

CORRELATION OF HUMAN HEIGHT WITH HAND LENGTH IN INDIAN INDIVIDUALS

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ABSTRACT

Introduction: The estimation of sex and stature is crucial in identifying the individual especially when the body has been destroyed, decomposed or certain parts of unknown victim remains either in mass disasters like plane crash, mass suicide, homicides, train and road accidents, tsunamis, forest fires, earth quakes or from those disposed off in gutters or waste dumps. The estimation of height is a very important parameter in anthropometric measurements, in identification in medico-legal cases and in establishment of racial differences. The hand length varies in different races and ethnic groups and is used to determine sex, stature and nutritional status of an individual

Aims: To study the relationship of human height with hand length and to derive a mathematical module to predict the height from hand length.

Materials and Methods: This study has been done in Ramaiah Medical College in the year 2016 where hand length and height of 220 individuals aged between 18 and 25 years of age in and around Bangalore has been measured in centimeters. Descriptive statistics, Pearson's correlation coefficient and Linear regression were employed for the Statistical analysis of the data

Results: There was a weak positive correlation between height and hand length of both sides ($r = 0.25, 0.26$; $p < 0.001$) which was statistically significant.

Conclusion: It was observed from the present study that, there was a weak positive correlation between height and hand length. However, further analysis revealed that hand length alone is not sufficient for accurate prediction of height.

KEYWORDS: Hand Length, Stature, Correlation, Height, Anthropometry, Regression Equation.

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INTRODUCTION

The stature or height of an individual can be estimated from length of long bones of upper

extremity and lower extremity, metacarpal bones or from different body parts. This is important to anthropologists, forensic experts and anatomo-

mists. anatomists. The definitive proportion of various parts of the body to stature has been depicted in statues in various temples in India and also in the Vitruvian man by Leonardo da Vinci. The estimation of sex and stature is crucial in identifying the individual especially when the body has been destroyed, decomposed or certain parts of unknown victim remains either in mass disasters like plane crash, mass suicide, homicides, train and road accidents, tsunamis, forest fires, earth quakes or from those disposed off in gutters or waste dumps. [1,2]. When height cannot be measured directly like in case of kyphosis, scoliosis, contractures or missing limbs, other tools of measurement have to be used like hand length or foot length[3].

Stature throws light into various features of a population like nutrition, health, genetics, geographical location, environment and climatic condition [4,3,1].

The hand length varies in different races and ethnic groups and is used to determine sex, stature and nutritional status of an individual. The lower limb bones show positive allometric secular changes with stature and upper limb bones show isometric changes with stature. The positive allometry of the lower limb bones might disprove the existing data of the estimation of stature from femur or tibia alone which is based on constant proportionality, as an alternative to regression equations. The secular change in stature due to allometric changes in long bones and migration of world population poses a constant challenge to stature estimation. It has also been documented that hand & foot parameters are genetically derived and marked secular changes have not been observed. The biological profile obtained from skeletal remains, gives biological insight into the individuals or populations studied and is included as one of the standard protocols in the fields of forensic and biological anthropology, bio-archaeology and paleo-anthropology. 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 [5]. Hand length has been documented as significant predictor of body surface area and body mass [6].

Aim: To study the relationship of human height with hand length. To derive a mathematical module to predict the height from hand length.

MATERIALS AND METHODS

Study Design: Cross-sectional study, **Source of data:** Individuals aged between 18 and 25 years of age in and around Bangalore, **Place of study:** Ramaiah Medical College, Bangalore, **Duration of study:** 6 months. **Sample size:** Based on the previous studies conducted by Dr Sajad Hamid et al[7]; Anwesa Pal et al [3] and Dr Wakode NS et al[8], the correlation co-efficient varied from 0.58 to 0.87. Considering the correlation co-efficient as 0.58 with the power of 80 and alpha error of 5%, sample size was estimated to be 220.

Criteria: Inclusion criteria: Individuals aged between 18 and 25 years in and around Bangalore

Exclusion criteria: Individuals with features suggestive of dysmorphic syndromes

Method: Informed consent has been taken from all participants. The ethical clearance has been obtained from the institution. The measurements were taken thrice and their mean value has been considered.

PARAMETERS STUDIED: Hand length: 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 Vernier slide callipers

Height: The height of the participant was measured with the wall mounted height measuring device- Stadiometer.

Statistical Methods: Descriptive statistics such as mean and standard deviation has been computed for height and hand length. Mean difference value of right and left hand length was compared for statistical significance using students t test. Pearson's correlation coefficient has been used to find the correlation between

stature and hand length. Multiple Linear regression has been used to predict height from hand length of an individual. P value <0.05 was considered as statistically significant. Data analysis was carried out using SPSS version 18.0.chicago SPSS Inc.

