# DESCRIMINATION VALUE OF HAND DIMENSIONS IN DETERMINATION OF GENDER

**Muhammad Junaid[1], Shahabuddin[2], Jamshed Khan[3], Ihsanullah[4]**

## ABSTRACT

**Aims and objectives:** To calculate hand length, hand breadth for adult males and females. To calculate hand index from these dimensions in order find out discrimination values for both sexes.

**Methods:** Two hundred and fifty healthy students (125 males and 125 females) were randomly selected from Rehman Medical College of the age above 18 years. Hand length and hand breadth was measured by sliding caliper. The hand index was calculated by dividing the hand breadth by hand length and multiplied by 100. Collected data were expressed as mean and standard deviation (Mean ± SD). Cut off points were calculated for hand length, breadth and index as Cut off point = (Mean value for male + Mean value for female) / 2. T test was applied to compare male and female hand dimension. A statistically significant *p*-value of ≤ 0.05 was used.

**Results:** The average hand length of male students was 19.1 cm while that of female students was 17.33 cm. The average hand breadth of male students was 8.69 cm as compare to female students was 7.56 cm. The average hand index of male students was 45.56 as compare to female students was 43.79. Comparison of hand length, breadth and index show significant difference ($p = 0.000$). Cut off points to differentiate male and female for hand length, breadth and index were 18.21, 8.14 and 44.6 respectively.

**Conclusion:** To conclude, the hand dimension of male cases are significantly greater than female cases. Value of hand dimension more than cut off point is suggestive of male and less than is that of female.

**Key words:** Hand dimensions, determination of gender, Anthropometry

## INTRODUCTION

Medical anthropometry is a systematic knowledge developed from the discipline of forensic anthropology dealing with identification of human leftovers with the help of metric procedures[1]. In current time, mutilated body fragments are commonly found due to increased occasions of natural and man-made tragedies and also due to augmented events of the murders where the disfigurement of dead body is done by a killer to abolish all hints of identity as well as to ease the disposal of the departed. In such cases, forensic anthropologist can offer a tentative identification of unidentified leftovers by framing a 'biological data', which involves the determination of gender, age, ethnicity and stature[2]. Such documentation is important as it helps to tapered down the pool of sufferers in mass demise situations by excluding persons who do not have the identical biological features[3].

Among these four attributes of the biological data, determination of gender is reflected as one of the key parameters of individual identification as it cuts the possible number of identical characters by half[4]. Gender determination is usually a simple process when whole body is accessible as exterior or interior genitalia can straightly suggest the sex of the individual; but problem arises when mutilated body fragments are found. For Anthropometrics use numerous anthropometric procedures to determine gender from such mutilated body fragments. Such anthropometric procedures drive to find out cut off point in dimension of various body parts or bones that differentiate between male and female[5]. Due to consequence of sex hormones, males are taller, larger and more muscularly built than females, so dimension less than cut off point is indicative of female and above than that is indicative of male[6,7]. The grades of such sexual differentiation are influenced by a diversity of ecological and inherited factors, and also by communication between them. As inherited and ecological factors are different between different inhabitants, no two inhabitants can have similar anthropometric measurements. So population exact cut off point should be establish[8,9]. Keeping this in view, present study was carried out to originate cut off points for hand dimensions specifically for healthy young adult students of Rehman Medical College, Peshawar.

[1] Department of Anatomy, Khyber Medical College Peshawar – Pakistan.
[2] Department of Anatomy, Khyber Girls Medical College Peshawar – Pakistan.
[3] Department of Anatomy, Loralai Medical College Loralai Balochistan – Pakistan.
[4] Department of Pathology, Khyber Medical University Peshawar – Pakistan.

