gm.

Data Management and Analysis

Data were coded and entered in MS Excel and analysed using SPSS v 20.0. Descriptive statistics such as mean and standard deviation were computed for height, hand breadth and hand length. Pearson correlation test was used to find the correlation between height and dimensions of hand. Linear regression model was used to derive the equations to predict the height using the dimensions of hand.

Results

The mean age of the study population was 20.06±1.28 years. Among the study population, 22 (44%) were males and 28 (56%) were females. Mean stature of the study participants was 163.6 ± 9.52 cm and mean weight was 62.5 ± 11.03 Kg. The mean dimensions of the hand were as follows; length of right hand was 17.73 ± 1.13 cm, breadth of right hand was 7.56 ± 0.65 cm, length of left hand was 17.65 ± 1.14 cm and breadth of left hand was 7.42 ± 0.70 cm.

1. **Correlation of hand dimensions with stature**

The Pearson Correlation Coefficient test was done to find the relationship between the stature of the individuals and various dimensions of hands such as length of right hand, breadth of right hand, length of left hand and breadth of left hand.

i. Correlation of length of right hand with stature

A positive correlation was found between the length of right hand and stature and it was found to be statistically significant (r value of 0.785 and p value of <0.001). The scatterplot portrays the result in the figure 1.

ii. Correlation of breadth of right hand with stature

There was a statistically significant positive correlation found between breadth of right hand and the stature of the individual with Pearson Correlation value 0.814 and p value <0.001. Figure 2 shows the scatterplot with this finding.

iii. Correlation of length of left hand with stature

The Pearson correlation test showed a statistically significant positive correlation between length of left hand and height, with Pearson Correlation value r = 0.782 and p value <0.001 and this result is shown in the figure 3.

iv. Correlation of breadth of left hand with stature

There was a statistically significant positive correlation between the stature and the breadth of left hand, with Pearson Correlation value 0.809 and p value <0.001 and shown in figure 4.

2. **Regression equations to predict the stature of an individual**

Linear regression model was used to derive equations predicting the stature of individuals using various dimensions of hands as follows.

i. Regression equation to predict the stature using the length and breadth of both hands: Stature = 50.629 + 2.012 (Length of right hand) + 1.139 (Length of left hand) + 5.262 (Breadth of right hand) + 2.348 (Breadth of left hand). The model had R2 value of 0.725, F value of 29.659 and p value <0.001.

ii. Regression equation to predict the stature using the length and breadth of right hand: Stature = 48.836 + 3.248(Length of right hand) +7.565 (Breadth of right hand). The model had R2 value of 0.721, F value of 60.777 and p value <0.001.

iii. Regression equation to predict the stature using the length and breadth of left hand: Stature = 56.147+3.177 (Length of left hand) + 6.927(Breadth of left hand). The model had R2 value of 0.710, F value of 57.461 and p value <0.001.

iv. Regression equation to predict the stature using the length of right hand: Stature = 46.285 + 6.616 (Length of right hand). The model had R2 value of 0.617, F value of 77.254 and p value <0.001.

v. Regression equation to predict the stature using the breadth of right hand: Stature = 73.073 + 11.979 (Breadth of right hand). The model had R2 value of 0.662, F value of 94.198 and p value <0.001.

vi. Regression equation to predict the stature using the length of left hand: Stature = 48.157 + 6.541 (Length of left hand). The model had R2 value of 0.611, F value of 75.45 and p value <0.001.

vii. Regression equation to predict the stature using the breadth of left hand: Stature = 82.064 + 10.99 (Breadth of left hand). The model had R2 value of 0.655, F value of 91.193 and p value <0.001.

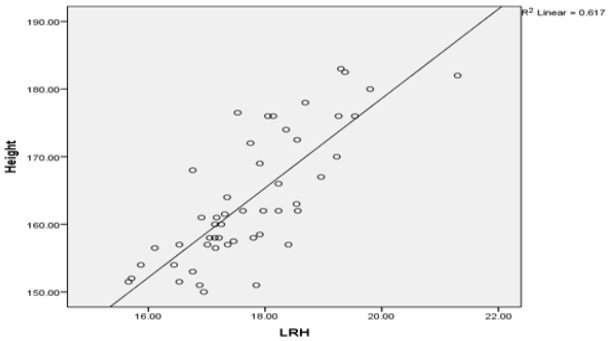

Figure 1: Scatterplot showing the Correlation between stature and length of right hand (LRH).

