ORIGINAL ARTICLE

ANTHROPOMETRIC MEASUREMENTS OF THE HAND LENGTH AND THEIR CORRELATION WITH THE STATURE IN EASTERN INDIAN POPULATION

Anwesa Pal[1], Prerana Aggarwal[2], Subhadip Bharati[1], Madhusmita Panda[3], Indra Datta[4], Prithwish Roy[5]

Authors Affiliation: [1]Post-graduate trainee; [2]Assistant Professor, Dept of Anatomy, IPGME&R, Kolkata; [3]Assistant Professor, Dept of Anatomy, SCB Medical College, Cuttack, Odisha; [4]Professor,Dept of Anatomy, IPGME&R, Kolkata; [5]Junior Consultant, Dept of Pediatrics, Vision Care Hospital, Kolkata
Correspondence: Prerana Aggarwal, Email: dr_prerana@yahoo.com

ABSTRACT

Introduction: Estimation of height of an individual is important not only for anthropologists and forensic medicine personal but also for physical assessment of nutritional status of an individual by nutritionists and physicians.

Materials and Methods: Stature and hand length of 235 medical students of both sexes belonging to the Eastern part of India were measured and a correlation between the two was determined.

Result: A significant ($p<0.001$) positive correlation was found between the stature and hand length. Multiplication factor is found to be a more reliable tool than the regression equation for estimation of height with the help of hand length in Eastern Indian population. The multiplication factor derived for males is 9.05 and that for females is 9.26. For males the correlation coefficient obtained is $r^2 = 0.583$ ($p < 0.05$) and for females it is $r^2 = 0.487$ ($p < 0.05$)

Conclusion: The result of this study can be used as baseline information for further population based study in the eastern part of India so that the anthropologist and forensic experts can estimate the height of adult individuals of either sex by use of either of the hand. Further nutritionists and the physicians can also use the results of this study as a reference while estimating the nutritional status of adult individuals specially the bedridden patients.

Key Words: Hand length, stature, eastern Indian population, anthropometric parameters

INTRODUCTION

Stature or body height is a useful anthropometric parameter for identification of an individual. Estimation of stature from incomplete skeletal or decomposing bodies is a recurring theme in physical anthropology and forensic science. From the time of Leonardo de Vinci (the Virtuvian man) the human hand is estimated to bear a 1:10 ratio with height. Hand length measurement is coming up as a basic tool in estimating age-related loss of stature, in individuals where direct height can not be measured due to physical deformities like kyphosis, scoliosis, contractures, missing limbs etc.[1] There are infact literatures citing the use of hand length in estimation of height and thereby nutritional status of individuals.[2] In his book, Ann M. Coulston has also mentioned about the use of this knowledge by the nutritionists and physicians.[3] Stature and its relation to hand length varies in different ethnic groups all over the world. The present study was done to estimate stature from the hand length on two hundred and thirty five adult medical students of both sexes belonging to the Eastern part of India.

MATERIALS AND METHODS

A descriptive cross sectional study was done over a period of one year in two medical colleges- one in Cuttack, Odisha and another in Kolkata, West Bengal. Height and hand length of 110 female and 125 male medical students between 20-23yrs of age (since most of the long bones in the body are ossified by this time)were taken after obtaining consent. Chronic diseases like asthma, endocrinal disorders etc, which may affect the height of the indi-

vidual and any deformity or anatomical malformation of hands which can affect the length of hand were excluded. Height was measured using Seca 213 mobile stadiometer in standing position with occiput, both the scapulae, both gluteal regions and both the heels touching the wall, both the feet flat with heels together and feet pointed outwards, both the lower limbs straight and knees together, both upper limbs by the side of the body, shoulder relaxed and eyes looking straight ahead at Frankfort horizontal plane. Hand lengths of both hands were measured from distal most point of proximal wrist crease to the tip of the middle finger with sliding calipers. Total three observations were taken by a single investigator and their mean were recorded. To rule out diurnal variation, all stature measurements were done at 9am. Data was analysed with IBM SPSS for Windows version 22.

RESULT

The study population comprised of 235 subjects including 110 female and 125 male medical students between 20-23 yrs of age. The characteristics of study population are given in Table1.

The right and left hand size of each sex were compared using students t test and the difference was found to be non-significant ($p = 0.03$). Thus use of either hand would be satisfactory for the analysis. Scatter plots (Figures1 & 2) showed the Loess lines of fit including 99% of points, for each hand plotted against stature, to be roughly linear. Linear regression analysis was thus deemed to be most suited for the analysis.

Linear regression analysis using either of the hand gives equation:

For males: Height (cm) = 9.3 X hand length (cm) – 5.2; correlation coefficient $r^2 = 0.583$ ($p < 0.05$)
For females: Height (cm) = 14.3 X hand length (cm) – 78; correlation coefficient $r^2 = 0.487$ ($p < 0.05$)

Removing the points of high leverage and large Cook's distances new equation becomes:

For males height (cm) = 9.05 X hand length (cm)
For females height (cm) = 9.26 X hand length (cm)

DISCUSSION

In this study we have found a significant ($p<0.001$) positive correlation between the stature and the hand length. It suggests that the hand length presents a linear correlation with the stature in Gaussians distribution curve.

