

Estimation of Stature from Length of Middle Finger Among People of Nellore District State Andhra Pradesh

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Abstract

Background: It is necessary to establish a biological profile of an individual by estimation of age, race, sex and stature to determine the individuality of an individual. It is considered as Big Four parameters in Anthropology.

Aim and Objective: To obtain a specific regression equation for stature estimation from middle finger length among male and female population of Nellore district of state Andhra Pradesh

Type of Study: Descriptive cross sectional study with analytical and comparative components.

Place of Study: At Narayana Medical College, Chinthareddy Palem, Nellore State Andhra Pradesh by the Department of forensic medicine and Toxicology.

Material and Method: The measurement was taken in standing position with stabilization of hand on table. The caliper was horizontally placed along the ventral surface of the hand. The fixed part of the outer jaw of the caliper was applied to the proximal crease of middle finger and the mobile part of the caliper was approximated to the tip of the middle finger and measurement was taken and the measurement was obtained up to one decimal place.

Result and Discussion: The mean middle finger length of 8.031 (SD±0.542)cm on right side as compared to 8.036 (SD±0.536)cm on left side indicate that the descriptive parameters are more on left side as compared to right side in males. Similarly in females also the mean middle finger length of 7.578 (SD±0.427) cm on right side and 7.586 (SD±0.428) cm on left side indicates the same thing that the parameters are more on left side. Our observation are in accordance to findings of a study conducted by Rahule et. al. in Indian population where good correlation existed between right middle finger length and stature in males and females and higher correlation coefficient in females than males similar to our study.

Conclusion: Middle finger length provides good reliability in Stature estimation, by deriving the population specific linear regression equations; as well the study reveals that the middle finger length can be used successfully to predict stature in the population of Nellore region of Andhra Pradesh state.

Keywords: Middle Finger Length; Stature; Regression.

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Introduction

It is necessary to establish a biological profile of an individual by estimation of age, race, sex and stature to determine the individuality of an individual. It is considered as Big Four parameters in Anthropology.¹ It also forms the features of tentative Identification.² In the era of modern advancement and digital technology has

facilitated identification of an individual on various aspects which includes National Identity, gender, age, profession or any criminal record or any involvement in conspiracy.^{3,4} IO often experience problematic situations in determination of identity of an individual where death of an individual may be caused due to natural disasters such as floods, hurricanes, earth quakes, and tsunami or in cases of explosion and plane crash. Excessive complication is usually faced in burnt dead bodies where only remnants are recovered.^{5,6}

In various study significant correlations were found in between stature and different body measurements of a person. This principle helps to establish stature and thus overall it helps in partial identity of a person in natural and manmade disaster where fragmented and mutilated body parts are available. In previous studies estimation of stature are available but applicable to only one specific population group and it cannot be generalized to other population, the reason behind is variations in genetic and environmental factors, hence it becomes necessary to determine stature estimation methods in various different ethnic groups.^{7,14-23} Many researchers had done studies to calculate stature from foot length and long bones, but there is paucity of research on finger lengths in south India population. The middle finger length do show a significant correlation with stature so we made an efforts to evolve a regression equation to determine stature from middle finger length using statistical methods in South India population of Nellore District of state Andhra Pradesh.

Aim and Objective

The present study was undertaken with an aim and objective to obtain a specific regression equation for stature estimation from middle finger length among male and female population of Nellore district of state Andhra Pradesh, To find out correlation between middle finger length with stature of the individual and to devise a linear regression equation to determine stature from middle finger length.

Material and Method

Present study was conducted at Narayana Medical College, Chinthareddy Palem, Nellore State Andhra Pradesh by the Department of forensic medicine and Toxicology on the Consenting volunteers of Nellore District of State Andhra Pradesh. The research was with the aim of estimation of stature

from per cutaneous Tibial Length measurements collected in 300 adult volunteers with age of 18 to 25 years.

The subjects were confirmed to be descent from Nellore district and were specifically selected with residence of Nellore district only, irrespective of their caste, religion, dietary habits and socio-economic status. The study was a predominantly descriptive cross sectional study with analytical and comparative components. Sufficient permissions and consents are procured before the measurements of the volunteers are taken and clearance from the Institutional Ethical committee is obtained in advance. Measurements taken by single investigator and with the same instrument to avoid any technical or inter observer error and to maintain reproducibility and measurements were taken thrice and their mean value were considered for stature estimation.

