

Estimation Of Stature From Hand Length In Living Subjects Of Gujarat Region

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Abstract : Background: The hand length can be used as a basis for estimating stature in cases where only fragmentary or mutilated remains of an unknown person are recovered and also in age related loss in stature. Objectives: To investigate the relationship between Personal Stature and Hand Length in living subjects of Gujarat region and derive a population specific formula (regression equation) to estimate Stature from Hand Length. Methods: Height and Hand Lengths were measured of total 510 living subjects (258 males & 252 females) between the age group of 18-25 years belonging to Gujarat Region. Results: A positive correlation was found between Height and Hand Length and it was statistically significant. Regression equation for stature Estimation was formulated using Hand Length in both sexes. Conclusion: Dimensions of Hand can provide good reliability in estimation of stature. Simple linear regression equation so far derived can be used for estimation of height. If either of the measurement (Hand length or Total Height) is known, the other can be calculated. This fact will be of practical use in Medico Legal investigations and in Anthropometry. [Jethva N et al NJIRM 2013; 4(4) : 57-60]

Key Words: Gujarat Region, Hand Length, Regression Equation, Stature.

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Introduction Estimation of stature from incomplete skeletal and decomposing human remains is particularly important in personal identification. Traits tend to undergo change in varying degrees from birth to death, in health and disease. Persons living under different environmental conditions, having different nutritional requirements and dietary habits, different levels of physical activity and members of different ethnic groups and the offspring of unions between them, present interesting differences in bodily form and proportions frequently.¹

There is a definite relationship between the height of the person and various parts of the body like head, trunk and lengths of upper and lower limbs. Estimate of which is considered to be important in those cases where only fragmentary or mutilated remains of an unknown person are recovered.

Many of previous workers have done this study on cadavers. But cadavers cannot represent a population & they are largely of persons who are aged and might have suffered from chronic debilitating diseases, likely to have been dying in an abnormal posture and it may not be possible to straighten the body to get accurate stature measurement. Group specific works can be done when stature cannot be measured directly due to deformity like kyphosis, lordosis and scoliosis, contractures or missing legs. To the best of our

knowledge data on estimation of Stature from Hand Length are not available for adult Gujarati community.

Material & Methods: Total 510 (258 males & 252 females) asymptomatic healthy students of different faculties, between the age group of 18-25 years, belonging to Gujarat region, who are culturally and linguistically similar.

All the study subjects were given adequate information about the study and informed consent was taken. The protocol was approved by the institutional review board, (Regd. No. IRB00008091). All the measurements were taken in a reasonably well lit room, at a fixed time between 2:00pm to 5:00pm to eliminate diurnal variation. It was measured and recorded only by me to avoid inter observer error in methodology. Stature, Right and Left Hand length of each individual was recorded.

Stature was measured with standard anthropometer as the vertical distance from the vertex to the floor, when the person is standing erect on a horizontal resting plane bare footed having the palms of the hands turned inwards and the fingers pointing downwards and the head in the Frankfort plane. Hand Length was measured with sliding caliper by direct linear distance between the distal wrist crease and the distal end

of the most anterior projecting point, i.e., tip of the middle finger. The subjects were asked to place their hands supine on a flat hard horizontal surface with fingers extended and adducted, following which the hand length was measured. Care was taken that the forearm should be directly in line with the middle finger. Left handed persons and persons having significant disease or deformity that could have affected the general or bony growth were excluded.

Results: The observations were analyzed separately for both Right & Left side in each sex in all 510 subjects. The statistical data which were extracted from the calculation and analysis are tabulated in Table-1 to Table-3. The results shows that the relationship between Hand length and Height is positive for every unit increase in Hand length.

Table 1 : Mean Height and Hand Length

Variable(cm)	Male	Female	Combined
Height	169.60	156.98	163.36
RH length	18.88	17.31	18.11
LH length	18.95	17.36	18.16

Table 2 : Pearson's Correlation Coefficient

Correlation Coefficient (r)	Right Hand Length	Left Hand Length	Correlation Coefficient (r)
Male	0.741	0.762	Male
Female	0.701	0.678	Female
Combined	0.848	0.851	Combined

The value of 'r' implies that there is positive correlation.

