

## Prediction of Stature and Sex by Hand Dimension-A Statistical Analysis in North and South Indians of Same Age Group.

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### Research Article

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#### ABSTRACT

Lots of researches are going on for assessing stature, sex, race and age from different parts of the body to help the law enforcement agencies in achieving "personal identity" in case of unknown human remains. Purpose of present study is to analyze the anthropometric relationship between dimensions of hands with stature and sexual dimorphism. The present study consists of 100 males and 100 females each containing 50 North Indian and 50 South Indian males and females, aged between 18-21 years. All measurements exhibit statistically significant correlation coefficients with stature. It is observed that in males, the highest correlation is exhibited by right hand length. Stature prediction is more accurate and reliable in case of females than males and also, a single dimension of hand can estimate stature of an unknown person with a great accuracy.

#### INTRODUCTION

In the last century or so, sexual differences and stature have been analyzed by many researchers using different body segments.

Traditionally limb bones have been taken up for the measurements of stature and sex of an individual spine, limbs, hand, vertebra, metacarpals, and clavicle [1].

Krishnan analyzed the anthropometric relationship between dimensions of hand with stature and concluded that dimensions of hand can be reliability in estimation of stature in forensic field [2].

Amirsheybani et al., opined that the length of hand increases more proportionately than width of the hand and he obtained a curvilinear relationship when the hand length was compared with body weight for both sexes. Therefore hand length has been considered as an excellent predictor of body surface area and body mass [3].

Although number of studies have been conducted regarding sexual dimorphism and stature estimation using hand dimensions, majority of the studies have been focused attention on the elderly population [4,5,6,7]. None of the studies compare those parameters with different ethnic groups in India.

In the light of the above mentioned studies, the present study aimed at comparing the changes in anthropometric characteristics among South and North Indians of same age group and to calculate stature and sex of an individual by using hand dimensions.

#### MATERIAL AND METHODS

The present study consists of cross-sectional sample of 100 male and 100 females from different parts of India who came for various academic purposes belonging to 18 years of age.

Anthropometric measurements like Hand length, Hand Breadth were taken independently on the right and left side of each individual along with the stature.

All measurements were taken at a fixed time between 2 to 4 pm due to substantial diurnal variation in stature [2].

### Hand length

Each subject was asked to place his/her hand on a white paper with the palm facing upwards keeping the fingers close together with the thumb lying comfortably but not tightly against the radial aspect of the hand and index finger. An imaginary line joining the tips of radial and ulnar styloid process (interstyloid line). The distance between the midpoint of the interstyloid line and the tip of the middle finger in extension was measured as the length of the hand [4].

These parameters were analyzed using various subroutines of Statistical Package for Social Sciences (SPSS) and regression formulae were developed for various combinations to reach the best estimate possible.

Statistical significance of the difference between the and the mean was calculated with student 't' test by putting the correlation co-efficient of Pearson's and regression analysis, logistic regression analysis and Spearman's correlation co-efficient and cut-off values calculated for males and females.

## RESULTS

**Table 1. Comparison of palm dimensions between Indian males and females**

Parameter	Palm length				Palm width			
	Right		Left		Right		Left	
	Males	Females	Males	Females	Males	Females	Males	Females
Number	100	100	100	100	100	100	100	100
Mean	186	176.2	186.2	175.6	79.8	73.7	79.8	73.1
Standard deviation	8.1	7	8.1	6.9	5.2	3.6	5.3	3.8
Maximum	204.6	201.9	204.9	202.2	97.9	83.1	98.4	82.9
Minimum	160.1	160.2	163.5	159.2	65.6	62.8	65.3	62.6
Standard error of mean	0.81	0.7	0.81	0.69	0.52	0.36	0.53	0.38
median	187.2	176.3	186.6	175.2	79.1	73.7	79.2	73.2
Degree of freedom	198		198		198		198	
T value	9.11		10.01		9.54		10.32	
Test significant	Significant		Significant		Significant		Significant	
Two-tailed probability	<0.001		<0.001		<0.001		<0.001	
P value	<0.001		<0.001		<0.001		<0.001	

Table No.1 shows the statistical analysis of palm length and palm width in Indian population. Right hand length of males compared with that of females and left hand lengths between males Vs females shows statistically significant values. Similarly palm width of males right side compared with females right palm and width of males right palm shows statistically significant values with females left palm. Regarding the palm length and width, both males and females exhibit differences in mean values with respect to right and left side.

