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Cross Sectional Study on Estimation of Stature from Index, Middle and Ring Finger in Adult Population of Hyderabad Telangana.

K Srinivasulu[1], Ankit Sunil Kulkarni[2], Uday Sankar Akash Vankayala[3], Akkalashetty Uday Shree[4], Doddikindiwad Madhulata ravindra Reddy[5]

[1]Prof HOD, Department of Forensic Medicine, Malla Reddy Institute of Medical Sciences. Suraram, Hyderabad, Telangana.
[2,3,4,5]Internee, Department of Forensic Medicine, Malla Reddy Institute of Medical Sciences, Suraram, Hyderabad, Telangana.

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Abstract

Cross sectional study on estimation of stature from length of fingers (Index, Middle and Ring finger of both the hands) was conducted on 150 individuals in the region of Hyderabad, Telangana. Study results showed that there is a significant correlation between length of fingers and stature, Index and middle finger lengths are more reliable than a ring finger length was observed in our study. The height of the individual is approximately 23 times the length of the ring finger, 21 times the length of the middle finger and 22 times the length of the index finger. Standard error of 1.34 to 1.60, R square less than 0.5 and P value less than 0.001 shows statistical significance of our study. 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).

Regression formulae for total population for right index finger is y = 69.75 + (13.75 x), left index finger is y = 66.05 + (14.15 x), right middle finger is y = 63.75 + (13.21 x), left middle finger is y = 62.79 + (13.25 x), right ring finger is y = 71.88 + (13.24 x) and left ring finger is y = 71.84 + (13.22 x). A separate linear regression equation for male and female found more accuracy than equation for total population was observed in our study. Calculated statures from these equations are close to the actual height, only ±5cm difference was observed in most of the individuals.

Keywords: Stature, finger length, regression equation.

Introduction

Forensic Anthropology is the branch of science that deals with the study of human remains in medico legal aspects. Stature is the distance from human feet to the vertex, when standing in erect position. Human height grows from intrauterine life to 20-25 years of age and later decline 2 to 2.5cm in every 25 years after the age of 30 years due to the natural senile degeneration1. Stature even varies at different times of the day by 1.5-2cms. It is usually less in the afternoon and evening hours due to reduced elasticity of inter vertebral discs and longitudinal vertebral muscles. Stature estimation is based on a principle that every body part has some constant relationship with height of an individual.

Anthropometry is the study of human body measurements. It is used to help forensic experts and anthropologists to estimate the stature of the

Corresponding Author: **Dr K Srinivasulu,**
Prof HOD,
Department of Forensic Medicine,
Malla Reddy Institute of Medical Sciences.
Suraram, Hyderabad, Telangana-500055.

individual from different body measurements. Forensic anthropologist should explain age, sex, race and stature, commonly called as the "Big Four" of anthropology from skeletal remains examination; it helps to recognize the individual in mass disaster cases like plane crash, terrorist attacks and warfare.

The anthropometric correlation of a human stature with the arm or leg span has been known since ancient times as portrayed by Leonardo Da Vinci in his famous drawing, the 'Vitruvian Man' which depicts a man in two superimposed positions with his arms and legs apart and inscribed in a circle and a square[2]. The length of the outspread arms is equal to the height of an individual. The measurement from bottom of chin to the top of the head is 1/8th the height of an individual.

The roots of forensic anthropology dates back to 1755's in Europe, the measurement of body parts of cadavers aging from fetus to young adults by an art anatomy instructor Jean Joseph Sue lead to research of stature calculation, which was published by Orfila in the early 19th century[3].

Alphonse Bertillon was a French police officer and biometric researcher who applied anthropological techniques in enforcement of law by creating an identification system based on physical measurements[4].

Identification of the individual through stature becomes very easy when the entire body is found at crime scene, but in certain cases like plane crash, bomb blast, war crimes and other mass disasters where dismembered body parts or amputated limbs of the body are found, at such situations forensic anthropology techniques are useful to estimate stature and identification.

Several studies show that the regression equations yield better results for stature estimation. 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].

