Original Article

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Estimation of Stature from Length of Little Finger in the Population from South India

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Abstract

Background: In Forensic identification, widely used is Anthropometry which deals with expressing human form in numbers. Out of these Sex and stature are the most important. Identification is also an important criterion in human remains, one of the important tasks for the forensic anthropologist is to determine the Individuality of dismembered, mutilated and fragmentary remains. Determination of stature and gender and comparison with ante mortem data is the processes commonly employed in process of Identification. *Aim and Objective:* to derive linear regression formulae from correlation of little finger length and stature and later have a comparison of correlation between stature and little finger length with the studies made by earlier researchers. *Place of Study:* Department of Forensic Medicine of Gandhi Medical College Musheerabad, Secunderabad, Hyderabad. *Material and Method:* The study is made on the Volunteers total 194 subjects were selected irrespective of their caste, religion, dietary habits & socio-economic status at Department of Forensic Medicine of Gandhi Medical College Musheerabad, Secunderabad, Hyderabad. *Observation and Discussion:* Regression equation of Male little finger length on stature is, Male Stature (X) = 86.191 + 4.3727*YRLF + 6.8783*ZLLF. Similarly for Female Stature is highly correlated to little finger length (i.e. Correlation coefficient = 0.80) with P-value is 0.0000. Therefore, Regression equation of Female little finger length on stature is, Female Stature (X) = 85.1299 + 10.2972*YRLF + 1.2561*ZLLF. The linear regression equation derived from little finger length for estimation of stature showed a statistically significant relationship in both the genders. *Conclusion:* The regression equations arrived in the study can be absolute use for south India population. Our study will help the investigating agencies to collect information about victim around the particular area while minimize the time duration of investigation. It definitely could be proved as a milestone for judiciary in the population of South India region.

Keywords: Stature estimation; Little finger length; Regression equation.

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Introduction

In Forensic identification, widely used is Anthropometry which deals with expressing human form in numbers. Various criterions like sex, age and stature of a person are included in Identification of a person. Out of these Sex and stature are the most important [1]. Identification is also an important criterion in human remains, one of the important tasks for the forensic anthropologist is to determine the Individuality of dismembered, mutilated and fragmentary remains. Determination of stature and

gender and comparison with ante mortem data is the processes commonly employed in process of Identification. This process of Identification is usually encountered in cases of mass disaster, assault cases where the body is mutilated to dismembered and establishment of identity of the victim poses a big challenge for investigating authorities [2]. Rollet [3] was the first to conduct a study in this field, studied 50 males and 50 females corpses to show the relationship between various body measurements and the stature in 1888. Later, it was Pearson [4] basically a mathematician, who used this data to derive the regression equations, and he suggested that it was population specific. Hence forth numerous advancements have been made in this particular field and this is being efficiently applied in the process of Identification. As these all study are population specific, it becomes imperative to collect data from more populations and make a comprehensive data.

Tyagi et al. [5] carried out the study on subjects from Delhi India, he concluded that a positive correlation existed between stature and finger lengths and it also stressed that the index finger was the best for prediction of stature in both sexes. As well in similar study, it was concluded that the correlation between stature and hand length was greater on the right side in both sexes [6]. Stature of an individual is directly proportional to different parts of body and definitely shows a biological and genetic relation with each other. In medico legal cases, stature is usually estimated using anatomical and mathematical techniques [7], various studies had established a positive relationship between stature and measurements of different body parts which are being represented by sue of linear regression equation derived from them [1]. It is very common that often a part of skeletal framework is encountered in various forensic cases. Also inherent population differences among the different population exist, thus it raise a point that different formulae need to be derived from different populations [8].

In regards with relation to overall weight and height of the individual the calculation and measurement of stature is based on the relative proportion of different body weight. For the stature estimation the multiple researchers had conducted studies and had derived stature from multiple parameters for example percutaneous measurement of various body parts which includes arm, forearm, leg, foot etc [9-10]. Based on the current scenario, we felt there is a strong need to determine the stature estimation from little finger Length, the current study was undertaken to estimate stature from measurement of little finger length. Our aim of the study was to derive linear regression formulae from correlation of little finger length and stature and later have a comparison of correlation between stature and little finger length with the studies made by earlier researchers.

Aim and objective

Current studyhad been conducted on the consenting volunteers whose ages fall between a range of 22 to 42 years to establish the relation of stature and little finger length along with regression formula in relation.

Materials and methods

The study is made on the Volunteers total 194 subjects were selected irrespective of their caste, religion, dietary habits & socio-economic status at Department of Forensic Medicine of Gandhi Medical College Musheerabad, Secunderabad, Hyderabad. Sufficient permissions and consents were procured before the measurements of the volunteers are taken and clearance from the Institutional Ethical committee is obtained in advance. Stature; using the Stadio-meter, the subject was made to stand barefoot in the standard standing position on its baseboard. Both feet are in close contact with each other and head oriented in Frankfurt's plane. The height was then recorded in centimeter from the standing surface to the vertex in the weight bearing position of foot.

