ORIGINAL RESEARCH PAPER
Volume - 14 | Issue - 05 | May - 2025 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

A CROSS-SECTIONAL STUDY ON ESTIMATION OF STATURE FROM THE FINGER LENGTHS OF AN INDIVIDUAL AMONG STUDENTS OF A TERTIARY CARE CENTER, CHENNAI

Forensic Medicine

Dr. Priyadharshini Dekal Post Graduate Resident (Final year), Department of Forensic Medicine and Toxicology, ACSMCH-Dr.MGRERI, Chennai.

Dr Hari Prasad V Asst Professor, Department of Forensic Medicine and Toxicology, SVIMS-Sri Padmavathi Medical College for Women, Tirupati, Chittor dt, Andhra Pradesh.

Dr Sarathkumar P Assistant Professor, Department of Community Medicine. ACSMCH-Dr.MGRERI, Chennai

Dr Ravi Hosaholalu L* Assistant Professor, Department of Forensic Medicine and Toxicology, ACSMCH-Dr.MGRERI, Chennai. *Corresponding Author

Dr Balaji Singh M Professor and HOD, Department of Forensic Medicine and Toxicology, ACSMCH-Dr.MGRERI, Chennai.

ABSTRACT

Background: The determination of the stature of an individual is important in various forensic, anthropological, and medical contexts. Cases involving mixed, dismembered, and mutilated bodies present a significant challenge in approximating the individual's height for investigative purposes. Estimating stature using finger lengths can help in these situations. **Aims:** This study aimed to estimate the correlation between all 10 finger lengths and stature and to formulate a regression equation for each finger. **Methods:** This study was carried out in a tertiary care center in Chennai on 220 students of south Indian origin in the age group of 18 to 25 years. Finger length measurements were obtained from each participant using a Digital Vernier Caliper for all 10 fingers of both hands, while stature measurements were taken using a stadiometer. Statistical analysis was conducted on the data. **Results:** On correlation of the height of the individual with the length of individual fingers, there was a significant positive correlation ($p<0.00$) between the two variables in all the fingers. A regression equation for height was derived for each of the ten fingers, and it was found to be significant for all ten fingers. **Conclusion:** The study results indicated that finger lengths can be used to estimate stature of an individual. The regression formula derived from our study can be applied to estimate the height of an unknown individual from the length of any finger and it will help anthropologists, anatomists and forensic experts in their work when an intact finger must be examined.

KEYWORDS

Identification, Height estimation, Finger lengths, Regression equation.

INTRODUCTION

The stature of an individual is an inherent characteristic, and its estimate is an important process in the identification of an individual. Establishing identity has always been a matter of concern, especially in forensic cases involving mutilated or dismembered body parts, as found in accidents, natural disasters, homicides, etc. Identification can be done by various methods, one of which is by estimating the stature.[1]

There are two methods to estimate living stature from skeletal remains. The anatomical method can be applied in cases where all skeletal elements that contribute directly to stature are available. The second is the mathematical method, which is based on the development of regression equations; in most cases, this is calculated from the lengths of long bones. This method, which produces less accurate stature estimates than the anatomical method, has made significant progress in recent years. [2]

Regression formulas are equations in which the first variable is used to predict the second variable. Stature estimation from individual elements assumes that height of an individual is dependent upon the length of bones of that individual. A regression analysis is one of the widely used statistical tools because it provides a simple and reliable method for establishing a functional relationship among variables. [3]

There is an established relationship between stature and various body parts like the head, trunk, upper, and lower extremities. As medico-legal experts, the stature of the individual must be determined by using the regression equation from the accessible skeleton part, in the form of an incomplete skeleton or from the reconstructed length of long bones from its available fragments for establishing the individuals' individuality. [4] "Karl Pearson's regression formula" is the most used method to determine the stature based on long bones. Femur provides the best estimate of stature among all the six long bones for either sex and the highest correlation with stature The formula of femur being: Stature= 81.306+1.88 x F (length of femur). [5]

Stature varies at different times of the day by one and half to two centimeters. It is less in the afternoon and evening, because of the reduced elasticity of intervertebral disc and longitudinal vertebral muscles. After the age of thirty, the natural process of senile degeneration causes gradual decrease in stature by 0.6 mm per year on an average. The stature is greater by one to three cm on lying down. [6]

Many studies have been conducted in different ethnic groups to estimate stature from finger lengths. But, most of the studies have been attempted to find out the stature from one or two fingers of the hand. Very less data was available in estimating the height from all 10 fingers. An attempt has been made in the present study to estimate stature from all the fingers in a sample of south Indian individuals.

AIMS AND OBJECTIVES

1. To find the correlation between finger lengths and stature of an individual.
2. To formulate a regression equation for each finger to predict the stature by using the finger length.

