

Prediction of Stature from Hand Dimensions in Undergraduate Medical Students

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Abstract

Background: Stature estimation from different body segments is a very important tool for identification purposes. This has very important implications in modern world to identify bodies in natural disasters, terrorist attacks and accidents. Literature proves that the regression formula and multiplication factor to calculate stature from hand dimensions differs for every region.

Objectives: To measure stature and hand dimensions of undergraduate medical students. To calculate standard equation derived from hand length and hand breadth to calculate stature in North Indian population.

Material And Methods: Height (in cms), Right hand length (RHL), Left hand length (LHL), Right hand breadth(RHB) and Left Hand breadth(LHB) were measured for undergraduate medical students in North India. Descriptive statistics was used to expressed quantitative variable as mean±S.D. Independent t test was used to compare hand dimensions and stature in male and female. Pearson correlation coefficient was used to find correlation between the variables. Regression equation to calculate stature from hand dimensions was derived.

Results And Conclusions: Mean value for stature for all subjects was 163±8.92 cms. For males, it was 173.88 ± 7.599 cms whereas for females it was 159.47 ± 5.874 cms. Mean value for RHL for all subjects was 18.76±1.17 cms, for males it was 19.792 ± 1.28 cms and females it was 18.413 ± 0.90 cms. Difference between all values was statistically significant. Right hand breadth (RHB) for all subjects was 7.5±0.6 cms, for males it was 8.307 ± 0.56 cms and females it was 7.234 ± 0.492 cms difference between two genders was statistically significant. (p<0.001). Left hand breadth (LHB) for all subjects was 7.48± 0.66 cms for males it was 8.19 ± 0.523 cms and for females it was 7.244 ± 0.522cms. Correlation coefficient of RHL, LHL, RHB and LHB with height was 0.75,0.73,0.72 and 0.46 respectively. Regression equation for stature estimation from hand dimensions was calculated. Hand length was found to be a better predictor of stature as compared to handbreadth.

Keywords: Stature, Hand Length, Hand Breadth, Regression equation.

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Introduction

Estimation of stature from decaying bodies and deficient skeletons for establishing identity is considered as one of the biggest aspects of forensic science. The subject has gained significance due to increase in incidence of natural calamities, road traffic accidents and terrorist activities.[1]

The interrelationship between various segments of the body has been utilized to emphasize the distinctions between different racial groups and to relate them to locomotor functions and lifestyle patterns.[2]

Previous literature has mostly focussed on estimating stature using hand length. Moreover there is regional variation in formulae for each region as every population is different with respect to climate, heredity and nutritional status[3]

Anthropometric dimensions vary in different geographical areas due to racial and ethnic variations, area wise study seems to be crucial.[4]

Previous literature supports that stature and hand dimensions both differ according to geography and ethnicity. Hence, the regression formula should be calculated regionally. The objective of this study was to measure stature and hand dimensions. To formulate regression equation and multiplication factor for estimation of stature from hand length (HL) and hand breadth (HW) in North Indian population.

Results

Table 1: Comparison of variables measured in this study. RHL= Right hand length, LHL=Left hand Length, RHB=Right Hand Breadth, LHB=Left Hand Breadth, S=Significant, NS=Not Significant

Variable (In Cms)	Female (Mean \pm S.D.)	Male (Mean \pm S.D.)	p-value
HEIGHT	159.47 \pm 5.874	173.88 \pm 7.599	< 0.001(S)
RHL	18.413 \pm 0.90	19.792 \pm 1.287	0.001(S)
LHL	17.60 \pm 1.600	19.53 \pm 0.812	0.001(S)
RHB	7.234 \pm 0.492	8.307 \pm 0.566	< 0.001(S)
LHB	7.244 \pm 0.522	8.19 \pm 0.523	< 0.001(S)

Material and methods

Subject: This was a cross sectional observational study performed at Heritage Institute of Medical sciences, Varanasi. 100 undergraduate medical students in age group 18-22 years (M= 30, F= 70) were recruited for the study. After obtaining institutional ethical clearance informed consent was taken from all participants.

