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Prediction of height from percutaneous tibial length amongst Oriya population

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Abstract

Establishing individuality on the mutilated part of a dead body is quite a difficult work in forensic medicine. Among the factors required, to establish individuality of an unidentified dead body or any mutilated part of such dead body, height is one of them. In the present work an attempt has been made to calculate the height from the percutaneous tibial length (PCTL) as measured by surface anatomical landmarks that is between the most prominently palpable part of the medial condyle of tibia and tip of the medial malleolus. To find out the relationship of PCTL with that of the height and to evolve a regression equation formula necessary statistical evaluation has been done on the data obtained from 1000 adult individuals comprising of 500 males and 500 females. By using the regression equation formula so derived the height of an individual can be calculated by the help of PCTL, when only the mutilated ley portion is available for autopsy examination.

Keywords: Individuality; Medial condyle of tibia; Medial malleolus; Percutaneous tibial length (PCTL); Height; Regression equation formula

1. Introduction

Identification of an unknown dead body is one of the important work in the field of forensic medicine. In establishing the individuality of an unknown dead body, many factors are necessary among which height or stature of the person is one. But in mutilated bodies or in skeletal remains, establishing the individuality becomes extremely difficult. In such cases the height is calculated indirectly from the length of long limb bones, as because the long limb bones. have got a definite correlation to the height of the

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individual. Further, it has also been established that it is the lower limb bones which have got greater contribution to the height than the bones of the upper limb.

Since quite a good number of authoritative works have been done in this field, yet rarely any work has been done by using the surface, length of long limb bones for the purpose of calculation of body height [1,2]. Keeping this view in mind, the present work was taken up among 1000 adult Oriya individuals comprising of 500 males and 500 females and effort has been made to calculate the body height from the percutaneous tibial length (PCTL.) as measured by surface anatomical landmarks that is between the most prominently palpable portion of medial condyle and medial malleolus of tibia basing on the regression analysis. Thus, a regression equation formula has been derived for both sexes separately to calculate the body height by using PCTL.

2. Materials and methods

In the present work 1000 living adult individuals compressing of 500 males of age range 20 to 77 years and 500 Females of age range 20 to 80 years were measured for their standing height and for their PCTL. The standing height was measured in centimeters by making the individual stand on the base board of a standard metric height measuring stand. At the same time the individual was instructed to stand bare foot, both feet in close contact with each other, trunk braced along the vertical board on the height measuring stand with eyes forward (standard anatomic position). The face was adjusted to keep the lateral palpebral commissure and the tip of the auricle of the pina in a horizontal plane parallel to that of the feet. Then the measurement was taken in centimeters by bringing the projecting horizontal sliding bar to the vertex.

With the same individual the right percutaneous tibial length was measured from the most prominently palpable portion of the medial condyle of the tibia to the tip of medial malleolus by the help of a spreading calliper having blunt ends by fixing the knee and making the foot inverted partly so as to relax the soft tissue and render the bony land mark more prominent.

3. Results

It was observed that, though the standing height of many individuals were found to be the same, yet their percutaneous tibial lengths differed. To overcome this biological variation and for further analysis and interpretation the relevant characters like the height and PCTL of both sexes were averaged out. The data thus obtained were analyzed for their range, mean, standard deviation, % of coefficient of variation and standard error which have been presented in Table 1. It was observed that the relative dispersion of tibial length over the height in both sexes was absolutely negligible, which indicate about the direct relationship of tibial length to the height.

The correlation coefficient (r) value between the tibial length and height of the

Table 1
Descriptive statistics, coefficient of variation, standard error, and correlation between stature and PCTL

	Stature		PCTL	
	Male	Female	Male	Female
Range	145–178	135–169	32–42.25	31–41.6
Mean	161.92	152	37.08	35.03
SD	9.21	9.87	2.34	2.60
% of C.V.	5.7	6.5	6.3	7.4
Standard Error	–	–	0.41	0.45

individuals in both sexes were highly significant. This shows that the relation of PCTL is being accounted for by the height ranging from 77% a to 90% which was determined by coefficient of determination and proved to be quite better. Since there was a high correlation between the PCTL and stature, a simple regression analysis was done between each bone length and standing for both sexes. Regression equations were fit to predict the stature when the PCTL is available (Table 2). The table reveals that regression coefficient which represented as a change in standing height per unit change in the tibial length is highly significant for both sexes. Thus the predicted height could be approximated when the percutaneous tibial length is given within the observed range.

Also the line of regression was so fit that the sum of the squares of Y deviations from it was less than those from any other straight line. The estimated value can never be accepted as the exact value since the variations from this value is always expected. To overcome this difficulty the problem of falling within a range of error has been established by the appropriate statistical calculation. Applying the evolved regression equation formula the expected height has been calculated taking the observed PCTL into consideration. The observed height arid their PCTL have also been plotted into graphs to find out graphically with a view to compare the estimated results obtained by the estimating equation when the percutaneous tibial length within the observed range is known.

Table 2
Correlation coefficient (r), slope (b), standard error of estimate (SEE), intercept (a) and regression equation

Statistics	Male	Female
Correlation (r)[a]	0.9518	0.9392
Slope (b)	3.7500	3.5587
Standard error of slope (b)	0.2205	0.2335
Intercept (a)	22.8325	27.3032
SEE	±2.8735	±34423
Simple regression equation:		
Males:	$Y=22.8325+3.7500\times PCTL\pm 2.8735$	
Females:	$Y=27.3032+3.5587\times PCTL\pm 3.4423$	

[a], Both significant at $P<0.01$.

4. Discussion

It is quite problematic to establish the height from the length of long limb bones, since the proportional relationship of the length of a long limb bone to the body height is variable from individual to individual. For example to have a total number of 10 one can have any combination of 1+9, 2+8, 3+7, 4+6 and 5+5. In this mathematical example although the total number 10 remains constant, the proportion of the additive digits to the total varies widely. Such is a problem which is also seen in the study of biological data of this nature. Hence in the study of such biological data one is forced to take into account, a ''mean height'' and a ''mean bone length'' (in the present work the mean PCTL) for the type of work.

Age factor must also be considered. All the individuals in this study were 20 years or older and usually by 20th year Oriya people and many other populations reach their maximum height. Indians stop growing in height on completion of union of epiphysis and diaphysis by the age 20 which have been confirmed by several workers [3–7].

Since workers have used regression equation formula for the estimation of height from surface bony length of tibia [8–10]. The present study used only PCTL to develop a simple regression equation for both sexes. It has already been noted that the estimated height values by using the regression equation formula can never be accepted as the exact value since variations from this are always expected and to avoid this difficulty a standard error of estimate has also been calculated.

5. Conclusion

In the present study the height of 500 Oriya males and 500 Oriya females were measured along with their PCTL in centimeters. The mean height for Oriya males was observed to be about 162 cm and 152 cm for females. The mean PCTL was about 37.1 cm and 35.0 for both males and females, respectively.

For estimation of height for both sexes from the PCTL a simple regression equation formula was derived which is as follows:

(I) Male Stature$=22.8325+3.7500\times\text{PCTL}\pm2.87$
(II) Female Stature$=27.3032\pm3.5587\times\text{PCTL}\pm3.44$

The estimated height so found were accepted within a range of an error and were in close approximation with that of the observed height. Hence, it is possible to determine the height of a deceased person whose mutilated leg portion is only available (even without the help of the leg bones either tibia and or fibula) 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.

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