Research Journal of Pharmaceutical, Biological and Chemical Sciences

Correlation Of Human Height With Hand Dimensions: A Cross Sectional Study.

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ABSTRACT

Hand dimensions have been extensively used in research to estimate stature of individuals in identification. Identification has been the most important part of forensic investigations and hence this study was designed to establish a correlation between height, hand length and hand breadth in both males and females. This descriptive cross-sectional study was conducted amongst 150 participants of medical college over a period of 1 month. Hand dimensions along with height were measured. The data was entered in software SPSS -20 & descriptive statistics was calculated & Pearson's correlation test was applied to find out correlation & linear regression equation was derived. The mean height was 173.78 cm in males and 158.22 cm in females. Mean right hand length was 19.42 cm in males and 17.38 cm in females, whereas mean left hand length was 19.56 cm and 17.51 cm in males and females respectively. The mean right hand breadth was 10.98 cm in males and 9.73 cm in females, whereas mean left hand length was 11.1 cm and 9.9 cm in males and females respectively. There was statistically significant correlation found between height & hand dimension. Based upon study results linear regression equation was derived. The study depicts that the relationship between height and hand dimensions was significant. The data obtained was computed for providing a linear regression equation for height and hand dimensions so that if later variable is known the other can be predicted. This study will prove helpful in situation where the trace evidence was recovered and from that complete evidence has to be derived by forensic experts.

Keywords: Hand dimensions, Human height, forensic utility.

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INTRODUCTION

Identification is an important facet of any forensic investigation. Height of the individual is one of the important parameters of the individual identification**.** Height prediction is important in medico legal cases for victim- identification. There is evident correlation between height of the individual with hand dimensions and so if either of the measurements is known, the other can be calculated [1]. Hand Length (HL) and Hand Breadth (HB) have been considerably used in to estimate stature of individuals for identification in the literature and have received ample attention from anthropologists. This is due to the established strong correlation between stature and hand dimension [2].

This has been found imperative in the process of individual identification in case of mass disasters like bomb explosions, accidents, natural calamities, murders where bodies or isolated extremities are found in disintegrated, mutilated and skeletonized state [3, 4].

Ilayperuma et al in there study estimated individual stature of incomplete skeleton and decomposing human remains from hand length and determined 0.58 and 0.59 correlation coefficient in males and females respectively [5]. The study by *Jasuja and Singh*, revealed that hand length have a positive and statistically significant correlation with the stature [6]. Sangeeta and Kapoor did stature estimation from the dimensions recovered from hand outlines and shown that Pearson's correlation was statistically significant between stature and hand dimensions [7]. Charmode et al found a strong statistically significant positive correlation between height and hand dimensions in their study[1]. *Chawla et al* concluded that a positive correlation exists between height and hand length & regression equation for height estimation determined using hand length [8] Literature has shown that many studies have been carried out to illustrate the possibility to calculate stature through regression equation from hand length & hand breadth [1-8]. Height determination from the size of a body part such as hand is important for forensic purposes. Hence, the present study was planned to find out correlation of hand dimensions with stature for accurate identification in forensic investigations.

MATERIALS AND METHODS

The present study was carried out in the Department of Anatomy, Raipur institute of Medical sciences, Medical College, Raipur, Chhattisgarh state, after due approval from Research Advisory Committee (RAC) & Institutional Ethics Committee (IEC) of the medical college.

Study Type: Descriptive Cross-sectional study.

Study Population: First year MBBS students consented for the Study.

Sample Size: 150 participants.

Inclusion Criteria: First year MBBS students consenting for the proposed study.

Exclusion Criteria: Students with poorly defined wrist creases, deformities of vertebral column & limbs, contractures, missing limbs, history of trauma to hand and foot, with features suggestive of dysmorphic syndromes, chronic illness and hormonal therapy were excluded from the study.

Methodology

Anthropometric measurements of Hand

Hand length and Hand breadth for both hands of each study participant was measured using Vernier slide caliper in CM according to the standard techniques described by Mohite et al [9].

Each participant was asked to place his / her hand on a white paper with the palm facing upwards with the fingers extended & close together during measurement. A tracing of the hand was made with a lead pencil. The tracing proceeded from the radial styloid process to the ulnar styloid process. A line designated as the inter-styloid line was drawn joining the two styloid tips.