The aim and objective of our study is to determine stature from fragmentary bodies like Index, middle and ring fingers of hand in Telangana population, to derive a separate regression formulae for estimation of stature in this region. Study is very useful to forensic scientists, anthropologists and law enforcement authorities to determine stature which in turn useful in crime investigation.

Materials and method

A Cross-sectional study on correlation of length of index, middle and ring fingers in relation to the height of an individual was conducted in Medical students of Hyderabad Telangana area in the age group of 18-25yrs. Maximum height usually attained in this age group hence these age group individuals were selected for this study. Body parts like index, middle and ring fingers length of both right and left hand measured separately in male and female individuals. A total of 150 individuals among 75 males and 75 females of Telangana area were taken as participants in this study after obtaining informed consent from all the participants. A healthy individual of normal skeletal growth and without any skeletal deformities were included in this study. Individual with genetic, hormonal, nutritional and skeletal disorders or abnormalities were excluded.

The instruments used in this study are vernier caliper, scale, stadio-meter (Height stand) and weighing machine. Height was measured using stadio meter in standing posture. Measurements of the Body parts, finger length has taken as distance between the proximal wrist creases to the tip of the finger in midline was measured by using vernier caliper, students were asked to place their hand on a table with palm facing upwards and fingers are in extended flat position and the measurements were taken.

Statistical Analysis

Analysis was done by descriptive statistics like mean standard deviation, Correlation coefficient and linear regression. P value< 0.05 was considered as statistically significant. The data was analyzed by 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 finger).

Figure 1: Measurement of middle finger length using vernier caliper.

Results

A cross sectional study on correlation of stature from Fingers length index, middle and ring fingers of both right and left hand was conducted on 150 individuals, among 75 males and 75 females in the age group of 18 to 25 years in the region of Hyderabad Telangana, the following observations were found.

Table 1: Study population Mean age (mean + SD)

Characteristics	Men	Female	Total
Age(mean ± SD)	19.80 ± 1.21	19.51± 1.26	19.66 ± 1.24

Table 2: Study population Mean height and weight (mean + SD)

Characteristics	Male	Female	Total	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	53.8011.43	<0.001

Table 2: The average height of the study population is 163.40 9.51(cm) among male average height is 169.74 7.14 and female average height is 156.80 6.80. The difference between mean stature of males and females in each group was statistically significant (p<0.001). Weight proportion to the height was observed in the study population.

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

Independent Variables (Length)	Formula(y = a + bx)	R square	P value	Standard Error	95% Confidence Interval (CI)
Right Index Finger (cm)	y = 69.75 + (13.75 x)	0.49	<0.001	1.14	11.48 – 16.01
Left Index finger length (cm)	y = 66.05 + (14.15 x)	0.53	<0.001	1.08	12.00 – 16.03
Right middle finger length (cm)	y = 63.75 + (13.21 x)	0.55	<0.001	0.97	11.28 – 15.14
Left middle finger length (cm)	y = 62.79 + (13.25 x)	0.58	<0.001	0.93	11.42 – 15.09
Right ring finger length (cm)	y = 71.88 + (13.24 x)	0.56	<0.001	0.96	11.33 – 15.16
Left ring fingerlength (cm)	y = 71.84 + (13.22 x)	0.57	<0.001	0.94	11.35 – 15.10

y = dependent variable (height). a = constant. b = independent variable coefficient. x = independent variable i.e. length of the finger)

Table 4: Prediction of linear regression formula for Female population.

Independent Variables: (Length)	Derived Formula (y = a + bx)	R square	P value	Standard Error	Confidence Interval
Right Index Finger (cm)	Y=94.00677+9.562513 x	0.33	<0.001	1.55	6.31 – 12.49
Left Index finger (cm)	y=87.70714+10.43777 x	0.31	<0.001	1.63	6.32 – 12.83
Right Middle Finger (cm)	y=85.80732+9.764081 x	0.38	<0.001	1.39	6.60 – 12.15
Left Middle Finger (cm)	y=86.54274+9.624353 x	0.36	<0.001	1.51	6.85 – 12.88
Right Ring finger (cm)	Y=90.53503+10.01065 x	0.34	<0.001	1.45	6.27 – 12.08
Left Ring Finger (cm)	y=90.5667 + 10.01007 x	0.33	<0.001	1.51	6.11 – 12.14

Table 5: Prediction of linear regression formula for Male population.

