Original Article

TO STUDY THE CORRELATION BETWEEN STATURE AND PALM PRINTS AMONG NORTH INDIANS AND SOUTH INDIANS
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Abstract:

Forensic anthropology is an applied discipline. It is a branch of physical anthropology which interacts with other disciplines pertaining to understanding of crime and its investigation. Personal identification is an integral part of the crime investigation in cases of mass disaster where mutilated and disintegrated body parts are frequently found. Finger print and palm prints are available at most of crime scenes. In this study, efforts have been made to estimate the stature (height) of a person from palm prints. Palm prints were obtained from 160 individuals in the age group of 18 to 25 years. Their height is measured along with complete physical examination. All the above measurements were tabulated and subjected to statistical calculations and final results were further analyzed.

In the present study, regression formulae and multiplication factor has been derived to calculate stature from hand prints.

Key Words: Forensic anthropology, Stature, palm prints.

Introduction:

Forensic anthropology is the application of the anthropological knowledge and techniques in a legal context[1]. Forensic anthropologists while dealing with skeletol remains have very little choice to use anatomical method for stature reconstruction due to non availability of complete skeleton from crime scene in most of cases. Thus they have no choice but to use mathematical method which is workable even with a single long bone. Estimation of stature from skeletal material or from amputed and mutilated limb has significance in cases such as mass disaster, accident and murder.[2]

Estimation of stature from hand length has been reported from Saxena1984, Thakur and Rai 1987, Sharma and Kapoor 2001, Jasuja and G. Singh 2004, from hand length and breadth by Bhatnagar et al 1984, Rastogi et al 2008. [3]

In many crime scenes one can find latent prints including palm and fingerprint. Moreover in India, in every Government offices and most of the private sector companies, hand prints are obtained at the time of recruitment of employees. This definitely helps to identify the person who is missing and estimation of stature from these palm prints narrows the margin of error.

Previously Sharma and Kapoor 2001 and Jasuja and Singh 2004 have reported similar studies in North India.

India is a big country with varied geographic variations. Stature varies with geographical condition, race, environment and climatic conditions.[4] Considering all these facts, in present study attempt has been made to estimate stature of a person from palm prints. Also an attempt has been made to study relation of stature with palm print length and breadth in North Indians and South Indians separately.

Material and Method:

160 students of a medical college in Pondicherry aged 18 to 25 years were chosen for the study. Amongst them 40 were North Indian males and 40 were North Indian females.

Remaining 80 students comprised of 40 South Indian males and female respectively. Maximum height of a person is attained after the age of puberty, to be more precise at 18-21 years of age. For all practical purposes stature at 18 years of age is accepted as adult stature. The age above 18 year is chosen for the reason that by this age, there is completion of skeletal growth and ossification of all bones. Upper limit of age is taken as 25 years. Their consent was obtained, full particulars like name, age, sex and place to which they belong were recorded and their general and systemic examination was done. Permission was sought from the Institutional Ethical committee.

Following measurements were taken:
1. Stature (standing height): The subject was asked to stand barefoot on the base of a standard stadiometer in a standard standing position. The individual was instructed to stand with both feet in close contact with each other, trunk braced along the vertical board on the stadiometer with head oriented in ear-eye plane and the lateral palpebral commisure and the tip of the auricle of the pinna in a horizontal plane parallel to that of the feet. Then the measurement was taken in centimeters as the distance between the standing surface and highest point on the head (vertex) by bringing the sliding bar to the vertex.
2. Palm prints: Before taking the inked impression, subject's hands were thoroughly washed and allowed them to dry. The subjects were asked to place their hand prone on graph paper placed on table. Palm prints of both the hands are taken on the graph paper with hand fully relaxed with finger close to each other and thumb is apart. Palm print length is measured from midpoint of line joining the proximal maximum far points on print of wrist (corresponds to wrist crease) to tip of middle finger. Palm print breadth is measured as a distance between radial side of 2nd metacarpophalangeal joint to ulnar side of 5th metacarpophalangeal joint on the print on graph paper.[5]

All these measurements were taken by the candidate himself to avoid inter observer bias and recorded in the pretested and predesigned proforma. From which a master chart is prepared. All the above measurements were tabulated and subjected to statistical calculations and final results were further analyzed using SPSS (Statistical Package for Social Sciences, [12].)

Results:
Stature estimation in North Indian and South Indians is shown in table No.1

Table No.1: Comparison of stature between North Indian and south Indians

Stature (cm)					
	Min	Max	Mean	SD	*P*
Males					
North Indians (n=40)	156	182	170.67	9.06	0.302
South Indians (n=40)	160	184	172.96	7.09	
Females					
North Indians (n=40)	137.8	175	157.77	8.44	0.752
South Indians (n=40)	147	167.5	172.86	5.22	

SD: standard deviation

In North Indian population, height is more in males as compare to that of females but in south Indian population, there is no significant difference. In this study south Indians are comparatively taller than north Indian in both sexes.

