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Department of Forensic Medicine & Toxicology, Third Floor, Library Building, Seth G S Medical College & KEM Hospital, Parel, Mumbai, Maharashtra, India. Pin-400 012. Email id: [mlameditor@gmail.com](mailto:mlameditor@gmail.com) Phone: 022-24107620 Mobile No. +91-9423016325.



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## Original Research Article

### **Palm Length as an Aid for Stature Estimation in South Indian Population.**

Vishal Koulapur<sup>a</sup>, Vinay R Hallikeri<sup>b\*</sup>, B Manoranjan<sup>c</sup>

<sup>a</sup>Associate Professor, <sup>c</sup>Post-graduate student; Dept. of Forensic Medicine and Toxicology, KAHER's J N Medical College, Belagavi, Karnataka, India..

<sup>b</sup>Assistant Professor, Dept. of Forensic Medicine and Toxicology, Gadag Institute of Medical Sciences, Gadag Karnataka, India.

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Forensic Anthropology,  
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#### Abstract

**Introduction:** Human remains identification is a paramount task for any investigator in a forensic investigation. The present paper focuses on relationship between the palm length and stature in the South Indian student population and regression formulae to estimate the stature from this measurement have been devised. These findings would be a valuable tool for the anthropologists in general and forensic experts in specific for estimation of stature. **Objectives:** To derive regression equations that can be applied for estimation of stature of South Indian population using the palm length. **Material and Methods:** Palm length and height were measured from 200 students (100 males & 100 females) aged between 18 to 25 years belonging to south Indian population. Measurements of palm length of males and females were taken by using a Vernier callipers and the height was recorded using Anthropometer rod. Pearson's correlation co-efficient was calculated and its significance was tested at a p-value of less than 0.05. **Results** The mean stature of males and females were 173.8 and 159.1 cm respectively. Mean palm length of right and left sides for males was same (11.3 cm) whereas in females was 10.1 cm and 10.3 cm respectively. Linear regression equations for estimation of stature in males and females and palm length showed a significant correlation with the stature in males and females. The right-palm length in both sexes appears to be the better predictor of stature. **Conclusions** It is better to use the combined regression equations than the specific gender-based equations.

#### 1. Introduction

Forensic anthropology is a rapidly evolving discipline, with numerous applications in biological anthropology, archaeology and in medico-legal issues. In Forensic practice the science is helpful to

determine whether the recovered article is bone or not, species, time since death estimation, age estimation, sex, stature, taphonomy etc.<sup>1</sup> In recent years forensic anthropology has reinforced its application firmly.

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\***Corresponding author:** Dr. Vinay R Hallikeri, Assistant Professor, Dept. of Forensic Medicine and Toxicology, Gadag Institute of Medical Sciences, Gadag, Karnataka, India. E mail: [vrhallikeri@gmail.com](mailto:vrhallikeri@gmail.com) (M): +91-7829742529.

In medicolegal point of view the contribution of forensic anthropometry in trauma analysis is considered as a huge endowment.<sup>1</sup> Estimation of stature guides in identification of individuals. Human remains identification is a paramount task for any investigator in a forensic investigation. Geographical, ethnic, genetic, dietary and other variations demand population specific regression models.<sup>2</sup> Studies have shown that length of long bones, fragmentary bones, spine, foot dimensions, metacarpal and metatarsal lengths, skull, and scapula can be used for stature estimation in identification of an individual. In natural calamities, bomb blasts or any other mass disasters extremities are easily found and can be used in stature estimation and hence establishing individual identity.<sup>3</sup>

The present paper focuses mainly on relationship between the palm length and stature in the south Indian student population, wherein an attempt has been made to develop regression formulae to estimate the stature from this measurement. These findings would be a valuable tool for the anthropologists in general and forensic experts in specific for estimation of stature.

### Aims and objectives

To derive regression equations that can be applied for estimation of stature of south Indian population using the palm length.

### 2. Material and Methods

The study was conducted in the department of Forensic Medicine and Toxicology at JNMC, Belgaum, Karnataka state, India. In this study length of palm length and height were measured from 200 students (100 males & 100 females) aged between 18 to 25 years belonging to south Indian population. Non-resident Indians and subjects from northern, western and eastern India were excluded from the study. Subjects with Skeletal abnormalities and connective tissue diseases, which may be congenital or acquired, were also excluded. Informed written consent was obtained prior to recording the measurements.

**Table1.** Descriptive statistics of stature, palm of both sexes.

Gender	Age (Years)	Stature (cm)	Right palm (cm)	Left palm(cm)
Female	19.8+/- 0.83	159.1+/-5.77	10.1+/-0.55	10.3+/-1.39
Male	21.5+/-4.11	173.8+/-5.95	11.3+/-0.68	11.3+/-0.74
combined	20.6+/-3.07	166.5+/-9.41	10.7+/-0.86	10.8+/-1.21

Anthropometric measurements and Techniques: Measurements of palm length of males and females were taken by using a Vernier calipers and the height was recorded using Anthropometer rod. Stature was measured as vertical distance from the vertex to the floor. Measurement was recorded by making the subject to stand erect on a horizontal resisting plane, bare footed with shoulder blocks and buttocks touching the wall. Palms were turned inwards and fingers horizontally pointing downwards. Anthropometer was placed in straight vertical position in front of the subject with head oriented in eye-ear-eye plane (Frankfurt Plane). The movable rod of the Anthropometer is brought in contact with vertex in the mid sagittal plane. To measure palm length the subject was asked to place the hands on a flat table, and the distance between the midpoint of the proximal crease of middle finger and the distal transverse crease of wrist was recorded using a Vernier calipers.