Anthropometric measurement little finger length of both hand - It is the distance from the tip of little finger to the proximal crease of the little finger respectively. Instruments: Digital Vernirecaliper. Technique The measurement was taken in standing position with stabilization of hand on table. The caliper was horizontally placed along the ventral surface of the hand. The fixed part of the outer jaw of the caliper was applied to the proximal crease of little finger and the mobile part of the caliper was approximated to the tip of the little finger and measurement was taken and the measurement was obtained up to one decimal place. In entire course of the study for each volunteers measurement was taken twice, that is once with the spreading caliper and second with a self retracting measuring tape. To avoid diurnal variations and to eliminate any discrepancies both measurements were taken in a time slot between 1:00 to 15:30 hours of the day. Any kind of error from Instrumental, all

the instruments were verified at significant level and variation of ± 0.01 cm was observed. Value of the constant and regression coefficient was calculated using SPSS Version 19 program.

Inclusion criteria

All volunteers, both Male and Female were selected, irrespective of their socio-economic standards. The ages of these volunteers are falling between 22 years and 42 years with no history of any sort of deformity of the hand, metabolic disorders and any developmental process.

Exclusion criteria

Volunteers morphologically showing the congenital malformations, Dwarfism / Achondroplasia, features of nutritional deficiencies and injuries to extremities were not included in the present study.

Data Analysis

Data thus collected was analyzed using SPSS version 19. The mean values and the standard deviations were calculated for stature and Little finger length. Correlation of the Little Finger length with the stature was assessed. Regression co-efficient and constant was calculated for estimating stature through regression equation from little finger length. The effectiveness of regression equation was tested by significance Z test.

Results

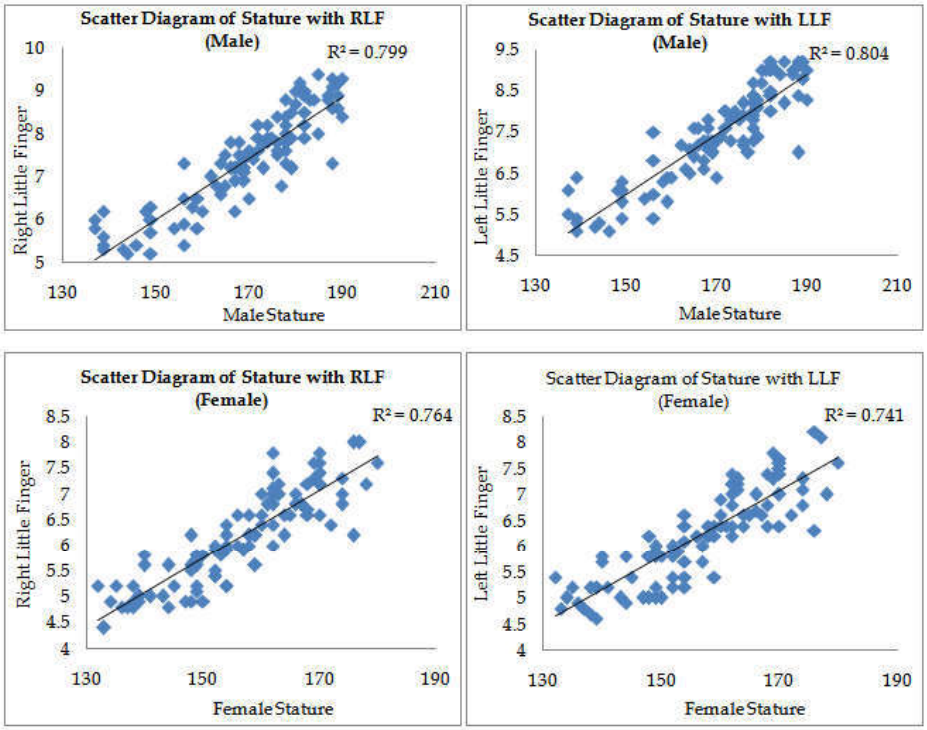

Fig. 1: Scatter diagram of stature with Little finger length for Male and Female.

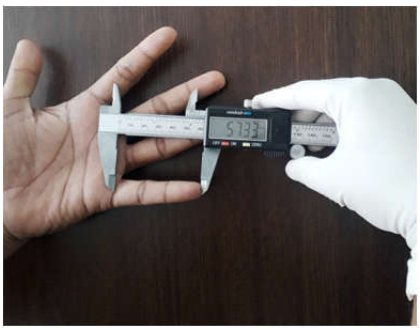

Fig. 2: Digital Vernier caliper used to measure the little fingerlength; hand placed on the plane surface, palm of the handfacing upwards.

As per Table 1 Total 194 Subjects were measured in various age groups starting from 22 years to 42 years Females and Males both were 97 each. Heights of individual are varying irrespective of age and sex.

Table 1: Sex-wise and combined Distribution of statures and little finger Lengths (cm)

Character		Male	Female	Combined (M + F)
Age	Maximum	40	40	40
	Minimum	22	22	22
Stature	Maximum	190	180	190
	Minimum	137	132	132
Right Hand Finger	Maximum	9.4	8	9.4
	Minimum	5.2	4.4	4.4
Left Hand Finger	Maximum	9.2	8.2	9.2
	Minimum	5.1	4.6	4.6

Table 2: Distribution of Stature and little finger Length in cm for both sex and combined.

