THE RELATIONSHIP BETWEEN HAND BREADTH AND HEIGHT IN ADULT MALES OF NORTH INDIAN PUNJABI POPULATION.

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ABSTRACT: INTRODUCTION: Estimation of stature forms important-criteria for establishing individuality of a person and require special attention in cases, where bodies are found in mutilated state and only fragments are re-covered. The stature prediction occupies relatively a central position both in anthropological research and in the identification necessitated by the medical jurisprudence or by medico legal experts. Estimation of stature of an individual from the skeletal material or from the mutilated or amputated limbs or parts of limbs has obvious significance in the personal identification in the events of the murders, accidents or natural disasters mainly concerns with forensic identification analysis. Whether this is true for the North Indian Punjabi male population is not known till date. **AIMS:** The aim of study is to see the co-relationship between Height and Hand breadth in adult males of North Indian Punjabi population and also to evaluate the reliability of the hand breadth in estimating height of unidentified skeletal as it is not seen in the accessible literature till date to the best of our knowledge. **MATERIALS AND METHOD:** The study was conducted at Govt. Medical college and hospital, Patiala (Punjab) under department of Anatomy on 150 healthy male Punjabi population of the age group ranging between 18-25 years irrespective of caste, religion, dietary habits and socioeconomic stature etc. The subjects having any disease or deformity were not included in the study. Height and hand breadth were measured with the help of an anthropometric rod and sliding calipers respectively. The height of all the students was measured in anatomical position keeping all the subjects erect. The height measured was vertical distance from the vertex to floor. Hand breadth is the straight distance between metacarpal radiale and metacarpal ulnare. **RESULT:** A positive correlation between height and hand breadth was observed and it was statistically significant. Regression equation for height estimation was formulated using hand breadth. For statistical analysis **IBM (Statistical Package for Social Sciences) SPSS + Version 20** was used. The mean difference of the height was **1773.273 ± 78.832 mm** and Hand breadth (Right and Left) were **83.687 ± 5.720 and 83.593 ± 5.720 mm respectively**. **CONCLUSION:** The height and hand breadth measurements were statistically significant (**p<0.001**). Hand breadth is a good predictor of height. The correlation between hand breadth and height (**r=0.587(HBR), r=0.575(HBL); p<0.001**) was high and significant in all the subjects. This study has succeeded in establishing standard values of hand

dimensions for this population which will not only serve as a useful tool in forensic investigation and clinical practice, but also relevance in ergo-design applications of hand tools and devices.

KEY WORDS: Height, hand breadth right and left side, anthropology, Vertex, metacarpal radiale and ulnare, Anthropometric rod, sliding calipers, Punjabi population.

INTRODUCTION: Forensic Anthropology has a varied array of means and method to identify the culprit as well as the victims in crime cases. In any investigative process, particularly in crimes resulting in fatality, the identification of the culprit starts from the detailed examination of the victim. Stature or body height is one of the most important and useful anthropometric parameter which determines the physical identity of an individual. Therefore, determination of stature from different body parts and skeleton remains has obvious importance in the identification of the criminals and victims. In cases where the evidences are skeleton remains, forensic anthropology has put forward means to estimate the stature from these skeleton and even fragmentary bones^{4,5}.

Artists use dimensional relationships in depicting the ideals of beauty, and this has resulted in creation of the rules of body proportions. The earliest evidence of the use of such rules comes from the ancient Egyptians³.

The earthquake in Turkey in August 1999 and the terrorist attack on the World Trade Centre created great challenges to identification efforts. The same is true for all mass disaster (wars, accidents, terror events and natural disasters), where proper stature estimation is important for identification of the victims⁹.

Relationship between the dimensions of individual body segments and the whole body has been of interest to artists, anthropologists, and scientists for many years. Height measurement is required for assessment of children's growth, calculation of nutritional indexes of children and adults for prediction and standardization of physiological parameters such as lung volumes, muscle strength, glomerular filtration, metabolic rate and for adjustment of drug dosage in patients. However, in many cases measurement of body height is difficult or impossible due to deformities of the trunk or legs, lower limb amputation, fractures or contractures or in patients who are unable to stand.¹³

Patients own hand as a tool to estimate the area of burn injury is well documented. The area of palmer surface of one hand has been estimated to be one percent of body surface area. This study also sought to determine natural history of the growth of the hand to permit development of a readily available bedside means of estimating hand area and body surface area².