The mean value of hand dimension in both north and south Indian are shown in table 2 and 3 respectively.

Table No. 2: Hand dimensions in North Indians

Dimensions	Side	Male (n=40)					Female (n=40)				
		Min	Max	Mean	SD	*P*	Min	Max	Mean	SD	*P*
Hand Length	Right	15.9	20	17.78	1.14	0.917	14.4	17.8	16.02	0.91	0.670
	Left	16	19.8	17.81	1.06		14.4	17.9	16.12	0.95	
Hand Breadth	Right	6.8	8.9	7.58	0.49	0.896	6.0	7.6	6.88	0.40	0.528
	Left	6.7	8.7	7.56	0.48		6.3	7.6	6.94	0.32	

Palm Print length=Hand length, Palm print breadth=Hand breadth

Table No. 3: Hand dimensions in South Indians

Dimension	Side	Male (n=40)					Female (n=40)				
		Min	Max	Mean	SD	*P*	Min	Max	Mean	SD	*P*
Hand Length	Right	16.9	20.8	19.19	0.93	0.989	15.1	18.8	16.52	0.87	0.870
	Left	16.9	20.7	19.20	0.97		15.1	19.1	16.55	0.85	
Hand Breadth	Right	6.4	9.2	7.64	0.57	0.932	6.2	7.8	6.78	0.34	0.813
	Left	6.1	9.0	7.65	0.62		6	7.5	6.76	0.29	

Table No.4: Comparison of hand dimensions between North & South Indians

Dimensions	Side	Male			Female		
		North (n=40)	South (n=40)	*P*	North (n=40)	South (n=40)	*P*
Hand Length	Right	17.78	19.19	0.000	16.02	16.52	0.036
	Left	17.81	19.20	0.000	16.12	16.55	0.071
Hand Breadth	Right	7.58	7.64	0.668	6.88	6.78	0.327
	Left	7.56	7.65	0.534	6.94	6.76	0.032

In groups, hand length and hand breadth are larger in males as compared to that of females. Left hand length is comparatively and marginally larger in both North and South Indian population than right hand length. However difference is insignificant in breadth.

The linear regression equations are derived for estimation of stature in males and females in North Indian population shown in table no. 5 and 6 respectively.

Table No.5: Table showing Linear Regression Equation from both dimensions for height estimation in North Indian males

Dimensions	Side	Equation	Standard Error (SE)	Correlation coefficient (R)	Coefficient of determination (R2)
Hand Length	Right	S= 109.99+3.41(RHL)	1.35	0.429	0.184
	Left	S= 108.78+3.47(LHL)	1.46	0.408	0.166
Hand Breadth	Right	S= 105.56+8.64(RHB)	3.04	0.472	0.222
	Left	S= 117.41+7.04(LHB)	3.27	0.377	0.142

RHL=Right Hand Length, LHL=Left Hand Length, RHB=Right Hand Breadth, LHB= Left Hand Breadth

Table No.6: Table showing Linear Regression Equation from both dimensions for height estimation in North Indian Females

Dimensions	Side	Equation	Standard Error (SE)	Correlation coefficient (R)	Coefficient of determination (R2)
Hand Length	Right	S= 49.677+ 6.746(RHL)	1.186	0.732	0.5358
	Left	S= 49.752+ 6.698(LHL)	1.103	0.754	0.5685
Hand Breadth	Right	S=81.854+ 11.035(RHB)	3.339	0.530	0.2809
	Left	S=80.235+11.173(LHB)	4.480	0.426	0.1814

RHL=Right Hand Length, LHL=Left Hand Length, RHB=Right Hand Breadth, LHB= Left Hand Breadth

In both the sexes positive correlation coefficient shows relationship between hand length and hand breadth with stature. However in both sexes standard error is more in breadth as compared to that of length.

The linear regression equations are derived for estimation of stature in males and females in North Indian population shown in table no. 7 and 8 respectively.

