Research Article

REVIEW STUDY; FEASIBILITY OF STATURE ESTIMATION FROM THE PALMAR SURFACE DIMENSION AMONG THE VARIOUS INDIAN POPULATIONS

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ABSTRACT

Personal identification of a living person or a dead body is based on certain physical characteristics that are unique to that individual, which helps in fixation of distinctive identity of that person. Among various parameters used for identification like age & sex, stature estimation of the dead has also gained importance in the field of forensics particularly in cases of mass disasters such as tsunami, building collapse, bomb explosion and vehicle accidents such as airplane crash, car accident, etc. Determination of stature is straightforward when the whole corpse/skeleton is recovered. However, the identification of remains can be complicated when the deceased can no longer be recognized due to the nature of the injuries sustained, or where fragments of the body are available, or the bodies are in advanced conditions of putrefaction, mutilation, and skeletonization. In such scenarios, statistical assessment of measurements of numerous bones and their correlation with various parameters of identification is studied and calculated. Studies in the past have provided satisfactory evidence of correlation between hand length and stature. This review is an attempt to discuss the assessment of stature demonstrated by the anthropometry of hand length among the Indian population to aid forensic professionals in establishing the identity of amputated remains. Review of vast literature on this topic revealed that variations are present between genders and also races in stature and hand length measurements, hence the resultant formulae applicable for one race and both genders possibly will not applicable to other races and gender. It also showed that either hand can be used for stature determination with great accuracy. Finally, it illustrated that prediction of stature is more reliable and accurate in case of females than males.

INTRODUCTION

In forensic investigation, the identification of the deceased from the Skelton remnants play a vital role. Although the identification of the victim can be done with the help of the DNA for which tooth, bone is used. Even, it becomes an important task for the investigator to get an estimation about gender determination and estimation of stature of the victim. The personal identification of a living being, or a dead body assumed based on convinced physical characteristics that are ubiquitous to an individual, which helps in fixation of distinctive identity of that person. Often in cases of mass disasters, flood, earthquake, tsunamis, fires, explosions, building collapse; vehicle accidents, train and airplane crash; decomposed, mutilated, dismembered, and skeletonized bodies etc. the identity of a dead body arises in questioned. In such conditions, the distinct parameters of identification are used by the forensic investigators i.e. race, sex, age, stature, general appearance, fingerprints, handwriting, dentition, gait pattern, anthropometric measurements, DNA etc.

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Whenever any decomposed, putrefied dead bodies or skelton remains are recovered, it becomes the first priority to estimate the stature of an individual along with age and gender. Therefore, stature estimation is significantly important role for identification purpose and to narrow down the possibilities. It is a straight forward procedure determine the height, race, gander from these recoveries. In living subjects, it is the height of the subjects while standing erect. However, the identification of remains can be complicated when the deceased can no longer be recognized, due to the nature of the injuries sustained, or where fragments of the body are found, or the bodies are in advanced conditions of putrefaction, mutilation, and skeletonization. In such scenarios, statistical assessment of measurements of numerous bones and their correlation with various parameters of identification is studied and calculated.

Numerous studies have been accounted since so long for a reasonable possibility of assessing stature from the skeletal remains and different body fragments. Among them all, hand length is to be considered one of the common and best resource. Although various studies have been conducted concerning stature estimation from hand dimensions, not many have compared those parameters among the different ethnic

groups in India.This review study was an attempt to discuss the feasibility for the assessment of stature, demonstrated by the anthropometry of hand length among the Indian population to aid forensic practitioners in the identification of amputated remains.

