Estimation of stature from hand length and breadth- An anthropometric study on 100 Bangladeshi adult Muslim males of lower socioeconomic status group

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Abstract

Body physique is influenced to a greater extent by climatic, hereditary, nutritional and racial factors. The stature prediction occupies relatively a central position in the anthropometric research and estimation of stature of an individual from mutilated or amputated limbs has obvious significance in the personal identification in the events of murders, accidents or natural disasters. The present study was undertaken to measure the stature as well as some length and breadth of hand and to determine whether there is any correlation between stature and the hand variables and to estimate the stature using respective multiplication factor from these variables and to assess the effectiveness of the above estimations by comparing the 'estimated' values with the 'measured' values.

It is descriptive type of study. The study was carried out with a total number of 100 Bangladeshi adult Muslim males of age between 25 to 30years of lower socio-economic status group. The analyses were conducted in the Department of Anatomy of BSMMU, Dhaka during the study period of January 2006 to December 2006.

Hand length and breadth along with their stature were measured directly from The subjects by using Anthropometric sliding caliper, steel plate and measuring tape. The data were then statistically analyzed by computation to find out its normative value. Multiplication factors were estimated for estimating stature and comparisons were made between measured and estimated stature using paired "t" test.

The mean measured values of the length and breadth of right and left and hands as well as the stature were 18.04($\pm$0.71)cm, 17.99 ($\pm$9.08)cm, 8.06 ($\pm$0.26)cm, 7.98 ($\pm$0.27)cm, and 163.70 ($\pm$5.98)cm, respectively were found. The multiplication factors were estimated for the same hand measurements with the stature. Significant positive correlations were found between stature and hand variables and the differences between the measured value and estimated values were not statistically significant.

Introduction:

Stature can be defined as natural height of a person in erect position. It is determined by many factors such as genetic and environmental factors. Stature estimation has immense medicolegal importance, where identifying the deceased from few body parts is much of a problem. It is also useful when the stature cannot be measured directly due to deformities like kyphosis, Scoliosis, missing legs etc.[1]

Personal identification is an integral part of the investigation in cases of mass disasters where disintegrated and amputated body organs are found very frequently. Establishment of an identity is very essential to forensic medicine from decomposing bodies. The forensic scientists are well aware of unavailability of complete skeleton at the scene of crime and sometimes only a body part like hand or foot is available. Thus the scientists have to use mathematical method of stature reconstruction.[2]

The stature of an individual is an inherent characteristic. It is considered as one of the important parameters for personal identification. There is an established relationship between the stature and the dimensions of various body parts which allows forensic experts to estimate stature from different parts of the body.[3]

As the incidences of crime are going on increasing. The matter of identification of an individual is becoming prime importance now a days. Estimation of stature

forms important criteria for establishing individuality of the person or require special attention in cases when bodies are found in mutilated state and only fragments are discovered. The mutilation of dead body is done intentionally by criminals who want to destroy all traces of identity and thus facilitates the disposal of the death.[4]

Materials:
Trotter and Glesser in 1951 used 30 years as the age when stature decrease begins but Galloway in 1988 and cline et al in 1989 reported that stature loss begins around 45 years of age.[5]

Investigators have shown that mean loss of stature is 1.2cm in every 20 years after the age of 30.[5]
Some studies have when that females lose more stature with aging than males.[6]

By keeping in mind the above citation the age limit of the subjects in this study was determined from 25 to 30 years because this age limit is safe and there is no chance for change in the maximum stature and the study was carried out on 100 adult Muslim males of lower socio-economic status group of Bashaboo slum areas of Dhaka city.

All measurements were taken at fixed time i.e., from 7.30 A.M to 2 P.M to prevent the discrepancies of diurnal variation. The duration of collection was from July/ 2006 to October/ 2006. The analyses were conducted in the department of anatomy of BSMMU, Dhaka during the study period of January 2006 to December 2006.

Methods:
If each subjects is measured twice and the mean value of the two measurements is considered the best estimate of the true value[7].
In this study each subject was measured twice and the mean value of the two measures was taken as true value of the subject.

