SEX DETERMINATION FROM HAND DIMENSIONS IN KOLHAPUR POPULATION

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ABSTSRACT

Background: Sex is one of the most important elements, amongst the various parameters of identification. Personal identification from human remains becomes more important in cases of mass disasters, mutilated & fragmentary remains in which it is common to recover dismembered & peripheral parts of the body. **Objectives:** The present study has been conducted to estimate sexual dimorphism from hand dimensions from Kolhapur population.

Methods: A cross sectional study was carried out on 1000 subjects (500 males & 500 females) within age 18-50 years, devoid of any deformity, fracture or surgical proceedings of either hand were randomly selected from Kolhapur populations. Hand length, breadth and hand index were estimated. **Results:** The mean valve of hand dimensions and hand index are greater in male than in females. Differences in length and breadth of hands for both sexes were statistically significant ($p<0.001$) Cut off points for hand length, breadth and index are 17.5, 8.08 and 46.05 respectively and their accuracy to differentiate sex are78.8%, 74.7% and 53.05%, respectively. So, hand length is showing highest accuracy in determination of sex.

Conclusions: Hand dimensions and hand index can be reliably used to determine sex in mass disasters, criminal cases where an isolated hand is recovered and needs forensic identification.

Keywords: Sex Determination, **Hand Index, Hand Length, Hand Breadth**

1. INTRODUCTION

Personal identification is one of the main tasks of forensic research. Stature, age, sex, and ancestry are the primary characteristics of identification helps in providing useful clues to the investigating agency establishing the identification of the individuals.

Amongst the various parameters of identification, sex is one of the most important elements. Personal identification from foot and hand segments becomes more important in cases of mass disasters, where there is always likelihood of recovering feet or hands separated from the body. (Amitava Pal, 2016)

Sex determination is considered as major element of personal identification. (Prasanna LC, 2014). Sex identification using anthropometric measurements is a topic that is currently covered in a multitude of studies; including anthropometric measurements of the upper and lower extremities, the long bones of the extremities, hands and feet small bones, as well as other bones of the body. (Krishan K et al., 2011; Mall G et al., 2001; Rogers TL, 2009; Bidmos MA etal., 2003; Mountrakis C et al., 2010; Teke HY et al., 2007; Spradley MK et al., 2011)

Earlier anthropologists had to depend exclusively upon pelvic and skull bones to determine the sex whereas now, they are able to determine sex from long bones as well (Case DT et al., 2007; Tatarek NE et al., 2005; Iscan MY, 2005). Hand index which is acquired from hand dimensions could be used to assess variation concerning sex, age and race in forensic and legal sciences (Burns K, 2007). Importance of morphometric and skeletal examination of hand and foot dimensions in identification was mentioned previously (Jasuja OPet al., 2004; Habib SR et al., 2010).

Studies using hand measurements for sex determination have been performed in several races (Danborno B et al., 2008; Kanchan T, 2009).

The present study has been conducted to estimate sexual dimorphism from hand dimensions from Kolhapur population.

2. MATERIAL & METHODS

A comparative study was carried out at D Y Patil Hospital and Research Institute, Kolhapur, Maharashtra. The present qualitative study was conducted between December 2017 to December 2019 with1000 subjects, after obtaining institutional ethical clearance and written consent. A total of 500 males and 500 females, in the age group of 18 to 50 years, free from any skeletal deformity, were recruited in the study. Whereas, subjects with any disease, deformity, injury, fracture, amputations, or record of any surgical procedures of hand were excluded from the study.

All the measurements of hand were taken by using standard anthropometric instruments in centimeter. Measurements were taken at a fixed time to eliminate the possibility of diurnal variation and by only one observer, to avoid the inter-observer error. The following parameters were measured to collect the data:

2.1 HAND MEASUREMENTS

2.1.1. Hand Length: Measured as a distance from mid-point of the distal crease of wrist joint to the most anterior projecting point of the skin of the middle finger, which is tip of the middle finger. Fig.1.

2.1.2. Hand Breadth: Measured as the distance from the most laterally placed point on the head of 2nd metacarpal bone to the most medially placed point located on the head of the 5th metacarpal bone. The measurement was taken over the dorsum of hand in full extension, with thumb abducted and other fingers held together. Fig.2.

Fig.1. Hand length

Fig.2. Hand breadth

2.2. Statistical Analysis:

All the measurements were statistically analysed using Microsoft Excel 2007.Basic descriptive statistical calculations of data (mean, standard deviation, and t-test) were carried out. To determine statistical significance of gender difference in Hand dimensions and Hand Index independent samples T-test was applied. P value of less than 0.05 was considered significant. To determine sex from Hand length, Hand breadth and Hand index cut off points were derived.
Cut off point = (Mean value for male + Mean value for female) / 2. Value more than cut off point suggests male and

value less than that suggests female.

