



Determination of stature from hand dimensions in Indian population

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Abstract:

Stature is one of the most important elements of identification of an individual. Establishment of the identity of an individual plays a important role in identifying the deceased in forensic examinations. The dimensions of the hand can be used for the determination stature of an individual. The purpose of the present study was to determine sex by hand dimensions among 200 South Indian and North Indian subjects. Statistical analysis indicated that bilateral variation was significant for the measurements of hand length whereas bilateral variation was insignificant for hand breadth measurements. Hand dimensions on both sides were significantly greater ($p < 0.001$) in males when compared with females. Statistically significant differences were not found in the mean hand dimensions of South and North Indian population when compared in the same sex.

Key words: Stature, Hand dimensions, Indian population

Introduction:

Estimation of stature and sex from incomplete skeletal and decomposing bodies is a recurring theme in physical anthropology and forensic science. This is useful during mass disasters like plane crash, mass suicide, tsunamis, forest fires, earthquakes, etc. Parameters used by several authors for this purpose include hand length, hand breadth and foot length, foot breadth and their indices.¹ Research works 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.²

The purpose of the present study is to analyze the anthropometric relationship between dimensions of hand length and hand breadth with stature and to obtain a regression equation which would help to estimate the stature with help of hand measurements alone.

Materials and Methods:

The present study was done in the

Department of Anatomy, in a Medical College, south India amongst 294 medical 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. All the subjects included in the present study were healthy and had no history of symptomatic deformity of the spine or hand.

Standing Stature was measured with the individual standing barefoot on the platform of the stadiometer with the upper back, buttocks and heels pressed against the upright position of the instrument. Head was positioned in the Frankfurt horizontal plane and the head plate was brought into firm contact with the vertex.

Hand measurements were taken from each hand of the subject using a sliding caliper. Hand length was measured when the subjects placed their hands supine on a flat horizontal surface with the fingers extended and adducted. Hand breadth was measured when the subjects placed their hands supine on a flat horizontal surface, with the thumb abducted and other fingers extended and adducted. Length of hand

was measured using sliding calipers (graduated in mm) as the straight distance between the midpoint of a line joining the two styli (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.³

Statistical Analysis

Analysis was done using descriptive statistics like mean standard deviation and range. Correlation coefficient and linear regression equations were used for estimating stature from hand dimensions. $P < 0.05$ was considered as statistically significant. The data was statistically analyzed using Epi info 3.4.3.

Results:

The study sample consisted of 129 females and 109 males belonging to South India and 33 females and 33 males belonging to North India. The mean statures of all groups are represented in **Table I**. The difference between mean stature of males and females in each group was statistically significant ($p < 0.001$). However, the difference in mean stature between South and North Indians of the same sex was insignificant.

Descriptive statistics for bilateral hand dimensions among South Indian and North Indian males and females are depicted in **Table II**. Mean values of hand length among South Indian and North Indian males was more than 18 and in females it was less than 18. Mean values of hand breadth among South Indian and North Indian males was more than 8 and in females it was less than 7.

Statistical analysis indicated that bilateral variation was significant for the measurements of hand length whereas bilateral variation was insignificant for hand breadth measurements. Hand dimensions on both sides were significantly greater ($p < 0.001$) in males when compared with females. Statistically significant differences were not found in the mean hand dimensions of South and North Indian population when compared in the same sex.

Correlation coefficient and linear regression equations for estimating stature from hand dimensions in both the populations are shown in **Tables III, IV and V**.

Table I: Mean values of stature

	Range	Mean±SD
SM	157-189	171.73±6.82
NM	158.5-179	169.04±5.49
SF	139-177	159.25±6.21
NF	150-175	158.42±5.20

SM - South Male, NM - North Male, SF - South Female, NF- North Female

Discussion:

Estimation of stature is considered as an important anthropometric parameter to the anthropologist, anatomist and obstetrician and in medico-legal practice. Differences are seen in different races. Studies have shown that no two individuals are exactly alike genetically; even identical twins differ in some aspects, and the variability is strongly influenced by genetic and environmental factors.⁴ One of the important objectives of examination is identification.⁵

Studies have shown that hand dimensions vary in different races. Therefore, formulae derived for one ethnic group may

Table II: Comparison of hand length & breadth between different groups

		Hand length		Hand breadth	
		Range	Mean±SD	Range	Mean±SD
SM	RT	16.4-24.2	18.81±1.12	7.3-9.2	8.24±0.38
	LT	16.4-24.5	18.74±1.47	7.2-9.0	8.00±0.63
NM	RT	16.0-23.1	18.95±1.32	7.4-9.3	8.24±0.38
	LT	16.2-23.2	18.70±2.13	7.0-8.9	8.10±0.33
SF	RT	14.8-19.8	17.17±0.93	6.3-9.2	7.24±0.46
	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	6.4-8.5	7.26±0.42
	LT	15.9-19.5	17.31±1.05	6.6-9.0	7.22±0.48