Independent variable (Length)	Formula (y = a + b x)	R square	P value	Slandered Error	Confidence Interval
Right Index Finger (cm)	y=103.4977+9.403386 x	0.33	<0.001	1.60	6.34 – 12.76
Left Index finger (cm)	Y= 101.4436+9.582213 x	0.41	<0.001	1.45	7.51 – 13.31
Right Middle Finger (cm)	Y=96.57112+9.380895 x	0.44	<0.001	1.29	7.19 – 12.33
Left Middle Finger (cm)	Y=92.0828+9.869744 x	0.48	<0.001	1.17	7.22 – 11.89
Right Ring finger (cm)	y=103.7343 +9.179499 x	0.42	<0.001	1.36	7.13 – 12.57
Left Ring Finger (cm)	Y=103.8295+9.129502 x	0.43	<0.001	1.34	7.24 – 12.58

Discussion

Cross sectional study on estimation of stature from length of Index, middle and ring fingers among 150 individuals in the region of Hyderabad Telangana. The study results showed that there is a significant correlation between length of fingers and stature, Index and middle finger lengths are more reliable than a ring finger length was noticed in our study. It is approximately ring finger length multiply by 23, middle finger length multiply with 21 and index finger length multiply with 22 will get the stature of individual. A separate regression equation for male and female found more accuracy than equation for total population was observed in our study. Standard error of 1.34 to 1.60, R square less than 0.5, 95% confidence interval between 6 to 12 was observed in this study, P value less than 0.001 shows statistically more significant.

Several studies conducted in India and abroad found a great correlation between stature and finger length. Hence this equation can be considered for estimation of height in all mutilated bodies when other body parts are not available.

Raju *et al* carried out a similar study at Davangere, Karnataka[6], India, by taking the measurement of Index and ring finger length of the right hand and height of 250 medical students (125 males and 125 females) of 18–25 years of age was observed significant positive correlation.

Tyagi AK[7] *et al* also found significant relationship between finger length and stature and recommended the use of regression equation for stature estimation. Likewise, Shintaku and Furuya in 1990[8] detected good association between middle finger length and stature among Japanese females.

Jasuja and singh[9] also observed statistically significant correlation between stature and phalanges length and concluded stature could be estimated from their study parameters.

Verghese AJ *et al* in Mysore and surrounding regions of Karnataka[10] found significant correlation between middle finger length of both the hands and stature in males and females and recommended that those equations should be used for estimation of stature in their region of Karnataka.

Suseelamma *et al* conducted a study on 200 students (100 males and 100 females) at Kamineni Institute of Medical Sciences Hyderabad[11] to derive correlation between the stature and little finger length in both hands was found significant.

A study conducted at Manipal by Rastogi[12] et al explained a significant relation between middle finger length and height of an individual.

Krishan K *et al* conducted a study in a north Indian[13] adolescent population and concluded that Index finger and Ring finger length has statistically significant correlation with stature of adolescent population of north India, stature of a person can be predicted with a reasonable accuracy from both the fingers.

Conclusion

Estimation of stature is the most important aspects in cases of identification, anthropological evidences in those cases where dismembered body parts are found. Stature estimation is based on a principle that every body part has some constant relationship with height of an individual. The results of the present study shows the significant correlation observed with the length of index, middle and ring finger of both

the hands and stature. Linear regression equations derived separately for the both the sexes are more reliable than the total population. Index and middle finger lengths are more reliable than a ring finger length was noticed in our study. ± 5 cm variations were observed in regression equation derived in our study. Several studies in India and Abroad also revealed similar correlation between finger length and stature.

Conflict of interest: Nil

Ethical clearance: Yes

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