Height was measured by anthropometric tape. Subjects were made to stand on flat ground and measurements were taken. A sliding vernier calliper was used to measure hand dimensions. Hand length on left and right side (RHL and LHL) was measured from wrist crease to tip of middle finger. The handbreadth on both sides (RHB AND LHB) was measured as a distance between the lateral side of 2 nd metacarpophalangeal joint to the medial side of 5 th metacarpophalangeal joint. [5]

Statistical analysis: Data was tabulated using excel sheet. Descriptive statistics was used, and all values were expressed as mean and standard deviation. Unpaired t-test was used to find the significance of difference of stature, hand length and breadth on both sides. The significance value was set at $p < 0.05$ at 95% confidence of interval. Karl Pearson's correlation coefficient was employed to find relationship between variables. Regression equation was calculated.

Mean value for stature for all subjects was 163 ± 8.92 cms. For males, it was 173.88 ± 7.599 cms whereas for females it was 159.47 ± 5.874 cms. When values were compared between male and female subjects, difference was found to be statistically significant ($p < 0.001$). (Table 1, 2)

Mean value for RHL for all subjects was 18.76 ± 1.17 cms, for males it was 19.792 ± 1.28 cms and females it was 18.413 ± 0.90 cms. The difference between two genders was statistically significant. For left hand length mean for all subjects was 18.09 ± 1.66

cms for males it was 19.53 ± 0.812 and females it was 18.413 ± 0.90 (difference being significant). (Table 1, 2)

Right hand breadth (RHB) for all subjects was 7.5 ± 0.6 cms, for males it was 8.307 ± 0.56 cms and females it was 7.234 ± 0.492 cms difference between two genders was statistically significant ($p < 0.001$). Left hand breadth (LHB) for all subjects was 7.48 ± 0.66 cms for males it was 8.19 ± 0.523 cms and for females it was 7.244 ± 0.522 cms. Difference between genders was statistically significant. ($p < 0.001$) (Table 1, 2)

Table 2: Correlation coefficient and regression equation for hand length on both sides in this study. RHL= Right Hand Length, LHL= Left Hand Length. r= correlation Coefficient. S= Significant.

Variable (In cms)	Mean \pm S.D.	Correlation Coefficient r(p)	Regression Equation
HEIGHT	163.18 ± 8.92	----	----
RHL	18.76 ± 1.17	0.75 (<0.001) (S)	Height = $63.03 + 5.33 \times$ RHL
LHL	18.09 ± 1.66	0.73 (<0.001) (S)	Height = $117.7 + 2.51 \times$ LHL

Correlation coefficient between height and right-hand length (RHL) was found to be 0.75. The difference between two variables was statistically significant ($p < 0.001$). Between height and Left-hand length (LHL) was positive ($r=0.73$) difference

being statistically significant. Regression equation calculated between RHL, and height showed that height was roughly five times RHL plus constant of 63.03 cms. With LHL it was 2.5 times LHL plus constant of 117.7 cms. (Table 2)

Table 3: Correlation coefficient and regression equation for hand width on both sides in this study. RHB= Right Hand Breadth, LHB= Left Hand Breadth. r= correlation Coefficient. S= Significant.

Variable (In Cms)	Mean \pm S.D.	Correlation Coefficient r(p)	Regression Equation
Height	163.18 ± 8.92	----	----
RHB	7.50 ± 0.69	0.72 (<0.001) (S)	Height = $90.37 + 9.69 \times$ RHW
LHB	7.48 ± 0.66	0.46 (0.005) (NS)	Height = $89.36 + 9.85 \times$ LHW

Correlation coefficient between height and right-hand length (RHL) was found to be 0.72. The difference between two variables was statistically significant ($p < 0.001$). Between height and Left-hand length (LHL) was weakly positive ($r=0.46$) difference being statistically non-significant. Regression equation calculated

between RHL, and height showed that height was roughly nine times RHB plus constant of 90.37 cms. With LHB it was 9.8 times LHL plus constant of 89.36 cms. (Table 3)

Discussion

Stature can be assessed from body parameters by means of regression equation

or multiplication factor for identification purposes. However, for a particular region, regression equation and multiplication factor are explicit and cannot be applied to all population groups. There have been many studies correlating hand length to stature internationally and in India, [6-9] but very few which consider both hand length and breadth as factors. There is lacunae in literature of studies which calculate regression equation for calculation of stature from hand dimensions in North Indian population, hence this study becomes significant.