Character		Mean	Std. Dev.	Confidence Interval
Age	Male	30.8	6.221	30.8 ± 1.2444
	Female	31.14	6.278	31.14 ± 1.256
Stature	Male	169.833	14.164	1.69.833 ± 2.83
	Female	156.260	11.776	156.26 ± 2.356
Right Hand Finger	Male	7.4323	1.1335	7.4323 ± 0.227
	Female	6.1521	0.8958	6.1521 ± 0.1792
Left Hand Finger	Male	7.4354	1.1356	7.4354 ± 0.2272
	Female	6.1948	0.8704	6.1948 ± 0.1741

Table 3: Relation between Stature and little finger Length, correlation coefficient.

Characteristics		Correlation Coefficient	p Value
Male Stature	Right Little Finger	0.89425	0.0000
	Left Little Finger	0.89687	0.0000
Female Stature	Right Little Finger	0.87438	0.0000
	Left Little Finger	0.86104	0.0000

Correlation Coefficient between male Stature with left, right little finger measurement, and also Correlation Coefficient between male Stature with left, right little finger measurement is highly correlated. Regression Formulae of Male and Female for prediction **Stature (X)** on **Right hand little Finger (Y)** and **Left hand little Finger (Z)** is given bellow.

$$X \text{ (Stature)} = \beta_0+\beta_1 Y+\beta_2 Z$$

β_0, β_1, β_2 are Regression Coefficient.

Male Stature (X) = 86.191 + 4.3727*Y_{RLF} + 6.8783*Z_{LLF}

Female Stature (X) = 85.1299 + 10.2972*Y_{RLF} + 1.2561*Z_{LLF}

Discussion

Stature prediction of a person had an important function in forensic investigation as well in anthropological researches. Stature of person is a characteristic feature that is based onmany factors such as sex, age, genetic makeup, ethnic and geographical radix, social stratum and physical activity [11].

The study was conducted on volunteers at Musheerabad Hyderabad GMC, belonging to various religious and regions were studied. Our attempt was to devise the linear regression equations as well as multiplication factors for estimation of stature from little finger length in both the genders. In this study little finger length is found to be good parameter for predicting stature in both the genders. The linear regression equation derived from little finger length for estimation of stature showed a statistically significant relationship in both the genders. As such Estimation of stature, as part of identification process, has a long history in physical anthropological studies. Stature plays a very important role in the description of a human population, for physical, anthropological, and biomechanical research.

In comparison a relatively less amount of work had been done as well use of statistical methods to calculate the stature from little finger Length. In our current study the observation shows that there is high degree of positive correlation in case of males and females as well combined.

Regression equation of Male little finger length on stature is, **Male Stature (X) = 86.191 + 4.3727*Y_{RLF} + 6.8783*Z_{LLF}.**

Similarly for Female Stature is highly correlated tolittle finger length (i.e. Correlation coefficient = 0.80) with P-value is 0.0000.

Therefore, Regression equation of Female little finger length on stature is, **Female Stature (X) = 85.1299 + 10.2972*Y_{RLF} + 1.2561*Z_{LLF}**. The males had longer little finger lengths, in comparison to females.

On the point of bilateral differences for the right and left hand measurements in both the sexes, there are no statistical significance and these findings of our study are in agreement with Zeybek et al. [1] and Uhrova et al.[12] on the contrary it was Rastogi et al. [13] and Ishak et al. [14] reported that there were statistical significance bilateral differences in

hand and foot breadth, and it was concluded that it might may be due to more physical activity of one side over the other. Hence the side with dominant activity leads to more strengthening of muscles and bone development of that particular side [15].

Estimation of stature was determined by use of calculated regression coefficient and constant values for both the sex from Index and Ring finger lengths on the population from eastern India; it gives a description of how the index and ring finger lengths can be sued to estimate stature shall be utilized to estimate sex of the individuals when multiple reliable methods of sex estimation are not available during medico legal investigation [16].

Conclusion

Stature estimation of a person is a substantial parameter in Forensic investigation as well in anthropological research, and the morpho-metery of the hands has specific evidence in crime scene examination which definitely helps in estimation of stature. In our present study, we could conclude an ultimate and powerful correlation between the stature and little finger length; it will surely assist in medico legal situations in specific for establishment of personal identification whenever only some skeletal remains are found. The regression equations arrived in the study can be absolute use for south India population. Our study will help the investigating agencies to collect information about victim around the particular area while minimize the time duration of investigation. It definitely could be proved as a milestone for judiciary in the population of South India region. There is a need to conduct more studies among people of different regions & ethnicity so that stature estimation becomes more reliable & identity of an individual is easily established. We conclude that the obtained formulas are specific to that study populations therefore application of these by the other populations might cause incorrect results. Thus necessity in creation of specific equations peculiar to populations should be taken into account by researchers.

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