Morphology of Hand

Hands are unique appendages that are present at the farther most point (distal) of the upper extremities. Their main function is holding and they also perform precision movements for skilled work. Fingers are important part of our hand and are present towards the distal most area of the hand. According to standard anthropological formula, fingers are denoted as thumb-1, index-2, middle-3, ring- 4, and little-5, so the fingers are marked as 1D, 2D, 3D, 4D and 5D individually.
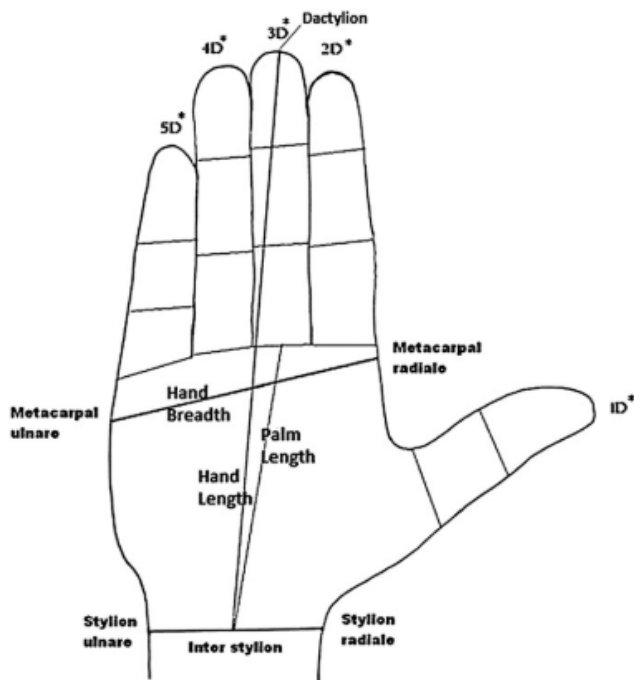

Figure 1 Important Landmarks of Hand

Flexure creases of hand usually wrinkle the skin over the flexure surface of the digits, palm, and the wrist and are the locales of skin folding during the process of moving hands. These flexure lines are valuable points of interest for estimations from the hand. Points of interest utilized for estimating hand length and hand breadth incorporate:

Interstylion- It is the centre point of the crease joining the points stylionradiale and stylionulnare. Stylionradiale is the distal most point on the styloid process of radius bone whereas stylionulnare is the distal most point on the styloid process of ulna bone.

Dactylion- It is the apex most point on the tip of the middle finger i.e. 3D digit.

Metacarpal Radiale- It is the point projecting most medially on the head of the 2nd metacarpal when the hand is stretched.

Metacarpal Ulnare- It is the point projecting most laterally from the head of the 5th metacarpal.

The distance between dactylion and the centre point of interstyloid line is known as hand length. All the measurements of hand in various studies were recorded using a sliding caliper.

METHODOLOGY

For the purpose of this study, extensive review of relevant literature has been studied. This study focuses on reviewing the literature on stature estimation from hand length in the Indian population and comparatively analyzing among all the Indian population. To ease the assessment and make it feasible for investigation purposes, this study was alienated Indian population into 5 regions/ states that were then analyzed individually i.e. Northern region, Western region, Southern region, Eastern region, Central region.

Stature Estimation from Hand Length

Stature refers to the vertical distance from the vertex (highest point on skull) to the surface on which the subject is asked to stand. For measurement of stature in all the current studies reviewed, the subjects were asked to stand erect, bare foot on a level platform with their hips and the backside touching the bar/wall, both the foot close to each other with the heals touching the bar/wall while the upper limbs hang by the side. The subject's head must be resting without any pull in the Frankfurt's plane. The measurement was made either by using a Stadiometer or an Anthropometer. The stature estimation of an individual is given below in figure no.1-

Figure 1 Stature measurement of an individual by using stadiometer.

Stature or body height is a significant anthropometric factor that helps todetermine the physical identity of an individual/subject. In living subjects, it is the height while standing erect, but stature estimation becomes problematic in cases where the dead bodies are mutilated, burnt, skeletonized or incomplete. Therefore, relationships between specific body measurements or indices have been developed so that these can be used in solving crimes where complete evidences are absent. For example, previous studies have reported

relationships using which stature can be determined from imprints of hand, small bones of hand, long bones, foot or footprints, etc. Certain studies have also shown positive correlation between stature and individual finger length. However, it must be understood that these relationships between body parameters vary between populations, ethnic groups, gender, and age groups.

This comparative study was conducted to determine the feasibility the stature estimation from the hand length in forensic investigation. Does an individual's stature of one region differ to the another one' stature from distinct region/state in a country? Can it play a vital role to prove the identity of an individual from the Skelton remains recovered from the scene of occurrence?

