

SEXUAL DIMORPHISM ON METRIC EVALUATION OF HAND DIMENSIONS

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ABSTRACT

Introduction: Identification of human remains is an important part of any medicolegal investigation. Among the primary parameters of identification like race, sex, age and stature, determination of sex is one of the foremost criteria in establishing the identity of an individual. It is a challenging task for forensic experts and physical anthropologists. The human hand being the most used and versatile part of the body is of great scientific importance to investigators in the field of anthropometry.

Aim: The aim of present study is to correlate sexual dimorphism with hand dimensions

Materials and Methods: Present study included analyzing measurements of hand length, hand breadth and hand index amongst 304 students, aged between 20-22 years. The data were statistically analyzed using Statistical software Epi info 3.4.3

Results: In the present study there was no significant bilateral variation for measurements of hand length and hand breadth in both sexes except for hand breadth in south males (P value < 0.01). The mean values of hand dimensions and hand index were more in males than in females in both north and south Indian population. There was no significant bilateral variation of hand index in both sexes of different regions.

Conclusion: The present study confirms sexual dimorphism in hand dimensions. Hence hand dimensions can also be used in Sex determination in medico legal aspects.

KEY WORDS: Hand index, Hand length, Hand breadth, Sexual dimorphism.

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INTRODUCTION

The human hand being 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 [1].

Among the primary parameters of identification viz. race, sex, age and stature, determination of sex is one of the foremost criteria in establishing the identity of an individual. In cases of mass

disasters and assault cases where body is dismembered to conceal the identity of the victim, identification of dismembered, mutilated and fragmentary remains is vital. Accurate sexing of the remains primarily narrows down the pool of possible victim matches [2-4]. The hand length, hand breadth, hand shape index and other hand dimensions are sexually dimorphic markers. It is influenced by prenatal estrogen and testosterone levels. High

prenatal levels of androgens (high testosterone/estrogen) which may have an early organizing effect on strength in men, and is likely to be widespread in human groups [5]. Hox A and Hox D genes are responsible for both Gonadal and digital differentiation [3].

An association of Y chromosome with stature has been documented. In addition age of puberty being two years later in males as compared with females gives them additional time for growth [6].

The assessment of the physical dimension of the human hand provides a metric description to ascertain human-machine compatibility in the design of manual systems for the bare and gloved hand (e.g., design of the hand tools, knobs and controls, personal equipment, consumer appliances in the home and industry). Today there is increasing demand among professional hand tools users to have ergonomically designed products. To design any product for human use, engineers have to rely on anthropometric data; otherwise the resulting product may turn out to be ergonomically incompatible [7].

The present study aimed to determine sex from hand dimensions and hand index.

MATERIALS AND METHODS

The present study was undertaken amongst 304 students, aged between 20-22 years after taking informed consent to participate in the study. The study subjects were classified into South and North Indians based on their region of origin by questionnaires. Prior informed consent of the study was obtained from subjects in writing. The subjects with any apparent physical hand anomalies, inflammation, trauma, deformities and surgery were excluded. In the present study, both hands of each individual were measured using sliding calipers in centimeters to the nearest millimeter. All the measurements were taken by single observer in order to avoid inter-observer bias. The measurements were taken at a fixed time between 2.00 to 4.30 p.m. to eliminate any diurnal variation. To measure hand dimensions, subjects were asked to place their hands prone with fingers extended and adducted on a flat horizontal surface.

Length of hand was measured using sliding calipers (graduated in mm) as the straight distance between the midpoint of a line joining the two stylium (styloid process of radius and ulna) and dactylion (the lowest point on the anterior margin of the middle finger).

Breadth of hand was measured using sliding calipers (graduated in mm) as the straight distance between metacarpal radiale (the most medially placed point on the head of second metacarpal on the stretched hand) and metacarpal ulnare (the most laterally placed point on the head of fifth metacarpal on the stretched hand). Measurements were taken to accuracy of 0.1 cm . Hand index was calculated by dividing the hand breadth by hand length and multiplied by 100. The techniques of measurements were followed as described by Singh and Bhasin[8].

RESULTS

The data were statistically analyzed using Statistical software Epi info 3.4.3 to determine sex by Hand dimensions.

Table 1: Hand length and Hand breadth of Males and Females in different population.

