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ORIGINAL ARTICLE

Estimation of Stature from Length of Middle Finger using Regression Analysis among Adults in Visakhapatnam, Andhra Pradesh: A Cross-Sectional Study

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ABSTRACT

Background: Stature estimation is a crucial element of forensic identification, specifically in cases involving mass disasters and unknown bodies. Establishing reliable associations between body measurements and height is essential for accurate identification.

Aim: To assess the association between middle finger length and height among adults in Visakhapatnam, Andhra Pradesh

Materials and Methods: Cross-sectional research was carried out with 147 subjects (75 males and 72 females) aged 21 years and above, ensuring completion of skeletal growth with fused secondary ossification centres. The mean age was 26.82 years. Stature was recorded in centimetres, and middle finger lengths (right and left) were recorded.

Results: The mean height of subjects was 162.04 ± 8.51 cm. The mean right and left middle finger lengths were 7.44 cm and 7.3 cm, respectively. A notable association was found between middle finger length and height for both hands ($p < 0.0001$). The right middle finger showed a slightly stronger predictive value than the left.

Conclusion: Middle finger length serves as a notable and reliable predictor of height. Both right and left middle fingers can be effectively used for height

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estimation, making this approach valuable in forensic cases where only partial remains are available.

KEYWORDS

• Stature • Identification • Mass disasters • Correlation; • Middle finger length

INTRODUCTION

Identification of deceased people is a crucial goal in a variety of medico-legal circumstances, notably in mass disasters such as plane crashes, earthquakes, cyclones, floods, tsunamis, bomb blasts, and instances involving unknown corpses. Race, gender, age, and height are the primary criteria for identifying individuals. Among these, height is one of the most crucial indicators. Karl Pearson developed a regression formula for estimating height from the total length of long bones. Trotter and Gleser studied the racial differences in height calculation and evolved regression formulae for three major races. However, when only body parts are accessible at the crime scene, Forensic medical experts face a considerable obstacle in estimating height. However, height varies at different times, like 2cm more in the morning than in the afternoon and evening, due to the reduced elasticity of intervertebral disks and the longitudinal vertebral muscles[1]. Despite being a partial identity, correct height estimation might assist in ruling out or confirming potential identities.[2] Significant research has proven relationships between height and anthropometric parameters, such as skull length, long bones, and other body elements. Among these measurements, the length of the middle finger has been shown to play an essential role in determining height and, as a finding, identifying deceased individuals.[3] Regression formula for stature from right and left ulnar length in males in Tamil population was taken up for estimation of stature in mutilated bodies.[4] While various studies have been undertaken in Karnataka, notably in towns such as Mangalore and Belgaum & in Hyderabad, the state of Telangana, there is a distinct paucity of studies focusing on the height of the middle finger in Andhra Pradesh. Therefore, this research assesses the link between middle finger length and height in Visakhapatnam, Andhra Pradesh.

MATERIALS & METHODS

Study Design

This is cross-sectional research; measurements of both right and left middle finger lengths and their height (length) were collected from a cohort of individuals who visited the casualty of GIMSR and residing in and surrounding areas of Visakhapatnam, Andhra Pradesh. The research has 147 subjects, 75 males and 72 females. All subjects provided informed written consent. To guarantee uniformity, the same researcher took all measurements.

Inclusion criteria: The people who visited the casualty, GIMSR, were born and brought up in and around Visakhapatnam and are aged 21 years and above as per the birth certificate to guarantee that subjects have reached full skeletal maturity.

Exclusion criteria: The research eliminated those who were not born in Visakhapatnam, who were below 21 years of age and who had skeletal anomalies like dwarfism or gigantism.

METHODOLOGY

The height was recorded with an anthropometric rod set. We recorded the height of all subjects in the morning, i.e., before 12 Noon, because height will decrease by 1.5cm to 2cm in the afternoon. The subjects were advised to stand upright barefoot against a flat wall with heels, head, and back touching the wall. The movable element of the anthropometric rod set was brought into contact with the vertex of the participant's head, and the distance from the vertex to the floor was recorded. The length of the middle finger was recorded using a vernier calliper. Participants were instructed to place their right hand on a table, palm facing upward. The middle finger was recorded from the palmar digital crease to the dactylion (tip of the finger) with a vernier calliper. The same approach was followed for the left hand. The data collected was entered in Excel and analysed using IBM-SPSS version 25.

RESULTS

The research population's maximum, minimum, and average heights, along with the lengths of their middle fingers (both right and left), were calculated. The regression equations, standard errors, standard deviations, and correlation coefficients for the aforementioned data were computed using statistical approaches, using X as the independent variable and Y as the dependent variable. A p-value of less than 0.05 was considered statistically notable.

