Estimation of height from hand length in Gujarat region.

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Abstract:

Introduction: Personal identification is an immense importance to forensic expert for investigation in cases of mass disasters where only human remains were found. In this study we try to get regression equation for estimation of height from hand length. **Material and Methods:** Total 140 subjects, 70 male and 70 female, age group of 17 to 21 years were included in current study. Hand length was measured using a spreading calliper. Height of individual was measured. Regression formulae for height estimation were formulated using the hand length for both sexes. **Result:** Regression equation for estimation of height from hand length was formulated. By using the derived regression equations, height of subjects was calculated and then compared with actual height of subjects. **Conclusion:** A positive correlation between height and hand length was observed in current study in both sexes and it was statistically significant. Regression equations for height estimation were formulated using the hand length for both sexes. So the data will be useful to forensic experts, archaeologists and anthropologists.

Keywords: - Estimation of Height, Hand length, Measurement.

Introduction:

Height is the combination of length of certain bones and appendages of body which is determined by racial differences[1]. Many factors such as genetics, environment and nutrition affect it. In certain medico-legal cases, where only parts or fragments of human body are found as in incidents like bomb blast, aeroplane crash, earthquake, close compartment fire, accidents, body maimed by human or animals, establishing height is of paramount importance. Many studies have been done in the past to estimate the stature from various body parameters such as length of long bones, hand length, hand breadth, foot length, arm span, cephalic index etc. The aim of current study was to establish anthropometric correlation of between height and hand length in population of Gujarat and also to derive regression equations for correct estimation of stature of male and female in Gujarati population.

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Material and Methods:

Total 140 asymptomatic, apparently healthy, adolescent and adult medical students with age between 18 to 22 years belonging to various regions of Gujarat were selected for current study. Left hand was selected for measurement as per

recommendation of international agreement for paired measurement at Geneva.

- **Height:** Height was measured in standing erect anatomical position vertically in midline from heel to vertex.

- **Hand length:** Hand was placed on flat surface and hand length measured as a direct distance from tip of the styloid process of radius to the tip of the middle finger by using spreading calipers.

All the measurements in limbs were taken during fixed time of the day to avoid any diurnal variation and by the same person to avoid personal error in methodology. Obtained data was statistically analyzed by linear regression analysis.

Results:

The measurements were taken on 140 medical students, 70 males and 70 females. Regression equations for estimation of height using hand length were formulated. From the analysis of the data, it can also be said that stature can be predicted using hand lengths with fairly good accuracy as they show significant correlation.

Table 1: Measurement of Height and Hand length in Males

	N	Minimum (cm)	Maximum (cm)	Mean (cm)	SD (cm)
Rt. Hand	70	14.80	21.70	19.08	1.14
Lt. Hand	70	14.80	21.60	18.95	1.13
Height	70	159.10	191.30	176.28	5.98

Table 1 indicates that, Mean height of the males to be 176.28 cm with astandard deviation of +5.98 cm, Mean hand length of the males of the left side tobe 18.95 cm with a standard deviation of +1.13 cm, whereas mean hand length of right side of maleshas been found to be 19.08 cm with standarddeviation of +1.14 cm.

Table 2: Measurement of Height and Hand length in Females

	N	Minimum (cm)	Maximum (cm)	Mean (cm)	SD (cm)
Rt. Hand	70	13.20	19.20	17.21	0.99
Lt. Hand	70	13.10	19.10	17.09	0.99
Height	70	144.50	174.30	161.11	5.49

Table 2 indicates that, Mean height of females has been found to be 161.11 cm with a standard deviation of +5.49 cm.Mean hand length of female of left side has beenfound to be 17.09 cm with a standard deviation of+0.99 cm whereas the mean hand length of right sidewas observed to be 17.21 cm with a standarddeviation of +0.99 cm.

Table 3 and 4 shows regression equations for handlength of male and female of both sides respectively.

Table 3: Correlation coefficient and regression equations for estimation of height from hand length in male.

Male	Correlation coefficient (r)	R2	Regression equation	P Value
Rt. Hand	0.512	0.262	HT=124.81+2.70(Hand length)	<0.0001
Lt. Hand	0.507	0.257	HT=125.56+2.68(Hand length)	<0.0001

Table 4: Correlation coefficient and regression equations for estimation of height from hand length in female.