Table No.7: Table showing Linear Regression Equation from both dimensions for height estimation in South Indian Males

Dimensions	Side	Equation	Standard Error (SE)	Correlation coefficient (R)	Coefficient of determination (R2)
Hand Length	Right	S=62.49+5.75(RHL)	0.928	0.76	0.577
	Left	S= 60.01+5.87(LHL)	0.80	0.81	0.656
Hand Breadth	Right	S= 142.67+3.95(RHB)	2.193	0.32	0.1024
	Left	S=136.32+4.77(LHB)	1.96	0.418	0.174

RHL=Right Hand Length, LHL=Left Hand Length, RHB=Right Hand Breadth, LHB= Left Hand Breadth

Table No. 8: Table showing Linear Regression Equation from both dimensions for height estimation in South Indian Females

Dimensions	Side	Equation	Standard Error (SE)	Correlation coefficient (R)	Coefficient of determination (R2)
Hand Length	Right	S=111.18+2.85(RHL)	0.992	0.478	0.228
	Left	S=104.625+3.26(LHL)	0.97	0.537	0.288
Hand Breadth	Right	S=143.57+2.17(RHB)	2.793	0.146	0.021
	Left	S=163.05-0.695(LHB)	3.28	0.04	0.0016

RHL=Right Hand Length, LHL=Left Hand Length, RHB=Right Hand Breadth, LHB= Left Hand Breadth

In both the sexes positive correlation coefficient shows relationship between hand length and hand breadth with stature. However in both sexes standard error is more in breadth as compared to that of length.

Multiple regression equations are derived to estimate the stature using various hand dimensions in north and south Indians.

Table No.9: Multiple regression equation for stature estimation

Population	Sex	Side	Equation	SEE	R
North Indian	Male	Right	98.174 + 1.413(RHL) +6.246(RHB)	6.520	0.487
		Left	97.513 + 2.433(LHL) + 3.940 (LHB)	5.761	0.443
	Female	Right	43.430 + 6.051(RHL) +2.527 (RHB)	4.979	0.738
		Left	42.442 + 6.404(LHL) + 1.736 (LHB)	5.100	0.756
South Indian	Male	Right	64.318 + 6.440(RHL) – 1.973(RHB)	2.944	0.772
		Left	59.609 + 6.724 (LHL) – 2.070 (LHB)	2.672	0.823
	Female	Right	101.445 + 2.8(RHL) + 1.570(RHB)	3.524	0.489
		Left	112.601 + 3.296 (LHL) – 1.305 (LHB)	3.806	0.542

Multiple regression equation shows better correlation coefficient than linear regression equations.
Multiplication factors were also calculated for hand dimensions in both the population.

Table No.10: Multiplication Factor in North Indian Population

| Dimensions(cm) | Side | Male | | Female | |
		Multiplication Factor	Standard Deviation(cm)	Multiplication Factor	Standard Deviation(cm)
Hand Length	Right	9.62	0.61	10.35	2.67
	Left	9.6	0.59	10.23	2.36
Hand Breadth	Right	22.56	1.36	22.47	2.73
	Left	22.61	1.46	22.31	2.76

Table No.11: Multiplication Factor in South Indian Population

Dimensions(cm)	Side	Male		Female	
		Multiplication Factor	Standard Deviation(cm)	Multiplication Factor	Standard Deviation(cm)
Hand Length	Right	9.01	0.29	9.6	0.44
	Left	9.01	0.27	9.58	0.41
Hand Breadth	Right	22.71	1.63	23.39	1.34
	Left	22.69	1.66	23.45	1.33

In both the population standard deviation is more in case of hand breadth as compared to that of hand length.

Discussion:

The reviewed literature shows that certain factors like heredity, nutrition, climatic condition and races have influence over the stature. Considering this fact, in the present study an attempt has been made to find out stature from palm prints in North and South Indian populations.

In this study, in both groups males had greater hand dimensions and stature as compared to females which is similar to other studies.[5,6,7] This suggest that there is genetic difference between male and female and hence formula for one sex cannot be applied for other while estimating stature from palm print.

In present study, in both groups hand length is more on left side in both male and female though all subject selected in study were having right hand dominance. But similar difference is not found in case of hand breadth. So it does not show any significant relation between hand dimensions and dominance of hand.

Linear regression equation was derived to estimate stature from palm print length and breadth. The correlation coefficient ranges from 0.337 to 0.472 in North Indian males and 0.426 to 0.754 in North Indian females. Similarly in South Indian males it ranges from 0.32 to 0.81 and in South Indian females from 0.04 to 0.537. Hand length thus shows better correlation coefficient than hand breadth. Similar findings are observed in study done by Rastogi P et al.[4]

Multiple regression equation that has been derived using both hand length and breadth shows better correlation coefficient.

Multiplication factors were calculated with relatively higher standard deviation. But still it can be used for calculation of stature.

Conclusion:

In present study 160 students of medical college in Pondicherry aged 18 to 25 years were chosen. Among them 80 were North Indians and remaining were South Indians. Only students with right hand dominance were included though both hands palm prints were obtained .

No significant difference was found between hand dimension in north and south Indians.

No significant relationship between dominance of hand and hand dimensions was seen.

Regression equations are useful in estimating stature from palm print.

Multiple regression equation gives better results than linear regression equation.

Multiplication factors are also useful in determining stature from palm print.

Acknowledgement

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