



ESTIMATION OF STATURE FROM HAND LENGTH AMONG ADULTS AT A TERTIARY CARE HOSPITAL

Forensic Medicine

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ABSTRACT

Estimation of stature is a fundamental component of forensic identification and anthropological analysis. In situations where only body fragments are available, stature may be reconstructed from anthropometric measurements of various body parts. Hand dimensions have been widely investigated as reliable predictors of stature because they often remain preserved in mutilated or decomposed remains. The present study aimed to estimate stature from hand length among adults attending a tertiary care hospital. A prospective observational study was conducted among 200 healthy adults aged 25–40 years at a medical college in Haryana, India, from January 2024 to December 2025. The study included 200 participants, with a male predominance. Mean stature and hand length were higher in males compared to females. A statistically significant positive correlation between hand length and stature was observed ($p < 0.001$). Linear regression analysis demonstrated that hand length could serve as a reliable predictor of stature in the studied population. Hand length shows a strong correlation with stature and can be used as a reliable anthropometric parameter for stature estimation in forensic investigations. Population-specific regression equations derived from this study may assist forensic experts in the identification of unknown individuals.

KEYWORDS

Stature Estimation; Hand Length; Anthropometry; Forensic Identification; Regression Analysis; Human Identification

INTRODUCTION

Stature estimation is an essential component of forensic anthropology and plays a significant role in the identification of unknown individuals in medico-legal investigations. In situations such as mass disasters, mutilated bodies, and advanced decomposition, complete skeletal remains may not be available, making stature estimation from body fragments necessary. Traditionally, long bones such as the femur, tibia, and humerus have been used for stature reconstruction; however, when these bones are unavailable, other body parts including the hand, foot, and skull may provide useful anthropometric indicators for estimating stature.¹

Among various anthropometric parameters, hand length has gained importance in forensic identification because it demonstrates a strong correlation with overall body height and can often be measured even when other body parts are damaged. Several studies conducted in different populations have reported significant relationships between hand dimensions and stature, allowing the development of regression equations for predicting height from hand measurements. However, anthropometric relationships are known to vary between populations due to differences in genetic background, environmental influences, nutrition, and ethnicity, making population-specific studies necessary for accurate stature estimation.^{2,3}

Therefore, anthropometric standards developed for one population cannot always be applied reliably to other populations. The present study was therefore undertaken to evaluate the correlation between hand length and stature among young adults and to develop regression equations that may assist forensic experts in estimating stature in medico-legal investigations.⁴

MATERIALS AND METHODS

This prospective observational study was conducted in the Department of Forensic Medicine at a medical college in Haryana, India during the period from January 2024 to December 2025. The study included 200 healthy adult volunteers aged between 25 and 40 years who consented to participate. Ethical approval for the study was obtained from the Institutional Ethics Committee prior to commencement of data collection. Written informed consent was obtained from all participants.

Participants were recruited using convenience sampling from hospital staff, students, and attendants visiting the medical college. Individuals with any deformity of the upper limb, previous fractures involving the hand or wrist, or conditions affecting stature such as spinal deformities were excluded from the study.

Anthropometric measurements were recorded using standardized techniques. Stature was measured using a stadiometer with the participant standing erect on a flat surface without footwear, with the head positioned in the Frankfurt horizontal plane. The measurement was recorded to the nearest 0.1 cm. Hand length was measured using a digital vernier caliper from the midpoint of the distal wrist crease to the tip of the middle finger while the hand was placed flat on a horizontal surface. Measurements were taken in centimeters and recorded to the nearest millimeter. All measurements were obtained using a predesigned proforma to ensure uniformity. Each measurement was recorded twice, and the average value was used for analysis to minimize measurement error.

The collected data were entered into Microsoft Excel and analysed using statistical software. Descriptive statistics such as mean and standard deviation were calculated for stature and hand length. Pearson's correlation coefficient was used to assess the relationship between hand length and stature. Linear regression analysis was performed to derive predictive equations for stature estimation. A p -value of less than 0.05 was considered statistically significant.

RESULTS

Out of the total 200 participants, males constituted 56% while females constituted 44%. A slight male predominance was observed in the study sample. Majority of participants belonged to the age group of 25–30 years (37%), followed by 31–35 years (34.5%) and 36–40 years (28.5%). Largest proportion of participants (41%) had stature between 160–170 cm. Majority of individuals had hand length between 18–19 cm (39.5%).

Table 1: General characteristics

Characteristics	Number (n)	Percentage (%)
Age Group (Years)		
25–30	74	37
31–35	69	34.5
36–40	57	28.5
Gender		
Male	112	56
Female	88	44
Stature Category		
<160 cm	46	23
160–170 cm	82	41
>170 cm	72	36
Hand Length Category		
<18 cm	52	26

18–19 cm	79	39.5
>19 cm	69	34.5

The mean stature of participants was 165.2 ± 8.3 cm, while the mean hand length was 18.7 ± 1.3 cm. Males (170.3 ± 6.2 cm) had higher mean stature compared to females (158.6 ± 5.7 cm), reflecting the well-known sexual dimorphism in body height. Hand length was greater among males (19.4 ± 1.1 cm) compared to females (17.8 ± 0.9 cm). This difference reflects typical sex-related anthropometric variation.