Hand length

It measures the distance between the distal crease of wrist to tip of middle finger.

Hand breadth

It measures the distance from 1st metacarpo- phalangeal joint to base of 5th metacarpal.

Measurement of Height

Stadiometer was used to measure the height in cm with subject standing erect on a horizontal resting plane bare footed having the palms of the hands turned inward and the finger pointing downwards. The height was measured from the sole of the feet to the vertex of the head as recommended by International Biological Program[10].

Data Analysis

The data was entered in Microsoft Office Excel & statistical software spss-20 and descriptive statistics was carried out to estimate mean, standard deviation and test of significance like Pearson's Chi Square Test for correlation equation.

RESULTS

Out of total study participants 59 were male and 91 were female participants. Table 1 show descriptive analysis of height and hand length of right and left hand amongst male participants and their correlation. Height of the male participants ranged between 161-190 cm with mean 173.78 and SD of 6.08. Right hand length ranged between 17.4 – 21.8 cm with mean 19.42 cm & SD 1.14 while left hand length ranged between 17.6-21.6 cm with mean 19.56 & SD 1.06. Positive correlation was observed between height & hand length (both sides) in male participants, which was found statistically significant (p<0.01). so, following linear regression equations were obtained to predict height based on hand length in males.

Height = 71.58 + (3.56 × Right Male Hand Length) and
Height = 67.59 + (3.89 × Left Male Hand Length)

Table 1: Correlation of Height and Hand Length in Males

Variables	Range	Mean	SD	N	Correlation (r)	p value
Height (cm)	161-190	173.78	6.08	59	--	--
Right Hand Length (cm)	17.4-21.8	19.42	1.14	59	0.670	p<0.01
Left Hand Length (cm)	17.6-21.6	19.56	1.08	59	0.698	p<0.01

Table 2 show, the range of hand breadth 8.2 – 13.2 cm & 8 – 13.5 cm of right & left hand respectively amongst study participants. The mean hand breadth was 10.98 & 11.10 with SD 1.17 & 1.13 of right & left side respectively. There was positive correlation between height and hand breadth of both side & which was statistically significant (p<0.01). The linear regression equation derived from the study to predict height from the known value of hand breadth in males as mentioned below:

Height = 103.97 + (0.86 × Right Male Hand Breadth) and
Height = 98.59 + (0.65 × Left Male Hand Breadth)

Table 2: Correlation of Height and Hand Breadth in Males

Variables	Range	Mean	SD	N	Correlation (r)	p value
Height (cm)	161-190	173.78	6.08	59	--	--
Right Hand Breadth (cm)	8.2-13.2	10.98	1.17	59	0.493	p<0.01
Left Hand Breadth (cm)	8-13.5	11.10	1.13	59	0.509	p<0.01

Table 3 show the height for female participants ranging between 144-173 cm. the hand length ranged between 14.9-20.2 cm and 15.2–20.5 cm of right & left hand respectively. Further analysis revealed positive correlation between height and hand length of right and left hand which was statistically significant (p<0.01) in females. The following linear regression equation was derived from the study to estimate height in females if the values for hand length are known.

Height = 70.04 + (2.89 × Right Female Hand Length) and
Height = 66.59 + (3.02 × Left Female Hand Length)

Table 3: Correlation of Height and Hand Length in Females

Variables	Range	Mean	SD	N	Correlation (r)	p value
Height (cm)	144-173	158.22	6.37	91	--	--
Right Hand Length (cm)	14.9-20.2	17.38	1.14	91	0.514	p<0.01
Left Hand Length (cm)	15.2-20.5	17.51	1.10	91	0.521	p<0.01

Table 4 show hand breadth ranging from 7.7-12 cm & 8- 12.6 cm with mean breadth 9.73 & 9.90 with SD 1.10 & 1.11 of right and left hand respectively. There was found statistically significant positive correlation between height and hand breadth of right and left (p<0.01) in females. The study determined the linear regression equation to estimate height based on known values of hand breadth in females.

