Stature Estimation from Dimension of Hands and Hand Prints in Dehradun Population

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ABSTRACT:

Background: Stature estimation by hand dimension is one of the common parameters in anthropometry but using the handprints for the same and its positive correlation with height of the subject, makes it a more useful parameter for identification of suspects who have left hand prints at the crime scene.[1]

Methodology: A cross-sectional study was carried out on 150 (75 males and 75 females) healthy subjects after taking voluntary informed consent. Stature was measured by stadiometer and hand and hand print dimension were measured by vernier caliper. Data was analysed by Statistical Package for Social Sciences (SPSS) version 20.

Results: All parameter's measurement were higher in male as compared to female subjects and shown range of weak to strong but positive correlation with height. Maximum positive correlation was observed in total population whereas minimum positive correlation was observed in between left hand breadth and left hand print breadth with height in female subjects. All the parameters were shown statistically significant correlation with height as p value was less than 0.05.

Conclusion: The regression models thus formed is able to predict stature would be beneficial in challenges of identification of humans.

KEYWORDS: Identification, Hand prints, Hand dimension, Stature.

INTRODUCTION

Anthropometry is the discipline of science dealing with measurement and proportion of various body parts or the body as a whole for the purpose of identifying and studying human physical variations. Every part of the body of a person has a relationship with their height and this forms the basis of stature estimation which is one of the important parameters of identification. Estimation of stature is done by using metric method, not only in cases of mass causality such as natural disasters, accidents, massacres where body as a whole or dismembered body parts are found but also by using hand[2-6] and foot prints[7-10] left at the scene of crime. Numerous studies have been conducted in the past for stature estimation with positive correlation and minimum standard error of estimation using hand[11], foot[12], upper limb[13], arm span[14] and lower limb[15]. The current study estimated the correlation between hand prints with hand as well as with stature and derived regression equations for Dehradun population considering what is true for one race or population may not be true for the other.

AIMS AND OBJECTIVES

Aim: To find out the relationship between hand dimensions, handprint dimensions and stature.

Objectives:
1) Correlation of hand dimension with hand print dimension

2) Correlation of hand dimension with stature of person
3) Correlation of hand print dimension with stature of person.

MATERIAL AND METHODS

A descriptive cross-sectional study was carried out on 150 (75 males and 75 females) healthy subjects, aged above 18 years after obtaining voluntary informed consent. Subjects having history of surgical amputation of hand, any fracture or deformity of hand and spine were excluded from the study. Materials used for the study were standard stadiometer, vernier calliper and ink. Various methods used for measurement of stature, hand and hand print is mentioned below:

(1) Stature: The person was asked to stand erect, barefooted on the horizontal flat base with his back straight and in line as well as in contact with the vertical board of the stadiometer. The head was in the eye ear eye plane. The distance between heel and the vertex of head measured in centimetres was noted as the stature of the subject.

(2) Hand: Hand dimensions were measured in centimeter to the nearest millimeters using vernier caliper. The subjects are asked to keep their hand in supine position with fingers extended and close to each other. The forearm and hand were so positioned that their long axis is parallel to each other. (a)Hand length: length between the distal crease of the wrist joint and tip of middle finger. (b)Hand Breadth: length between the lateral point of the head of second metacarpal bone and medial point of fifth metacarpal bones.

(3) Hand print: Print from both the hands were taken by asking the subjects to relax their hands with fingers extended and the thumb apart. They were taken using blue ink; subjects were asked to place both their hands one by one in prone position first in the ink pad with a little pressure and then on a white sheet of paper. Three readings were taken by different authors and mean value of the parameter was taken in order to reduce errors.

Statistical analysis: The obtained data was entered in Microsoft Excel and computation as well as analysis was done by SPSS software 2020.

RESULT

The descriptive analysis shows that mean values of all the parameters were high in males as compared to female subjects. All the parameters showed a range of weak to strong but positive correlation with stature. Maximum positive correlation was observed between stature and right-hand print length in the total population whereas minimum positive correlation was observed between left-hand breadth and left hand print breadth with stature in female subjects. All the parameters showed statistically significant correlation with stature as p value is less than 0.05 [Table no. 1]. Correlation between the hand prints with hand dimensions in all the subjects ranged from 0.652 to .994 with statistically significant correlation as p value is less than 0.05 except in cases of correlation between right hand index with right hand print index in total subjects, male subjects and female subjects [Table no. 2].

Table No.1: Pearson's correlation and regression equation between various parameters and stature

SUBJECTS	PARAMETER	MEAN	S.D	CORRELATION WITH STATURE	p VALUE (< 0.05)	REGRESSION EQUATION
Total	Right hand length	17.84	1.13	.823	.000	37.500-0.448*RHL
	Right hand print length	17.56	1.15	.828	.000	37.500+3.158*RHPL
	Right hand breadth	7.30	.54	.618	.000	37.500-4.085*RHB
	Right hand print breadth	7.07	.54	.635	.000	37.500+5.405*RHPB
	Left hand length	17.88	1.16	.823	.000	37.500+1.807*LHL
	Left hand print length	17.63	1.15	.825	.000	37.500+1.871*LHPL
	Left hand breadth	7.30	.55	.620	.000	37.500+0.304*LHB
	Left hand print breadth	7.01	.55	.611	.000	37.500+0.767*LHPB
	Right hand length	18.41	.99	.719	.000	50.249+6.540*RHL
	Right hand print length	18.16	1.0	.721	.000	50.249-4.123*RHPL
	Right hand breadth	7.53	.53	.504	.000	50.249-10.813*RHB

