

## A Cross sectional Study on Estimation of Stature from Forearm length in the age group of 18 to 25 years in Telangana population

K Srinivasulu<sup>1</sup>, Prashanti Mylabathula<sup>2</sup>, M Karteek Sai<sup>3</sup>,  
B Ruchitha<sup>4</sup>, Tanneru Bhanu Prathyusha<sup>5</sup>

<sup>1</sup>Professor HOD, <sup>2</sup>Internee, <sup>3</sup>Student of Final MBBS Part-2, <sup>4</sup>Student of Final MBBS Part-1, <sup>5</sup>Student of 2nd MBBS, Department of forensic medicine and toxicology, Malla Reddy Institute of Medical Sciences, Suraram, Telangana.

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### Abstract

A cross sectional study on correlation of the stature from forearm length was conducted in the population of Telangana region of India, A total of 150 members participated in the study among 75 males and 75 females in the age group of 18 to 25 years. The aim of the study is to estimate stature from a fragmentary body part forearm in the population of Telangana and to derive a separate regression equation for both right and left hand and for both male and female individuals. Measurement of the body part forearm length has taken as distance from the tip of the olecranon to proximal wrist crease in semi flexed posture measured by using vernier caliper.

Statistical analysis was done by descriptive statistics like mean standard deviation, correlation coefficient and linear regression. P value <0.05 was considered as statistical significant. The data was analyzed by using SPSS version 25 software. The formula for right forearm is  $y = 50.76 + 4.18 X$ , left forearm is  $y = 50.89 + 4.19 X$  for total study group. For male population the formula for right forearm is  $y = 67.80 + 3.62 X$ , left forearm is  $y = 72.84 + 11.19 X$ . For female population the formula for right forearm is  $Y = 68.45 + 8.13 X$  and for left forearm is  $Y = 64.88 + 3.60 X$ .

We found highly significant correlation between the forearm length and height of the individual. We observed a separate regression equation for right and left hand in both male and female population yield better result. We also observed left forearm equation is more accurate than right forearm. The height of the individual is about 6.1 times of forearm length. Linear regression formula developed in our study group is more appropriate for Telangana population.

**Key word:** Stature, Forearm length, linear regression.

### Introduction

Stature means a height of a person from crown to heel length. Identity of person is basic necessity in

modern world, every person identified by different biometric criteria's like face recognition, fingerprints, Iris pattern, etc. but identification in dead body can be

**Corresponding Author:** K Srinivasulu, Professor and HOD, Department of forensic medicine and toxicology, Malla Reddy Institute of Medical Sciences, Suraram, Hyderabad, Telangana.

**E-mail:** drksrinivas1968@gmail.com

relied on different identification features, like age, sex, stature, and other identification marks, among them stature is the most characteristic of identification.

Identification of the individual by height is easy when the entire body is found at crime scene, but in certain cases like aero plane crash, bomb blast, Railway injuries, earth quakes, war crimes and other mass disasters where mutilated body parts or amputated limbs of the body are found, at such situations forensic anthropology study methods like regression equations are more useful to estimate stature and identification.

In living body diurnal variation of stature is common, a difference of one and half to two cm is observed at different times of a day, it is less in the afternoon and evening due to reduced elasticity of the intervertebral discs and longitudinal vertebral muscles. After the age of 30, due to the natural process of senile degeneration can gradually decreases stature by about 0.6mm per year on an average. The stature also varies in different postures of the body it is greater by 1-3 cm on lying down position than erect posture. After death the height of the body increases by about 2cm due to complete relaxation of muscles of the body including vertebral and para vertebral muscles<sup>1</sup>.

Ancient Italian artist Leonardo da Vinci's painting of Vitruvius<sup>2</sup> man describes the estimation of stature by means of different body measurements. The length of the outspread hands is equal to the height of a man. The length from chin to the top of the head is equal to one eighth of the height of a person. The normal width of the shoulders is a quarter of the height of an individual. The distance from the elbow to the tip of the hand is a quarter of the height of a man.

Several studies reveal that the regression equation yield better results for estimation of stature. Regression formula derived from one population does not always give accurate result for other population. The variations occur because of genetical, environmental and nutritional factors (Krogmen and Iscan 1986, Duyar and Pelin 2010)<sup>3</sup>.