Stature: Using the stadiometer, the subject was made to stand barefoot in the standard standing position on its baseboard. Both feet are in close contact with each other and head oriented in Frankfurt's plane. The height was then recorded in centimeter from the standing surface to the vertex in the weight bearing position of foot.

Middle Finger Length: Anthropometric measurement Middle finger length of both hands: It is the distance between middle of metacarpo - phalangeal crease (proximal flexion crease) of the middle finger and the extreme projecting point on the tip of middle finger.

Instruments: Digital Vernier caliper. *Technique:* The measurement was taken in standing position with stabilization of hand on table. The caliper was horizontally placed along the ventral surface of the hand. The fixed part of the outer jaw of the caliper was applied to the proximal crease of middle finger and the mobile part of the caliper was approximated to the tip of the middle finger and measurement was taken and the measurement was obtained up to one decimal place. In entire course of the study for each volunteers measurement was taken twice, that is once with the spreading caliper and second with a self retracting measuring tape. To avoid diurnal variations and to eliminate any discrepancies both measurements were taken in a time slot between 1:00 to 15:30 hours of the day. Any kind of error from Instrumental, all the instruments were verified at significant level and variation of + 0.01 cm was observed.

Exclusion Criterion: Those with any apparent disease, orthopedic deformity, morphologically showing the congenital malformations, Dwarfism /

Achondroplasia, features of nutritional deficiencies and injuries to extremities, using medication thought to alter growth, neuromuscular weakness or abnormal tone or with any other major medical illnesses or growth disturbance were excluded from the study.

Statistical Part: Descriptive statistics like min., max., mean, standard deviation, stand. Error etc. of height and length of right and left middle finger of male, female and combined group were done. We compared the length between right and left middle finger of male and female and combined group. Association between Stature and middle finger length were positively correlated and it is shown by scatter diagram also checking the significance of correlation between height and middle finger length of right and left hand by using correlation t-test. So, on the basis of that we calculate the simple regression equations of Stature on right and left middle finger length, by using regression equation we can predict the Stature value by using independent variable middle finger length. We evaluated the significance at 5% level of significance and complete statistics was done in MS-Excel.

Results

Data collected was statistically analyzed and regression equation, pearsons correlation coefficient

and various other statistical parameters were evaluated and calculated using MS Excel sheet.

Table 1: Descriptive statistics of stature [CMs].

Parameter	Male	Female	Combined
Minimum	150	148	148
Maximum	190	184	190
Mean	170.808	163.013	166.911
Std. Deviation	9.924	9.143	10.295
Standard error of mean	0.810	0.747	0.594

As per Table No 1 in our study reflects that the distribution of stature among study population, ranging from 150 – 190 cm in males and 148 – 184 cm in females, mean stature among males is 170.80 cm with the standard deviation of ± 9.924 cm and the mean stature among females was 163.013 cm with the standard deviation of ± 9.143 cm. The overall mean stature of the population is 166.911 cm with the standard deviation of ± 10.295 cm.

As per Table No 2 and 3. It reflects the descriptive statistics of middle finger length of both right and left side in males and females. The mean middle finger length of 8.031 (SD \pm 0.542)cm on right side as compared to 8.036 (SD \pm 0.536)cm on left side indicate that the descriptive parameters are more on left side as compared to right side in males. Similarly in females also the mean middle finger length of 7.578 (SD \pm 0.427) cm on right side and 7.586 (SD \pm 0.428) cm on left side indicates the same thing that the parameters are more on left side.

Table 2: Descriptive statistics of RMFL & LMFL in male and females.

Parameter	Male		Female		Combined	
	RMFL	LMFL	RMFL	LMFL	RMFL	LMFL
Minimum	7.07	7.1	6.9	6.9	6.9	6.9
Maximum	9.1	9.1	8.5	8.5	9.1	9.1
Mean	8.031	8.036	7.578	7.586	7.805	7.811
Standard deviation	0.542	0.536	0.427	0.428	0.537	0.534
Standard error	0.044	0.044	0.035	0.035	0.031	0.031

Table No 3: Comparing length significance between RMFL & LMFL.