Mean value for height for all subjects was 163 ± 8.92 cms. For males, it was 173.88 ± 7.5 cms whereas for females it was 159.47 ± 5.8 cms (Table 1,2). When values were compared between male and female subjects, difference was found to be statistically significant ($p < 0.001$). In a study done on Bangladeshi females showed that the average stature was 152.79 ± 5.62 cm which was similar to our study [5] The average stature for males in present study was dissimilar from values from a Chinese study (170.49 cms), but for females it was similar. The correlation between the stature and different parameters studied in males and females were found to be positive and statistically highly significant ($P < 0.001$) in present study which was similar to other studies. [10]

RHL and LHL for all subjects in present study was 18.76 ± 1.17 and 18.09 ± 1.66 . RHL and LHL for male subjects in present study was 19.79 ± 1.28 and 19.53 ± 0.81 respectively. RHL and LHL for female subjects in present study was 18.41 ± 0.90 and 17.60 ± 1.60 respectively. (Table 1, Table 2) This finding was similar to another study by Supare et al on-Maharashtrian population, [4]. The mean normal values for hand length for females in our study was different from a study done Bangladeshi females of the hand measurements (right and left hand length were $16.39 + 0.72$ cm

and $16.33 + 0.67$) [5] The observed measurements for hand length in present study was dissimilar from another study in Saudi where hand length for higher for males on both sides (20.11 ± 1.14 for right and 20.75 ± 1.18 left) and higher for females for left hand (18.60 ± 1.34). [11] This dissimilarity proves that there is regional difference in hand length and hence should be measured geographically.

RHB and LHB for males in present study was 8.30 ± 0.56 and 8.19 ± 0.52 respectively. This was dissimilar from studies by Supare et al (RHB 7.96 ± 0.55 cm and left HB (LHB) was 7.94 ± 0.56 cm) and similar to a similar study done by Ibrahim et al on middle east population (RHB 8.76 ± 0.55 and LHB 8.70 ± 0.43) [4,11]. For females the parameters were measured as 7.23 ± 0.49 and 7.24 ± 0.52 respectively which was similar to other studies. [4] (Table 1)

Correlation coefficient in present study between RHL and LHL with stature was 0.75 ($p < 0.001$) and 0.73 ($p < 0.001$) respectively. For RHB and LHB it was 0.72 ($p < 0.001$) and 0.46 ($p = 0.005$) respectively. Hence, in present study stature was found to be more strongly correlated to height as compared to hand breadth which was similar to other Indian and international studies. [4,10, 12-14] (Table 2, Table 3)

The regression equation to calculate stature from hand length and breadth are tabulated in tabulated in Table 2 and 3. Regression equation is unique for a particular population [15]. Hence, it needs to be calculated for every region.

Conclusion

The study gives the regression formula for North Indian population which will help in calculation of stature from skeletal remains. Hand length was found to be a better predictor for calculation of stature than hand breadth.