Male	Right hand print breadth	7.32	.51	.556	.000	50.249+14.738*RHPB
	Left hand length	18.49	1.07	.711	.000	50.249+3.549*LHL
	Left hand print length	18.25	1.03	.726	.000	50.249-0.681*LHPL
	Left hand breadth	7.54	.53	.509	.000	50.249-1.935*LHB
	Left hand print breadth	7.25	.51	.475	.000	50.249+1.489*LHPB
Female	Right hand length	17.04	.76	.699	.000	50.362-1.074*RHL
	Right hand print length	16.73	.75	.704	.000	50.362+3.140*RHPL
	Right hand breadth	6.99	.38	.313	.006	50.362+9.855*RHB
	Right hand print breadth	6.75	.41	.225	.038	50.362-8.279*RHPB
	Left hand length	17.05	.69	.710	.000	50.362+3.883*LHL
	Left hand print length	16.77	.66	.637	.000	50.362-0.205*LHPL
	Left hand breadth	6.99	.39	.300	.008	50.362+2.455*LHB
	Left hand print breadth	6.67	.41	.300	.008	50.362-2.798*LHPB

Table No. 2. Correlation of hand dimensions with hand print by Paired t- test

SUBJECTS	PARAMETER (TOTAL)	CORRELATION VALUE	P VALUE
Total	Right hand length	.992	.000
	Right hand print length		
	Right hand breadth	.970	.000
	Right hand print breadth		
	Right hand index	.659	.331
	Right hand print index		
	Left hand length	.973	.000
	Left hand print length		
	Left hand breadth	.902	.000
	Left hand print breadth		
	Left hand index	.823	.000
	Left hand print index		
Male	Right hand length	.994	.000
	Right hand print length		
	Right hand breadth	.967	.000
	Right hand print breadth		
	Right hand index	.652	.401
	Right hand print index		
	Left hand length	.973	.000
	Left hand print length		
	Left hand breadth	.934	.000
	Left hand print breadth		
	Left hand index	.876	.000
	Left hand print index		
	Right hand length	.971	.000
	Right hand print length		
	Right hand breadth	.950	.000
	Right hand print breadth		

Female	Right hand index	.679	.627
	Right hand print index		
	Left hand length	.899	.000
	Left hand print length		
	Left hand breadth	.720	.000
	Left hand print breadth		
	Left hand index	.749	.015
	Left hand print index		

DISCUSSION

In this study, sexual dimorphism was observed with higher values consistently recorded in male cases than their female counterpart in all the measured parameters for hand dimensions and handprints. This is in concordance with study conducted by a number of authors[1-6],[16-17] The most probable reason for mean values of men being higher than those of women is due to genetics[16] and their later maturity and growth cessation as seen in puberty.[1],[17]

Asymmetry in bilateral handprints has been observed in few authors who reported significant statistical ($p<0.05$) difference between left and right handprint values in both sexes[3-4],[16],[18-20] which they have attributed to hand dominance.[16] However, the others either observed symmetry[1] or like our study did not consider this parameter for analysis.

Similar to other studies[3-4],[6], we also observed that the parameters of hand dimensions and handprint showed statistically significant correlation with stature except in cases of correlation between right hand index with right hand print index in total subjects, male subjects and female subjects.

In this study, the female's values consistently showed lesser association with stature than the result of males sample in all the studied variables. This finding is in concordance to many authors[2-3],[17],[21] while differs with the study conducted by few[1],[22] Suitable explanation for this phenomenon is yet to be offered.[3] In addition, foot dimensions were also measured in the study conducted by Zhang X et al and it was concluded that a combination of right hand/foot length is considered as best predictor of stature because it had the lowest Standard error. Also, multiple regression equations resulted in lower values than did linear regression equations.[2]

The highest and lowest correlation values with stature varied when different parameters of hand dimensions as well as handprints were taken into consideration. The highest correlation with stature in our study was observed with right-hand print length in the total population whereas lowest correlation was observed with left-hand breadth and left hand print breadth in females.

These variations among the correlation values in various studies conducted at different regions[1-6],[16-21] further emphasize the fact that every region needs a population-specific regression equation for prediction of stature.

CONCLUSION

The dimensions of hand and handprint may prove to be reliable parameters for predicting the stature of an individual in Uttarakhand Population specially in cases of mass disasters, during recovery of dismembered body parts from the forest as well as in crime scene investigations where hand prints are found at the scene of crime. However, there are some factors which need to be considered during application of the results of this study such as the geriatric age group in which shortening of the intervertebral space occurs thereby affecting the stature of the person; no specific study has been reported in the literature about hand and handprint dimensions in old age.[3]

It has been observed that there are diversities in anthropometric measurements based on ethnicity and region. Also, since specific means for identifying gender and ethnicity from handprints are yet to be established[3], it is suggested that further studies and more exploration is required on this topic.

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