Parameter	RMFL	LMFL	t - test	P - Value	Significance
	Mean \pm SD	Mean \pm SD			
Male	8.03 \pm 0.542	8.04 \pm 0.536	-0.765	0.47	All are not significant
Female	7.58 \pm 0.428	7.57 \pm 0.428	-0.148	0.441	
Combined	7.81 \pm 0.537	7.81 \pm 0.534	-0.138	0.4452	

Table 4: Correlation analysis of Stature on RMFL & LMFL of male and female.

Parameter	Correlation (r) with Stature	t-test	P-value	Significance	
Male	Right middle finger length	0.695	11.75928	0.000001	All are highly significance
	Length middle finger length	0.689	11.56525	0.000001	
Female	Right middle finger length	0.688	11.53336	0.000001	
	Length middle finger length	0.681	11.31355	0.000001	
Combined	Right middle finger length	0.7393	16.97313	0.000001	
	Length middle finger length	0.734	16.7082	0.000001	

To assess the statistical differences between the observations of Right and Left side in males and females separately, paired sample “t” test was performed and analyzed.

As per Table 4 In our study it shows the correlation of stature with middle finger length among males and females. It was observed that in males the right middle finger length (r=0.695) shows greater correlation with stature than left middle finger length (r=0.689). Whereas in case of females it was right middle finger length (r=0.688) that shows greater correlation with stature than left middle finger length (r=0.681). All the parameters exhibit statistically highly significant positive correlation with stature in both males and females.

As per Table 5 and 6, in our study it reflects linear regression equations predicting stature using

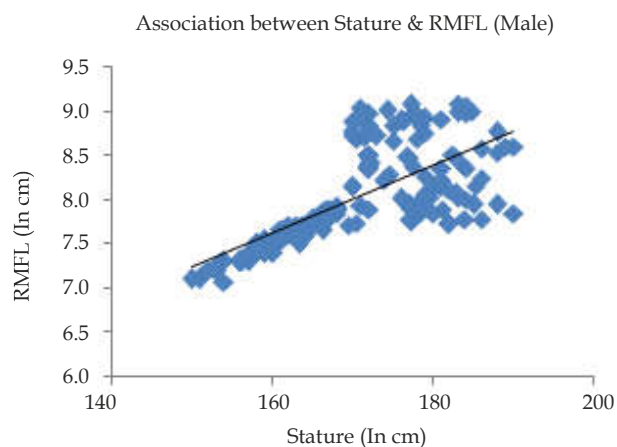
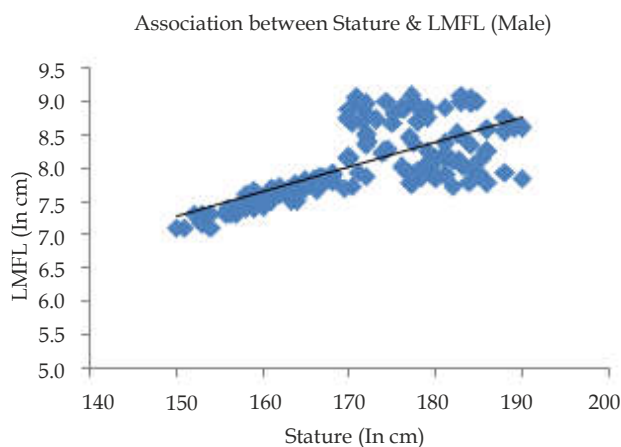
middle finger length of both sides in both males and females. The equations also exhibit Standard Error of Estimate (SEE). The SEE predicts the deviation of estimated stature from the actual stature. It ranges between ± 7.156 to ± 7.215 in males and ± 6.652 to ± 6.72 in females. Lower values indicate greater reliability in the estimated stature. Left Middle Finger Length exhibits a lower value in males and Left Middle Finger Length in females and thus gives better reliability in prediction of stature. The table also shows the power of prediction or coefficient of determination (r²), which is a measure of how well the variation in one variable explains the variation of the other. In case of males it is the Right Middle Finger Length which has the higher prediction power (r² = 0.484) and in case of females also it is the Right Middle Finger Length which has the higher prediction power (r² = 0.474).