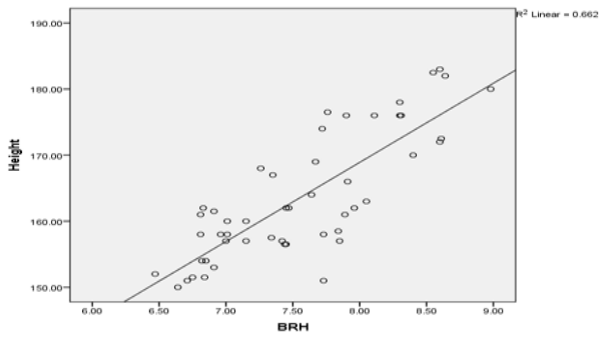

Figure 2: Scatterplot showing the Correlation between stature and breadth of right hand (BRH).

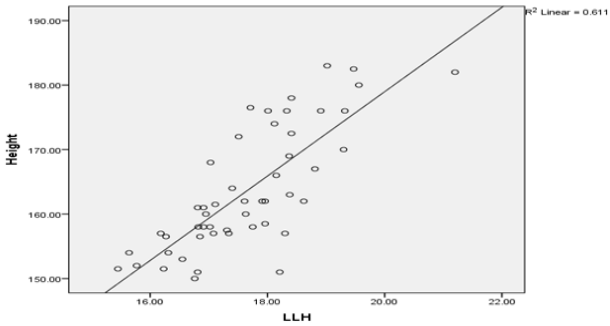

Figure 3: Scatterplot showing the Correlation between stature and length of left hand (LLH)

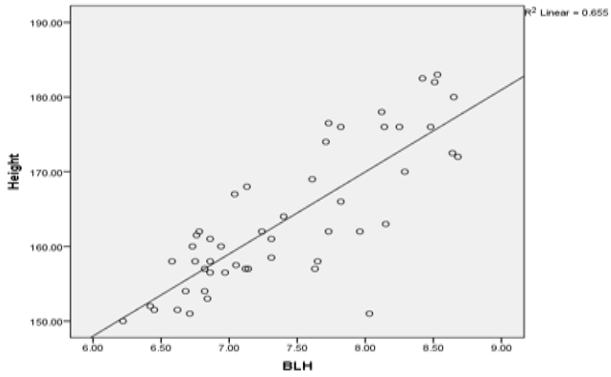

Figure 4: Scatterplot showing the correlation between stature and breadth of left hand (BLH).

Table 1: Comparison of regression equations from various studies to predict the stature using length of right hand

	REGRESSION EQUATION
Current Study	Height = 46.285 + 6.616 (Length of right hand)
Jasuja et al Male Female	 Height = 101.991 +3.767 (Length of right hand) Height = 133.961 +1.473 (Length of right hand)
Sunil et al Male Female	 Height = 86.93 + 4.25 (Length of right hand) Height = 72.42 + 4.56 (Length of right hand)

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Vijeta et al Male Female	 Height = 79.23 +4.91 (Length of right hand) Height = 86.03 +4.11 (Length of right hand)
MS Supare et al Male Female	 Height = 68.69 +5.52 (Length of right hand) Height = 65.22 +5.46 (Length of right hand)
Sangeeta et al Male Female	 Height = 111.25 + 2.71 (Length of right hand) Height = 79.758 + 4.168 (Length of right hand)
Amitava et al	Height = 88.1 + 3.88 (Length of right hand)

Table 2 Comparison of regression equations from various studies to predict the stature using length of left hand

	REGRESSION EQUATION
Current Study	Height = 48.157 + 6.541 (Length of left hand)
Jasuja et al Male Female	 Height = 133.961 + 1.473 (Length of left hand) Height = 130.035 + 1.66 (Length of left hand)
Sunil et al Male Female	 Height = 85.84 + 4.32 (Length of left hand) Height = 80.94 + 4.4 (Length of left hand)
Vijeta et al Male Female	 Height = 169.73 + 0.36 (Length of left hand) Height = 88.20 + 3.97 (Length of left hand)
MS Supare et al Male Female	 Height = 69.09 + 5.51 (Length of left hand) Height = 66.90 + 5.37 (Length of left hand)
Sangeeta et al Male Female	 Height = 111.884 + 2.686 (Length of left hand) Height = 80.971 + 4.134 (Length of left hand)

