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Original Research Article

Estimation of Stature from Hand Length in Adult Population of Jaipur: A Cross-Sectional Study

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Abstract

Introduction: Identification of individuals is a fundamental aspect of forensic medicine, especially in cases involving mutilated or decomposed remains. Stature estimation from body parts is widely used, and hand length has been shown to correlate positively with height. However, regional data for the adult population of Jaipur remains limited.

Methods: A cross-sectional observational study was conducted at SMS Medical College, Jaipur, including 40 adults (20 males and 20 females) aged 20–40 years. Stature was measured using an anthropometer, and hand length was measured using a sliding vernier caliper under standardized conditions. Statistical analysis included mean, standard deviation, and correlation, with $p < 0.05$ considered significant.

Results: The mean stature was 163.10 ± 8.56 cm. The mean right and left hand lengths were 17.00 ± 0.85 cm and 16.90 ± 0.87 cm, respectively. No significant bilateral difference was observed. A statistically significant positive correlation was found between hand length and stature ($p < 0.05$), indicating that hand length is a reliable predictor of stature.

Discussion: The findings support previous studies demonstrating a strong correlation between hand length and stature. The absence of bilateral variation suggests either hand can be used for estimation. However, population-specific variations necessitate regional regression models.

Conclusion: Hand length is a simple, reliable, and practical parameter for estimating stature in the adult population of Jaipur, with important applications in forensic identification.

Keywords: Stature estimation, Hand length, Forensic anthropology, Identification, Regression analysis.

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Introduction

Identification of an individual is a fundamental aspect of civil administration, criminal justice, and forensic medicine, playing a crucial role in medico-legal investigations and disaster victim identification. [1] It is often stated that "identification is an individual's birthright," highlighting the uniqueness of every person. [2] Among key parameters of personal identification—age, sex, stature, and ethnicity—stature serves as an important physical descriptor, especially when complete remains are unavailable. [3]

Stature estimation from skeletal or body parts is essential in cases of mass disasters, mutilation, or advanced decomposition. Anthropometric studies have shown significant correlations between body segments and height, enabling reconstruction from partial remains. [5,6] The hand, due to its distinct morphology and relative preservation, is particularly useful in forensic identification. Studies have demonstrated a positive linear correlation between hand length and stature, allowing formulation of regression equations; however, these relationships vary with sex, ethnicity, and geography. [9,10]

Despite available data from various populations, there is limited research for the adult population of Rajasthan, especially Jaipur. Therefore, the present study aims to assess the correlation between hand length and stature and to develop population- and sex-specific regression equations for forensic application in this region.

Materials and Methods

Aim: To assess the relationship between hand length and stature in adult individuals for the purpose of forensic identification.

Objectives:

1. To record precise measurements of hand length and stature in the study population.
2. To analyse the statistical correlation between hand length and stature.

Study Permission: The study was initiated after obtaining prior approval from the Institutional Review Research Board and the Ethical Committee of SMS Medical College and Attached Hospitals, Jaipur.

Study Type: The work was carried out as a descriptive observational study.

Study Design: It followed a cross–sectional design.

Study Place: The study was conducted at SMS Medical College and Attached Hospitals, Jaipur.

Study Duration: Data collection was conducted from January 2024 to December 2024.

An additional two months were taken for data processing and thesis writing.

Study Universe: All individuals and patients attending SMS Medical College and Attached Hospitals, Jaipur, formed the study universe.

Study Participants: Participants included individuals and patients attending the OPD of the Department of Forensic Medicine & Toxicology, SMS Medical College, as well as IPD patients, medical students, and employees of SMS Medical College and Attached Hospitals, Jaipur.

Inclusion Criteria

- Individuals aged 20–40 years
- Natives of Jaipur
- Willing to give consent

Exclusion Criteria

- Skeletal deformities or limb abnormalities
- History of fractures/surgeries affecting limbs
- Endocrinal or genetic disorders affecting height

Sample Size: A total of 40 participants were included. The sample size was calculated at 95% confidence and 5% allowable error to verify a standard deviation of 1.0 for right-hand length.

Measurements

Stature: Measured using a standard anthropometer with the subject standing erect in Frankfort plane.

Hand Length: Measured from the styloid process of the radius to the tip of the middle finger using a sliding vernier caliper.

Figure 1:

Standardization of Measurements: All measurements were recorded in centimetres to the nearest 0.1 cm. To ensure accuracy, all measurements were taken by the same observer using the same instrument. Instruments were calibrated, and observations were carried out during morning OPD hours (8:00 AM to 2:00 PM) to avoid diurnal variation in stature.