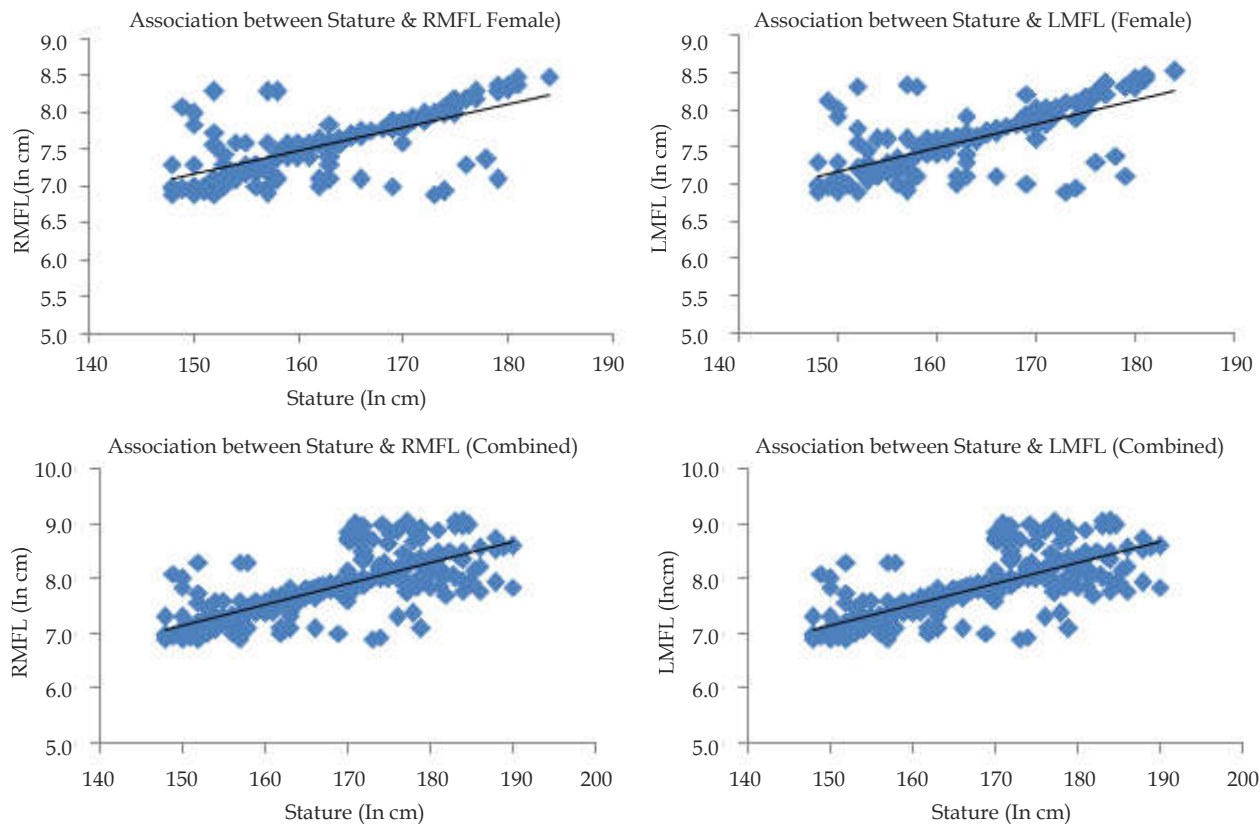
Table 5: Linear regression equation for Right middle finger length in Males and Females

Regression analysis of RIGHT MIDDLE FINGER	Male (Average Stature = 170.81)	Female (Average Stature = 163.01)	Combined (Average Stature = 166.11)
Independent Variable (x)	12.74	14.75	14.17
Intercept	68.51	51.27	56.33
Coefficient determination (R ²)	0.484	0.4743	0.547
Std. error of estimate (SEE)	7.156	6.652	6.94
Significance (p)	0.000001	0.00001	0.000001
Regression Formula of Stature	68.51 + 12.74 * RMFL	51.27 + 14.75 * RMFL	56.33 + 14.17 * RMFL
Predicted height (y) on RMFL	170.81	163.05	166.93

Table 6: Linear regression equation for Left middle finger length in Males and Females.