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

Table III: Correlation coefficient between Stature and different hand measurements

Variables	r value (SIF)	r value (SIM)	r value (NIF)	r value (NIM)
Stature vs Rt hand length	0.412	0.414	0.367	0.541
Stature vs Lt hand length	0.397	0.256	0.419	0.398
Stature vs Rt hand breadth	0.095	0.256	0.559	0.463
Stature vs Lt hand breadth	0.127	0.271	0.581	0.410

Table IV: Linear regression equations in South Indians

SF	SM
$S = 147.47 + 1.65 * \text{Left hand breadth} \pm 1.16$	$S = 148.17 + 2.94 * \text{Left hand breadth} \pm 1.01$
$S = 112.61 + 2.71 * \text{Left hand length} \pm 0.55$	$S = 149.47 + 1.18 * \text{Left hand length} \pm 0.43$
$S = 150.12 + 1.27 * \text{Right hand breadth} \pm 1.18$	$S = 151.18 + 2.54 * \text{Right hand breadth} \pm 0.92$
$S = 112.49 + 2.72 * \text{Right hand length} \pm 0.535$	$S = 124.18 + 2.52 * \text{Right hand length} \pm 0.535$

SF- South Female, SM South Male

Table V: Linear regression equations in North Indians

NF	NM
$S = 113.08 + 6.27 * \text{Left hand breadth} \pm 1.58$	$S = 114.75 + 6.7 * \text{Left hand breadth} \pm 2.68$
$S = 122.49 + 2.07 * \text{Left hand length} \pm 0.81$	$S = 149.87 + 1.02 * \text{Left hand length} \pm 0.42$
$S = 103.89 + 7.52 * \text{Right hand breadth} \pm 1.93$	$S = 114.36 + 6.63 * \text{Right hand breadth} \pm 2.28$
$S = 127.15 + 1.8 * \text{Right hand length} \pm 0.822$	$S = 126.41 + 2.25 * \text{Right hand length} \pm 0.628$

NF - North Female, NM - North Male

not be applicable to another ethnic group and this and this may be attributed to biological and environmental factors.⁶

In a study conducted on north Indian population, statistical analyses indicated that the bilateral variation was insignificant for all the measurements except hand breadth in both the sexes ($P < 0.01$). The correlation coefficients between stature and all the measurements of hands were found to be positive and statistically significant.⁷

One of the studies revealed no significant difference was observed in stature and hand dimensions between the Igbos and Hausas population. The study supports the fact that variations are present not only between races but also among ethnic groups.⁵ In one of the studies in north and south population, it was observed that in males, right hand length showed highest correlation. 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.²

A significant correlation of height with hand length has been observed in both the sexes. Measurements of right side were found to be greater but were statistically insignificant. Regression equations were derived which would help in estimation of stature.⁸ In a study by Manirul Islam, hand length showed a positive correlation with stature.⁹

In a study on Bangladeshi females, correlation between the stature and the hand variables was determined. Authors found significant positive correlation in case of hand length with the stature. Stature and hand breadth showed positive correlation but statistically insignificant.¹⁰

In a study by Jitendra P et al, the correlation coefficient was found to be statistically significant indicating a strong relationship between hand length and stature for males and females respectively.¹¹

One of the researchers have estimated that there are no significant differences in hand dimensions between north and south Indians. Right-hand dimensions were larger than the left hand, with statistically significant difference in hand length and hand breadth. Linear regression equations using hand length were found to be more helpful in estimating stature than the hand breadth.¹² In the present study, it was aimed to correlate stature with hand measurements. It shows a positive correlation of stature with hand measurements. Bilateral variation was significant for the measurements of hand length whereas bilateral variation was insignificant for hand breadth measurements. Hand dimensions on both sides were significantly greater ($p < 0.001$) in males when compared with females.

Conclusion:

Stature estimation has immense medico-legal importance where identifying the deceased from few body parts becomes a difficult task. From the present study, we conclude that mere availability of hand dimensions is sufficient to estimate the stature in forensic examination, especially whenever amputated hand is found and other parts of body are unavailable for examination.

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Conflict of interests- Nil

Source of funding- Nil

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Date of submission: 01-08-2015

Date of acceptance: 01-09-2015

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