Female	Correlation coefficient (r)	R2	Regression equation	P Value
Rt. Hand	0.481	0.231	HT=115.06+2.68(Hand length)	<0.0001
Lt. Hand	0.483	0.233	HT=115.19+2.69(Hand length)	<0.0001

Discussion:

Many authors has been tried to find correlation between height and length of various long bones[2-7]. Most of these studies were done on Caucasians and the regression equations derived by them cannot be applied to Indian population due to racial differences. In the present study we have tried to estimate stature from hand length of male and female and form regression equations using hand length in Gujarati population. A study by Abdi Ozaslan et al[8] on 224 males and 132 women of 20-51 years shows high amount of correlation between stature and all variables used such as hand breadth, hand length, wrist breath, foot breadth, foot length and ankle breath.

Table 5: Comparison of Correlation Coefficient and Regression Equations of various Studies

Studies done indifferent ethnic groups	Correlation coefficient Male	Correlation coefficient Female	Regression equation to measure stature in males	Regression equation to measure stature in females
Abdi Ozaslan et al.[8]	HL: 0.578 FL: 0.696	HL: 0.309 FL: 0.496	HT=668.04+(2.01)HL+(2.67)FL	
Abdi Ozaslan et al.[8]	0.578	0.309	HT=922.01+(4.15)HL	HT=1116.56+(2.80)HL
Abdi Ozaslan et al.[8]	0.696	0.496	HT=840.88+(3.52)FL	HT=941.95+(2.96)FL
Khanpurkar& Radke[12]	0.616	0.647	HT= 92.1 + (4.2) HL	HT= 84.9 + (4.3) HL
Ilayperuma et al.[13]	0.580	0.590	HT = 103.37 + (3.49) HL	HT = 93.70 + (3.63) HL
Sunil et al.[14]	0.7 (RT) 0.6 (LT)	0.7 (RT) 0.7 (LT)	HT= 86.93+(4.25) HLRT HT= 85.44+(4.32)HLLT	HT= 77.42+ (4.56) HLRT HT= 80.94+ (4.4) HLLT
Jasuja OP[15]	0.502 (RT) 0.0452 (LT)	0.529 (RT) 0.557 (LT)	HT= 69.51+(5.22) HLRT HT= 84.74+ (4.5) HLLT	HT= 130.95+(1.61)HLRT HT= 130.04+(1.66)HLLT
Krishan K et al.[16]	NA	NA	HT= 87.33+(4.45) HLLT	HT= 84.539+(4.238) HLLT
Present Study	0.512(RT) 0.507(LT)	0.481(RT) 0.483(LT)	HT=115.06+2.68(HLRT) HT=115.19+2.69(HLLT)	HT=115.06+2.68(HLRT) HT=115.19+2.69(HLLT)

(HT= Height, HL=Hand Length, FT=Foot Length, RT=Right, LT=Left)

A study by Jitendarkumar et al[9] on 52 males and 51 females in age group of 21-32

years in Haryana state showed significant correlation between height and left foot length (r=0.969). A study by S. M.Patel et al[10]on 502 students in age group of17-22 years also showed significant correlation between foot length and stature (r=0.6102) in population of Gujarat. Similarly, a study by Agnihotri et al[11]on 250 students showed positive correlation between height and foot length (r=0.769). In all the above mentioned studies a single parameter was compared and used to derive the stature. In current study, the correlation coefficient was found to be statistically significant suggesting a strong relationship between hand length with height of both males and females. Regression equations for estimation of stature from hand length were derived for both males and females. Previous studies have positively found that the regression equations using various anatomical parameters of one race or population do not apply to another[17,18]. We also found that to be correct as our data differs from data of previous studies of other ethnic groups[19,20].

Conclusion:

By the current study we conclude that hand length can be used to estimate the height of both males and females in Gujarati population. The regression equations we derived can be used in cadavers or in cases where only body parts are available. Estimation of individual's height is of paramount importance for forensic expert and anthropologist. By estimation of stature one can come to know individual's physical description which is very useful in forensic and archaeological studies as well.

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