3. RESULTS

3.1. Hand Length

In males, the right hand length ranged from 16.63cm to 20.02cm (mean 18.11cm & SD 0.77) and left hand length ranged from 16.59cm to 19.69cm (mean 18.17cm & SD 0.77). In females, the right hand length ranged from 14.97cm to 18.84cm (mean 16.84cm & SD 0.92) and left hand length ranged from 15.1cm to 18.84cm (mean 16.82cm & SD 0.90). There existed statistically significant difference in length of male and female hands ($p<0.001$). (Table1)

Table 1: Descriptive Statistics: Hand Length (cms) in Males and Females (N=500)

	Sex	Max.	Min.	Mean (±SD)	T Score	P Value
Right Hand Length	Male	20.02	16.63	18.11 ±0.77	23.597	< 0.001
	Female	18.84	14.97	16.84 ±0.92		
Left Hand Length	Male	19.69	16.59	18.17 ±0.77	25.494	< 0.001
	Female	18.84	15.1	16.82 ±0.90		

3.2. Hand Breadth

In males, the right hand breadth ranged from 6.68cm to 9.51cm (mean 8.39cm & SD 0.46) and left hand breadth ranged from 6.79cm to 9.60cm (mean 8.38cm & SD 0.46). In females, the right hand breadth ranged from 6.76cm to 9.21cm (mean 7.72cm & SD 0.49) and left hand breadth ranged from 6.84cm to 8.94cm (mean 7.69cm & SD 0.48). There existed statistically significant difference in breadth of male and female hands ($p<0.001$) (Table 2)

Table 2: Descriptive statistics: Hand Breadth (cm) in Males and Females (n=500)

	Sex	Max.	Min.	Mean (±SD)	T Score	P Value
Right Hand Breadth	Male	9.51	6.68	8.39 ±0.46	21.714	< 0.001
	Female	9.21	6.76	7.72 ±0.49		
Left Hand Breadth	Male	9.60	6.79	8.38 ±0.46	23.072	< 0.001
	Female	8.94	6.84	7.69 ±0.48		

3.3. Hand Index

In males, the right hand index ranged from 34.33 to 55.98 (mean 46.39 & SD 2.99) and left hand index ranged from 34.89 to 56.60 (mean 46.21 & SD 3.01). In females, the right hand index ranged from 40.60 to 54.30 (mean 45.95 & SD 2.81) and left hand index ranged from 40.06 to 52.32 (mean 45.78 & SD 2.64). (Table. 3)

The mean right hand index were for males and females were 46.39 (± SD 2.99) and 45.95 (± 2.81) respectively. The difference in means was tested with t test and found to be statistically significant ($t=2.402$, $p<0.05$). Similarly, mean left hand index for males and females were 46.21(± 3.01) and 45.78 (± 2.64) respectively and the difference in means of left hand index for males and females was also found to be statistically significant ($t=2.438$, $p<0.05$).

Table 3: Descriptive statistics: Hand Index in Males & Females

	Sex	Max.	Min.	Mean (±SD)	T Score	P Value
Right Hand Index	Male	55.98	34.33	46.39 ± 2.99	2.402	<0.05
	Female	54.31	40.60	45.95 ± 2.81		
Left Hand Index	Male	56.60	34.89	46.21 ± 3.01	2.438	<0.05
	Female	52.32	40.06	45.78 ± 2.64		

Cut off points for Hand length, breadth and index are 17.5, 8.08 and 46.05 respectively and their accuracy to differentiate sex are78.8%, 74.7% and 53.05%, respectively. So, hand length is showing highest accuracy in determination of sex, followed by hand breadth and hand index

Table 4: Sex determination based on Sectioning Point (S.P) in the entire population (n = 1000)

Variables	**Mean for combined right and left measurements (cm)**		**CUT OFF POINT**
	Male	Female	
HL	18.14	16.83	17.49
HB	8.38	7.70	8.04
HI	46.30	45.86	46.08

HL, Hand Length; HB, Hand Breadth; HI, Hand Index

4. DISCUSSION:

The human hand is the most used chief tactile apparatus and versatile part of the body. Anthropometric dimensions of hand are also helpful to investigators in the field of forensic science, forensic anthropology, criminology, biometrics, ergonomics, reconstructive surgeries, mechanical studies, clinical practice etc. Identification of deceased can be problematic when deceased can no longer be recognised due to nature of injuries sustained. In such cases, sex determination of a deceased can play important role in their identification.

The present study was done with aim to develop sex estimation standards from hand measurements specifically for Kolhapur population.

In this study, male hand length and breadth were found to be larger as compared to the female hand length and breadth. But there was no significant bilateral difference in hand length and hand breath. Combined right and left hand measurements were used to derive cut off points in both these studies. In the present study, value of hand index for male is greater than the value of hand index for female, both for right and left sides. The hand index in males was found to be more than 46.08, and in females, it was less than 46.08. Therefore, this value i.e. 46.08 can be used as deviation point for the determination of sex. So the present study shows a positive correlation between the hand dimensions and gender in individuals. Present correlates with the findings observed by various studies(Agrawal KN et al., 2010; Dewangan KN et al., 2005).

There are some limitations of this study, since hand dimension differs in different population residing in different geographical locations, results from our study can be generalized to the Kolhapur population around the study region only**.**

5. CONCLUSION:

To conclude from present study, the human hand show sexual dimorphism in hand length, breadth and hand index, so that it can be used for determination of sex from isolated hand. In the present study cut off point has been derived,

irrespective of side of hand, so they are useful even in conditions where side of isolated hand cannot be determined. Value more than cut off point indicates male and less than that indicates female. Hand length is showing highest accuracy in determination of sex, followed by hand breadth and hand index

Further it is necessary to carry such similar studies for the other populations to find out population specific cut off points in hand dimensions.

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