The aim and objective of the study is to estimate stature from a fragmentary body part forearm in the population of Telangana and to derive a separate

regression equation for both right and left hand and for both male and female individuals. This study will be useful to forensic scientist's anthropologists and law enforcement authorities to estimate stature in this region which in turn helpful in crime investigation.

## Materials and Methods

A cross sectional study on correlation of forearm length in relation to the height of an individual was conducted in medical students of Telangana region in the age group of 18-25yrs. The maximum height usually attained in this age group, hence these age group individuals were selected for this study. Body part forearm 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 were taken as participants in this study, an informed consent was obtained from all the participants before commencement of study.

A healthy individual of normal skeletal growth without any skeletal abnormalities were selected from the study. Individuals with skeletal disorders, genetic disorders, hormonal and nutritional disorders are not considered.

Instruments used in the study are vernier caliper, measuring scale, stadio meter (height stand) and weighing machines. Height of an individual was measured by using stadio meter in standing posture. Measurement of body part forearm length taken as distance from the tip of the olecranon to proximal wrist crease in semi flexed posture was measured by using vernier caliper. The participants were asked to place their forearm of hand on the table in semi flexed with palm facing upward position and the measurements were taken.

## Statistical Analysis

Statistical analysis was done by descriptive statistics like mean standard deviation, correlation coefficient and linear regression. P vale <0.05 was considered as statistical significant. The data was analysed by using SPSS version 25 software. The formula of linear regression for estimation of height is  $y=a + bx$ . Y=dependant variable (height), a=constant, b=independent variable coefficient and x=independent variable i.e. length of the forearm.

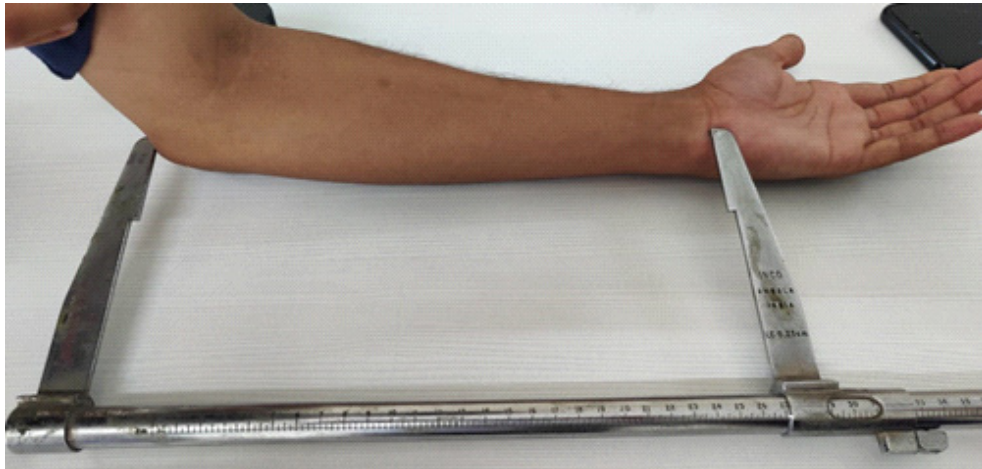


Figure 1: showing the measurement of length of forearm from olecranon to proximal wrist crease.

**Results**

Telangana, among 150 students 75 were males and 75 were females, the following results were observed.

A cross sectional study on estimation of stature from forearm length was conducted in the region of

**Table 1: Mean standard deviation of age and weight for total study group.**

Characteristics	Male	Female	Total	P value
Age ( mean ± SD)	19.80 ± 1.21	19.51± 1.26	19.66 ± 1.24	0.14
Weight ( mean ± SD)	57.05 ± 10.49	50.42 ± 11.45	53.80 ± 11.43	<0.001

**Table 2: Mean standard deviation of right and left forearm for total study group.**

Characteristics	Male	Female	Total	P value
Right forearm ( mean ± SD)	28.14 ± 1.41	25.59 ±1.55	26.89 ± 1.95	<0.001
Left forearm ( mean ± SD)	28.05 ± 1.46	25.51 ±1.48	26.80 ± 1.94	<0.001

The mean length of right forearm in males was 28.14 and in female population were 25.59 and for total population 26.89 whereas the length of left forearm in

males was 28.05, female population 25.51 and for total population 26.80. P value less than 0.001 considered as good.

