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Original Research Article

Development of a Linear Regression Model for Estimation of Human Stature Using Little Finger Length: A Cross-Sectional Study among South Indian Adults

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Abstract

Background: Stature estimation is a fundamental component of forensic identification and anthropological investigations. Although long-bone measurements provide the highest accuracy, they are not always available in cases involving fragmented or incomplete human remains. Anthropometric measurements of the hand and fingers offer practical alternatives because they are simple, inexpensive, and non-invasive. The little finger has been comparatively underexplored as a predictor of stature, particularly in South Indian populations. ***Objectives:*** To evaluate the relationship between little finger length and stature and to develop regression models for anthropometric estimation. ***Materials and Methods:*** A cross-sectional observational study was conducted among 105 healthy adults aged 18–40 years at Yenepoya Medical College. Standing height was measured using a stadiometer, while right and left little finger lengths were measured using a Vernier caliper following standard anthropometric techniques. Each measurement was recorded twice, and the average value was used for analysis. Pearson correlation and linear regression analyses were performed using Microsoft Excel. Statistical significance was set at $p < 0.05$. ***Results;*** Stature demonstrated a significant positive correlation with right little finger length ($r = 0.484$, $p < 0.001$) and left little finger length ($r = 0.390$, $p < 0.001$). Weight showed a significant correlation only with the right little finger ($r = 0.328$, $p = 0.001$), whereas BMI was not significantly associated with either measurement. Regression analysis identified height and gender as significant predictors of right little finger length ($R^2 = 27.3\%$), while height alone significantly predicted left little finger length ($R^2 = 15.2\%$). Discriminant analysis based on bilateral little finger lengths correctly classified 67.61% of participants according to sex. ***Conclusion:*** Little finger length demonstrates a statistically significant association with stature and may serve as a practical anthropometric parameter in forensic and anthropological applications. Population-specific regression models may improve the accuracy of stature estimation in situations where conventional skeletal measurements are unavailable.

Keywords: Anthropometry, Forensic anthropology, Linear regression, Little finger length, Stature estimation.

INTRODUCTION

Stature is one of the primary biological characteristics used for establishing personal identity in forensic medicine, anthropology, archaeology, and disaster victim identification [1]. Estimation of stature contributes significantly to constructing the biological profile of unidentified individuals, especially when complete skeletal remains are unavailable. Although long bones remain the most reliable indicators of stature, they are often absent in medico-legal investigations involving fragmented remains.

Anthropometric measurements obtained from the hands and fingers provide a convenient alternative because they are easy to obtain, inexpensive, and reproducible [2]. Previous studies have demonstrated significant correlations between stature and various hand dimensions, including hand length, palm length, and finger lengths. However, the little finger has received comparatively limited attention despite its potential utility. Moreover, anthropometric relationships vary according to ethnicity, sex, and geographical location, necessitating population-specific regression equations

[3]. This study aimed to evaluate the relationship between little finger length and stature among South Indian adults and to explore its usefulness for anthropometric estimation.

MATERIALS AND METHODS

This cross-sectional observational study included 105 healthy adults aged 18–40 years recruited by convenience sampling from Yenepoya Medical College. Individuals with congenital deformities, previous hand fractures, or conditions affecting hand morphology were excluded.

Standing height was measured using a standard stadiometer with participants standing barefoot in the anatomical position. Right and left little finger lengths were measured from the tip of the finger to the metacarpophalangeal crease using a Vernier caliper. Measurements were obtained bilaterally, repeated twice by the same observer, and averaged to minimize measurement error [4].

Statistical analysis was performed using Microsoft Excel and SPSS. Pearson correlation coefficients were calculated to evaluate associations between stature, weight, BMI, and little finger length. Linear regression analysis was performed to develop predictive models, and discriminant analysis was used to evaluate sex classification. A p-value < 0.05 was considered statistically significant.

RESULTS

Among the 105 participants, stature showed significant positive correlations with both right and left little finger lengths. The right little finger demonstrated a stronger association with stature (r = 0.484) than the left (r = 0.390), and both correlations were highly significant ($p < 0.001$). Weight correlated significantly only with right little finger length, whereas BMI showed no significant relationship with either side as shown in Table 1.