MATERIALS AND METHODOLOGY:

The present study was carried out in ACS Medical College in Chennai during the period of October 2023-April 2024. Younger sample size was used as the primary source of data for this study involving undergraduate medical students. After obtaining ethical committee clearance, a convenient sample of 220 healthy and voluntary subjects was chosen for the study, comprising of both genders in equal numbers in the age group of 18-25 years and belonging to South Indian origin. A written informed consent of each participant was taken before taking measurements.

Inclusion Criteria

- Subjects should belong to south India by domicile of their parents.

Exclusion Criteria

- Students with deformity of finger or stature, and those with missing or extra fingers.
- Students with history of significant trauma to fingers, spine and lower limbs.

A data sheet was given to all the participants to fill in their preliminary details such as age, gender and native (state). Then, finger length measurements were obtained non-invasively from each participant,

including all fingers on both hands using a digital vernier caliper by placing the hand on a plane surface, palm kept facing upwards, a straight distance from the midpoint of the proximal finger crease to the tip of the finger, after trimming the nails, if they extend beyond the tip of the finger. Stature measurements were taken by making the subject stand erect on a stadiometer, barefooted, and head-oriented in the eye-ear-eye plane (Frankfurt Plane). The movable rod of the stadiometer was brought in contact with the vertex in the mid-sagittal plane. All the measurements were taken in a well-lighted room, by one observer to avoid inter-observer error. The same procedure was followed for all the fingers. All the measurements were entered in Excel sheet as data. Diurnal variations have been reported in the stature of an individual.[7] All the measurements were taken during the afternoon hours, between 2 to 4 pm and recorded on a predefined proforma. Data analysis includes descriptive statistics, regression equations and Pearson correlation.

Fig 1. Taking Measurement from Little Finger (Rt)

Fig 2. Taking Measurement from Index Finger (Rt)

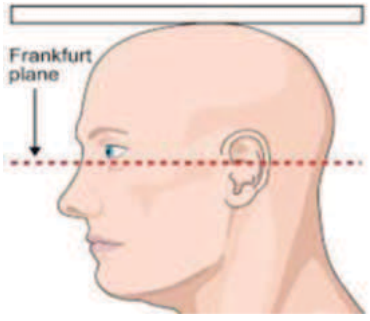

Fig 3. Stature Measurement Complying to Frankfurt Plane.

The anatomical position of the skull is the Frankfurt plane which is used to orient the head during physical examinations and stature measurements. In this position, the lower margins of the orbitals (eye sockets), the lower margin of the orbits, and the upper margins of the ear canals (poria) lie in the same horizontal plane.

Statistical analysis using SPSS software version 28 was conducted to estimate the stature of participants from the finger lengths using a regression equation. Multiplication factors for finger lengths were calculated. Pearson's correlation coefficient was calculated to establish the correlation between the stature and the finger length. P value< 0.05 was considered as statistically significant.

RESULTS

The present study comprised of a cross-sectional sample of 220 students (110 males and 110 females), ranging in age from 18 to 25 years. The average stature among participants was 164.7 ± 6.5. The mean difference, standard difference and t values were higher in cases of males and were statistically significant. (p<0.05). Our study results are shown in tables below.

Table 1 shows the mean height, and mean length of all 10 fingers of the subjects. The standard deviation is revealed in the second row. The median age of our study population was 21 years followed by 20. In total subjects, mean value of left middle finger length is more than the right middle finger length followed by left index and then right index fingers. The right middle finger (RMF) exhibited the least standard deviation among all 10 fingers.

Table 1- Mean Height and Length of Fingers.

	RIF	RMF	RRF	RLF	RT	LIF	LMF	LRF	LLF	LT	Height (cm)
Mean	76.39	83.90	78.39	65.78	71.68	77.46	84.49	78.93	65.71	71.32	164.72
Standard deviation	71.31	82	76.03	64.55	69.46	73.64	81.7	77.18	61.69	67.19	164

The variables like age, height, each finger mentioned with the side it belongs to, i.e. right index finger as R- Index, left middle finger as L-Middle and so on, were non-normally distributed and expressed as median with interquartile range (IQR) in Table 2.

Table 2 - Descriptive Statistics for Variables with Non-normal Distribution

Variables	Median (IQR)
Age	21 (20 – 21)
R- index	71.31 (64.95 – 89.06)
R- middle	82 (71.64 – 96.57)
R- ring	76.03 (64.73 – 91.185)
R- little	64.55 (53.175 – 77.66)
R- thumb	69.46 (60.18 – 82.42)
L- index	73.64 (64.55 – 90.52)
L- middle	81.7 (71.28 – 97.31)
L- ring	77.18 (65 – 90.52)
L- little	61.69 (52.24 – 78.07)
L- thumb	67.19 (60.24 – 84.155)
Height	164 (159 – 168)

The correlation of height of the individual with the length of the individual fingers, shows significant positive correlation (p<0.00) between the two variables in all the fingers as shown in Table 3. Highest correlation is observed by the middle finger length (both right and left) with height while least correlation is observed in left little finger length with height in total subjects.