RESULTS

The study consisted of 220 subjects, out of which 88 were males and 132 were females. Mean lengths between the two sides were compared and it was found to be 18.57± 1.07 for right hand and 18.63± 0.99 for left hand and t test revealed that there was no significant difference in the mean values between right and left hand length which is statistically significant(P value = 0.51)(Table – 1)

The gender wise comparison between right and left hand length measurements revealed that there was no difference in mean values of right hand and left hand length in in males and females (p=0.90,0.30) (Table – 2).

It was observed that there was a weak positive correlation between height and mean hand length of both the sides which was statistically significant (Table -3).

The genderwise correlation of left and right hand length revealed that there was a weak positive correlation between right and left hand length which was statistically significant(r=0.264, p = 0.013) in females. Similarly, correlation of height with hand length in males also revealed weak positive correlation for both the sides (r=0.221, p=0.011- for right hand length); (r=0.186, p=0.033 – for left hand length) . Linear regression equation was derived to predict height from right hand length in males. Whereas, it was not carried out in females since there was no significant correlation.

Regression equation to predict height in males, right hand: Y (height) = 7.96+ (0.061X right hand length)

Regression equation to predict height in males, left hand: Y (height) = 10.49+ (0.04X left hand length)

Regression equation to predict height in females, left hand: Y (height) = 13.96+ (0.024X right hand length)

The co-efficient of determination obtained for

the above regression equations were less than 0.035, hence we can conclude that accurate and reliable prediction is not possible and other parameters need to be considered.

Table 1: Comparison of mean differences in hand length between right and left sides.

	Mean right hand length (cms)	Mean left hand length (cms)
Mean	18.57	18.63
SD	1.07	0.99
P value	0.51	

Table 2: Comparison of mean difference in hand length between right and left sides among males and females.

	In males		In females	
	Mean Right Hand Length	Mean Left Hand Length	Mean Right Hand Length	Mean Left Hand Length
Mean	18.21	18.35	18.81	18.82
SD	0.9	0.86	1.11	1.02

Table 3: Correlation of height with hand length.

	Correlations	Mean Right Hand Length	Mean Left Hand Length
	Height	Pearson Correlation	.249**
	P value	<0.001	<0.001

Table 4: Correlation of height with hand length in males and females.

Sex			Mean Right Hand Length	Mean Left Hand Length
Females	Height	Pearson Correlation	0.172	.264*
		P value	0.11	0.013
Males	Height	Pearson Correlation	.221*	.186*
		P value	0.011	0.033

Table 5: Different studies of correlation between hand length and height.

Study	Sample size	Males	Females	Parameters
Sunil (2005) et al[9]	150	75	75	Hand length, height
Nanayakkara(2009) et al[10]	258	140	118	Hand length, height
Anwsha Pal (2014) et al[3]	235	125	110	Hand length, height
Jitendra P Patel (2014) et al [11]	150	72	78	Hand length, height
Lukpata PU (2015) et al[2]	1028	412	616	Hand length & breadth, height
Wakode NS (2015) et al[8]	200	94	106	Hand length, height
Sahana(2015) et al[12]	300	-	-	Hand length & breadth, height
Sajad Hamid(2015) et al[7]	150	100	50	Hand length, height
MS Supare(2015) et al [13]	400	219	181	Hand length & breadth, height
Subashri A (2016) et al[14]	100	40	60	Hand length, height
Maryna Kornieieva(2016) et al[15]	200	100	100	Hand length,breadth, prints, height
Present study(2016)	220	132	88	Hand length, height

DISCUSSION

A statistically significant positive correlation between hand length and height has been observed in both sexes by Nanayakkara et al and

Sunil et al who have concluded that hand length is a precise tool to estimate stature of an unknown person. Anwesa Pal et al have reported a positive correlation between stature and hand length and have found multiplication factor to be a more reliable tool than the regression equation for estimation of height with the help of hand length in Eastern Indian population. Lukpata PU et al, Jitendra P Patel et al and Wakode NS et al have reported that hand length strongly correlated with stature and linear regression equations derived can be used for estimation of stature reliably and accurately.

Sahana et al have concluded in their study that the right hand length was the most reliable and accurate hand dimension to estimate stature in population of interior of North Karnataka. Sajad Hamid et al have found that hand length can be used to predict height and the parameters used show a 2-tailed significant correlation between hand length and height indicating that the parameter used to predict height can also be used to determine hand length. They have also reported that height of any age group is nine times more than the length of hand. MS Supare et al and Subashri A et al have found a strong relationship between the stature and hand length in their study. Maryna Kornieieva et al have found hand length measurements more reliable than hand width measurements in stature estimation. In the present study, there was a weak positive correlation between height and hand length of both sides ($r= 0.25, 0.26$; $p<0.001$) which was statistically significant.

CONCLUSION

There was no significant difference in right and left side mean hand lengths measurements. It was also observed from the present study that there was a weak positive correlation between height and hand length. However, further analysis revealed that hand length alone is not sufficient for accurate prediction of height.

Conflicts of Interests: None

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