		Hand length			Hand breadth		
		Range	Mean±SD	p value	Range	Mean±SD	p value
SM	RT	16.4-24.2	18.81±1.12	0.69	7.3-9.2	8.24±0.38	0.001
	LT	8.4-24.5	18.74±1.47		7.2-9.0	8.00±0.63	
NM	RT	16.0-23.1	18.95±1.32	0.57	7.4-9.3	8.24±0.38	0.11
	LT	9.2-23.2	18.70±2.13		7.0-8.9	8.10±0.33	
SF	RT	14.8-19.8	17.17±0.93	0.73	6.3-9.2	7.24±0.46	0.39
	LT	14.5-19.8	17.21±0.90		6.3-9.2	7.19±0.47	
NF	RT	15.6-19.1	17.30±1.06	0.97	6.4-8.5	7.26±0.42	0.72
	LT	15.9-19.5	17.31±1.05		6.6-9.0	7.22±0.48	
Total	RT	14.8-24.2	17.97±1.34	0.73	6.3-9.40	7.65±0.69	0.2
	LT	8.4-24.5	17.93±1.51		6.3-9.20	7.58±0.67	

Table 2: Comparison of Hand Index between different groups.

		Hand index		p value
		Range	Mean±SD	
SM	RT	17.03-50.28	43.00±3.48	0.98
	LT	17.58-92.86	43.02±5.83	
NM	RT	39.90-47.22	43.62±2.30	0.74
	LT	38.36-83.70	44.07±7.48	
SF	RT	36.00-58.60	42.25±2.97	0.22
	LT	37.06-57.14	41.81±2.73	
NF	RT	37.43-47.20	42.06±2.48	0.69
	LT	36.70-46.54	41.81±2.67	
Total	RT	17.03-58.60	42.65±3.09	0.27
	LT	17.58-92.86	42.49±4.75	

NM- North Male, SM- South Male, NF-North Female, SF-South Female, RT- Right, LT-Left

As shown in Table 1, mean value of hand length among North and South Indian males was more than 18 and in females it was less than 18.

The mean value of hand breadth among North and South Indian males was more than 8 and in females it was less than 8.

Statistical analysis shows that mean values of hand length and hand breadth were more in males than in Females both in North and South Indian population.

There was no significant bilateral variation for measurements of hand length and hand breadth in both sexes except for hand breadth in South Indian males. (P value<0.01). There was no statistical significant difference in hand lengths among North and South Indian population when compared for the same sex.

As shown in Table 2, the mean values of hand index were more in males than in females in both the population. There was no significant bilateral variation of hand index in both sexes of different regions.

DISCUSSION

Identification of human remains is an essential element of any medico legal investigation. DNA technology has simplified the issue of sex determination to a great extent, but technology has its limitations with regards to skilled man power, time and financial issues involved, especially in developing countries and in cases when DNA analysis cannot be performed. Various techniques in forensic anthropology have been employed for identification of human remains [9].

Studies have shown that, when an individual hand is recovered and brought for examination, somatometry of the hand, osteological and radiological examination can help in the determination of sex, age and stature [10].

Owing to variability of dimensions according to the build of a person, individual parameters like hand length and breadth are not always reliable sex discriminators. The sex difference in the ratios of these parameters is independent of the body size, as the ratios are not significantly related to height and age in either sex [11]. Sexing by indices is more reliable since the relative growth of bony components are

proportional to each other. Various indices and ratios are derived to determine sex of human remains [12].

The mean values of hand dimensions in the present study were similar with those of the study done by Agnihotri et al [13]. But in the present study, the hands are shorter and broader in comparison to studies carried out by Krishan K et al [2], Kanchan and Rastogi [14]. These observations can be attributed to the population and ethnic differences between the study population and the other studies.

In the present study, the hand dimensions in males are found to be statistically larger than females in both North and South population groups. These were consistent with the earlier observations that female hand dimensions are smaller than those of the males in different human populations [2,6,7,9,14]. In the present study the mean values of hand index in males was greater than that in females in both the population groups. Similar result was obtained by Agnihotri et al, [13] and Khaled E. Aboul-Hagag et al . But this differed from the study of Kanchan and Rastogi on North and South Indian population which reports that sex differences were statistically significant for hand index on left side and hand index was poor sex indicator [14].

In the study conducted by Agnihotri et al [13] the hand index in males was found to be more than 44, and in females, it was less than 44 and the deviation point of hand index for sex determination was considered as 44. The deviation point in study of Donoboorno's [15] on Nigerian population was 47. In the present study it was 43.

Study by Krishan K et al reported that hand and Foot dimensions show higher accuracy when compared to Hand and foot index.[16].

Recent study by sangeeta Dey also shows significant statistical difference of hand dimensions and hand index in males and females [17].

In an another recent study by Jee S et al on Korean population, the breadth, circumference and thickness of hand parts showed higher accuracy than the hand lengths in predicting the sex of the participant [18].

CONCLUSION

Determination of race, sex, and stature is an important criterion in establishing population-specific data based on anthropometric measurements in various population groups which becomes a problem of identification when the body is recovered in advanced stage of decomposition, mutilated state, fragmented remains and skeletonized form. The present study shows the importance of hand dimensions in sexual determination. Hand dimensions and Hand index can be considered with fair accuracy for sex determination in forensic and anthropological examinations.

Conflicts of Interests: None

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