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Estimation of Stature from Hand Length and Hand Breadth among Population Groups of Himachal Pradesh

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Abstract - **Estimation of stature is an important parameter in medico legal examinations and anthropological studies. This paper demonstrates that the anthropometry of hand plays a significant role in estimating stature. The aim of the present study is to compute regression equation from hand measurements (Length and Breadth) and to find the difference from direct and indirect measurements for the estimation of stature among population groups of Himachal Pradesh, India. The present investigation is based on the hand prints of 73 Rajput (34 male and 39 female)and 110 Brahmin (48 male and 62 female) with age group 20-60 years of Sunder Nagar, District- Mandi, Himachal Pradesh, India by the ink method (kapoor,1987). Hand lengths (direct) was measured with the help of sliding caliper from bracelet crease to the tip of the print of the middle finger and Hand breadth (indirect) was measured between meta carpel radiale and meta carpel ulnare with the help of sliding caliper. Hand length and Hand breadth (indirect) was measured from the palm print taken on a plain paper. The stature of each subject was measured following the standard techniques of Martin and Seller (1959). Result was analyzed with the help of SPSS-17 using basic statistics and t-test, simple linear regression and correlation. In the present study regression equation has been computed in order to observe the possible predictor of estimating stature from direct and indirect measurements among males and females.**

Keywords: **Stature, Hand Length, Hand Breadth**

I. Introduction

Estimation of stature is an important parameter in medico legal examinations and anthropological studies. Crimes can be detected through the scientific analysis of shoe marks, fired bullets, cartridges bites, broken headlight glass, blood or blood stains, hair, textiles, clothing, and burns etc. There are different methods in use for detecting a crime. Dermatoglyphics has made a unique contribution in forensic science and forensic Anthropology. (Kapoor, 1987). Studies on the estimation of stature from skeletal remains or mutilated limbs, mostly of long bones have been reported as indicated by the published work of the Pearson (1899), Trotter and Glesser (1952).

The Indian perspective of the problem of stature estimation has been studied by Athwale *et al* (1963), Patel et al (1964), Joshi *et al* (1964,65), Lal and Lala (1972), Kalte and Bansal (1974), Kapoor, (1987); Thakur and Rai (1987), Saxena (1984), Bhatnagar *et al* (1984), Jasuja (1987) and Jasuja *et al* (1991, 1993, 1997). Rollet (1899) was the first to publish tables to calculate stature from humerus, radius, ulna, femur, tibia and fibula in 50 male and 50 female French cadavers. He measured the bones first in the "fresh state "and 10 months later in the "dry state ". In this time, they had lost 2mm in over length. Since then a voluminous literature has been added to calculate stature from long bones and from different parts of body.

The present paper attempts to estimate stature from the hand length and hand breadth (Direct and Indirect) as obtained through palm prints among Rajput and Brahmins of Himachal Pradesh. The fingers or palms come into contact with objects and leave their latent impressions, it is these chance prints that sometimes provide evidence and help in criminal investigation. Thus if a palm print (hand length and hand breadth) is discovered at the scene of crime, we can obtain hand length and hand breadth of criminals and through regression equations, we can assess the stature of the criminals. The estimation of the stature can be helpful to Law Enforcement Agencies and other related with Police Science.

II. Materials And Methods

The present investigation is based on the hand prints of 73Rajput (34 male and 39 female) and 110 Brahmin (48 male and 62 female)with age group 20-60 years of Sunder Nagar, Distt. Mandi, Himachal Pradesh, India.

Ink method (given by Cummins and Midlo, 1961 and technique developed by Kapoor, 1987) was used to take the hand prints. Hand lengths (direct) were measured with the help of sliding caliper from bracelet crease to the tip of the print of the middle finger and Hand breadth (direct) were measured between meta carpel radiale and meta carpel ulnare with the help of sliding caliper. Hand lengths and Hand breadths (indirect) were measured from the palm print taken on a plain paper. The stature of each subject was measured following the standard techniques of Martin and Seller (1959). Results were evaluated through SPSS 17. Comparisons of measurement values between direct and indirect were evaluated with t-test analysis. The relation between right hand length direct and stature was determined by Pearson Correlation Analysis. The formulae were worked out by employing Linear Regression Analysis for stature estimation for gender estimation.

