



## CORRELATION BETWEEN HAND-LENGTH & BODY HEIGHT IN NORTH INDIAN POPULATION & ITS ROLE IN SEXUAL DIMORPHISM.

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**ABSTRACT** It is vital concern for forensic medicine, forensic pathology and anthropology experts to estimate the complete stature, especially when fragmentary remains of victims of mass disasters are brought for postmortem. Complete stature reconstruction from available fragments depend upon the facts that each part exhibits consistent ratios when compared with complete height of an individual. Present study is done to find out ratio between hand-length and body height in Haryana region of India. Results of the study reveal highly significant gender differences between the selected parameters necessitating the need for separate data for both sexes. The mean values of handlength for right and left hands in females were  $172.09 \pm 9.21$  and  $172.69 \pm 9.42$ . The mean values of handlength for right and left hands in males were  $186.69 \pm 10.49$  and  $188.08 \pm 11.0$ . The mean values of height for male and female were  $1894.07 \pm 65.93$  &  $1703.70 \pm 51.71$  & their handlength/body height ratios were found to be  $0.11 \pm 0.01$  for both the right and left hand were found out to be positively significant with correlation coefficient of 0.079 and 0.010 for present population. Mean values thus obtained for both sexes of Haryana, which is part of North India can be used practically in anatomy, forensic and archeological investigations.

**KEYWORDS :** Hand length—body height—hand-length/body height ratio--sexual dimorphism.

### INTRODUCTION

Increasing frequency of mass disasters like tsunamis, plane crashes, earthquakes, genocides etc. have created problems in the determination of stature and identification of victims when only fragmented or dismembered human remains are available for investigations (Jasuja OP and Singh G et. al. 2004)<sup>1</sup> (Ozaslan A, Koc S et al. 2006)<sup>2</sup>, (Kanchan et al. 2008)<sup>3</sup>.

For past many years scientists, anatomists and anthropologists have laid focus on dimensional relativity between various body segments (Abdel Malik AK et. al. 1990)<sup>4</sup>, (Bhatnagar DP. et. al 1984)<sup>5</sup>

Extensive work has been carried out by different researchers to estimate the stature from different hand measurements and small bones of the hands (Jasuja OP and Singh G et. al. 2004)<sup>1</sup>.

Although researchers have attempted sex determination from small bones of the hands (Scyheuer and Elkington)<sup>6</sup> only few systematic studies are available on determination of sex from the hand dimensions (Williams et al, 2000)<sup>7</sup>. The hand length, hand breadth, hand shape index and other hand dimensions are sexually dimorphic marker (Kanchan et al. 2008)<sup>3</sup>. In such cases the forensic experts has no choice but to use relatively less precise method of reconstruction e.i. the mathematical method which is workable even if a part of body is available (Bhavna and Nath S, 2007)<sup>8</sup>.

Recent studies have observed differential limb proportions between two sexes and among different populations. For example, Negroes have relatively long arms and legs (Ebite LE, Ozoko TC et al. 2008)<sup>9</sup>.

Anthropometry is well established forensic technique, which uses anthropological databanks to calculate computational ratios of specific body parts for determination of primary indicators of identification, such as sex, age and stature. (Krishan K. 2007)<sup>10</sup>

The aim of the present study is to provide a database on right and left hand length and their relations with height in North Indian population.

### MATERIAL AND METHODS

This study was conducted with 106 north Indian subjects, 54 males and 53 females with age group 18 to 45, Dept of Radiology Ch Lekh Raj Multispeciality Hospital Associated With Yamuna Institute of Dental Sciences & Research, Gadholi, Yamuna Nagar Haryana.

**Procedure:** a computerized radiographic system with CPU and X-ray machine, 500 MA as shown in figure 1. was used for all hand anthropometric measurements. Radiograph of both the hands was obtained by placing palm and digits fully stretched on radiographic plate. Distance between dorsum of hand and source will be 155 cms for all the radiographs during the procedure for obtaining PA view of both hands.

Measurements from x-rays exported to a computer using Konika 2006 MERG-E-Med program which allowed anthropometric measurements of skeleton of both the hands.

The same radiography device featuring 1,9 MAS and 48 KW by the same technician was used with millimetric precision on the radiograms. Anthropometric measurement results according to Martin technique on the radiograms taken in radiodiagnostic position of left hand are listed below;<sup>12,13,14,15</sup>

### SOMATOMETRIC MEASUREMENTS:

- 1. Hand length:** distance between the mid-point of line in the radio-ulno-carpal joint space and most protuberant point of distal phalanx of middle finger. [
- 2. Body Height:** Measured in individuals in upright position in front of the wall looking ahead and heels touching one another with the help of a metallic measuring tape with bare feet.

The data obtained was recorded in MS-Excel® and subsequently analyzed. The results for continuous variables were recorded as mean  $\pm$  SD. The difference between mean values of two groups was performed using unpaired t-test and the difference between two values of same group was performed using paired-t tests. A p-value of less than 0.05 was considered statistically significant.



Fig 1. Showing position for taking x-ray of hands.



Fig 2. Showing X-ray film with hand measurements

Table 1. Interpretation of defining values of the hand length, mean height and hand length/height index by sex (in mms).

Hand	Male	Female	p-value
Right hand length	186.69±10.49	172.09±9.21	≤0.001
Left hand length	188.08±11.60	172.69±9.42	≤0.001
Mean height	1894.07±65.93	1703.70±51.71	≤0.001
Right hand length/height	0.11±0.01	0.11±0.01	>0.05
Left hand length/height	0.11±0.01	0.12±0.18	>0.05

Table 2. Significance of right-left differences by sex.