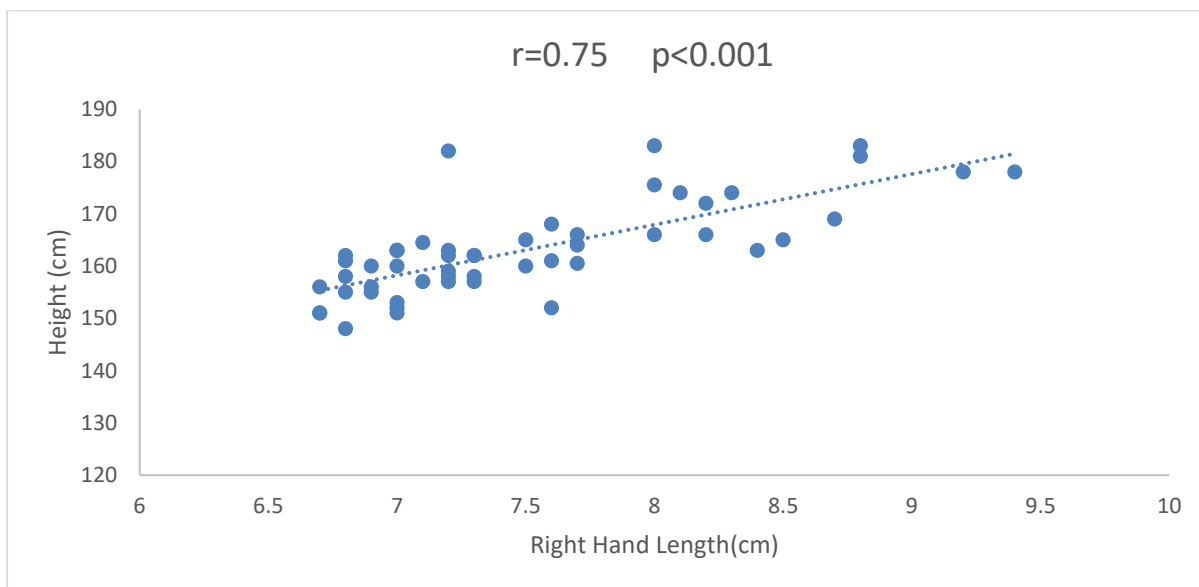


Figure 1: Plot showing positive correlation between height (in cms) and Right-hand length (RHL)($r=0.75$). $p<0.001$ indicates statistically significant difference

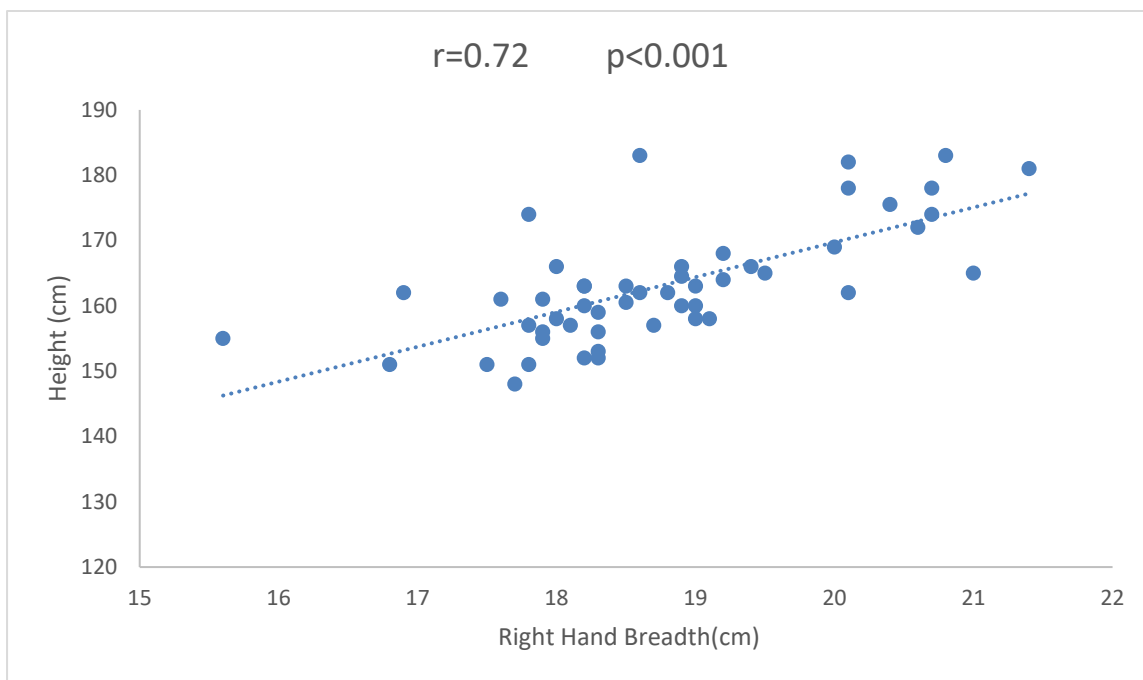


Figure 2: Plot showing positive correlation between height (in cms) and Right-hand breadth (RHB)($r=0.72$). $p<0.001$ indicates statistically significant difference

