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A Cross Sectional Study to Estimate the Stature from Hand length in the Age Group of 18 to 25 Years in Telangana Population

K Srinivasulu[1], B. Shruthi Reddy[2], Sowmya Bhashini Popuri[3], T Rahul Reddy[4], Ram Prasanjith Reddy Bollampalli[5], Sudheera Polavarapu[6], Rishabh Chormalle[7]

[1]Professor HOD, Department of Forensic Medicine, Malla Reddy Institute of Medical sciences, Suraram, Hyderabad, Telangana, [2-7]Internee, Department of Forensic Medicine, Mediciti Institute of Medical sciences, Medchal, Telangana.

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Abstract

A Cross sectional study on correlation of length of hand in relation to the height of an individual was conducted in medical students of Telangana region in the age group of 18 to 25yrs during the period of January 2018 to December 2019. A total of 150 individuals among 75 males and 75 females were taken as participants in this study. Measurement of the Body part hand length has taken as distance between the proximal wrist creases to the tip of middle finger, measured by using vernier calipers. The data was statistically analyzed by using SPSS (version-25) software.

The formula for linear regression for estimating the height is y = a + (b x), y = dependent variable (height). a = constant. b = independent variable coefficient. x = independent variable i.e. length of the Hand. The linear regression formula for Right hand is y = 41.25 + (6.89 x) and left hand is y = 43.9 + (6.71 x). In case of male individuals the formula for Right hand is y = 68.77 + (5.47 x) and for left hand is y = 63.69 + (5.70 x). In case of female individuals the formula for Right hand is y = 59.51 + (5.72 x) and for left hand is y = 63.63 + (5.48 x), standard error was 0.3, R square of 0.7 and confidence interval was 6.17 – 7.60, the data results show the statistical significance the P Value less than 0.001.

Calculated stature from the equation Y=a + (b x), is close to the actual height, only ± 5cm difference was observed in most of the individuals. Height of an individual is approximately 9 times the height of the hand length. A separate linear regression formula for male and female is more accurate and reliable.

Keywords: Stature; hand length; linear regression.

Introduction:

Stature means standing height i.e., height of the person in upright position. It is usually measured from top of the vertex to the ground. Estimation of stature holds a significant role in the field of anthropology. When a complete dead body is found, stature determination is rather an easy task; but in cases where only some parts of the body are available, the determination of stature of the individual is difficult.

Corresponding Author: K Srinivasulu, Professor HOD, Department of Forensic Medicine, Malla Reddy Institute of Medical sciences, Suraram, Hyderabad-500055, Telangana.

Email: drksrinu1968@gmail.com

Vitruvius[1], says in his work on architecture that the measurements of human body are distributed by nature as follows, that is 4 fingers make 1 palm and 4 palms make 1 foot, 6 palms make 1 cubit; 4 cubits make a man's height. And 4 cubits make one pace and 24 palms make a man; and these measures he used in his building and he says the length of a man's outspread arms is equal to his height.

Stature is estimated from the length of long bones of both upper and lower limbs, skull, vertebra and metacarpal bones, etc. Estimation of stature from body parts also helps in estimating the height of the person and plays an important role in identifying the person. Forensic anthropologist depends on various anthropometric features to estimate sex, age, race and stature of an individual, among which stature is the most crucial aspect (Wilson[2]). Stature prediction occupies relatively a central position in anthropometric research.

Among the various parameters of identification, the individual stature is characteristic, the estimation of which is important when only mutilated remains of an unknown person are available. The length of certain long bones and appendages of the body represent certain proportion of relationship to the total stature. Hand length has documented as a significant predictor of stature[3,4]. Study conducted by Amirsheybani HR[3] and another study by Saxena, Thakur and Rai[4], shown a great reliability of prediction of stature from hand length.

Estimation of stature is based on the principle that every body part bears more or less a constant relationship with height of an individual. Several studies show that the out of all mathematical methods used to estimate the stature, regression equations yield better results. Regression analysis is most widely used because of its ubiquity and wide availability in statistical methods. The regression formulae derived for one population does not always give accurate results for other populations, variations are because of nutritional, environmental and genetic factors. (Krogman & Iscan, 1986; Duyar & Pelin, 2010)[5].

Stature, age and sex have key role in identification of unknown dead bodies.[3] When a mutilation of body parts occurs in mass disasters like bomb blasts, fire accidents, building collapse, train accidents and plane crashes and even in natural disasters like cyclones, earthquakes, tsunamis and floods, where only parts of the body are available in such cases identification of the person can be done by estimating the stature from the mutilated body parts. In criminal offences, where criminals usually conceal the identity of the dead body by mutilation to mislead investigation team, stature estimation plays a key role for identification.

Variations of stature observed in several situations like posture of the body, diurnal variation, malnutrition and age. The statue is 1 to 2 cm more on lying down position compared to standing due to relaxation of muscles; it is less in afternoon and evening than in morning due to reduced elasticity of inter vertebral discs, in both malnutrition and advancing age the stature reduced due to gradual atrophy and loss of elasticity of inter vertebral discs.[6]

The aim and objective of present study is to correlate the stature in relation to length of hand in the population of Telangana region. It is useful for estimation of stature of the individual indirectly. Our study is highly useful for forensic scientists and physical anthropologists to determine stature from fragmentary bodies of upper limb of hand, in turn useful in crime investigation.

Materials and Method

A Cross sectional study on correlation of length of hand in relation to the height of an individual was conducted in Medical students of Telangana region in the age group of 18 to 25 yrs, during the period of January 2018 to December 2019. A total of 150 individuals among 75 males and 75 females were taken as participants in this study. Hand length of both right and left hand measured separately in male and female individuals. We took informed consent from the participants and the names of the participants were kept anonymous.