Right-left differences in Males and females			p-value
Hand Length	1.39±1.14	0.14±243	≤0.001
Hand length/ height	0.00±0.0	-0.1±0.17	>0.05

**RESULTS**

The distribution of subjects by (Table1) shows the sexual difference observed in Haryanvi population by hand length, body height, and hand-length/ body height ratio. The difference in values of Hand length in males and females were found to be highly significant. When the right-left difference of hand length, body height and handlength/ body height ratio was interpreted by sex, it was found to be significant only for hand length (Table 2).

**DISCUSSION**

The human hand is the most used and versatile part of the body is of great scientific importance to investigators in the field of anthropometry, forensic pathology, orthopedic surgery and ergonomics.

Ever since the formulation of multiplicative factors and regression equations for stature estimation on the bases of long limb bone dimensions by (Allbrook D. 1961)<sup>13</sup>, many workers have presented parameters to reconstruct stature from various skeletal remains as well as body parts. This reconstruction becomes crucial because sometimes amputated and dismembered parts of the body are found disposed off in the open, ditches, rubbish, dumps etc. at the site of crime or disaster and are brought to forensic medicine experts with the objective of

identification. Studies have been done in recent past on height determination from length of feet upper extremity and facial measurements in living subjects (Jibonkumar and Lilinchandra 2006)<sup>14</sup>. To best of our knowledge, the relation between right handlength and left handlength to the body height has not been formulated in Indian population. The present study for the first time documents a relationship between these two variables in the Haryanvi Brahmins for practical use in medico legal, anthropological and archeological studies. The results of present study reveal that the mean values for male height is 1894.07±65.93 and for females is 1703.70±51.71 and mean right and left hand lengths for males are 186.69±10.49 and 188.08±11.60 respectively and mean right and left hand-lengths for females are 172.09±9.21 and 172.69±9.42 on statistical analysis these figures shows highly significant differences between left and right as well as in males and females ≤0.001 . but, mean values for hand length/body height ratio were equal ie 0.11±0.01 except for left hand-length/body height ratio in females.

Table 3. Comparative evaluation of hand length in males and in females.

AUTHOR	POPULATION	MALES		FEMALES		p value
		RIGHT	LEFT	RIGHT	LEFT	
Kulaksiz and Gozil <sup>12</sup>	Ankara (Turkey)	186.92±8.31	187.34±8.10	171.19±7.64	171.44±7.65	<0.001
Kar et al <sup>15</sup>	West Bengal	175.1±8.5	175.9±8.8	160.9±7.0	160.6±7.5	<0.001
Oomen et al <sup>16</sup>	Karnataka	190.60±7.30	190.62±7.10	173.28±8.90	172.46±8.70	<0.001
Agnihotri et al <sup>17</sup>	Mauritius	188.91±8.80	189.00±8.70	172.20±9.20	172.20±9.30	<0.001
Krishan & Sharma <sup>3</sup>	Himachal Pradesh (Rajputs)	182.4±9.00	182.1±9.1	168.3±8.00	168.00±8.30	<0.001
Danborno & Elukpo <sup>18</sup>	Zaria, Nigeria	198.5±0.60	199.30±9.30	185.10±6.60	185.21±7.70	≤0.001
Ibeachu et al <sup>19</sup>	University of Port Harcourt Nigeria	190.2±0.8	190.9±0.7	176.2±0.7	176.9±0.7	<0.001
Krishan et al <sup>20</sup>	Himachal Pradesh	182.70±9.00	182.10±9.00	168.10±8.00	167.70±8.00	<0.001

In Haryanvi Population, the mean hand length values in males were 186.69±10.46 on right side and 188.08±11.60 on left side and in females it was 172.09±9.21 on right side and 172.69±9.42 on left side.

The mean values were more in males as compared to females and the difference in values between males and females was significant on both the sides. This is in agreement with the studies done by Kulaksiz and Gozil<sup>12</sup>, Kar et al<sup>15</sup>, Oomen et al<sup>16</sup> (in males), Agnihotri et al<sup>17</sup>, Krishan & Sharma<sup>3</sup>, Danborno & Elukpo<sup>18</sup>, Ibeachu et al<sup>19</sup>, Krishan et al<sup>20</sup> (Table 9).

In the present study, values of mean hand length were found to be higher on the left side. Which is in agreement with the studies of Kulaksiz and Gozil<sup>12</sup> and Danborno & Elukpo<sup>18</sup>. **Table 4.** Comparison of right and left mean hand length/body height ratio of Present study with the previous studies in both the sexes.

Author	Population	MALES		FEMALES		p value
		Right	Left	Right	Left	
Kulaksiz and Gozil <sup>12</sup>	Ankara (Turkey)	0.11±0.004	0.11±0.004	0.11±0.004	0.11±0.004	≤0.001
Present study	Haryanvi Population	0.11±0.01	0.11±0.01	0.11±0.01	0.12±0.18	>0.05

In Haryanvi Population, the mean hand length/body height values in males was 0.11±0.01 on right side and 0.11±0.01 on left side and in females was 0.11±0.01 on right side and 0.12±0.18 on left side .

The mean values of hand length/body height ratio were almost equal in both the sides in males of this endogamous group except in case of females. These results are in agreement with the study done by Kulaksiz and Gozil<sup>12</sup> except in case of north Indian females where the values were more on the left side (Table 4).

**CONCLUSION**

1. The mean values of both the parameters were significantly different between males and females and for right hands and left hands which is an indicator of sexual dimorphism.
2. Since majority of the subjects use their right hand, it is usually found to be shorter.
3. Approximate determination of body height ( stature) from right and left hands in North Indian males and females is possible.
4. These values are of considerable significance for experts in estimation of stature of an individual in medico-legal cases when only fragmentary remains of the body are available.

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