Procedure of the measurement of the stature:
The subject stood with heel together and back as straight as possible. The heels, buttocks, shoulders and the head touched the wall. The arms were hung freely by the sides with the palm facing the thighs.[8]

After taking a deep breath and holding it, a steel plate square was placed against the head and the wall to determine maximum height on the wall and this was marked. Participants were then told to breathe and step away from the wall. Height was then measured from the floor to the mark on the wall with steel tape.[9]
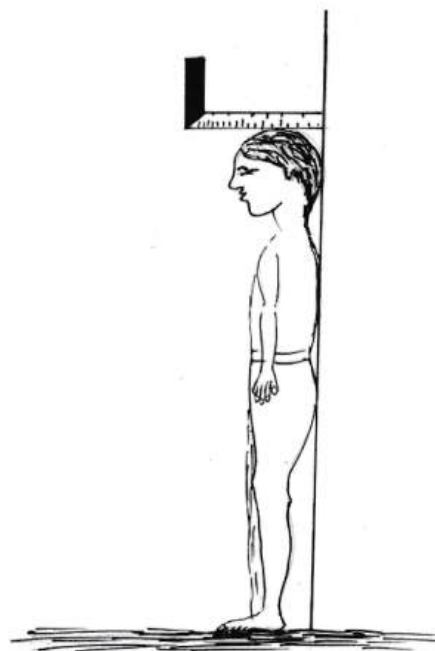
Figure-1: Procedure of the measurement of stature.

Procedure of the measurement of the hand length:
Hand length was measured as the straight distance from distal wrist crease to the most forwardly projecting point on The middle finger. Sliding calliper was used to measure the hand length.[10]
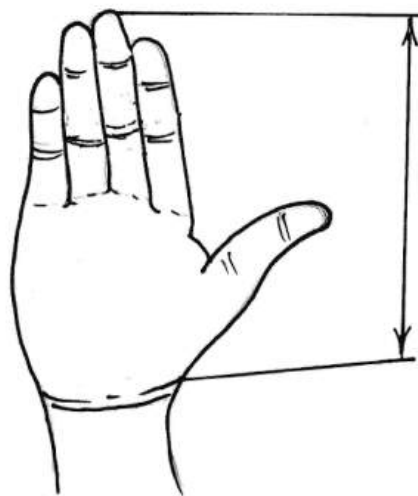
Figure-2: Procedure of the measurement of the hand length.

Procedure of the measurement of hand breadth:
The hand breadth was measured as the width of the hand from metacarpal II. To the metacarpal V. The hand was placed on a table with fingers together and the thumb out to the side. With a sliding caliper the width of the hand was measured at the knuckles[11].

Figure-3: Procedure of the measurement of the hand breadth.

Calculation of multiplication factor:

Each multiplication factor is the ratio of the stature to the respective physical measurements. A mean multiplication factor was then calculated for each measurement. These mean multiplication factors were used for estimating the stature from those variables. According to lal and Lala[12] multiplication factor is

$$MF = \frac{Stature}{Hand\ Variables}$$

Statistical analyses of data:

The collected data were calculated using a computer based program (SPSS and MS Excel). Regression analysis was done. Mathematical relationship between sets of two measurements were calculated as multiplication factor (i.e., ratio between the two). Using the paired t test, the measured values were compared with the corresponding value estimated (using the corresponding multiplication factors) from other relevant measurements.

Results:

The mean value of the stature, hand length and hand breadth were found, The mean (± SD) of the stature was found 163.70 ± 5.98 cm (Table - I). The length of the right hand of subjects varied from16.30 to 19.30 centimeter, as shown in Table 1. In about 75% of the subjects the length of the right hand was between 17.1 to 19.0 centimeters (Figure 4). The length of the left hand of these subjects varied from 16.30to 19.20 centimeters, as shown in Table - 1.