Table 3 : Regression analysis for Prediction of Total Height in Males & Females

Regression Formula	Males (258)	Females (252)
$Y_1 = a + bX_1$	$Y_1 = 76.737 + 4.917X_1$	$Y_1 = 72.763 + 4.865X_1$
$Y_2 = a + bX_2$	$Y_2 = 74.797 + 5.004X_2$	$Y_2 = 75.030 + 4.721X_2$

Regression analysis for Prediction of Height in all cases i.e. Combined Males and Females (Total 510):

Right Hand : $Y_1 = 51.118 + 6.119X_1$

Left Hand : $Y_2 = 51.202 + 6.176X_2$

Where, Y= Height,
 X_1 =Right Hand Length
 X_2 =Left Hand Length
 a = Intercept/ Constant
 b = Regression Coefficient

Discussion: The stature of an individual mainly being genetically predetermined is an inherent characteristic, the estimate of which is considered to be an important assessment in the identification of unknown human remains.

Trotter M et al. have stated requirement of different regression equations among different races after studying different races for relationship between lengths of long bones and stature. It is important to note that every race of particular age group and sex should have its own table for estimation of height using various parameters.

Isurani Ilayperuma investigated the relationship between personal stature and hand length among Sri Lankan adults and derived a linear regression formula.² Dr. Sunil investigated the relationship between personal stature and hand length among individuals of Delhi.³ Various other workers have done similar studies among different populations⁴⁻⁸ Investigators have also used other parameters to estimate stature which include head lengths⁹, foot lengths¹⁰ and breadth, phalangeal lengths, vertebral column lengths, skull measurements, measurements of bones of the upper limb like humerus, radius, ulna¹¹, lower limb bone lengths like femur, tibia, fibula, calcaneus, metatarsals, measurements of sacrum, coccyx and sternum. These studies were conducted on skeletons, cadavers and living subjects by somatometric measurements and radiographic measurements of different population groups.¹²⁻¹⁶

Height estimation formulae based on hand length show similar levels of accuracy to calculations based on the length of other long bones. This is supported by the standard errors of the estimations reported in several studies. Compared

to other bones of the body, it is easier to get a more accurate measure of hand length in living subjects.

Following is the Comparison of various similar studies in a tabulated form.

Sr. No	Author, Year, Population, Area and Age Group	Sample Size	Sex	Regression Equation	SEE	Value of r
1	Dr O.P.Jasuja ¹⁷ 2004, Jat Sikhs, Punjab, 18-60 yrs	T:60 M:30 F:30	M	H=069.513+5.223*HLRT	4.003	0.502(R) 0.452(L)
				H=84.742+4.491*HLLT		
			F	H=130.954+1.612*HLRT	5.127	0.529(R) 0.557(L)
				H=130.035+1.660*HLLT		
2	Dr Sunil ³ 2005, North Indian Students, Delhi 18-22 yrs	T:150 M:75 F:75	M	H=86.93+4.25*HLRT	4.35	0.7(R)
				H=85.84+4.32*HLLT	4.26	0.6(R)
			F	H=77.42+4.56*HLRT	4.57	0.7(R)
				H=80.94+4.40*HLLT	4.63	0.7(R)
3	Ilayperuma ² Medical students, Galle, Srilanka, 2009 20-23 yrs	T:258 M:140 F:118	M	H=103.732+3.493*HL	5.22	0.58
			F	H=93.689+3.625*HL	5.75	0.59
				H=158.91+0.44 * HLLT		
4	Adel Kamel Abdel-Malek ⁷ Egyptians, Assiut, Upper Egypt, 1990	T:166	C	H=34.5+5.77HL+2.7HB ±5.1	-	-

In comparison to previous studies correlation coefficient of the present study is having large (0.5-0.7) to very large (0.7-0.9) correlation. This suggests that the significant and positive correlation exist between stature and measurements of hand length.

The relationship between hand length and stature is of practical use in medico-legal, anthropology and archaeological studies when such evidence provides the investigator the only opportunity to gauge that aspect of an individual's physical description. The only precaution to be taken into consideration is that these formulae are applicable to the population from which the data has been collected, due to inherent population variation in these dimensions, which may be attributed to genetic and environmental factors like climate, nutrition etc.

Conclusion: The study showed significant positive correlation between the Stature and Hand Length, hence it is concluded that Hand Length can provide good reliability in estimation of stature in living subjects of Gujarat region. Simple linear regression equation so far derived can be used for estimation of height, if Hand length is known.

These types of studies are of medico legal importance, as the first step in forensic analysis is establishing identity of the person in question, where stature is one of the primary characteristics of identification. These studies are also of anthropological importance as it helps to know the differences between different population groups. If the same study is conducted on the same population group after several years, it will help to identify the micro evolutionary changes.

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