Statistical Analysis

- Mean and standard deviation calculated
- Correlation analysis performed
- $p < 0.05$ considered statistically significant

Results

The present cross-sectional study included 40 adults (20 males and 20 females) aged 21–40 years, with equal age-sex distribution and no statistically significant difference ($\chi^2 = 0.00$, $p = 1.000$), indicating a balanced sample. Participants showed a heterogeneous socio-demographic profile. The largest group had intermediate/diploma education (20%), while professionals (25%) formed the major occupational category. Most participants (22.5%)

belonged to the ₹2,641–7,883 income group, with no significant variation across categories ($p > 0.05$).

Regarding BMI, 82.5% were normal, 15% overweight, and 2.5% obese, showing a significant distribution ($\chi^2 = 44.5$, $p < 0.001$). Most participants belonged to the lower middle class (42.5%), followed by upper middle (30%) and upper lower (25%), with a significant predominance of middle socio-economic class ($\chi^2 = 13.4$, $p = 0.004$).

Descriptive Anthropometric Measurements: The mean stature of participants was 163.10 ± 8.56 cm (range: 145.30–177.20 cm).

The mean right hand length was 17.00 ± 0.85 cm (range: 15.30–18.60 cm), while the mean left hand length was 16.90 ± 0.87 cm (range: 15.40–18.40 cm).

Table 1:

Variable	N	Mean	Median	SD	Minimum	Maximum
Stature (cm)	40	163.10	163.40	08.56	145.30	177.20
Right Hand Length (cm)	40	17.00	16.90	00.85	15.30	18.60
Left Hand Length (cm)	40	16.90	16.80	00.87	15.40	18.40

The close approximation between mean and median values indicated a symmetrical distribution of anthropometric variables.

Comparison between Right and Left Hand Length: The mean values of right and left hand lengths were nearly identical, suggesting no significant bilateral variation, and both hands can be reliably used for stature estimation.

Correlation between Hand Length and Stature: A positive and statistically significant correlation was observed between hand length (both right and left) and stature ($p < 0.05$).

This indicates that as hand length increases, stature also increases proportionately, confirming the reliability of hand length as a predictor of stature.

Table 2:

Correlation Tested	Pearson's r	p-value	Interpretation
Stature VS Right Hand	+0.89	<0.001	Strong positive correlation
Stature VS Left Hand	+0.89	<0.001	Strong positive correlation

Discussion

The present study demonstrated a positive and statistically significant correlation between hand length and stature, supporting the utility of hand measurements in forensic identification. The mean stature and hand length values observed were comparable to previous Indian and international studies, indicating consistency of anthropometric relationships across populations. The absence of significant bilateral variation between right and left hand lengths suggests that either hand can be reliably used for stature estimation. The strong correlation observed in this study aligns with findings of earlier researchers, reinforcing that hand length is a dependable predictor when long bones are unavailable. However, as anthropometric parameters vary with sex, ethnicity, and regional factors, the need for population-specific regression models is emphasized. The relatively small sample size remains a limitation, which may affect the generalizability of the findings.

Conclusion

The study confirms that hand length is a reliable and practical parameter for estimating stature in the adult population of Jaipur. A significant positive correlation exists between hand length and stature, and no significant bilateral difference was observed.

Thus, hand length can serve as an effective tool in forensic identification, especially in cases of mutilated or incomplete remains, and the derived regression equations may aid medico-legal investigations in the regional population.

Limitations

1. The small sample size (n=40) limits statistical power and generalizability.
2. The restricted age group (21–40 years) limits applicability to other age populations.
3. Geographic and ethnic homogeneity confines applicability to populations outside Jaipur.
4. Lower predictive accuracy in females suggests gender-based variability in results.
5. The cross-sectional design prevents assessment of longitudinal or age-related changes.
6. Minor measurement errors and possible diurnal variation may have influenced accuracy.

Recommendations

1. Future studies should include larger sample sizes to improve statistical validity and generalizability.

2. Inclusion of wider age groups is recommended to assess applicability across the lifespan.
3. Studies involving diverse geographic and ethnic populations are needed for broader applicability.
4. Gender-specific regression models should be developed to enhance prediction accuracy.
5. Longitudinal studies are suggested to evaluate changes over time and improve precision.
6. Advanced analytical methods using multiple anthropometric parameters should be applied to increase accuracy.

Ethical Committee Approval: Office of the Ethics Committee, S.M.S. Medical College and Attached Hospitals, Jaipur, Reference No.: MC/EC/2023/85, Date of Approval: 08/11/2024.

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