RESULT AND DISCUSSION

Since the early phase of forensic investigation, estimation of stature is considered one of the most important anthropometric parameters in medico-legal practice. Stature of an individual varies among sexes, races, ethnic groups, etc. These differences arise due to genetic factors, Ethnicity, Climatic conditions, Dietary habits, etc. Therefore, same regression equations cannot be used for analysis of stature among diverse groups of people. Hence, the statistical assessment of stature from hand length is made using different formulas for different groups and gender of people. Many studies have compared based on the right- and left-hand sizes of each sex using 't-test' and the difference was found to be statistically non-significant. In first table no.1; a comparative study was observed among the northern and eastern male individual's stature. As per the resultant of this observation, it was noticed that the regression equation among the Kashmiri population was S = 80.31 + 4.98(RHL) ± 4.99 while for LHL, it was S = 90.16 + 4.46(LHL) ± 5.06. It is an indication of variation which may be present in instruments or human measurement error. A comparative measurements table is given below in which all males stature was estimated. During all the studies, a specific age group of 18-35 was targeted.

Table 1 A comparative study among the northern and eastern male's stature estimation.

S.no.	Region	Population	Area	Age group (yrs.)	Correlation Right	Correlation Left	Regression equation* Rigth	Regression equation* Left
1.	N O R T H E R N E A S T E R N	Kashmiri	J&k	18-25	0.626	0.611	S = 80.31 + 4.98 (RHL) ± 4.99	S = 90.16 + 4.46 (LHL) ± 5.06
2.		Punjabi	Patiala , Punjab	18-25	0.654	0.654	H= 26.489+0.096 (RHL)	H = 27.058+0.095 (LHL)
3.		Jat Sikh	Patiala , Punjab	18-60	0.502	0.452	Y= 69.513 + 5.223(RHL) ± 4.033	Y= 84.742 + 4.491 (RHL) ± 4.406
4.		Kayastha community	Bundelkh and, U.P.	20-40	0.61		74.47+5.24(HL)	
1.		Eastern	Cuttack, Odisha and Kolkata, West Bengal	20-23	0.583		H(cm) = 9.3 X hand length (cm) ± 5.2	

Similar like of earlier, the comparison among the female's stature of northern and eastern population are given below in table no. 2-

Table 2 A comparative study among the northern and eastern female's stature estimation.

S.no.	Region	Population	Area	Age group (yrs)	Correlation Right	Correlation Left	Regression equation* Right	Regression equation* Left
2.	N O R T H E R N E A S T E R N	Kashmiri	J&k	18-25	0.685	0.69	S = 66.75 + 5.28 (rhl) ± 4.43	S = 66.41 + 5.32 (lhl) ± 4.38
		Kashmiri	J&k	20-45	0.787	0.777	-	-
4.		Jat sikh	Patiala, punjab	18-60	0.529	0.557	Y= 69.513 + 5.223(lhl) ± 4.033	Y= 130.035 + 1.660(lhl) ± 5.064
5.		Kayastha community	Bundelkhand, u.p.	20-40	0.30		135.29+1.12(hl)	
1.		Eastern	Cuttack, odisha and kolkata, west bengal	20-23	0.487		H (cm) = 14.3 x hand length (cm) ± 7.8	
2.		Bengalee women	West bengal	20-40	0.683	0.682	3.88 * hl+ 88.1 ± 3.49	

The above-mentioned table is the representation of northern and eastern population which was conducted in an age group of 18-60 years old. All the samples were collected by several researchers from distinct parts of west Bengal, Punjab, Odisha, Jammu and Kashmir etc. as a resultant of these studies, it was observed that a slight variation was present among all the residents as the right-hand length was S = 66.75 + 5.28(RHL) ± 4.43 while it was S = 66.41 + 5.32(LHL) ± 4.38 for the left-hand length. Similar like of that, the estimation of hand length 3.88 + 88.1 ± 3.49 was determined with slight variation in stature estimation. Similar like of it, according to the researches that were conducted on western and southern population; findings are given below in table no.-3.

Table 3 A comparative study among the Southern and western male's stature estimation.