**Table 2: Comparison of palm length between north and south males, and north and south females**

Parameter	Males				Females			
	Right		Left		Right		Left	
	N	S	N	S	N	S	N	S
Sample Size	50	50	50	50	50	50	50	50
Min	160.1	170	163.5	171.1	165.3	160.1	164.2	159.2
Max	204.6	197.6	204.9	197.6	190.5	201.9	190.4	202.2
Mean	187.8	184.2	188	184.4	175.8	176.7	175.2	175.9
SD	7.9	8.1	7.7	8	5.7	8.1	5.7	8.1
SEM	1.1	1.1	1.1	1.2	0.8	1.1	0.8	1.1
Degree of Freedom	98		98		98		98	
't' value	2.25		2.29		0.64		0.47	
Statistically significant	yes		yes		no		no	
Two tailed 'p' value	0.027		0.024		0.53		0.64	

Later we consider the statistical analysis with respect to regions i.e, North and South Indians as the climate of these two regions are different and population race is different ( lighter skinned Aryans belong to North Indians and darker skinned Dravidians living in Southern India).

On comparing the right and left palm lengths (Table No.2) of North and South Indians males and females separately, we got difference mean values in palm lengths of North and South Indians which are statistically significant.

With respect to palm width (Table No.3), comparison of right and left palm widths of North and South Indian Males and females separately carried out. Statistically significant values were obtained in right and left palm width of North and South Indian males, similar values were noted in North and South Indian females also.

**Table 3: Comparison of palm width between north and south males, and north and south females**

Parameter	Males				Females			
	Right		Left		Right		Left	
	N	S	N	S	N	S	N	S
Sample Size	50	50	50	50	50	50	50	50
Min	65.6	70.9	65.3	71.1	69.5	62.8	68.7	62.6
Max	97.9	86.1	98.4	86.7	79.7	83.1	82.9	80.6
Mean	81.5	78.1	81.6	78.1	75.2	72.2	74.7	71.6
SD	5.6	4.3	5.7	4.2	2.5	3.9	2.9	3.9
SEM	0.8	0.6	0.8	0.6	0.4	0.6	0.4	0.6
Degree of Freedom	98		98		98		98	
t' value	3.45		3.5		4.5		4.58	
Statistically significant	yes		yes		yes		yes	
Two tailed 'p' value	0.001		0.001		<0.001		<0.001	

We also compared the actual stature and stature estimated from measurements of hand length and breadth using linear regression equations. Minimum, maximum and mean values of the measurements were substituted in their respective regression equation and the estimated stature calculated.

In both sexes, minimum and maximum estimated stature shows greater variation with respect to the actual minimum and maximum stature. However, the mean values of estimated stature are close to actual stature. This is due to the fact that regression equations are calculated from measures of central tendency.

## DISCUSSION

Anthropometric characteristics have direct relationship with sex, shape and form of an individual and these factors are intimately linked with each other and are manifestation of the internal structure and tissue components which in turn, are influenced by environmental and genetic factors.

It has been shown that these characteristics display population specific variation and therefore need to be studied for major populations around the world especially when the results from one population are applied to another.

In the present study, in male the mean value of right and left hand length is 18.62. Our findings correlate with Krishnan [2] study and slightly differ from the studies of Jasuja [8] and Ommen [9]. In females, the mean value of right and left hand length is 17.62 cm and 17.56 cm respectively. It may be due to racial and regional differences as well as the earlier former studies use less samples.

Very few workers have taken hand width as a parameter for the stature estimation so data available for comparison is also very limited. In the present study, in males the mean value of right and left hand breadth is 7.98 cm. In females, the mean value of right and left hand width is 7.37 cm and 7.31 cm respectively. Both findings were well correlate with Krishnan findings [2].

The correlation co-efficient between height and hand lengths of females is 0.77 and 0.7 which is more significant. It means there is a strong bond between height and hand lengths of females and if either of the measurement is known, the other can be calculated.

It is observed that in males, the highest correlation coefficient between stature with right hand length ( $r = 0.878$ ) and lowest by left hand width ( $r = 0.79$ ). Similarly in females, left hand length ( $r = 0.869$ ) and left hand width ( $r = 0.5$ ) exhibit the highest and lowest correlation coefficients respectively. This indicates that though we got statistically significant results on comparison hand length of North and South Indian males and females and also with hand width, hand length provides highest reliability and accuracy in estimating stature of an unknown individual.

## CONCLUSION

Present study shows higher mean values in each anthropometric dimension were obtained in males than in females. As far as the bilateral asymmetry is concerned, both hand length and width in North and South Indian males and females were statistically significant. In males the highest correlation co-efficient is exhibited by right hand length. Thus, hand length is the best parameter for estimating stature for males.

The only precaution which must be taken into consideration is that their formulae are applicable to the population from which the data have been collected due to inherited population variations in these dimensions which may be attributed to genetic and environmental factors like climate, nutrition etc.

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