Stature and Percutaneus Tibial Length: A Correlational Study in Maharashtrian Population

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Abstract

Stature is among the factors required to establish individuality of an unidentified dead, body or any mutilated part of such body. A dismembered body parts are being frequently brought to the Medico-legal expert for generating data for identification, due to incidence of mass disasters like air crash, terrorist attacks etc. Which is quiet frequent now a days? In present study an attempt is made to estimate the stature from percutaneous tibial length (PCTL). Study consists of 100 adult males and 100 adult females between the age group of 20 – 60 years, born in Maharashtra. On computing the data, it was found that a significant positive correlation exists between the stature and percutaneous tibial length. Stature was estimated from percutaneous tibial length using simple regression analysis.

Key words: Stature, percutaneous tibial length (PCTL) and regression equation.

Introduction

Establishment of the identity of a deceased person assumes great medico-legal significance. Human bones are not just a frame for the flesh; they are also frames for our identities. Even fragmentary remains of the body would tell something about its owner. In mutilated bodies or in skeleton remains, establishing individuality is more intriguing. Sometimes, after a murder, the body is thrown into the jungles, where it is usually destroyed by wild animals, and only parts of the body or bones may be left. Establishing the identity in these cases is a tedious process. Many factors are taken into consideration for establishing the identity in these cases, amongst which height or stature of the person is one.

Estimation of the standing height of the individual is exclusively a metric procedure. The regression formulae of Trotter and Glesser [1-2] for the long bones, and the calcaneus's and talus formulae developed by Holland [3] were used to reconstruct the stature of a person. These measurements are based on the maximum length of the adult bones [4]. However, numerous factors such as diet, climate, hereditary, region etc. influence the morphological parameters of a population [5-6]. In view of the same generating formulae specific to a region and population is a need necessity.

Extensive work has been done on correlation of measurements of various body parts with stature of a person in the India and abroad [4-16]. In fact all the studies have concluded that there is a linear relationship between the measurements and stature. However they have been conducted in different regions on different races, hence their data and statistical formulae cannot be generalized. In this work an attempt was made to use the surface bony length i.e. percutaneous tibial length (PCTL) for calculating the stature of the individual. Regression formulae had been devised from individual samples for estimating stature from measurements of percutaneous tibial length (PCTL) for both sexes separately.

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Material and Methods

Standing height and percutaneous tibial length (PCTL) of 200 apparently healthy Maharashtrian individuals comprising of 100 adult males and 100 adult females of age range from 20 to 60 years were taken for establishment of regression formulae. Standing height of the individual was measured by asking him to stand on the baseboard of a standard metric height-measuring stand with head oriented in eye-to-eye plateau ie the Frankfurt plane was horizontal. The measurement of height was taken in centimeters by bringing the projecting horizontal sliding bar to the vertex.

Percutaneous tibial length (PCTL) was measured in centimeters (cms) with the help of spreading calipers, by measuring the distance between the most prominent palpable portion of the medial condyle of the tibia and tip of the medial malleous. The data was then subjected statistical analysis using computer software.

Observations and Discussion

In the present study stature and percutaneous tibial length (PCTL) of 100 adult males and 100 adult females were measured in centimeters using standard height measuring equipment and spreading calipers respectively. As individuals stop growing in height on completion of union of the epiphysis and the diaphysis, which is usually by the age of 18 to 20 years, all individuals considered for the purpose of study were either at or above the age of 20 years. The height of males was in the range of 152 cm to 182 cm with a mean of 167.89 cm ± 6.21 cm. PCTL was in the range of 31 cm to 42 cm with mean of 37.32cm ±2.18 cm. The height of female subjects was in the range of 140 cm to 164.5 cm, with a mean of 151.41 cm ± 5.04 cm. The PCTL of females was in the range of 30 cm to 44 cm with a mean of 34.44 cm ± 2.10 cm.

The present study revealed that standing height of many individuals were same, but their percutaneous tibial lengths (PCTL) differed, i.e. the contribution of tibial length to the stature of a person varied from person to person, even for a given height. Keeping this in view, Mean of stature and PCTL were taken into consideration. The data were analyzed for range, mean, standard deviation, % of co-efficient variation and standard error (Table No. 1).

Table No. 1: Showing range, mean, SD, % of coefficient of variation and standard error.

Character	Male		Female	
	Height (cm)	PCTL (cm)	Height (cm)	PCTL (cm)
Range	152 – 186	31 – 42	140 – 164.5	30 - 44
Mean	167.89	37.32	151.41	34.44
SD	6.21	2.18	5.04	2.10
% Coefficient variations (%CV)	3.70	5.84	3.33	6.10
SE	0.62	0.22	0.50	0.21

Trotter and Gleser[1-2] had designed the most commonly used equations. The lower limb length is the greatest contributor to standing height; hence most of the predictive equations are based on the length of the long bones of the lower limb, the femur, tibia, and fibula [1-2]. To address the issue of poor preservation and fragmented and incomplete bones, Steele[5] had developed equations for predicting the complete length of the long bone [5].

Correlation coefficients (r) of height and PCTL were calculated for males and females. The value of 'r' for males was 0.82 and for females 0.68. Both these values were statistically significant (Table No. 2).

Table No. 2: Showing correlation coefficient (r), standard error of estimate

Sex	Correlation coefficient (r)	Standard error of estimate (SEE)	'P' value
Male	0.82	3.56	< 0.05
Female	0.68	3.69	< 0.05

Since there was high correlation between the height and PCTL, a simple regression analysis was done between them for males and females, to predict height from PCTL.

For estimation of height from PCTL, a simple regression formula was derived as follows (Table No. 3):

For male Stature in cm = 81.30 + 2.32 x PCTL (cm) ± 3.56

Table No. 3: Showing mean height ± SD, mean PCTL ± SD, Correlation coefficient (r), regression coefficient (b), intercept, standard error of estimate (SEE).

Characters	Male	Female
Mean height ± SD	167.89 ± 6.21	151.41±5.04
Mean PCTL ± SD	37.32 ± 2.18	34.44 ± 2.10
Correlation coefficient (r)	0.82	0.68
Regression coefficient (b)	2.32	1.63
Intercept	81.30	95.28
Standard error of estimate (SEE)	3.56	3.69

For females Stature in cm = 95.28 + 1.63 x PCTL (cm) ± 3.69

The estimated height so derived was acceptable within a range of error and was in close approximation with that of the observed height.

Pelin and colleagues [12] in their study derived regression formulae applicable to Turkish population. Their regression formulae were derived after dividing the subjects (242 healthy males) into three categories:

Short Stature =753.89 + 2.421 (tibia) ± 31.22

Medium Stature =942.38 + 2.071 (tibia) ± 35.64

Tall Stature = 1389.87 + 1.142 (tibia) ± 26.90

* The unit used was in mm.

Their approach was in variance with ours, where we grouped all the subjects into one group.

Bhavna and Surender Nath [15] in their study on male Shia Muslims in Delhi derived the following linear regression equation; Height in cms = 84.74 + 2.27x (PCTL) ± 3.67, which is comparable to our study, but exemplifies the fact that the regression equation derived will be population group/region specific [15]. In our study we broadened the spectrum of assessment by including both males and females which has not been done in the above two studies.

Conclusion

It is possible to determine the stature of a deceased person whose only body part available is a mutilated leg, by using the data and formula derived from the present study fairly accurately, within a standard error of estimate which is acceptable from biological consideration in determining the height of a known cross section of population. However the formulae derived cannot be generalized to all population groups, hence it is necessary to derive regression equations which are region wise and population specific.

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