Population Group: Brahmin–The Brahmin form the largest social group in the Himachal Pradesh. They inhabit all parts of the state except Kinnaur and Spiti. However, in Lahaul, Swangla identify them Brahmin as such. The famous Brahmins Gotras are Kaushal, Pathak, Vashishtha, Bhardwaj, Saraswati, Kashyap, Gautam, Atri and Upamanyu. It is common belief in Himachal that the Brahmin have migrated from the plains, time to time.

Rajput - The Rajput form rather a ruling class than a true caste and compromise all the families of the hill chiefs and their descendants. They are divided into three races: Surajvanshi, Chandravanshi and Agnavanshi. Subsequently, this classification as changed into numerous clans: Pathania, Dadwal, Balauria, Gulera, Rana ,Parmaa, Chauhan, Glia, Chandel, Kalachuri, Thakur and Verma.

All the sub castes among the Brahmin and Rajput of different districts of Himachal Pradesh marry each other and hence make one each anthropological population.

III. Results

In the present study the results are summarized in Table I. The age group of the individuals have been restricted to that between 20-60 years with sample size 181.

Table 1 Computed Value of Mean, Standard Deviation and T-Test of Male And Female

Variables	Mean ± S.D		t-test	significance
	Males (N=79) F	emales (N=102)		
Stature	170.47 ± 7.22	156.41 ± 5.67	-12.529	p<0.001
Right Hand Length (direct)	18.56 ± 0.81	17.07 ± 0.77 -	10.729	p<0.001
Right Hand Length (indirect)	18.72 ± 0.84	17.19 ± 0.76 -	10.932	p<0.001
Left Hand Length (direct)	18.60 ± 0.81	17.11 ± 0.76 -	10.775	p<0.001
Left Hand Length (indirect)	18.63 ± 1.33 1	7.21 ± 0.75	-7.845	p<0.001
Right Hand Breadth (direct)	8.46 ± 0.38 7	.56 ± 0.34 -	14.198	p<0.001
Right Hand Breadth (indirect)	8.51 ± 0.38 7	.68 ± 0.32	-13.580	p<0.001
Left Hand Breadth (direct)	8.33 ± 0.36 7	.40 ± 0.32 -	15.458	p<0.001
Left Hand Breadth (indirect)	8.46 ± 0.38	7.56 ± 0.34	-14.384	p<0.001

Table I shows the mean of variables i.e. (Right hand length direct, Right Hand Length Indirect; Left Hand length Direct; Left Hand Length Indirect ;Right Hand Breadth Direct; Right Hand Breadth Indirect ;Left Hand Breadth Direct; Left Hand Breadth Indirect) with S.D. and 't'-test among males and females of Himachal Pradesh. It shows that the differences of means are significant for all the variables.

Table II Computed Value Of Correlation Coefficient and Coefficient of Determination with Stature with 'B' and 'Beta' Values

Variables	Type of Measurement (Direct/Indirect)	Unstandardized Coefficients	Standardized Coefficient	Significance Of regression coefficients	R^2
		b	beta		
Right Hand Length	Direct	6.872	0.794	0.000	0.630
	Indirect	6.771	0.601	0.000	0.361
Left Hand Length	Direct	4.952	0.658	0.000	0.433
	Indirect	0.121	0.161	0.031	0.026
Right Hand Breadth	Direct	5.913	0.681	0.000	0.464
	Indirect	5.756	0.454	0.000	0.206
Left Hand Breadth	Direct	11.752	0.699	0.000	0.489
	Indirect	11.546	0.627	0.000	0.393

Table II shows the computed values of regression coefficients and coefficient of determination for Right hand length direct, Right Hand Length Indirect, Left Hand length Direct, Left Hand Length Indirect, Right Hand Breadth Direct, Right Hand Breadth Indirect, Left Hand Breadth Direct, and Left Hand Breadth Indirect with stature.