Table 3: Correlation of Height with Length of the Fingers

Variables	Regression factor	P value
R- index	0.443	0.000
R- middle	0.499	0.000
R- ring	0.446	0.000
R- little	0.445	0.000
R- thumb	0.404	0.000
L- index	0.399	0.000
L- middle	0.436	0.000
L- ring	0.456	0.000
L- little	0.421	0.000
L- thumb	0.453	0.000

Linear regression analysis was done using finger length as the independent variable and the height of the individual as a dependent variable. The regression equation for height was derived for each of the ten fingers and it was significant for all ten fingers of both the right and left hands as illustrated in Table 4. 'X' denotes the finger length in the equations.

Table 4: Linear Regression Analysis for Estimation of Height from Finger Length

Variable	Regression Equation	R2	P value

R- index	0.197* X + 149.705	0.130	0.000
R- middle	0.242 * X + 144.443	0.175	0.000
R- ring	0.205 * X + 148.627	0.142	0.000
R- little	0.199 * X + 151.601	0.129	0.000
R- thumb	0.166 * X + 152.829	0.118	0.000
L- index	0.169 * X + 151.64	0.112	0.000
L- middle	0.191 * X + 148.563	0.143	0.000
L- ring	0.203 * X + 148.709	0.164	0.000
L- little	0.181 * X + 152.851	0.129	0.000
L- thumb	0.216 * X + 149.330	0.182	0.000

All the correlation were found to be statistically significant (< 0.05). This shows that the finger lengths are positively correlated with height and stature can be predicted by linear regression equation.

Examples of a calculation using linear regression equation:
The right Index finger length of a subject was measured as 96mm. On application of the regression equation of the R index finger, Equation:
= 0.197* X + 149.705
= (0.197) (96) +149.705
= 168.617.
So, the height was taken as 168cm.

Similarly,
Left Thumb finger length of a subject was measured as 47.75mm. On application of the regression equation of Left Thumb finger Equation:
= 0.216 * X + 149.330
= (0.216) (47.75) + 149.330
=159.644
So, the height was measured as 159cm.

DISCUSSION

The determination of the stature of an individual is important in various forensic and anthropological contexts. The main hurdle faced by forensic experts is to establish the identity of a person in disasters like plane crashes, railway accidents, bomb blasts, earthquakes etc. In such conditions, if any mutilated body fragment is found, then it is very useful for the expert to find the identity of an individual.

Estimating stature using finger lengths can provide vital information in crime scenes, and it can become an important assessment parameter in profiling of unknown human remains, especially in cases of mass disasters. [8]

The present cross-sectional study examined the relationship of lengths of all fingers separately with the stature among 220 individuals in Chennai, Tamil Nadu. The study results showed that there is a significant correlation between length of fingers and stature. We found index and middle finger lengths were easier and uncomplicated in the process of measurement when compared to others. It becomes useful whenever a dismembered or mutilated body with distal parts of the upper limb is brought for postmortem examination, and stature may have to be estimated using the available digits of the hand of the deceased. This study showed that estimation of the stature from the individual finger lengths is highly accurate. However, these formulae are valid for the age group (18-25 yrs) of the study population.

Our study observations were in accordance with a study in Maharashtra [9] and with another study in Davangere, Karnataka State [10] on medical students of 18–25 years of age, which showed that there is a significant correlation between index and ring finger lengths and calculated height. Rastogi et al.'s study [11] at Manipal also revealed a strong correlation between a person's height and middle finger length, which aligns with our study.

A study in Sri Lanka has shown that height estimation with middle finger length is the most significant. [12] Another study conducted on a total of 258 individuals with an age range of 20-23 years in Puducherry showed that the left thumb was the most significant independent variable for the estimation of the individual's height using the regression equation. [13] Our study, by showing a significant correlation between each finger length and stature of the participant, endorses the fact that different regression equations for each of the ten fingers are needed in different population groups to arrive at the most accurate height of the individual. Although several Indian studies [14,15] have been conducted for stature estimation from finger measurements, the current findings are not comparable to them as those studies were not conducted in similar populations. Due to the strong influence of genetic and environmental factors on the height of the individual, the similarity of the study population is vital in formulating regression equations.