**Address for correspondence:**
**Dr. Shahab-ud-din**
Anatomy Department Khyber Girls Medical College, Peshawar - Pakistan.
Contact: 00923339028959
Email: drshahab007@gmail.com

## MATERIAL AND METHODS

This cross-sectional study was conducted during May and June month of 2017 in Rehman medical College, Peshawar (Pakistan). A total of 250 young healthy students were randomly selected from Rehman Medical College (125 each for males and females) having the age from 19 to 24 years[8]. Students with injury, disease or anomaly that affect hand dimensions are excluded from this study. Students were briefed about the procedure and informed consent was taken. Based on previous studies, no significant difference was found in dimensions of right and left hands[8,9]. Therefore, hand breadth, hand length, and hand index for both hands were recorded. Measurement of these dimensions were performed by using the methods given in article 4 to 9. These measurements was taken in by using sliding caliper. The hand was kept straight and flat on table with the fingers extended, close to each other's and the palm facing up-wards. It was also assured not to adduct or abduct the wrist joint during this period. The distance between the tip of middle finger and the distal crease of wrist joint was measured as the hand length (Fig 1).The distance between medial most point on the head of 5th metacarpal and the lateral most point on the head of 2nd metacarpal bone was measured as the breadth of hand (Fig 1).The hand index was calculated by dividing the hand breadth by hand length and multiplied by 100. To calculate the hand index, the hand breadth was divided by the hand length and multiplied with 100.

### *STATISTICAL ANALYSIS*

Data collected was initially recorded on proforma, then entered into the computer on daily basis and processed by SPSS. Arithmetic Mean (M), Standard Deviation (SD) was calculated. To calculate the statistical significance for gender difference in hand dimensions Independent sample T-test was used. A statistically significant p-value of $\leq 0.05$ was used. Cut off points were calculated for hand length, breadth and index as below[9].

Cut off point = (Mean value for male + Mean value for female) / 2

Value more than cut off point indicates male and value less than that indicates female.

## RESULTS

### *Hand length*

In males, the length of right hand ranged from 17 cm to 21 cm (19.1±0.81cm). In females, the it ranged from 16 cm to 19 cm (17.33±0.75cm) as shown in table 1.

**Table 1: Hand length in males and females in cm (n= 250)**

| Gender | Mean | Standard deviation (S.D) | P value* |
|---|---|---|---|
| Male Right hand | 19.1 | 0.81 | 0.000 |
| Female Right hand | 17.33 | 0.75 | |

P value* ≤ 0.05 is significant (t- test)

**Table 2: Hand breadth in males and females in cm (n= 250)**

| Gender | Mean | Standard deviation (S.D) | P value* |
|---|---|---|---|
| Male Right hand | 8.69 | 0.47 | 0.000 |
| Female Right hand | 7.59 | 0.45 | |

P value* ≤ 0.05 is significant (t- test)

**Table 3: Hand index in males and females in cm (n= 250)**

| Gender | Mean | Standard deviation (S.D) | P value* |
|---|---|---|---|
| Male right hand | 45.56 | 2.31 | 0.000 |
| Female right hand | 43.79 | 2.06 | |

P value* ≤ 0.05 is significant (t- test)

**Table 4: Comparison of male and female hand dimensions**

| Parameter | Mean (cm) | | P value* |
|---|---|---|---|
| | Male | Female | |
| Right hand length | 19.1 | 17.33 | 0.000 (S) |
| Right hand breadth | 8.69 | 7.59 | 0.000 (S) |
| Right hand index | 45.56 | 43.79 | 0.000 (S) |

P value* ≤ 0.05 is significant (t- test), (S) significant

**Table 5: Calculation of cut off points**

| Parameter | Mean (cm) | | Cut off points* |
|---|---|---|---|
| | Male | Female | |
| Right hand length | 19.1 | 17.33 | 18.21 |
| Right hand breadth | 8.69 | 7.59 | 8.14 |
| Right hand index | 45.56 | 43.79 | 44.7 |

*Cut off point = (Mean value for male + Mean value for female) / 2
Value more than cut off point indicates male and value less than that indicates female.