Inclusion and exclusion criteria: A healthy individual of normal skeletal growth and without any deformities were included in this study. Individual with genetic or hormonal abnormalities, nutritional disorders and skeletal abnormalities were excluded.

The instruments used in this study are vernier calipers, divider, scale, Tape, stadio-meter (Height stand) and weighing machine.

Measurements of the Body part Hand length taken as distance between the proximal wrist creases to the tip of middle finger measured by using vernier calipers.

Statistical Analysis:

Analysis was done by descriptive statistics like mean standard deviation and range. Correlation coefficient and linear regression equations were used for estimating stature from hand dimensions. P value < 0.05 was considered as statistically significant. The data was statistically analyzed using SPSS (version-25) software. The formulae for linear regression for estimating the height is y = a + (b x), (y = dependent variable (height). a = constant. b = independent variable coefficient. x = independent variable i.e. length of the Hand).

Results

A cross sectional study on correlation of stature from hand length was conducted on 150 individuals, among 75 males and 75 females in the age group of 18 to 25 years, the following observations were found.

Table 1: Mean height and weight (mean ± SD)

Characteristics	Male	Female	Overall mean	P value
Ht (mean ± SD) in cm	169.74 ± 7.14	156.80 ± 6.80	163.40 ± 9.51	<0.001
Weight (mean ± SD) Kg	57.05 ± 10.49	50.42 ± 11.45	53.80 ± 11.43	<0.001

Table-1: The difference between mean stature of males and females in each group was statistically significant (p<0.001). Males are more in height than females due to hormonal and genetically variation.

Table 2: Mean value of hand length (mean ± SD)

Characteristics	Male	Female	Overall	P value
Rt hand (mean ± SD)	18.43 ± 0.94	16.98 ± 0.87	17.72 ±1.16	<0.001
Lt hand (mean ± SD)	18.58 ± 0.92	16.99 ± 0.88	17.80 ± 1.20	<0.001

Table-2: Results reveal not much difference between the length of right and left hand of both the sex.

Table 3: Prediction of height by linear regression formula for total study population.

Independent Variables (Length) in cm	Formula: y = a + (bx)	R square	P value	Standard Error	95% Confidence Interval (CI)
Right Hand (cm)	y = 41.25 + (6.89 x)	0.71	<0.001	0.36	6.17 – 7.60
Left Hand (cm)	y = 43.9 + (6.71 x)	0.72	<0.001	0.34	6.03 – 7.38

Table 4: Prediction of height by linear regression formula in male population.

Independent Variables: (Length in cm)	Derived Formula: y = a + (bx)	R square	P value	Standard Error	Confidence Interval
Right Hand	y = 68.77 + (5.47 x)	0.52	<0.001	0.60	4.27 – 6.67
Left Hand	y = 63.69 + (5.70 x)	0.54	<0.001	0.60	4.50 – 6.90

Table 5: Prediction of height by linear regression formula in female population

Independent Variable Length in cm	Formula: y = a + (bx)	R square	P value	Slandered Error	Confidence Interval
Right Hand	y = 59.51 +(5.72 x)	0.53	<0.001	0.62	4.48 – 6.97
Left Hand	y = 63.63 + (5.48 x)	0.50	<0.001	0.64	4.20 – 6.76

Formula for linear regression: y = a + b x, (y = dependent variable (height), a = constant, b = independent variable coefficient, x = independent variable i.e. length of the Hand).

Discussion

The study results revealed that the dimension of the hand length is associated with height and can be

used in the estimation of stature. Linear regression equation showed a significant correlation with hand length and stature; hence these equations can be used by forensic anthropologist and law enforcement agents to determine the height of an individual from the mutilated, dismembered body part like Hand.

The formula for linear regression for estimating the height is arrived as y = a + (b x). (y = dependent variable (height). a = constant. b = independent variable coefficient. x = independent variable i.e. length of the Hand). The linear regression formula for total population Right hand is y = 41.25 + (6.89 x) and left hand is y = 43.9 + (6.71 x).

The linear regression formula for male individuals Right hand is y = 68.77 + (5.47 x) and for left hand is y = 63.69 + (5.70 x). In case of female individuals the formula for Right hand is y = 59.51 + (5.72 x) and for left hand is y = 63.63 + (5.48 x).

As on today the most appropriate specimens for estimation of stature are long bones[6] but our study results are revealed that the hand lengths also equally significant like any other long bones of the body. A separate linear regression formula derived for male and female population in our study gives more accurate results because hand lengths and heights of male and female population are different.

Calculated statures from the above equations are close to the actual height, only ±5 cm difference in most of the individuals. Height of an individual in our study population is approximately 9 times the height of the hand length, which is obtained by the above equations.

Several similar studies conducted in India by Pratik R Varu[7] at Rajkot Gujarat, study conducted by Apurva chowdary[8] in Chennai Tamil Nadu and another study conducted by Amitava Pal[9] and Sujaya de in Bengal population also revealed similar results, ±5 cm variations are observed.

Study results R square 0.71, standard error of 0.36, confidence interval of 6.17 – 7.60 and the P value of <0.001 showing high accuracy of data. The linear regression formulae obtained in this study has got significant correlation with hand length and stature.

Conclusion

The results of the study revealed that hand length and height of the male and female individuals are slight difference, hence the linear regression formula designed separately for male and female individuals are more appropriate. Calculated statures from these equations are close to the actual height, only ±5cm difference in most of the individuals; this can be minimized if the study population is more. Height of an individual is approximately 9 times the height of the hand length; this is one of the best predictor for height estimation in mutilated bodies.

Conflict of interest: Nil

Ethical clearance: Yes

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