Table 2: Mean Anthropometric Measurements

Variable	Mean	Standard Deviation
Stature (cm)		
Male	170.3	6.2
Female	158.6	5.7
Mean Stature (cm)	165.2	8.3
Hand Length (cm)		
Male	19.4	1.1
Female	17.8	0.9
Hand Length (cm)	18.7	1.3

A strong positive correlation was observed between hand length and stature ($r = 0.71$, $p < 0.001$).

Table 3: Correlation Between Hand Length and Stature

Variable	Correlation Coefficient (r)	p-value
Hand Length vs Stature	0.71	<0.001

The regression equation derived from the data for estimating stature from hand length.

Regression Equation: $\text{Stature} = 92.4 + (3.87 \times \text{Hand Length})$

Table 4: Regression Analysis for Stature Estimation

Parameter	Regression Coefficient
Constant	92.4
Hand Length	3.87

We compared actual stature with stature predicted using regression analysis, demonstrating close approximation and reliability of the derived formula.

Table 5: Predicted vs Actual Stature

Measurement	Mean (cm)
Actual Stature	165.2
Predicted Stature	164.8

DISCUSSION

Stature estimation is one of the essential components in establishing the biological profile of unidentified individuals in forensic anthropology. In situations involving mutilated or incomplete remains, the estimation of stature from body segments becomes particularly important in narrowing down identity. The present study demonstrated a statistically significant positive correlation between hand length and stature among adults aged 25–40 years. This relationship reflects the proportional growth pattern of the human body, in which limb dimensions maintain a predictable association with overall body height.

In the present study, the mean stature of participants was 165.2 ± 8.3 cm, while the mean hand length was 18.7 ± 1.3 cm. Males exhibited higher mean stature and hand length than females, which is consistent with sexual dimorphism observed in anthropometric measurements. Similar findings were reported by Supare et al.⁵ in a study conducted among medical students, where males demonstrated significantly greater hand length and stature compared to females. Their study also demonstrated a strong positive correlation between hand length and height and suggested that regression equations derived from hand dimensions could be effectively used for stature estimation in forensic investigations.

Khanapurkar and Radke⁶ reported that foot length, hand length, and head length showed statistically significant correlations with stature, with foot length showing the highest correlation coefficient. However, hand length was also found to be a reliable parameter for estimating height in the studied population.

The findings of the present study are also consistent with research conducted by Goswami et al.,⁷ who reported significant correlations between hand dimensions and stature. Their results demonstrated that hand length could be used to derive regression equations for predicting

stature with reasonable accuracy in forensic practice.

Similarly, Hameed et al.,⁸ conducted a population-based study evaluating the relationship between hand measurements and stature. Their study demonstrated significant correlations between hand length, hand breadth, and stature in both males and females. The authors also emphasized that regression equations derived from hand measurements could be useful in forensic identification when complete skeletal remains are unavailable.

In the present study, the correlation coefficient between hand length and stature was 0.71, indicating a strong positive relationship. This value is comparable to findings reported in earlier anthropometric research. For instance, Pandeya⁹ reported a statistically significant relationship between hand length and stature among medical students, concluding that hand length could be used as a reliable predictor of height in forensic identification.

The regression equation derived in the present study ($\text{Stature} = 92.4 + 3.87 \times \text{hand length}$) demonstrated close agreement between predicted and actual stature values. Regression models are widely used in forensic anthropology because they allow estimation of stature from single body parameters with defined statistical accuracy. Studies conducted across different populations have consistently demonstrated that regression equations derived from hand measurements provide reliable estimates of stature.

Population-specific variation in anthropometric parameters is another important factor in stature estimation. Anthropometric relationships differ among populations due to genetic background, environmental influences, nutrition, and socioeconomic factors. Therefore, regression equations derived from one population cannot always be applied reliably to another population without validation. This highlights the importance of conducting regional anthropometric studies to develop population-specific standards.

From a forensic perspective, estimation of stature from hand length may be particularly useful in cases involving dismembered bodies, explosions, or mass disasters, where only partial remains may be recovered. Hands are frequently preserved even when other skeletal elements are destroyed, making them valuable anatomical structures for anthropometric analysis. Therefore, regression equations derived from hand measurements can assist forensic experts in reconstructing stature during medico-legal investigations.

Despite the usefulness of hand anthropometry, certain limitations should be considered. Measurement errors, inter-observer variability, and population heterogeneity may influence the accuracy of regression models. Additionally, anthropometric relationships may vary between different age groups and ethnic populations. Therefore, larger multicentric studies involving diverse populations are recommended to improve the accuracy and generalizability of stature estimation models.

Overall, the findings of the present study are consistent with previously published anthropometric research demonstrating significant correlations between hand length and stature. The regression equation derived from this study may serve as a useful tool for forensic identification in the regional population and may assist in medico-legal investigations involving unidentified human remains.

CONCLUSIONS

The present study demonstrated a statistically significant positive correlation between hand length and stature among adults aged 25–40 years in a tertiary care hospital in Haryana. Males exhibited greater mean stature and hand length than females, reflecting normal sexual dimorphism in anthropometric measurements. The regression equation derived from the study showed close agreement between predicted and actual stature values, indicating that hand length can serve as a reliable anthropometric parameter for stature estimation.

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