**Table 6: Comparison of present study hand dimensions with similar studies.**

| References | Study population | Age range | Gender | Right Hand length (Mean ± SD) | Left Hand length (Mean ± SD) | Right Hand breadth (Mean ± SD) | Left Hand breadth (Mean ± SD) | Right Hand index (Mean ± SD) | left Hand index (Mean ± SD) |
|---|---|---|---|---|---|---|---|---|---|
| Ishak et al. (4) | Western Australia | 18-68 | M | 19.54 ± 0.93 | 19.56 ± 0.92 | 9.10 ± 0.49 | 9.04 ± 0.49 | 46.09 ± 1.43 | 46.21± 1.41 |
| | | | F | 17.59 ±0.82 | 17.60 ± 0.82 | 7.93 ± 0.45 | 7.84 ± 0.45 | 44.03± 1.38 | 44.5 ± 1.33 |
| Agnihotri etal. (5) | Mauritius | 18-30 | M | 18.89 ± 0.88 | 18.90 ± 0.87 | 8.45 ± 0.40 | 8.42 ± 0.40 | 44.02 to 45.05 | 44.15 to 44.80 |
| | | | F | 17.22 ± 0.92 | 17.22 ± 0.93 | 7.48 ± 0.38 | 7.42 ± 0.37 | 43.06 ± 43.79 | 42.65 to 43.56 |
| Danborno et al. (6) | Nigerian | 19-35 | M | 19.85 ± 0.86 | 19.93 ± 0.93 | 8.90 ± 0.95 | 8.68 ± 0.92 | 44.92 ± 5.15 | 43.65 ± 5.15 |
| | | | F | 18.51 ± 0.66 | 18.52 ± 0.77 | 7.82 ± 0.49 | 7.72 ± 0.46 | 42.27± 2.67 | 41.74 ± 2.34 |
| Aboul – Hagag et al. (7) | Egyptian | >18 | M | 19.47 ±0.92 | 19.50 ± 0.92 | 8.13 ± 0.49 | 8.14 ± 0.40 | 41.78 ± 1.51 | 41.79 ± 1.44 |
| | | | F | 18.13 ±0.90 | 18.17 ± 0.91 | 7.17 ± 0.40 | 7.17 ± 0.41 | 39.54 ±1.50 | 39.51 ± 1.59 |
| Asha et al. (8) | South Indian | 20-30 | M | 19.44 ±1.13 | 19.38 ± 1.02 | 8.25 ± 0.41 | 8.19 ± 0.37 | 42.53 ± 2.46 | 42.32 ± 2.17 |
| | | | F | 17.47 ± 1.00 | 17.47 ± 1.01 | 7.31 ± 0.32 | 7.23 ± 0.31 | 41.95 ± 2.49 | 41.47 ± 2.48 |
| | North Indian | 20-30 | M | 19.53 ± 1.16 | 19.46 ± 1.12 | 8.28 ± 0.46 | 8.17 ± 0.43 | 42.46 ± 2.26 | 42.03 ± 2.09 |
| | | | F | 17.80 ± 0.93 | 17.80 ± 0.98 | 7.33 ± 0.43 | 8.09 ± 0.60 | 41.25 ± 2.46 | 45.48 ± 2.55 |
| Varu PR et al. (9) | Rajikot, India | >20 | M | 17.98 ± 0.95 | 16.57 ± 0.87 | 8.26 ± 0.53 | 7.15 ± 0.43 | 45.96 ± 1.85 | 43.17 ± 2.58 |
| | | | F | 16.65 ± 0.84 | | 7.27 ± 0.33 | | 43.72 ± 1.69 | |
| Present study | Hayatabad,Peshawar(Pak) | 19-24 | M | 19 .1 ± 0.81 | ------- | 8.69 ± 0.47 | -------- | 45.56 ± 2.31 | ---------- |
| | | | F | 17.33 ± 0.75 | -------- | 7.59 ± 0,45 | ---------- | 43.79 ± 2.06 | ---------- |

SD=standard deviation: M= Male: F=Female

**Table 7: Comparison of present study cut off points with references.**

| Author | Hand length | Hand breadth | Hand index |
|---|---|---|---|
| Ishank et al. | 18.57 | 8.48 | 45.6 |
| Varu PR et al. | 17.2 | 7.7 | 44.6 |
| Present study | 18.21 | 8.14 | 44.7 |

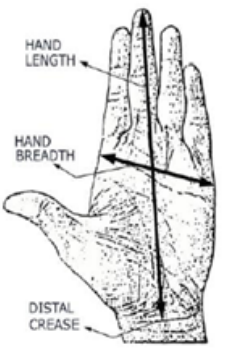


Figure 1: Measurements of Hand Length and Hand breadth

### *Hand breadth*

The values for males right hand breadth ranged from 8cm to 9.5cm (8.69±0.47cm). for females, it was from 6.5 cm to 8.5 cm (7.59±0.45cm) as shown in table 2.