MATERIAL AND METHODS: The present study was conducted at Govt. Medical college and hospital, Patiala (Punjab) under department of Anatomy on 150 healthy male Punjabi population of the age group ranging between 18-25 years irrespective of caste, religion, dietary habits and socioeconomic stature etc. who were born and brought up in Punjab.

APPARATUS: Height and Hand breadth right and left side were measured with anthropometer rod and sliding calipers.

Anthropometer Rod (Photograph No.1): It consists of four segments which when joined together form a rigid rod of 200cm. There is a fixed sleeve on the top of the rod. An adjustable graduated cross bar passes through it. There is also a movable sleeve with an adjustable graduated cross bar, which registers the height measurements.

Sliding Calipers (Photograph No. 2): It consists of a 25 cm long straight bar. It has 12.5cm long arm fixed at one end and there is a sliding sleeve with 12.5 cm long arm parallel to the first one. The arms are projected to an equal distance on both sides of the scale. They end in sharp points on one side and have blunted ends on the opposite.

PROCEDURE: Procedure was adopted from Singh and Bhasin¹¹ (1968).

Hand Breadth (HB) (Photograph No.3): It is the straight distance between metacarpal radiale and metacarpal ulnare.

Instrument used: Sliding caliper

Bony land marks were marked with a marker and then measurement were taken.

Vertex (Photograph No.4): It is the highest point on head when the head is in eye ear plane.

Metacarpal radiale: It is the most medially placed point on the head of metacarpal second on the stretched hand.

Metacarpal ulnare: It is most laterally placed point on the head of metacarpal fifth on the stretched hand.

Statistical Analysis: The obtained data were analysed statistically with the help of IBM SPSS VERSION .20

RESULTS: In present study, upper limb somatometric data and height of 150 male students of Patiala was collected.

$P < 0.001$ - considered as statistically significant;

The Height and Hand breadth (Right and Left) Measurements were 1773.273 ± 78.832 mm) and 83.687 ± 5.720 and 83.593 ± 5.720 mm respectively.

Regression Equation for Height (Table No. 4)

Height = $8.202 + 0.043$ (HBR)

$9.612 + 0.042$ (HBL)

8.202- constant (HBR)

9.612- constant (HBL)

0.043- coefficient (HBR)

0.042-coefficient (HBL)

HBR-Hand Breadth Right

HBL- Hand Breadth Left

DISCUSSION: The present study included 150 male students of Patiala aged 18-25 of Punjabi origin. Estimation of an individual's stature is an important parameter in forensic examinations and anthropological studies. Morphometry of the hand provides important evidence in a crime scene investigation which helps in the estimation of stature of a criminal⁷.

HEIGHT VS. HAND BREADTH (LEFT SIDE)

Correlation (table No. 3)

In the present study, it has been found that hand breadth of left side is correlated to stature by a coefficient of correlation 0.575. Krishan and sharma in 2007 deduced coefficient of correlation as 0.537 in Rajput males of Himachal Pardesh⁸. Abdel Malek et al in 1990 conducted a study and obtained the coefficient of correlation 0.42 in upper Egyptian males¹.

Regression equation (Table No.4) Regression equation has been derived for estimation of height with hand breadth of left side (as variable) in adult Punjabi males. Regression equation is as follows:

$H \text{ (mm)} = 9.612 + 0.042 \text{ (HB of Left Side in mm)}$ (Table 4)

Regression equation is available for adult Punjabi Males Derived by Bhatanagr⁶ et al 1984, which is as follows:

$S \text{ (cm)} = 141.67 + 3.13 \text{ (HB in cm)}$

Thus, as per the present study, height can be estimated with the help of regression equation from hand breadth of left side.

Mean (Table No.2)

Mean hand breadth obtained from present study 83.593 mm (Table 2) for left side. No such data was found for adult Punjabi males. The aim of the present study was to provide baselines data on adult Punjabi males. While mean hand breadth obtained by Abdel Malek et al in 1990 is 7.39 cm for left side for upper Egyptian¹.

HEIGHT VS. HAND BREADTH (RIGHT SIDE)

Correlation (Table No.3)

In the present study, it has been found that hand breadth of right side is correlated to stature by a coefficient of correlation 0.587 (Table 3)

Krishan and Sharma in 2007 obtained Coefficient of correlation is 0.514, on Rajput male of Himachal Pradesh while Abdel Malek et al in 1990 obtained coefficient of correlation 0.39 in upper Egyptian males.