In about 75% of the subjects, length of the left hand was between 17.1 to 1.90 centimeter (Figure 4). The lengths of the right and left land showed significant positive

correlation. (r = 0.565, P = 0.000 and r = 0.564, p = 0.000 respectively) with the stature (Figure 5 and 6).
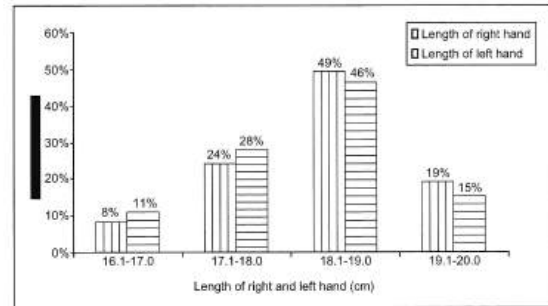
Figure-4: Multiple bar diagram showing the frequency distribution of the length of the right and the left hands (n = 100).
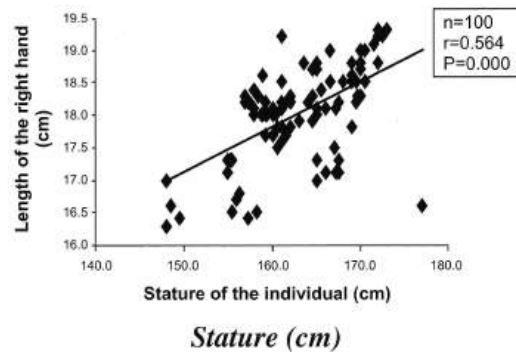
Stature (cm)
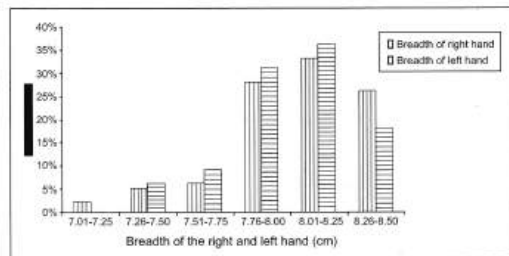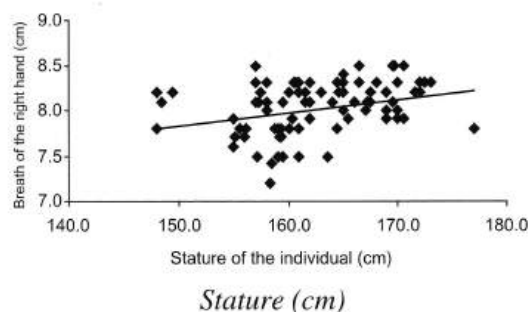
Figure-5: Scatter diagram with regression analysis showing significant (p=0) positive correlation between the stature and the length of the right hand.
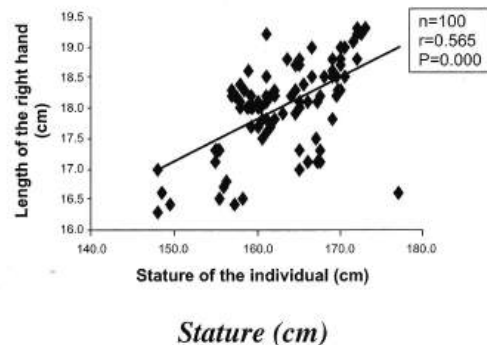
Stature (cm)

Figure-6: Scatter diagram with regression analysis showing significant (p=0) positive correlation between the stature and the length of the left hand. The breadth of the right hand of these subjects varied from 7.20 to 8.50 sentiments, as shown in Table-I.

In more than 60% of the subjects the breadth of the right hand was between 7.76 to 8.25 centimeters (Figure - 7). The breadth of the left hand of these subjects varied from 7.30 to 8.50 centimeters, shown in table 1. In More than 60% of the subjects, breadth of the left hand was between 7.76 to 8.25 centimeters (Figure-7).

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There was positive correlation (r = 0.302, p = 0.002 and r = 0.226, p 0.024 respectively) between the stature and the breadth of the right and left hand (Figure 8 and 9).

Figure-7: Multiple bar diagram showing the frequency distribution of the breadth of the right and the left hands (n = 100)

Stature (cm)

Figure-8: Scatter diagram with regression analysis showing significant (p=0.002) positive correlation between the stature and the breadth of the righ hand.
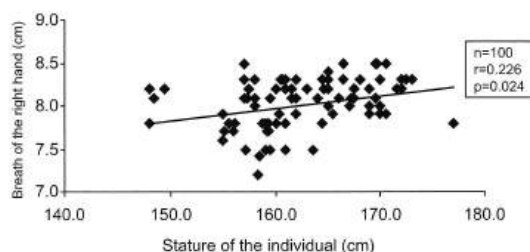
Figure-9: Scatter diagram with regression analysis showing significant (p=0.024) positive correlation between the stature and the breadth of the left hand.