Height = 96.61 + (0.98 × Right Female Hand Breadth) and
Height = 93.59 + (0.82 × Left Female Hand Breadth)

Table 4: Correlation of Height and Hand Breadth in Females

Variables	Range	Mean	SD	N	Correlation (r)	p value
Height (cm)	144-173	158.22	6.37	91	--	--
Right Hand Breadth (cm)	7.7-12	9.73	1.10	91	0.497	p<0.01
Left Hand Breadth (cm)	8-12.6	9.90	1.11	91	0.512	p<0.01

DISCUSSION

In present study, human height varies from 161 cm to 190 cm in males, and 144 cm to 173 cm in females. The mean stature was 173.78 cm in males and 158.22 cm in females, with SD of 6.08 and 6.37, respectively. These findings correspond with studies done on Indian population by various researchers in the past like Charmode et al [1], Patel et al [4], Mohite et al [9] and Chikhalkar et al [11].

Hand length on right side ranged from 17.4 cm to 21.8 cm in males, and 14.9 cm to 20.2 cm in females, with mean of 19.42 cm and 17.38 cm respectively, and SD of 1.14 in both males and females. Hand length on left side ranged from 17.6 cm to 21.6 cm in males, and 15.2 cm to 20.5 cm in females, and with mean of 19.56 cm and 17.51 cm respectively, and SD of 1.08 and 1.10, in males and females. These findings are in accordance with those of Charmode et al [1], Oommen et al [12], Shankar et al [13], Chikhalkar et al [11] and Kavyashree et al [14].

Hand breadth on right side ranged from 8.2 cm to 13.2 cm in males, and 7.7 cm to 12 cm in females, with mean of 10.98 cm and 9.73 cm respectively and SD of 1.17 and 1.10, in males and females. Hand breadth on left side ranged from 8 cm to 13.5 cm in males, and 7.7 cm to 12 cm in females with mean of 11.1 cm and 9.9 cm, respectively and SD of 1.13 and 1.11, in males and females. These findings were higher than those observed in almost all the previous studies. This is might because in present study, hand breadth was measured from 1st metacarpo-phalangeal joint to base of 5th metacarpal; whereas in previous studies it was measured from 2nd metacarpo-phalangeal joint to base of 5th metacarpal. Hand breadth values were comparable with observations of Charmode et al [1] and Mohite et al [9].

Correlation coefficient 'r' calculated for hand length (right : r = 0.670 in males and r = 0.514 in females, left : r = 0.698 in males and r = 0.521 in females) and hand breadth (right : r = 0.493 in males and r = 0.497 in females, left : r = 0.509 in males and r = 0.512 in females) corresponds with that calculated in studies of Charmode et al [1] (hand length (right : r = 0.493, left : r =0.524) and hand breadth (right : r = 0.569, left : r = 0.547), Chikhalkar et al [11] (hand length r = 0.5902, hand breadth r = 0.6004); Patel et al [4] (hand length r = 0.806 , hand breadth r = 0.467); Pal et al [15] (HL r = 0.683, HB r = 0.53), Tandon et al [16] (male , HL r = 0.224, HB r =0.154 ; female, HL r = 0.313, HB r = 0.272).

A strong correlation was observed in present study between human height and hand length and breadth similar to findings of Rastogi et al [17]. Linear Regression Equation derived in the present study corresponds with that determined in previous studies like Tandon et al [16] (regression formulae for male, female and complete samples were: y = 5.79x + 124.54; y = 7.125x + 105.5 and, y = 11.36x + 76.49 respectively); Shankar et al [13] (male : y = 7.96 + (0.061*right hand length), female: y = 10.49 + (0.04 * left hand length); Mohite et al [9] (2015) (h = 65.60+(0.54*head length), h = 104.03+(0.76*head breadth) ; Patel et al [4] (y=59.52+5.9163* HL, y=121.69+5.4188*HB).

CONCLUSION

Human stature has been studied extensively in relation to various body measurements. The present study was thus conducted to find out the correlation between the human height and hand dimensions. The results demonstrate that there is significant correlation between height & hand dimensions. The linear regression equation derived in the study can be used to predict hand dimension if one of the two variable is known. The equation can predict height within the standard error of estimate, thus can be used as a reference for future perspective in forensic domain. This data might be useful for forensic, epidemiological and anthropometric studies where stature determination is of utmost importance.

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