Regression Equation (Table No.4)

Regression equation has been derived for estimation of height from hand breadth of right side (as variable) in adult Punjabi males. Regression equation is as follows:

$H \text{ (mm)} = 8.202 + 0.043 \text{ (HB of Right Side in mm)}$ (Table 4)

Bhatanagr et al 1984 derived regression equation is available for adult Punjabi Males which as follows:-

$S \text{ (cm)} = 141.67 + 3.13 \text{ (HB in cm)}$

No regression equation was available from previous studies for calculation of stature from hand breadth of right side in adult Punjabi males.

Abdel Malek et al in 1990 derived regression equation in adult upper Egyptian as:

$S \text{ (cm)} = 115.51 + 5.8 \text{ (HB of right side in cm)}$

Thus, as per the present study, height can be estimated with the help of regression equation from hand breadth of right side.

Mean (Table No.2)

Mean hand breadth obtained from present study is 83.687mm (Table 2) for right side. The aim of the present study was to provide baselines data on adult Punjabi males, which is very important for forensic experts and tools design companies. In the present study, it has been found that breadth of right side is more as compared that of left side. Even in other previous studies, right hand has been found broader as compared to left hand. This may be due to right handedness¹². According to them right hand of right handers is significantly larger than the left hand while Plato et al in 1980 quoted that right hand is larger than the left regardless whether the person is right handed or left handed. So considering the views of above mentioned authors, a correlation between hand breadth and handedness can be studied in future.

CONCLUSIONS: Correlating and predicting the equations for height from upper limb somatometric measurements, using data from 150 male students of Patiala (aged 18-25 years) of Punjabi Origin, was the aim successfully achieved in this study.

The **hand breadth** and **height** was correlated and obtained the coefficient of correlation 0.587 (HBR) and 0.575 (HBL), Regression equation has been derived for adult Punjabi males as under:

$$H = 8.202 + 0.043 (\text{HBR})$$

$$9.612 + 0.042 (\text{HBL})$$

The mean **height** 1773.27 mm and mean of hand breadth 83.687(R), 83.593(L) mm.

This equation may be helpful to obtain approximate stature when there is difficulty in obtaining a direct measurement or where there is a chance print of a criminal or an amputated hand or arm.¹

We have used MS Excel 2007 for our calculations and have considered a linear relationship between X & Y and as such have calculated a linear regression equation of the form $Y = A + BX$.

The linear regression equations derived from Hand breadth for estimation of height showed statistically significant relationship ($p < 0.001$) in Punjabi males.

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Table No. 1 Somatometric data of height and hand breadth

Study group (18-25 years)	Sample size (n)	HEIGHT (mm)		HAND BREADTH		
		Mean $\pm$ SD	Range	Mean $\pm$ SD (Right side)	Mean $\pm$ SD (Left side)	Range
Male students of Patiala of Punjabi origin.	150	1773.273 $\pm$ 78.832	1640-1950	83.687 $\pm$ 5.720	83.593 $\pm$ 5.720	98-70

Significant ($p < 0.0001$).

TableNo.2 MEAN

Serial no.	Name of Authors	Mean of height	Mean of Hand breadth (R)	Mean of Hand breadth (L)
1.	Present study	177.3273 $\pm$ 7.8832	83.687 $\pm$ 5.720	83.593 $\pm$ 5.720
2.	Bhatnagar et al	167.52 $\pm$ 3.08	83.8 $\pm$ 8.2	82.6 $\pm$ 7.6

(Table No.3) Comparison of COEFFICIENT OF CORRELATION

Serial no.	Name of Authors	COEFFICIENT OF CORRELATION (R)	COEFFICIENT OF CORRELATION (L)
1.	Present study	0.587	0.575
2.	Krishana et al (2007)	0.514	0.537
3.	Abdel-Malek et al(1990)	0.39	0.42

(Table no.4) Comparison of Regression equation

Serial no.	Name of the Authors	Sample size	Age	Regression equation (R) (HB of right side)	Regression equation (L) (HB of left .side)
1	Present study	150(Male)	18-25 yrs	8.202+0.043 in mm	9.612+0.042 in mm
2.	Bhatnagar (1984) et al	100 (Male)	19-25 yrs	141.67+3.13 (HB in cm)	141+3.13 (HB in cm)

Photograph No. 1 (Anthropometer)

Photograph No. 2 (Sliding Calipers)

Photograph No. 3

Photograph No. 4

Photograph No.5

Mean of Height – Hand Breadth Right (HBR) Side Of Adult Males Of Punjabi Origin (Photograph No. 6)

Mean of Height – Hand Breadth Left (HBL) Side Of Adult Males Of Punjabi Origin (Photograph No. 7)