The measured values of hand length and breadth of both sides and the stature and also the multiplication factor for estimating stature are mentioned in Table - 1.

Table – 1:

Variable	Range (Cm)	Mean (Cm) SD	mean multiplication factor
Stature	148.00 - 177.00	163.70 ± 5.98	
Length of right hand	16.30-19.30	18.04 ± 0.71	9.03
Length of Left hand	16.30-19.20	17.99 ± 0.71	9.08
Breadth of Right hand	7.20-8.50	8.06 ± 0.26	20.23
Breadth of Left hand	7.30-8.40	7.98 ± 0.27	20.42

In this study, each hand variable was multiplied by mean multiplication factor and then estimated stature was obtained and then calculating the mean for 100 estimated values and comparison between the 'measured' stature and the stature estimated from hand length and breadth were done. All are shown in Table - II.

Table - II

Measurements from which the stature was estimated	Measured stature (Cm) Mean ± SD	Estimated Stature (Cm)		Significance of difference (P value)
		Range	Men SD	
Length of right hand		148.22-174.43	162.536 ± 6.81	p = 0.412 (NS)
Length of Left hand	163.70 ± 5.98	148.00-173.42	163.286 ± 7.07	P = 0.747 (NS)
Breadth of Right hand		145.66-171.95	163.134 ± 5.31	p =0.922 (NS)
Breadth of Left hand		149.09-177.68	162.701 ± 6.22	p = 0.631 (NS)

Discussion:

The length of the hand:

Thankur (1975) worked in Indian population and reported that the hand length was 19.34 (± 0.17) cm and the ratio between the stature and the hand length was 8.65.[10] The hand length is greater and the ratio is lesser than that of the present study.

Bhatnagar (1984) worked on 100 punjabi males and reported that positive correlation were present both for the right and left hand length with the stature respectively land the mean values of the hand length of the right and the left sides were 19.42 (± 1.60) cm and 19.30 (± 1.30) cm respectively. The ratio of the stature to the length of the right and the left hands were 8.62 and 8.67 respectively.[13] The hand lengths were greater than

that of the right and left sides respectively of the present study and the ratio is lesser than that of the right and left sides respectively of the present study.

Saxena (1984) worked on 100 Nigerian male medical students of Jos medical school, Nigeria between the age of 20 to 30 years and reported that the mean of length of the right and the left hands were 19.29 ($\pm$ 0.56) cm and 19.40 ($\pm$ 0.73) cm respectively and the ratio of the stature to the length of the right and left hand were 7.69 and 7.57 respectively. Significant positive correlations both for the right and the left hand length with the stature were present[14].

The length of the right and the left hands are greater than that of the right and the left sides respectively of the present study. The ratio in the right and the left sides are lesser than that of the right and the left side respectively of the present study.

Sunil et.al. (2005) worked on 75 males in various colleges of Delhi between 18-22 years of ages and found that the mean height and the length of the right and the left hands were 169 ($\pm$ 7.8) cm, 19.6 ($\pm$ 1.3) cm and 19.5 ($\pm$ 1.2) cm respectively[15].

All these measurements are greater than that of the present study.

Patel et.al (2014) worked on 72 male adult medical students of Gujrat and found that their mean height and the length of the right and the left hands were 175.95 ($\pm$ 5.95) cm, 18.87 ($\pm$ 1.12) cm and 18.86 ($\pm$ 1.12) cm respectively.[1]

All these measurements are greater than that of the present study.

Patel et.al (2014) worked on 124 male healthy students in age group of 17 to 21 years in the department of forensic medicine of Snt. N.H. L Municipal Medical College, Ahmadabad, Gujrat and found that their mean height and hand length were 169.6 ($\pm$ 3.97) cm and 18.41 ($\pm$ 1.04) cm respectively.[2] These results are greater than that of the present study.