Table 1: Descriptive statistics of the study population

	Gender	
	Female	Male
Stature (cm)		
Mean	158.5	170.5
Median	159.4	171.4
Standard Deviation	6.5	7.8
Maximum	171.9	190.5
Minimum	136.8	150.4
Right Hand Length (cm)		
Mean	17.11	18.79
Median	17.16	18.79
Standard Deviation	.69	1.13
Maximum	18.69	21.54
Minimum	15.18	16.25
Left Hand Length (cm)		
Mean	17.14	18.83
Median	17.15	18.80
Standard Deviation	.67	1.09
Maximum	19.00	21.24
Minimum	15.28	16.25

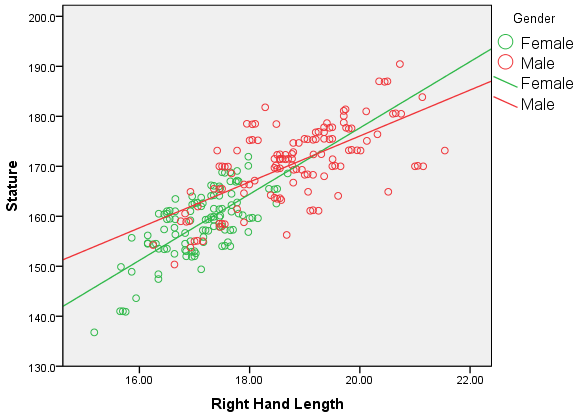

Figure 1: Linear regression plot of stature against right hand length (in cm) of both sexes

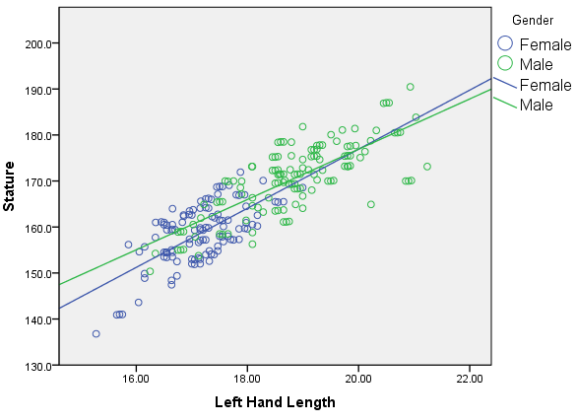

Figure 2: Linear regression plot of stature against left hand length in centimetres of both sexes

It also states that the multiplication factor for estimation of height with the help of hand length differs in Eastern Indian population from that for other regions in India.

Study by Nath et al on 302 Punjabi females of Delhi states a multiplication factor of 9.12, another study on 204 Punjabi females of Delhi by Sethi and Nath states a factor of 8.99 whereas that on 276 Hindu Baniya females of Delhi by Nath and Krishna states a factor of 9.11.[4] There is no mention of multiplication factor for males in the above-mentioned studies. Only one study has reported a multiplication factor (9.16) for males, which was conducted, by Nath et al on 160 Rajput males of Dehradun.[4] In this study we have derived multiplication factor for both males and females of the eastern part of India. For males (9.05) it comes out to be higher than that for females (9.26). The result differs from Manpreet Kaur et al study where the multiplication factor for males is higher (9.361) than that for females (8.679).[4]

The present study does not depict any significance in the difference in the length of right and left hand in either sex (p=0.03). Thus use of either hand would be satisfactory for the analysis whereas the study conducted by Laila et al on 150 adult Bengali Muslim females found a different multiplication factor for both the hands.[5]

Separate regression equations are derived for males and females. Inclusion of high leverage points is seen to decrease the accuracy of estimation of height with the help of hand length. Their elimination from analysis revealed that a multiplication factor is more reliable than a linear equation with a positive 'y' intercept for either sex in Eastern Indian population. It in contrast to the study by Manpreet Kaur et al [4], where the authors found a linear equation with positive 'y' intercept to be of better.

Studies from northern, western and southern parts of India are already available where height is estimated using hand length.[6,7,8,9] But no such study has been mentioned from the eastern part of India. Ours will be the first documented study from the eastern zone. Moreover the results found in these studies differ from each other. India being a vast country has different environmental conditions in its different regions (north, south, east, west or central). The customs followed by the people living in these regions also differ from each other immensely. This in turn leads to differences in physical activity and nutritional status of the individuals belonging to these areas. All these factors influence the size of the bones that in turn affect the height of an individual. This can explain the difference in findings from the different parts of the country. Moreover the genetic factors also determine the size of bones and these differ in one population from the other. Studies on mice and humans demonstrate that when a mutation in the Hoxd-13 gene increases the number of alanine residues, there is also an increase in the number and in size of bones of the wrist, ankle, fore and hind foot[10].

The result of this study can be used as baseline information for further population based study in the eastern part of India so that the anthropologist and forensic experts can estimate the height of adult individuals of this part of India of either sex by use of either of the hand. Since the study is done on adult individuals who have attained their maximum height even the nutritionists and the physicians can use the results as a reference while estimating the nutritional status of adult individuals specially the bedridden patients who are unable to stand for height estimation.

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