### *Hand index*

Right hand index for males varied from 41.02 to 51.42 (45.56 ± 2.31cm). For females, they were from 40 to 47 (43.79 ± 2.06cm). (Table 3).

### *Comparison of male and female hand dimensions*

The hand dimensions of male cases were compared with female cases by applying t test as shown in table 4. Significant gender difference was found in hand dimensions ($P<0.05$)

### *Calculation of cut off points*

Cut off points for hand length, breadth and index were 18.21, 8.14 and 44.7 respectively as shown table 5.

## DISCUSSION

The human hand is a multipurpose organ of the body. It has great scientific values in forensic investigations to develop identification standards using hand dimensions[4]. Documentation of deceased case can be problematic when the case can no longer be familiar due to nature of damages sustained. In such cases, determination of gender of deceased case can play vital role in the identification as it tapers down the possible number of identical cases by half. The current study was done with aim to develop gender standards from hand dimensions specifically for healthy young adults, represented by medical students of Rehman Medical College.

In this present study it was evident from (Table 1, 2 and 3) that for hand dimensions, mean with standard deviation of male case are more than their respective value of female cases. Comparison of hand dimensions shows significant gender difference.

Several studies have been done in past for population of different locality of world. Mean with standard deviation of hand dimensions of present study is compared with other similar studies in Table 6. All of these studies were carried out on adult population except study of Varu PR et al. was carried out on cadavers. From comparison of studies following points are derived

Mean of hand dimensions of all studies were different from each other, which clearly shows that different population have difference in measurement of body (Table 6, 7). This finding justifies need of population specific studies to derive cut off points for hand dimensions.

All these studies have found that compared to females, males have significantly larger hand dimensions which shows gender dimorphism and therefore they are useful parameter to differentiate gender.

Most of these studies show no significant bilateral difference in hand dimensions therefore current study was done on right hand only.

## CONCLUSIONS

From current study it was concluded that human hand show gender dimorphism in hand dimensions and therefore can be used as identification parameter of gender when isolated hand found. Cut off points derived by this study for hand length, breadth and index are 18.21, 8.14 and 44.7 respectively. Value more than cut off points signifies male and less than that signifies female.

As different population show difference in hand dimensions, results of present study are applicable to population of Hayatabad.

### *RECOMMENDATION*

Similar studies should be carried out for other

population to find out population specific cut off points in hand dimensions.

## REFERENCES


1. Krishan K. Anthropometry in Forensic Medicine and Forensic Science-'Forensic Anthropometry'.Internet J Forensic Sci. 2006:2(1).
2. Kanchan T, Krishan K. Personal Identification in Forensic Examinations. Anthropol. 2013;2(1):114.
3. Iscan MY, Steyn M. The human skeleton in forensic medicine.3rd ed. Springfield, Illinosis, Charles C. Thomas; 201376-77.
4. Ishak NI, Hemy NR, Franklin D. Estimation of stature from hand and handprint dimensions in a Western Australian population. Forensic Sci Int. 2012;216(1-3): 199.e1-7.
5. Agnihotri A, Purwar B, Jeebun N, Agnihotri S. Determination of Sex by Hand Dimensions. Internet J Forensic Sci. 2005:1(2).
6. Danborno B, Elukpo A. Sexual Dimorphism in Hand and Foot Length, Indices, Stature-ratio and Relationship to Height in Nigerians. The Internet Journal of Forensic Science. 2007:3(1).
7. Aboul-Hagag KE, Soheir AM, Maha AH, Eman AM. Determination of sex from hand dimensions and index/ring finger length ratio in Upper Egyptians.Egyptian Journal of Forensic Sciences. 2011; 1:80–86.
8. Asha KR, Lakshmi Prabha R, Gangadhar MR. Sex Determination from Hand Dimensions in Indian Population. Indian Journal of Public Health Research & Development. 2012;3(3):27-30.
9. Varu P R, Gajera C N, Mnagal H M, Modi P M. Determination of sex using Hand Dimension. International Journal of Medical Toxicology and Forensic Medicine.2016;6(1):23-8.