Prediction of Height from Percutaneous Tibial Length

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ABSTRACT

Introduction: Reconstruction of stature from human skeletal remains continues to be an important aspect of anthropology. Of these, lower limb bones have greater contribution to height than upper limb bones.

Materials and methods: The study was done on 100 medical students (50 males and 50 females) of the age group 18-22 years. The percutaneous length of both right and left sides was measured in centimetres (cms) using standard measuring tape from the most prominent palpable part of medial tibial condyle to the tip of medial malleolus, in anatomical position with barefoot, on standard beam scale for measuring height to avoid bias.

Results: In the present study using PCTL, the simple regression equation for both sexes, both right and left sides were equated separately. Results obtained were: Males: Right side: $Ht=83+2.28(PCTL)\pm 4.8$, left side: $Ht=74.7+2.49(PCTL) \pm 4.6$; Females: Right side: $Ht=103+1.47(PCTL)\pm 5.3$, Left side: $Ht=98.2+1.62(PCTL)\pm 5.4$.

Conclusion: By using the derived Pearson equation the values obtained are within biological acceptance for both sexes for right and left side. By using the derived regression formula, the height of an individual can be calculated with the help of percutaneous tibial length which is within biological acceptance. The present study can help the anthropologists and forensic experts to predict the stature from given tibia.

Key words: Anthropometry, Stature [Height- Ht], Percutaneous tibial length.

INTRODUCTION:

Reconstruction of stature is one of the important aspects of various parameters of identification and for establishing individuality of the person from mutilated, decomposed or fragmentary skeletal remains.¹⁻³ The stature of an individual may be estimated by adopting anatomical method. This means measurement of any bone or combinations of bone reflects stature.⁴ Quite a number of authoritative work has been done in this field,⁵ yet rarely any work has been done by using the surface length of

long limb bones for the purpose of calculation of body height. Keeping this view in mind the present work was taken up among 100 medical students comprising 50 males and 50 females and effort has been made to calculate the body height from Percutaneous Tibial Length (PCTL) as measured by surface anatomical landmarks that is, the distance between the most prominently palpable portion of medial condyle and medial malleolus of tibia based on the regression analysis.¹ A regression equation formula has been derived for both sexes separately to calculate the body height by using PCTL.

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MATERIALS AND METHODS:

The present study was conducted in the Department of Anatomy, SUIMS, Shivamogga. The subjects comprised of 100 medical students (50 males and 50 females) age between 18-22 years, the maximum height attained by this age. The standard metric height was measured in centimeters by making the individual to stand on the base board of a standard metric height measuring stand. The individual was instructed to stand barefoot in standard anatomical position and measurement was taken by bringing the horizontal sliding bar close to the vertex. PCTL was measured on both sides from the most prominently palpable portion of medial condyle of the tibia to the medial malleolus with help of standard measuring tape on both sides making foot inverted so as to relax the soft tissue and render the bony landmark more prominent.

RESULTS:

It was observed that though the standing height of many individuals was found to be the same yet their PCTLs differed. To overcome this biological variation and for the further analysis and interpretation the relevant parameters like the height and PCTL of both sexes were arranged out.

The data thus obtained was analysed for their Mean, Standard deviation, % Co efficient variation and Standard Error [Table (1, 2, and 3)].

Table 1. Shows Mean, Standard deviation, % Co efficient variation for both male and female tibial length.

	MALE				FEMALE			
	MEAN	SD	RANGE	CV%	MEAN	SD	RANGE	CV%
AGE	18.3	±1.5	17-26		18.8	±2.4	17-22	
HEIGHT	168.7	±6.8	150-185	4.1	155.3	±6.3	130-171	4.2
RIGHT TIBIAL LENGTH	37.4	±2.1	32-41	5.6	35.5	±2.3	30-42	6.5
LEFT TIBIAL LENGTH	37.7	±2	32-41	5.3	35.4	±2.1	30-41	5.9

Regression analysis done to establish relationship between height and tibial length and estimation of height for given tibial length - Table 2, 3.