**Statistical analysis:** The data was analysed using SPSS (Statistical Package for social science) version 18.0 to calculate descriptive statistics of stature and palm length for male and female subjects. For assessing the correlation between the stature and palm length, Pearson's correlation co-efficient was calculated and its significance was tested at a p-value of less than 0.05. The correlation coefficient was calculated separately for both male and female subjects. Linear regression models were derived for stature estimation from palm length in males and females keeping the stature as dependent variable and palm length as an independent variable.

### 3. Results

The mean stature of males and females were 173.8 and 159.1 cm respectively. Mean stature was significantly more in males than females. Mean palm length of right and left sides for males was same (11.3 cm) whereas in females was 10.1 cm and 10.3 cm respectively. Palm length was more in males than females in both the hands. Descriptive statistics of stature, palm length of both hands is depicted in [table No.1](#).

Statistically significant correlation was observed between stature and palm length of both hands. Pearson correlation ( $r$ ) for stature and palm lengths was higher in right palm than left palm as shown in **table No.2**. Linear regression equations for estimation of stature in males and females are shown in **table No.3**. The palm length showed a significant correlation with the stature in males and females.

**Table 3: Regression equations for estimation of stature from length of palm.**

Gender	Variable	Equation (St = a + bx)	r	r <sup>2</sup>	SE	t for b	p
Combined	Right (Rt.) Palm	St = 78.92+8.142 x Rt. Palm	0.797	0.558	6.289	11.128	0.000
	Left (Lt.) Palm	St = 122.943+4.013 x Lt. Palm	0.519	0.269	8.089	6.009	0.000
Female	Right Palm	St = 94.414+5.980 x Rt. Palm	0.572	0.327	4.785	4.834	0.000
	Left Palm	St = 145.618+1.307 x Lt. Palm	0.315	0.009	5.537	2.299	0.026
Male	Right Palm	St = 138.505+3113 x Rt. Palm	0.359	0.129	5.612	2.663	0.001
	Left Palm	St = 132.265+3.664 x Lt. Palm	0.458	0.210	5.341	3.569	0.001

## 5. Discussion

Anatomical method of estimation of stature of an individual is considered best in skeletal remains and cadaver stature estimation. If mutilated or parts of the bodies are produced, like most common in forensic examination then the expert's choice has to be mathematical method for estimation of stature and mathematical method has the advantage to estimate stature when body parts are produced, disadvantages are due to a vast variation in population ethnicity the attainment of accuracy is in subpar level.<sup>4</sup> It is well known to the forensic experts that climate, genetic, racial and nutritional factors play a vital role in body built of an individual. Our main objective of the study was to develop regression equations for estimating stature in Indian student population based at Belagavi, India and consequently we have developed a set of usable equations. In the present study, a total of 100 subjects were studied for estimation of stature from hand length in both the sexes. Average stature seen in our study is 159.1 cm in females and 173.8 cm in males, males being taller than females. These findings correlate with that of observations made by other studies involving stature.<sup>5,6,7,8</sup>

In this study we found that right-palm length was longer than the left palm in females and it was same in males. Generally, this is due to the fact that dominant palm has larger dimension than the non-dominant hand.<sup>3</sup> Our findings in males are in par with findings of a study conducted by Krishan and Sharma where it was found that length of the right and left palm didn't show any marked difference.<sup>9</sup> In another

**Table 2: Pearson's Correlation coefficient of palm length with height.**

Variable	R	P
Right Palm	0.747	0.00
Left Palm	0.519	0.00

The right-palm length in both sexes appears to be the better predictor of stature.

study by, Bhatnagar et al. it was found that length and breadth of both right and left palm showed no significant difference.<sup>10</sup> Our study demonstrated that length of female palms are shorter than the males which is in accordance to observations made in a study on Nigerian population wherein it was found that the length of the female hands are shorter than male but the breadth of the palm is wider when compared to male.<sup>11</sup>

Generally, the puberty is delayed in male by two years when compared to females this is the reason why the skeletal growth of male is more when compared to females it gives extra two years for the growth in male.<sup>12</sup> In a comparative study between three different ethnic females it was found that palm length varied significantly among Indians, west Europeans and natives of West Indies suggesting population based studies are warranted for developing regression equations.<sup>13</sup> Consequently we have developed sets of separate formula in both sexes to estimate stature. In our study we have found a positive correlation palm length and stature which in accordance to other studies.<sup>3,8,9</sup>

In a study conducted in north and south Indian population, it was found that the length of a right palm in male points to a highest correlation with stature. The same study stated that comparatively female stature estimation is accurate and reliable than male with a single dimension of palm in unknown person.<sup>14</sup> Interestingly our study demonstrated that the combined regression equations are more reliable than the gender specific equations.

## 6. Conclusion

In present study, length of the palms was used to predict the stature of a person. It is better to use the combined regression equations than the specific gender-based equations. The formulae to estimate stature vary according to the genetic and environmental factors like climate, nutrition.

**Contributor ship of Author:** All authors equal contribution.

**Ethical Clearance:** Yes.

**Conflict of interest:** None.

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