Table III Regression Equations to Estimate Stature Among Males and Females with Correlation Coefficient

Variables	Male	SEE	Significance	r between observed and predicted stature	Female	SEE	Significance	r between observed and predicted stature
Right Hand Length Direct (x):	y=79.23+4.91x	6.05	p<0.05	0.554**	y=86.03+4.11x	4.56	p<0.001	0.570**
Right Hand Length Indirect (x)	y=76.88+4.99x	5.92	p<0.05	0.342**	y=86.39+4.06x	4.55	p<0.001	0.475**
Left Hand Length Direct (x):	y=169.73+0.36x	7.24	ns	0.096	y=88.20+3.97x	4.67	p<0.001	0.541**
Left Hand Length Indirect (x):	y=135.84+1.86x	6.83	p<0.05	0.342**	y=88.33+3.94x	4.72	p<0.001	0.528**
Right Hand Breadth Direct (x):	y=165.218+0.63x	7.28	ns	.086	y=123.79+4.15x	5.35	p<0.01	0.268**
Right Hand Breadth Indirect(x):	y=140.368+3.53x	7.15	ns	0.186	y=148.70+0.94x	5.53	ns	0.139
Left Hand breadth Direct (x):	y=139.85+3.67x	7.15	ns	0.185	y=117.23+5.20x	5.18	p<0.05	0.318**
Left Hand Breadth Indirect (x):	y=139.60+3.64x	7.14	ns	0.192	y=122.29+4.42x	5.27	p<0.05	0.273**

**p<0.01

Table III shows the computed regression equations for males and females with error of estimation and the correlation between observed and predicted stature.

IV. Discussion

Estimation of stature is an important parameter in identification of skeletal remains in forensic examinations. Our result shows that 'b' and beta value was found more in direct measurements i.e. Right hand length direct, left hand length direct, right hand breadth direct and left hand breadth direct than the indirect measurements.

R^2 is the proportion of variation in stature explained by hand measurements in study, male and female groups. When r^2 was calculated between stature and variables (RHLD, RHLI, LHLD, LHLI, RHBD, RHBI, and LHBD AND LHBI), the highest value of r^2 was found in Right Hand Length direct and it has a significant relation with the stature. According to r^2 value results, 63 % of the stature change in study all groups can be explained with Right hand length (direct).

The regression equations for the estimation of stature from the hand measurements have been reported earlier also. The regression equations for estimation of stature from different hand measurements in population of Himachal Pradesh have been given in Table III. These equations were tested by putting the actual values and found that error of estimation of stature exists within the calculated range. In the present study, regression equations have been formulated with the standard error ranging from 7.28 to 5.92 centimeters in case of the males and 5.53 to 4.55 centimeters in case of females which indicates that these parameters are more efficient predictors in stature estimation for females than males. Shintaku and Furuya(1990) reported a correlation of proximal phalange and stature for Japanese women. It is also noticed that Egyptian females exhibit a low SEE (±4.54–5.48cm) and a relatively higher correlation coefficient between stature and lengths of hands and phalanges than those observed in their male counterparts (SEE ± 5.30–7.27 cm).This suggests that the accuracy in predicted stature would be greater among females than in males. Similar results were reported by Krishan and Sharma (2007) on their study of a North Indian population. Habib and Kamal (2010) showed that stature prediction is more reliable in case of Egyptian females than in males. The regression equations were derived from hand and phalange lengths and indicated that the stature can be estimated from them with SEE ranging from +4.54 to ±7.27 cm for both sexes. It indicates that if either of the measurements is known, the other can be calculated and this knowledge can be used in forensic studies as well as in medico legal investigation in the way that in some cases only partial prints are found.

Table IV Regression Equations to Estimate Stature Given by Different Authors Among Different Population Groups in India

POPULATION	AREA	VARIABLE	EQUATION				SOURCE
			MALE		FEMALE		
			RIGHT	LEFT	RIGHT	LEFT	
JAT	CHANDIGARH	HAND LENGTH	S=89.63+ 4.31±5.22	S=88.63+4.37 ±5.17	S=81.22+4.43± 3.78	S=84.54+4.24± 3.82	JASUJA,2004
		HAND BREADTH	S=98.23= 8.81±5.60	102.11+8.17± 5.50	S=102.39+6.13± 4.50	S=120.41+4.83± 4.76	
NIGERIAN& INDIAN	NIGERIA	HAND LENGTH	Y=92.2409 +3.9465X	Y=70.2426+ 5.0596X	-	-	SAXENA,2004
		HAND BREADTH	Y=90.4531 +3.5623X	Y=97.9845+ 3.1698X	-	-	
MEDICAL STUDENTS	KANPUR	HAND LENGTH	S=51.388+ 5.988X	Y=158.91+ 0.04404X	-	-	THAKUR AND RAI,1987
		HAND BREADTH	S=0.092.30 8 +8.908X	S=113.458+ 6.539X	- -	- -	
PUNJABI	CHANDIGARH	HAND LENGTH	Y=127.97+ 2.06X	Y=141.64+ 3.13	-	-	BHATNAGAR et al,1984

Regression equation is given to estimate stature for different population groups of India by different authors in table IV. On this basis, it can be concluded that one regression equation can be formulated for all Brahmin and Rajput of Himachal Pradesh to estimate stature from hand measurements, one from feet measurements, and one from finger prints and so on. Thus, this regression equation can be useful to estimate stature for Brahmin and Rajput from their hand prints are found and further the analysis can be done which can be used for law enforcement agencies.