S.no.	Region	Population	Area	Age group (yrs.)	Correlation Right	Correlation Left	Regression equation* Rigth	Regression equation* Left
1.	W E S T E R N	Gujarati	Ahmadabad, Gujarat	17-21	0.951		S = 103.20 + 3.606 (HL) ± 2.413.	
2.		Gujarati	Rajkot, Gujarat	20 & above	0.639	0.604	S = 85.517 + 4.452(RHL) ± 5.09	S = 92.972 + 4.079(LHL) ± 5.28
3.		Aurangabad	Maharashtra	18-25	0.72	0.66	S = 98.108 +3.903(RHL) ± 5.124	S = 97.557+ 3.907(LHL) ± 6.075
4.		Medical Students	Maharashtra	18-24	0.74	0.75	S=68.69+5.52 RHL ± 5.63 0	S=69.09+5.51 LHL ± 5.62
1.	S O U T H E R N	Students	Davangere, Karnataka	-	0.514	0.529	Y = 55.24 + 6.06(RHL)	Y = 70.55 + 5.21(LHL)
2.		Bangalore	Karnataka	18-25	0.221	0.186	Y = 7.96+ 0.061(RHL)	Y = 10.49+ 0.04(LHL)
3.		Tribals of Kasargod District	Northern Kerala	20-30	0.479	0.468	S = 106.306 + .283 x hand length ± 5.668	

Similar like of earlier studies, this study was comprised among the southern and western population stature. As per the obtained results of this study among the age group of 18-25 years, it was noticed that all the individuals of these populations have a variation among the stature but not significant. it is also suggested that it may be an effect of environmental conditions or genetic factors. Similar like above mentioned studies, another study was conducted between the western and southern population. The comparative table is given below in table no-4.

Table 4 A comparative study among the southern and western male's stature estimation.

S.no.	Region	Population	Area	Age group (yrs)	Correlation Right	Correlation Left	Regression equation* Rigth	Regression equation* Left
1.	W E S T E R N	Gujarati	Ahmadabad, Gujarat	17-21	0.943		S = 94.53 + 3.672 (HL) ± 2.802.	
2.		Gujarati	Rajkot, Gujarat	20 & above	0.571	0.556	S = 86.430 + 3.880(RHL) ± 4.70	S = 90.432 + 3.656(LHL) ± 4.76
3.		Aurangabad	Maharashtra	18-25	0.71	0.74	S = 83.260 + 4.269(RHL) ± 5.250	S = 84.572 + 4.208(LHL) ± 4.824
4.		Medical Students	Maharashtra	18-24	0.75	0.74	S=65.22+5.46 RHL ± 5.06	S=66.90+5.37 LHL ± 5.09
1.	S O U T H E R N	Students	Davangere, Karnataka	-	0.770	0.762	Y = 77.24 + 4.58(RHL)	Y = 65.49 + 5.21 (LHL)
2.		Bangalore	Karnataka	18-25	0.172	0.264	-	Y = 13.96+ 0.024 (LHL)
3.		Tribals of Kasargod District	Northern Kerala	20-30	0.949	0.949	S = 1.454 + .871 x hand length ± 2.394	

Even in this comparative study, a age group of 18-30 years was studied. As per the observation of it, only a minor variation was found among the right and left hand and its correlation with stature. The observed variation was up to ± 3 cm which can occur because of instrumental error or measuring errors.

As pert the obtained results of this study, it is suggested that hand can be used for a satisfactory analysis. Majority of the studies indicate that prediction of stature is less reliable and accurate in case of males than females and right hand has higher correlation than the left one. But this is not true in every case as evident in some of the above-mentioned studies.

CONCLUSION

Stature estimation from hand length has an enormous medicolegal significance especially in those cases where whole body of the victim is unavailable.This statue estimation can help to reveal the identity of the victim, other identifying parameters like race, age, etc. can also be determined. Merely availability of either hand or hand dimension can indicate the stature of that individual to a great accuracy as suggested by many studies in the past. These studies revealed that stature shows variations not only among genders but also between races. Therefore, the resulting formulae for a particular race and both the sexes will not be beneficial for stature assessment in some other race/ population of a specific region, country and to a gender. This review analyzed this aspect in the Indian population.

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