Table 2. Shows the values of Correlation Co-efficient, Regression Co-efficient and Regression Equation (Prediction of height) for both genders.

GENDER	SIDE	CORRELATION Co-efficient	Regression Co-efficient	Regression Equation (Prediction of height) (cms)	SE
MALE	RIGHT	+0.71	2.28	Ht=83.3+2.28 (TL)	4.8
	LEFT	+0.73	2.49	Ht=74.7+2.49 (TL)	4.6
FEMALE	RIGHT	+0.53	1.47	Ht=103.0+1.47(TL)	5.3
	LEFT	+0.54	1.62	Ht=98.2+1.62 (TL)	5.4

Table 3. Shows r-values and p-values of both males and females in relation to height and tibial length of both sides.

Relationship between	MALES		FEMALES	
	r-values	P-values	r-values	P-values
Ht and Right Tibial length	+0.71	<0.001	+0.53	<0.001
Ht and Left Tibial length	+0.73	<0.001	+0.54	<0.001

Regression coefficient, represented as a change in height per unit change in the tibial length was highly significant for both sexes. Thus the predicted height could be approximated when the percutaneous tibial length is given within the observed range. The results of study are shown in the form of scatter diagrams - Graphs 1,2,3 & 4.

Graph 1. Relationship between left tibial length and height - males

Graph 4. Relationship between left tibial length and height - Females

Graph 2. Relationship between right tibial length and height - Males

Graph 3. Relationship between right tibial length and height - Females

DISCUSSION:

In the present study using PCTL the simple regression equation for both sexes, both right and left sides were equated separately. The following equations were derived:

MALE

RIGHT SIDE : $Ht = 83 + 2.28(PCTL) \pm 4.8$

LEFT SIDE : $Ht = 74.7 + 2.49(PCTL) \pm 4.6$

FEMALE

RIGHT SIDE : $Ht = 103 + 1.47(PCTL) \pm 5.3$

LEFT SIDE : $Ht = 98.2 + 1.62(PCTL) \pm 5.4$

By using the derived Pearson equation the values obtained are found to be within biological acceptance for both sexes for right and left side in. The present study shows similar values with those of other studies (Table 4).

Hence it can be inferred that the derived regression equation of my study can be used for prediction of height in anthropological studies and by forensic experts.

Table 4: Shows values of present study in comparison to other studies.

AUTHOR	POPULATION	MEAN DIFFERENCE	SD	t	SIG
Trotter and Gleser ⁶	Puerto Ricans	-5.24	2.39	-17.30	0.000
I Can Pelin ⁷	Turkish	0.18	2.80	0.57	0.572
Present study	South Indian population	2.0	2.4	5.12	0.001
Allbrook ¹	Nilo Hamit	-11.60	2.46	-18.90	0.000
Telkka ¹	Finnish	-5.14	2.59	-7.95	0.000
Breitinge ⁸	German	-7.71	2.44	-12.64	0.000

Table 4 shows the values obtained in the present study, a mean of 2.0, in South Indian population is almost similar to other studies by I Can Pelin⁷ (0.18) in the Turkish. The SD of present study was 2.4 which is similar to studies of other authors, 2.44 by Breitinge⁸, 2.46 by Allbrook¹ and 2.39 by Trotter Gleser.⁶

CONCLUSION:

In the present study the mean height for 50 males and 50 females was 169 cms and 155 cms respectively. The mean PCTL in males was about 37cm on the right side, 38 cm on the left side whereas for the females 36 cm on the right side and 35 cm on the left side. The estimated values were within biological acceptance with standard error of 4.8 on right side and 4.6 on left side in males. In female the standard error was 5.3 on right and 5.4 on left. Hence, the derived regression equation of my study can be used for prediction of height in anthropological studies and by forensic experts.

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