V. Conslusion

It is concluded that hand measurements are highly reliable for the estimation of stature in forensic examinations. Hand measurements (direct) gives better prediction of stature than that of indirect in both sexes and stature prediction is more reliable in case of females than in males. The regression equations were derived from hand measurements indicated that the stature can be estimated from them with SEE ranging from +4.55 to ±7.28 cm for both sexes. We believe that stature estimation should be gender specific with right hand measurements being more reliable.

References

[1] N.C. Athawale, "Estimation of height from lengths of forearm bones; a study of one hundred Maharashtra male adults of ages between twenty five and thirty years", *J Phys Anthrop,* Vol. 21, pp.105-112, 1963.

[2] D.P. Bhatnagar, S.P. Thapar, and M.K. Batish, "Identification of personal height from the sometometry of the hand in Punjabi males", *Sci Inter;* Vol. 24, pp.137-141, 1984.

[3] H. Cummins, and C. Midlo, "Finger prints, Palms and Poles - An Introduction to Dermatoglyphics", *Dover Publications,* 1961.

[4] O.P. Jasuja, "Estimation of Stature from Hand Length and Phalange Length", *JIAFM,* Vol. 26, No. 3, 2004.

[5] N.B. Joshi, M.P. Patel, M.G. Amin, "Use of tibia and ulna in estimation of total body height", *Indian J med,* Vol.53, pp.831-834, 1965.

[6] A.K. Kapoor, "Estimation of stature from the hand length as obtained through palm prints among the Lodhas of district Midnagar, West Bengal", *Indian Journal of physical anthropology and human genetics,* Vol. 13, No.2, pp.139-742, 1987.

[7] P.M. Kolte, P.C. Bansal, "Determination of regression formulae for reconstruction of stature from the long bones of Upper limb in Maharashtra of Marathwada region", *Anat Soc India,* Vol. 23, No. 6-11, 1974.

[8] K. Krishan, and A. Sharma, "Estimation of stature from dimensions of hand and feet in North Indian population", *Journal of forensic and legal medicine,* Vol. 14, No.6, pp. 327-332, 2007.

[9] Kumar Sushil, A.K. Srivastava, and M.K.B. Sahai, "Estimation of stature by anthropometric examination of forearm and hand", *J Indian Acad Forensic Med,* Vol. 32, No.1, 2010.

[10] C.S. Lal and J.K. Lala, "Estimation of stature from tibial and ulnar lengths in North Bihar", *Journal of Medical Association;* Vol. 58, pp. 120, 1972.

[11] K. Pearson, "Mathematical contributions to the theory of evolution. V. On the reconstruction of the stature of prehistoric races", Phil Trans Roy London; Vol. 192, pp.169-244, 1989.

[12] S. K. Saxena, P. Jeyasingh,A.K. Gupta, and C.D. Gupta, "Estimation of stature from measurement of hand length", *J. Anat. Soc. India,* Vol. 30, pp.78-79, 1981.

[13] K. Shintaku, and Y. Furuya, "Estimation of stature based on the proximal phalangeal length of Japanese women's", *JUEOH,* Vol. 12, No.2, pp.215–9, 1990.

[14] Dikshit Sunil, A. Aggrawal, and M. Rani, "Estimation of Stature from Hand Length", *JIAFM,* Vol.. 27, No.4.

[15] A. Telka, "On the prediction of the stature from the long bones", *Acta. Anat.,* pp.103-107, 1990.

[16] S.D. Thakur, and K.S. Rai, "Determination of stature from hand measurements", *Med Law*, Vol. 9, No.2, pp. 25-28, 1987.

[17] M. Trotter and G.C. Gleser, "A re-evaluation of stature based on measurements taken during life and of long bones after death", *J Phys Anthrop,* Vol. 16, pp. 79-123