Table 1: Descriptive statistics of the research population

		Age	Height in cms	Length of right middle finger in cms	Length of left middle finger in cms
N	Valid	147	147	147	147
	Missing	0	0	0	0
Mean		26.82	162.04	7.444	7.3819
Median		23.00	161.00	7.400	7.3000
Std. Deviation		9.354	8.513	.5321	.62469
Range		53	44	2.8	2.80
Minimum		21	140	6.1	6.00
Maximum		74	184	8.9	8.80

The mean age of the research population was 26.82 (±9.354) years, the mean height was 162.04 (±8.513) centimetres, the mean length of the right middle finger was 7.44 (±0.53) centimetres, and the mean length of the left middle finger was 7.3 (±0.62) centimetres

Correlations:

Height in cms and Length of the left middle finger in cms

Table 2: Correlation between height and length of the left middle finger

Correlation		Value	Asymptotic Standard Error	Approximate T	Approximate Significance
Interval by Interval	Pearson's R	.617	.048	9.445	.000
Ordinal by Ordinal	Spearman Correlation	.622	.055	9.554	.000

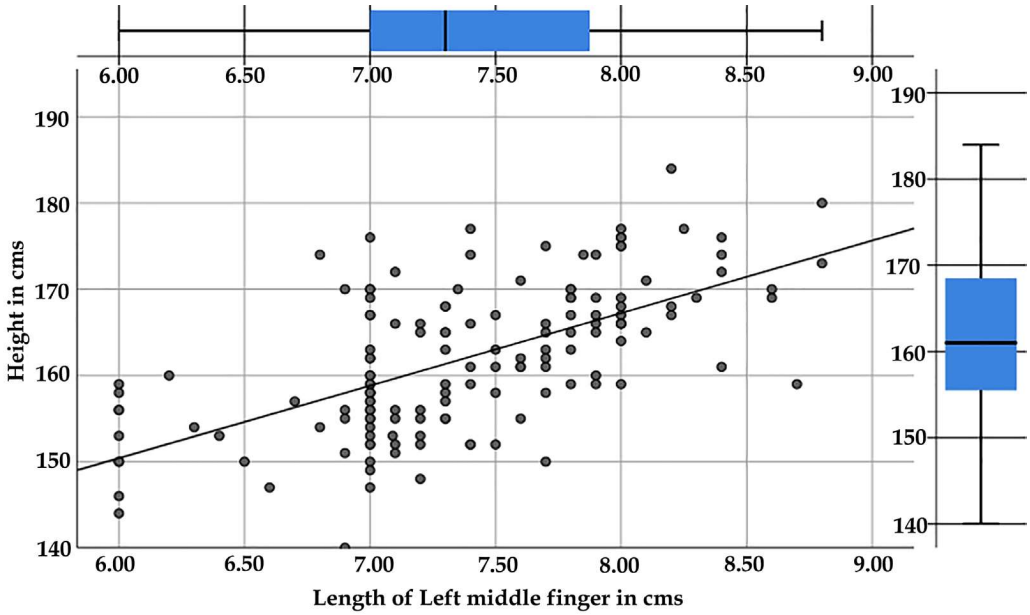

Figure 1: Linear relationship between Height (height) by Left middle finger length (cms) as a whole

There was a notable association between the length of the left middle finger and the height of the individual, which was statistically notable ($p < 0.0001$).

Height in cms and Length of the right middle finger in cms.

Table 3: Association between height and length of the middle right finger

Correlation		Value	Asymptotic Standard Error	Approximate T	Approximate Significance
Interval by Interval	Pearson's R	.707	.042	12.036	.000
Ordinal by Ordinal	Spearman Correlation	.728	.042	12.805	.000

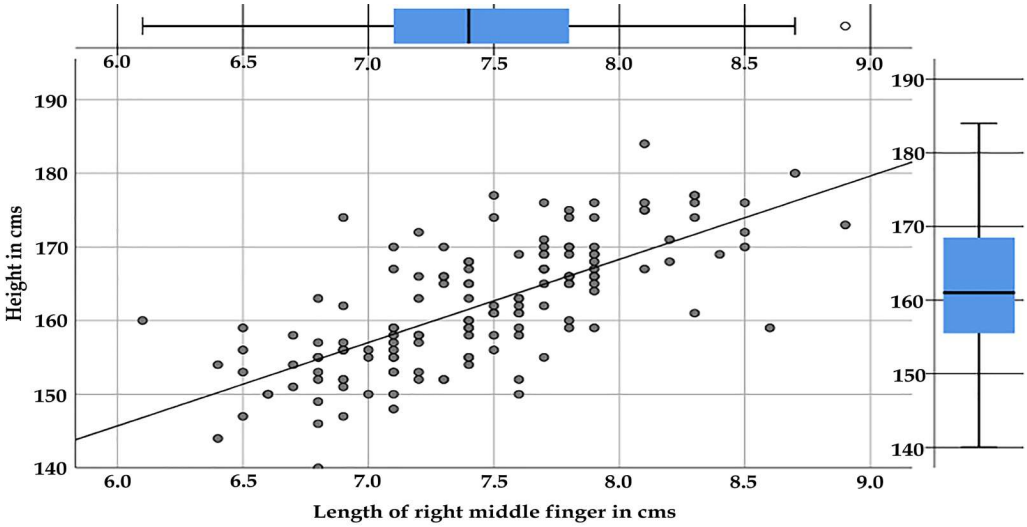

Figure 2: Linear relationship between Height (height) by Right middle finger length (cms) as a whole