**Table 3: Linear regression formula for total study group.**

Independent Variables: (Length)	Derived Formula: ( y = a + b x)	R square	P value	Standard Error	Confidence Interval
Right Forearm (cm)	y = 50.76 + 4.18 x	0.74	<0.001	0.20	3.78 - 4.58
Left Forearm (cm)	y = 50.89 + 4.19 x	0.73	<0.001	0.20	3.79 - 4.60

**Table 4: Linear regression formula of male individual.**

Independent Variables: (Length)	Formula: ( y = a + b x)	R square	P value	Standard Error	Confidence Interval
Right Forearm (cm)	y = 67.80 + 3.62 X	0.71	<0.001	0.40	2.80 - 4.43
Left Forearm (cm)	y = 72.84 + 11.19 X	0.50	<0.001	0.39	2.66 - 4.24

**Table 5: Linear regression formula of female individual.**

Independent Variables: (Length)	Formula: (y = a + bx)	R square	P value	Standard Error	Confidence interval
Right Forearm (cm)	$Y = 68.45 + 8.13X$	0.62	<0.001	0.31	2.82 - 4.08
Left Forearm (cm)	$Y = 64.88 + 3.60 X$	0.62	<0.001	0.33	2.93 - 4.26

### Discussion

A Cross sectional study on estimation of stature from forearm length was conducted in the region of Telangana, in the age group of 18 to 25 years in both male and female population, study results found a significant correlation between the length of forearm and height of the person. Statistical analysis results R square 0.74, standard error 0.2, p value <0.001 and confidence interval of 3.78 - 4.58 for right forearm and R square 0.73, standard error 0.2, p value <0.001 and confidence interval 3.79 to 4.60 considered as statistically significant. Studies conducted in India and other countries also showed similar results.

A separate linear regression formula for both right and left forearm revealed better results compared to the total study population. In our study we also observed that the left forearm length is showing more accurate results. The height of the individual is about 6.1 times of forearm length.

Study conducted by Bikramjeet Singh<sup>4</sup>, et al, on estimation of stature from forearm length in north Indian population in the age group of 17-25 years showed similar results they also found highly significant correlation between forearm length and height of a person.

A study on estimation of stature from combined length of forearm and hand in Jammu region of India by Shahnaz choudary<sup>5</sup>, et al, has shown highly significant results on correlation.

A study in Chennai, Tamilnadu was conducted by Sandhya<sup>6</sup> in the study group of 300 members also found positive correlation between the height of the individuals and forearm length.

Study conducted outside India by Kannika Song-in<sup>7</sup>, et. al on Estimation of Stature from Forearm Length in Thai Children in the ages between 5 to

19 years unlike our study age group also found significant results.

In another study conducted by Saeyed Hassan<sup>8</sup>, et al, in Iran on estimation of height from Forearm Length in Natives of Kerman in the age group similar like our study also found significant correlation between the length of forearm and stature.

Study conducted in the age group of 21 to 35 years by Samreen Panjakash<sup>9</sup> et. al, in North Karnataka also found significant correlation.

Similar significant correlation between forearm length and stature was observed in several studies conducted in India by Ashutosh B. Potdar et. al<sup>10</sup>, at Maharashtra. Manoj Balachandran et. al<sup>11</sup>, in Kerala. Biswa bhushan mohanty et al, in Eastern India.

### Conclusion

Cross sectional study on physical anthropometric measurement of forearm arm length in relation to the height of an individual conducted in the population of Telangana found significant correlation. Linear regression formula developed in this region is more accurate to measure the length of an individual from the fragmented body part forearm. We observed a separate linear regression formula for both right and left hand is more significant, we also found left forearm length is more accurate. A  $\pm 5$  difference was observed in most of our study group. Several studies conducted in India and abroad also revealed similar significant correlation.

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**Ethical clearance:** Yes

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