Regression analysis of LEFT MIDDLE FINGER	Male (Average Stature = 170.81)	Female (Average Stature = 163.01)	Combined (Average Stature = 166.11)
Independent Variable (x)	12.753	14.53	14.124
Intercept	68.33	52.81	56.52
Coefficient determination (R ²)	0.475	0.464	0.538
Std. error of estimate (SEE)	7.215	6.72	7.01
Significance (p)	0.000001	0.00001	0.000001
Regression Formula of Stature	68.33 + 12.753*LMFL	52.81 + 14.53 * LMFL	56.52 + 14.124 * LMFL
Predicted height (y) on LMFL	170.81	163.035	166.843





Discussion

The identification of dismembered and mutilated human remain after a disaster is a challenge to forensic experts and hence demands studies on estimation of stature from various body parts in different population groups. Studies like this can help in narrowing down the pool of possible victim matches in cases of identification from dismembered remains.

The mean stature among males is 170.80 cm with the standard deviation of ± 9.924 cm and the mean stature among females was 163.013 cm with the standard deviation of ± 9.143 cm. The males having greater stature than females and this difference was found to be statistically highly significant ($P < 0.001$).

In present study strong correlation was observed between right middle finger length and stature in males and females. Our observation are in accordance to findings of a study conducted by Rahule et. al.⁸ in Indian population where good correlation existed between right middle finger length and stature in males and females and higher correlation coefficient in females than males similar to our study. In our study the correlation coefficient was slightly higher (0.484) in males than females (0.474) suggestive of better correlation in males than females.

It was Shivakumar AH et. al.⁹ who also found a statistical significance correlation between right middle finger length and stature among males of south Indian population in Karnataka state of India. It was again Shiv Kumar AH et. al.¹⁰ in his another study among females with same south India population, again found a significant correlation between right middle finger length and stature. On the contrary the correlation coefficient and regression equations he obtained from his study is different from our study as per Table No 1, 2, 5 and 6. In an another study made by Verghese AJ et. al.¹¹ in Mysore and surrounding regions of Karnataka, south India 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 south India.

Our results were comparable with the previous studies made by Abdul-Malek et. al. (1990),¹² and Jasuja (2004),¹³ They have observed that the mean stature was greater in males than females. Such statistical significant differences may be due to the early pubertal growth spurt in girls which stops early and is under the influence of oestrogen, leading to early fusion of epiphysis. In males although the growth spurt occurs comparatively later, they continue to grow for a longer period under the influence of testosterone. This strongly insists different equations for males and females.

In our study parameters were statistically significant and positive correlation with stature in the present study and hence can be successfully utilized for the stature estimation. However, in case of males the right middle finger length showed comparatively higher correlation coefficient ($r=0.484$) than left middle finger length ($r=0.475$) and similarly in case of females it was also the Right middle finger length that showed higher values ($r=0.474$) as compared to Left ($r=0.464$). Thus, in case of male, middle finger length of right side as well in case of female's middle finger length of right side is the best parameters for the estimation of stature.

Conclusion

In present study it was concluded that middle finger length provides good reliability in Stature estimation, by deriving the population specific linear regression equations, as well the study reveals that the middle finger length can be used successfully to predict stature in the population of Nellore region of Andhra Pradesh state, even if only an amputated hand is found and other body parts are unavailable. However results of present study are applicable only when an intact middle finger is examined. Such type of studies can help in narrowing down the pool of possible victim matches in cases of identification from dismembered remains.