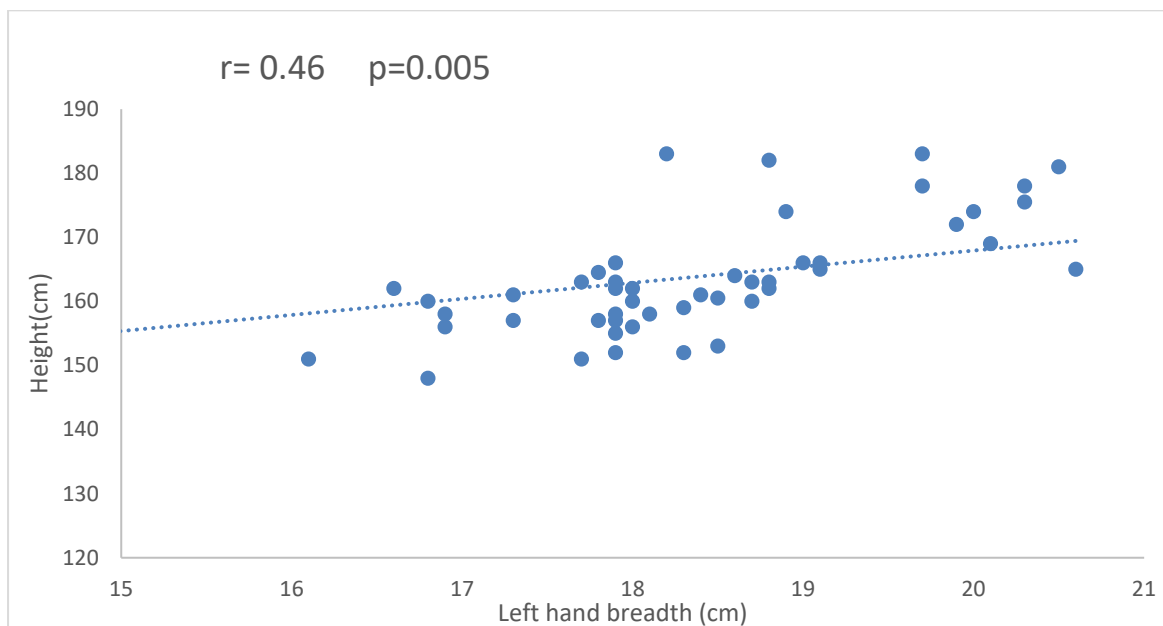


Figure 3: Plot showing positive correlation between height (in cms) and Left-hand breadth (LHB)($r=0.46$). $p=0.005$ indicates statistically insignificant difference

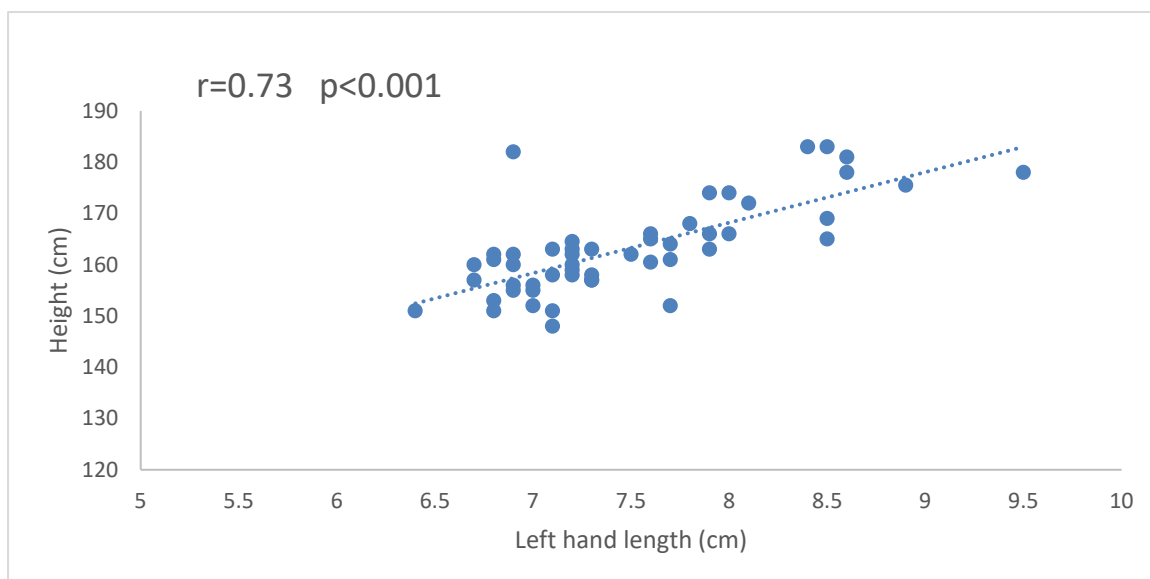


Figure 4: Plot showing positive correlation between height (in cms) and Left-hand length (LHL)($r=0.73$). $p<0.001$ indicates statistically significant difference

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