Table 3: Comparison of regression equations from various studies to predict the stature using breadth of right hand

	REGRESSION EQUATION
Current Study	Height = 73.073 + 11.979 (Breadth of right hand)
Vijeta et al Male Female	 Height = 165.21 + 0.63 (Breadth of right hand) Height = 123.79 + 4.15 (Breadth of right hand)
MS Supare et al Male Female	 Height = 115.32 + 6.96 (Breadth of right hand) Height = 98.48 + 8.18 (Breadth of right hand)
Sangeeta et al Male Female	 Height = 122.273 + 5 (Breadth of right hand) Height = 85.545 + 8.852 (Breadth of right hand)

Table 4: Comparison of regression equations from various studies to predict the stature using breadth of left hand

	REGRESSION EQUATION
Current Study	Height = 82.064 + 10.99 (Breadth of left hand)

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Vijeta et al Male Female	 Height = 139.85 + 3.67 (Breadth of left hand) Height = 117.23 + 5.2 (Breadth of left hand)
MS Supare et al Male Female	 Height = 115.92 + 6.90 (Breadth of left hand) Height = 100 + 7.99 (Breadth of left hand)
Sangeeta et al Male Female	 Height = 124.493 + 4.792 (Breadth of left hand) Height = 85.272 + 9.013 (Breadth of left hand)

Discussion

Most of the published studies to predict stature were done using length of hand and conducted among adult population. Similarly, there are dearth in studies to predict stature using breadth of hand. No such studies had been conducted among adolescent population in South India. To overcome such deficiency this cross-sectional study was planned among medical students in a rural area of South India.

In the present study, the mean age of the study population was 20.06 ± 1.28 years. There was almost equal representation from males (44%) and females (56%). The mean stature of the population was 163.6 ± 9.52 cm and weight 62.5 ± 11.03 Kg.

A positive correlation was found between various dimensions of hands and the stature in this study. The Pearson correlation was found to be statistically significant between stature and length of right hand. The studies done by, Supare et al (males r value 0.74 and females r value 0.75)[13], Jasuja O.P et al (males r value 0.502 and females r value 0.529)[14], Vijeta et al (males r value 0.554 and females r value 0.574)[15], Sangeeta Dey et al (males r value 0.54 and females r value 0.69)[16], Girish Shiv Shankar et al (r value 0.249)[17], Amitava et al (r value 0.683)[18]and Sunil et al (r value 0.7)[19]showed positive correlation between stature and length of right hand.

Current study showed a positive, statistically significant, correlation between breadth of right hand and stature. Similar correlation was found with studies by Supare et al males r value 0.45 and females r value 0.56)[13], Sangeeta Dey et al (males r value 0.35 and females r value 0.54)[16] and Amitava et al (r value 0.53)[18].

There was a statistically significant positive correlation between stature and length of left hand in this study. Results from studies by Sunil et al (males r value 0.6 and females r value 0.7)[19], Supare et al (males r value 0.75 and females r value 0.74)[13], Jasuja O.P et al (males r value 0.452 and females r value 0.557)[14] and Amitava et al (r value 0.682)[18] showed consistent result.

Breadth of left hand and stature was also found to have statistically significant positive correlation in our study. Similar finding was observed by Supare et al (males r value 0.46 and females r value 0.55)[13], Sangeeta Dey et al (males r value 0.33 and females r value 0.54)[16] and Amitava et al (r value 0.524)[18].

The regression equation derived to predict the stature using different hand dimensions in our study were compared with the regression equation derived from other studies in Table 1, Table 2, Table 3 and Table 4.

Conclusion

The length and breadth of both hands had statistically significant positive correlation with stature. In case of situations where only hand dimensions are available, the stature of an individual could be predicted with regression equation using length and breadth of both hands or any hand and length / breadth of any hand.

Ethical Clearance: The study was commenced after obtaining Institutional Human Ethics Committee clearance (IHEC No.2/Protocol no.1/2019) on 24.06.2019

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Conflicts of interest: No conflicts of interest

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