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Reference

1. Krishan K, Kanchan T and Sharma A. Multiplication factor versus regression analysis in stature estimation from hand and foot dimensions. *Journal of Forensic and Legal Medicine* 2012; 19: 211-214.
2. Vij K. *Textbook of Forensic Medicine, Principles and Practice*. 2nd edition, New Delhi: Elsevier India Pvt. Ltd, 2002: 62-134.
3. Tyagi AK, Kohli A, Verma SK, Aggarwal BB (1999) Correlation between stature and finger Length. *International Journal of Medical Toxicology and Legal Medicine* 1: 20-22.
4. Rastogi P, Kanchan T, Menezes RG, Yoganarasimha (2009) Middle finger length-a predictor of stature in the Indian population. *Med Sci Law* 49(2): 123-126.
5. Athwale MC (1963) Estimation of height from length of forearm bones. A study on 100 Maharashtrian male adults of age 25-30. *American Journal of Physical Anthropology* 21: 105-112.
6. Bhatnagar DP, Thapar SP, Batish MK (1987) Identification of personal height from somatometry of hands in the Punjabi males 24(2): 137-141.
7. Khan F, Vaswani VR, Pramod KL, Badiadka KK. Estimation of stature from middle finger length among college students in Mangalore. *International Journal of Recent Trends in Science and Technology* 2016;18(3):384-387.
8. Rahule AS, Shekhar Rao B, Mohd Saleem, Mohammed Shakeel Mohammed Bashir, Ajay Khade, MD Irfanuddin et. al.; A Study of Correlation between Middle Finger Length and Height in a Tribal District; *J Cont Med A Dent*. 2013 Sep-Dec; 1(1): 8-12.
9. Shivkumar AH, Raju GM, Vijaynath V. Prediction of stature by right middle finger length of males among south Indian population. *Journal of Pharmaceutical and Scientific Innovation* 2013; 2(1):31-33.
10. Shivkumar AH, Vijaynath V, Raju GM. Estimation of correlation between middle finger length and stature of female in south Indian population. *Indian Journal of Forensic Medicine Toxicology* 2011; 5(1):75-76.
11. Verghese AJ, Balaraj BM, Pramod Kumar GN. A study of estimation of stature from length of fingers in Mysore. *Indian Journal of Forensic Medicine Toxicology* 2010;4(2):12-13.
12. Abdul-Malek AK, Ahmed AM, EL-Sharkawi SA and EL-Hamid NA. Prediction of stature from hand measurements. *Forensic Science International* 1990; 46: 181 - 187.
13. Jasuja OP and Singh G. Estimation of stature from hand and phalange length. *Journal of Indian Academy of Forensic Medicine* 2004; 26(3): 100 - 106.
14. Perugu Vanishri, Nishat Ahmed Sheikh. Anthropometric Measurements of Hand Length and Breadth for Estimation of Stature in South Indians. *Indian J Forensic Med Pathol*. 2019;12(2):124-130.
15. B Vasant Nayak, Ch. Laxmanrao, Nishat Ahmed Sheikh. Estimation of Stature from Length of Little Finger in the Population from South India. *Indian J Forensic Med Pathol*. 2019;12(2):113-118.

16. Vasant NB, Sheikh NA. Regression Equation Analysis on Inter-Acromial Length for Stature Estimation in South India Population. *Indian J Forensic Med Pathol.* 2019;12(1):13-17.
17. Perugu V, Sheikh NA. Stature Estimation from Foot Length of School Age Group Children, *Indian Journal of Forensic Medicine and Pathology.* 2017;10(1):11-16.
18. Sutay SS, Sheikh NA, Garg K, Gupta R. Study of Stature by Per-cutaneous Ulnar Length in Madhya Pradesh Population of India, *International Journal of Medico-legal Update.* 2016;16(1):173-177.
19. Sheikh NA, Ramanaiah TV. Stature Estimation from Forearm Length. *Indian Journal of Forensic Medicine and Pathology.* 2014;7(2): 59-64.
20. Krishna VM, Sheikh NA. Estimation of Stature from Foot Length of school age group children in Telangana State. *International Journal of Current Research.*2015;7(1):11659-11663.
21. Gunti Damodar, Nishat Ahmed Sheikh. Estimation of Stature from Footprints measurements by Linear Regression analysis in South India Population. *Indian J. Forensic Med Pathol.* 2020;13(1):94-101.
22. Nishat Ahmed Sheikh, Perugu Vanishri. Odontometric Approach for Stature Estimation in South Indian Population: A Cross Sectional Analysis. *Indian J Forensic Med Pathol.* 2019;12(3):209-215.
23. K Rajesham, Nishat Ahmed Sheikh. Estimation of Stature by Per-Cutaneous Measurements of Distal Half of the Upper Limb. *Indian J Forensic Med Pathol.* 2017;10(2):109-114.