The breadth of the hand:

Bhatnagar (1984) worked on 100 normal healthy Punjabi males and reported that the hand breadth of the right and the left sides were 8.38 cm and 8.32 cm respectively. Significant positive correlations both for the right and the left hand breadth with the stature respectively were present13. The hand breadth and the ratio of the stature to hand breadth of the right and the left sides are greater than that of the right and the left sides respectively of the present study.

Sexena (1984) worked on 100 Nigeran adult male medical students of jos medical school, Nigeria, between the age of 20 to 30 years and reported that their mean hand breadth of the right and the left sides were 22.23 ($\pm$ 1.54) cm and 21.83 ($\pm$ 1.04) cm respectively. The ratios of the stature to the right and the left hand breadth were 7.69 and 7.57 respectively. Significant positive correlations both for the right and the left hand breadth with the stature respectively were present[14].

The hand breadths of both the right and the left side are highly lesser than that of the right and the left side respectively of the present study.

In the present study there are positive correlation of the hand length and the hand breadth of both sides with the stature and there is no significant difference is found in between the mean measured stature and the mean estimated stature.

So the mean multiplication factor can be used for estimation of stature from the hand variables in future.

Conclusion:

Though the sample size is very small in the present study yet the results will provide base line information regarding some variables of the hand of a particular population. Some amount of comparisons made with other population could contribute to the understanding the relative status of the population of the present study in the context of the anthropometric variations around the world. Significant correlations as detected in the study between some of the measurements and their implications in the development of proper multiplication factors to be useful in estimating one measurement from another. This should encourage others in taking up further research in this field.

References:

01. Patel P.J., Shah K. R., Bhojak R. N., Desai N. J., 2014. Estimation of Stature from hand length in Gujarat region. NHL Journal of Medical Sciences, 3 (1) 41-44.

02. Patel, R., Pareke K. U., Patel P., 2014.A study of estimation of stature from hand length in Gujarat, NHL Journal of Medical Sciences, 3 (2) 32-35.

03. Kapoor A. K., Saini M., Choudhury V., Estimation of Stature from hand length Prints among Ladakis of Kashamir. Available from http: //www.ijmanager.org/ index. php/ irjls/ articlar./ view/ 3.

04. Srivastava, A. K., Sahai, M.K.B., 2010. Estimation of stature by anthropometric examination of forearm and hand. Journal of Indian Academy of Forensic Medicine, 32 (1), 62-65.

05. Meadows, L., Jants, R. L., 1992 Estimation of stature from metacarpal length. Journal of Forensic Science, 37 (1), 147-154.

06. Trotter, M., Glesser, E. W., 1952 Estimation of stature from long bones of American white and Negroes. American Journal of physical Anthropology, 10, 463-515.

07. Steels, M. F., Mattox, J.W., 1987 correlation of arm-span and height in young woman of two races. Annals of human biology, 14, 445-447.

08. Frishancho, A. R., 1990, Anthropometric standards for the assessment of Growth and Nutritional status. United States of America. The University of Michigan Press.

09. Brown, J.K., Freng, J.Y., Knapp, T. R., 2002. Is self Related Height or arm-span a more accurate alternate Measure of Height? Clinical Nursing Research, 432-436.

10. Jasuja, O.P., Singh, G., 2004. Estimation of Stature from hand and phalange length. Journal of Indian Association of Forensic Medicine, 26 (3), 100-106.

11. HUMOSIN Anthropometric Measurements, 2003. University of Michigan. Available at: http:// www. emgin-umich. edu/ dept/ ioc/ humsim/docs/ anthro doc. pdf (Accessed 3rd. June 2006).

12. Lal C.S., Lala, K. J., 1972, Estimation of stature from tibal and ulnar lengths in north Bihar. Journal of India Medical Association, 58, 120-121.

13. Bhatnagar, D. P., Thapar, S. P., Bhatise, M. K., 1984. Identification of Personal Height from Somatometry of hands in the Punjabi meals. Forensic Science International 24, 137-141.

14. Saxena, S. K., 1984.Study of Correlations and estimation of Stature from hand length, hand breadth and sole length. Anthrop. ANZ, 42 (4) 271-276.

15. Sunil, D., Dikshit, P.C., Aggrawal, A., Rami, M., 2005. Estimation of Stature from hand length. Journal of Indian Association of forensic medicine, 27(4), 971-973.