Height is found to be significantly correlated with R5D & L5D, whereas weight is observed to be significantly correlated with only R5D. The fitted regression equation for the dependent variable R5D (cm) is R5D=2.741+0.019 Heig*h*t−0.214 Gender in which the R^2 is 27.3%

Weight & gender are insignificant predictors of L5D. The fitted regression equation is L5D=2.251+0.021 Height. The R^2 of above model is 15.2%.

Wilk's lambda is used to measure the contribution of the variables to the discriminant function. The fitted equation for the discriminant function will be Dm=−137.220+28.107 R5D+18.529 L5D for males and Df=−121.487+28.423 R5D+18.452 L5D for females. (Dm is the discriminant function for males and Df is the discriminant function for females).

Table 1: Significant Correlations of R5D and L5D with Height, Weight and BMI

		R5D (cm)	L5D (cm)
Height (cm)	Pearson Correlation	.484**	.390**
	Sig. (2-tailed)	.000	.000
	N	105	105
Weight (kg)	Pearson Correlation	.328**	.149
	Sig. (2-tailed)	.001	.130
	N	105	105
BMI	Pearson Correlation	.074	-.061
	Sig. (2-tailed)	.455	.534
	N	105	105

Regression analysis as shown in Table 2, identified right little finger length as significant predictors of height and gender, yielding the equation:

R5D = 2.741 + (0.019 × Height) − (0.214 × Gender)

This model explained 27.3% of the observed variation.

Table 2: Regression analysis indicating R5D as significant predictors of height and gender.

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Constant	2.741	.906	.000	3.026	.003
Height (cm)	.019	.005	.354	3.494	.001
Gender	-.214	.092	-.235	-2.313	.023

In table 3, the left little finger length alone remained as a significant predictor for height.

L5D = 2.251 + (0.021 × Height) with an R^2 value of 15.2%.

Table 3: Regression analysis indicating only L5D as a significant predictor of height.

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Constant	2.251	.778		2.893	.005
Height (cm)	.021	.005	.390	4.299	.000

Discriminant analysis using bilateral little finger lengths demonstrated among the population dynamics, a Wilks' lambda of 0.814 ($p < 0.001$), indicating significant discrimination between sexes as shown in Table 4. The overall classification accuracy was 67.61%, correctly identifying 70% of males and 67.56% of females.

Table 4: Wilks lambda classification

Wilks' Lambda	Chi-square	df	Sig.
.814	20.977	2	.000

DISCUSSION

The present study demonstrated a statistically significant positive relationship between stature and bilateral little finger lengths, supporting the use of finger dimensions as anthropometric indicators. The stronger correlation observed on the right side may reflect hand dominance or normal biological asymmetry, although further investigation is warranted.

These findings are consistent with previous studies by Kanchan and Krishan, who demonstrated the forensic value of hand anthropometry in Indian populations, and Agnihotri *et al.,* who reported significant associations between phalangeal dimensions and stature in an Indo-Mauritian population [1, 2]. Similarly, Sharma and Sharma observed that little finger length could serve as a useful predictor of stature among North Indian medical students. The present findings further support the concept that population-specific regression equations improve the applicability of anthropometric methods [3].

Despite demonstrating statistically significant relationships, the relatively modest coefficients of determination indicate that little finger length alone explains only part of the variation in stature. Therefore, prediction accuracy may be enhanced by incorporating additional hand or body measurements into multivariable regression models [3].

Agnihotri and colleagues in 2017 studied hand and phalange lengths in an Indo-Mauritian group: Finger measurements are useful predictors, though differences across populations mean equations need local validation [2].

Jasuja and Singh in 2004 also supported using hand and phalange lengths for height estimation. Our work builds on their methodology, offering updated models tailored to our population [5].

CONCLUSION

Little finger length demonstrates a significant association with stature and offers a simple, inexpensive, and non-invasive anthropometric parameter for forensic and anthropological applications. Although it cannot replace long-bone measurements, it may provide valuable supplementary information when complete skeletal remains are unavailable. Further studies involving larger, multi-centre populations and regression models with stature as the outcome variable are recommended to improve predictive accuracy.

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