There was a notable association between the length of the right middle finger and the height of the individual, which was statistically notable ($p < 0.0001$)

Linear regression:

Table 4: Simple linear regression examination of Height (height) by right finger length (cms)

Coefficientsa						
Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.
B		Std. Error	Beta			
1	(Constant)	77.224	7.078		10.910	.000
	Length of right middle finger in cms	12.707	2.152	.794	5.905	.000

a. Dependent Variable: Height in cms

Table 5: Simple linear regression examination of Height (height) by Left finger length (cms)

Coefficientsa						
Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.
B		Std. Error	Beta			
1	(Constant)	99.961	6.596		15.154	.000
	Length of left middle finger in cms	8.410	.890	.617	9.445	.000

a. Dependent Variable: Height in cms

Simple linear regression models predict the height of the individual with statistical significance ($p < 0.001$) for both middle fingers

Mean predictive height:

Table 6: Mean predictive heights of the research population using right and left middle finger length in comparison with the mean height

		Height in cms	estimated height with the right	estimated height with the left
N	Valid	147	147	147
	Missing	0	0	0
Mean		162.04	162.0541	162.0418
Std. Error of Mean		.702	.49639	.43332
Std. Deviation		8.513	6.01845	5.25368

The mean height of the research population was 162.04 (±8.513) centimetres, the predicted mean height using the right middle finger was 162.05 (±6.018) centimetres, and with the left middle finger was 162.04 (±5.25) centimetres.

DISCUSSION

The research involved 147 individuals from Visakhapatnam, Andhra Pradesh. The descriptive statistics of the research population are as follows:

Age: The mean age was 26.53 with a standard deviation of 9.55. The age ranged from 18 to 74 years.

Height: The mean height was 162.04 cm with a standard deviation of 8.51 cm, ranging from 140 cm to 184 cm.

Right Middle Finger Length: The mean length was 7.44 cm with a standard deviation of 0.53 cm, ranging from 6.1 cm to 8.9 cm.

Left Middle Finger Length: The mean length was 7.38 cm with a standard deviation of 0.62 cm, ranging from 6.0 cm to 8.8 cm.

Correlations

There were notable associations between height and the lengths of both the right and left middle fingers:

Left Middle Finger:

Pearson's association coefficient (r) = 0.617 ($p < 0.0001$)

Spearman's association coefficient = 0.622 ($p < 0.0001$)

This indicates a moderate to strong positive association between left middle finger length and height.

Right Middle Finger:

Pearson's association coefficient (r) = 0.707 ($p < 0.0001$)

Spearman's association coefficient = 0.728 ($p < 0.0001$)

This indicates a strong positive association between right middle finger length and height.

Linear Regression

Simple linear regression analyses were carried out to predict height based on the lengths of the middle fingers:

Right Middle Finger:

Regression equation: Height = 77.224 + 12.707 (Length of right middle finger)

The right middle finger length coefficient was notable ($p < 0.001$).

Left Middle Finger:

Regression equation: Height = 99.961 + 8.410 (Length of left middle finger)

The left middle finger length coefficient was notable ($p < 0.001$).

Predictive Heights

Using the regression equations, the predicted mean heights were calculated:

Actual Mean Height: 162.04 cm (± 8.51 cm)

Predicted Mean Height (Right Middle Finger): 162.05 cm (± 6.02 cm)

Predicted Mean Height (Left Middle Finger): 162.04 cm (± 5.25 cm)

Both regression models provided mean predictive heights that closely matched the actual mean height of the research population, with minor deviations, indicating the reliability of using middle finger lengths for estimating height.

The present research noted a good association between middle finger length and

the individual's height. ($p < 0.0001$ for both the right and left middle fingers)

K Srinivasulu *et al*.[5] found that middle finger length is a more reliable indicator for estimating height than any other finger, and the research was carried out in the state of Hyderabad, Telangana.

Shivakumar *et al*.[6] noted a substantial link between middle finger length and height in the South Indian population of Karnataka. However, the regression equations obtained in this research varied from theirs.

Verghese A.J. *et al*.[7] discovered a link between male and female height and middle finger length in Mysore and nearby Karnataka regions.

Krishan K. *et al*.[8] found a statistically notable association between index and ring finger length and height in the adult population of North India. Shintaku and Furuya's[9] research found a strong association between middle finger length and height in the Japanese population.

CONCLUSION

The research demonstrates a notable and reliable association between middle finger length and height. This association can be used effectively for height estimation in forensic cases, specifically in scenarios where only partial remains are available. Both right and left middle finger lengths are strong predictors of height, with the right middle finger showing a slightly stronger association.

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