Our study provides regression models for the estimation of the height of an individual based on the length of fingers among the South Indian population. Our findings were not consistent with a study conducted by Suseelamma et al. [16] who concluded that left thumb length is more reliable for stature estimation. Various other studies that analyzed the anthropometric measurements of different fingers have also found a significant association with the stature. The deviations of any study from ours might be attributed to variation in parameters defined, differences in the number of samples, and the age range of those samples.

CONCLUSION

We observed a significant correlation between finger length and stature. The findings of the present study indicate that finger lengths can be used successfully to predict the living stature of an individual. The formula derived from the regression analysis can serve as an important and reliable tool for stature estimation from any finger length. These formulas could be effective in the identification process in crime investigations and would be useful for anthropologists, investigating police officers, and forensic experts in stature estimation in cases of dismembered bodies. Further studies may be conducted in a different population to derive a standard regression equation to estimate stature from finger length measurements for a native community.

Recommentation

The present study also suggested that regression equations for stature estimation could be developed for other age categories and different kinds of populations. It is also recommended to conduct research to determine whether the findings could be equally applicable elsewhere when extended to a larger and varied population.

Limitations of the Study:

- Since our study involved measurement of each finger from proximal crease to its tip, the above results can be useful only when an intact finger is examined.
- More reliable data can be obtained if taken with a particular ethnic background.
- The present study was not gender-specific. Further studies can be conducted by narrowing it to gender specificity.

Ethical Clearance: A prior approval was obtained from the Institutional Ethics Committee (No. 653/2023/IEC/ACSMCH Dt. 06/02/2023)
Conflict of Interest: None.
Source of Funding: None.

REFERENCES

1. Ahuja, Pooja, et al. "Estimation of stature from finger length." J Forensic Sci & Criminal Inves 7.2 (2018): 1-4.
2. K. Krishan, T. Kanchan, Stature and Build, Editor(s): Jay A. Siegel, Pekka J. Saukko, Max M. Houck, Encyclopaedia of Forensic Sciences (Second Edition), Academic Press, 2013, Pages 49-53
3. Schroeder, Larry D., David L. Sjoquist, and Paula E. Stephan. Understanding regression analysis: An introductory guide. Vol. 57. Sage Publications, 2016.
4. Kumar R, Sharma N, Jain S, Budhiraja V, Rastogi R, Garg R, et al. Morphometric Study of Estimation of Stature from Index Finger Length in Indian Population. Annals of International medical and Dental Research 2016;2.
5. Biswas Gautam. Review of Forensic Medicine & Toxicology. 5th ed. Jaypee Brothers Medical P; 2021; p 95
6. Reddy K.S.N. The essentials of forensic medicine & toxicology. 35th Ed. Jaypee Brothers; 2022; p 61
7. Shetty B, Deepak M, Monteiro F, Castelino K, Xavier A. Estimation of stature from dimensions of hands and feet in a South Indian Population. IP International Journal of Forensic Medicine and Toxicological Sciences 2020; 5:14–9
8. Dahal, Ayusha, et al. "An interdisciplinary forensic approach for human remains identification and missing persons investigations." Wiley Interdisciplinary Reviews: Forensic Science 5.4 (2023): e1484.
9. Bardale, Rajesh Vaijnathrao, Taikhoom Mohammed Dahodwala, and Vaibhav Digambar Sonar. "Estimation of stature from index and ring finger length." Journal of Indian Academy of Forensic Medicine 35.4 (2013): 353-357.
10. Raju, G. M., et al. "Estimation of stature from index and ring finger length in Davangere district." Int J Clin Trials 1.1 (2014): 18-21.
11. Rastogi, Prateek, et al. "Middle finger length—a predictor of stature in the Indian population." Medicine, Science and the Law 49.2 (2009): 123-126.
12. Ilayperuma, Isurani, Gananda Nanayakkara, and Nadeeka Palahepitiya. "Prediction of personal stature based on the hand length." Galle Medical Journal 14.1 (2009).
13. Rajesh, J. James, et al. "Stature estimation from length of fingers in South Indian population:A cross-sectional study." Journal of Indian Academy of Forensic Medicine 41.4 (2019): 226-228.
14. Agrawal J, Raichandani L, Kataria SK, Raichandani S. Estimation of stature from hand length and length of phalanges. Journal of evolution of medical and dental sciences. 2013 Dec 16;2(50):9651-7.
15. Gupta K, Thalaur S, Singh R, Barwa J, Das S. Stature Estimation from Finger Length by Regression Equation. International Journal of Current Science Research and Review, (2023): 6(2), 1537-154
16. Suseelamma D, Gayathri. P, Deepthi. S, Chandra mohan. M, Uday KM, Amarnath. Study of correlation between stature and length of fingers. Sch. J. App. Med. Sci., 2014; 2(2D):773-784