Int J Biol Med Res. 2013; 4(1): 2752-2754

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International Journal of Biological & Medical Research

Journal homepage: www.biomedscidirect.com

Original Article

Estimation of Stature from Percutaneous Tibial Length

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ARTICLE INFO

Keywords:
Forensic anthropology
Regression equations
Stature estimation
Tibial length

ABSTRACT

Aims: The purpose of the study was to find out the relationship between tibial length and stature and to formulate a linear regression equation for estimation of stature from tibial length. Methods: This study consists of 210 subjects between 18-23 years of age. Stature was measured in standing erect, anatomical position with standard height measuring instrument. Tibial length was measured by spreading caliper. Results: The data obtained was statistically analysed separately for males and females using Microsoft ExcelTM software. The correlation coefficient between height and tibia length is 0.836 in males and 0.690 in females and it was significant. Conclusion: A highly significant correlation of stature was observed with tibial length in both sexes. The result of present study would be useful for anthropologist and forensic medicine experts.

1. Introduction

The stature of an individual is an inherent character [1]. The identification of an individual is of prime importance in forensic science and particularly so when the body is mutilated, damaged or when the bones are available as the time passes after death. And for personal identification stature is considered as an inalienable characteristic. There is a close relationship between stature and dimensions of various body parts. Although a variety of bones have been used to determine stature, the most reliable results are based on long bone length particularly of the lower limb bones.

In the present study, we used percutaneous tibial length because it is easily approachable for measurement. We have attempted to find out the correlation between stature and percutaneous tibial length. Our study will be useful for medico-legal cases where only a bone or a limb of dead body may be available.

2. Materials and Methods

The present study was conducted in department of Anatomy, Government medical college Bhavnagar, Gujarat. Total 210 subjects were taken; out of which 110 were male and 100 were female in the age group between 18-23 years. The length of right tibia was taken percutaneously. As there is no significant difference between the lengths of the two tibias [1], we have taken the length of right tibia uniformly in all the subjects. Height of all the subjects was taken in standing position with subject being barefooted and with close approximation of both the feet and head was kept in Frankfurt's Plane; with standard height measuring instrument.

Length of tibia was measured using Spreading Caliper with reference to distance between two points i.e. most prominent palpable portion of the medial condyle and the tip of medial malleolus. This measurement was taken while the subject was standing on left foot and his/her right foot resting on the wooden stool in semi-flexed knee position. Height and tibial length were measured in centimeters.

Observations and Results:

The observations were analysed using the Microsoft excel software and mean and standard deviations of the observations were calculated for tibial length and height separately. Male and female were also analysed separately for mean and standard deviation. Mean tibial length was calculated for both male and female. Table 2 shows all these characteristics. After obtaining the mean and SD, it was important to find out if there is any correlation between the tibial length and the height of an individual. For this we calculated the Carl-Pearson correlation coefficient between the tibial length and the height, separately for both male and female.

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The correlation coefficient (r) was 0.836 for male and 0.690 for female, indicating that there is a definite positive correlation between the height and the tibial length.

After knowing the positive correlation between the two variables, we set out to find the regression coefficient, which was 2.548 for male and 2.258 for female. Based on the regression coefficients and the value of the constants (male=74.519, female=82.471) obtained during regression analysis we formed a regression equation for the calculation of the height of an individual based upon his/her tibial length.

From the table 2, the regression equation for the estimation of height from the tibial length can be given as;

Male Y= 74.519 + 2.548*X

Female Y1= 82.471 + 2.258*X1

Where, 'Y' is the total height of a male and 'X' is the length of tibia of that subject and

'Y1' is total height of a female and 'X1' is the length of tibia of that subject.

The two graphs are showing the positive correlation graphically. The regression equation is also shown in the graph, separately for male and female.

Table 1: Age v/s Height and Tibial length

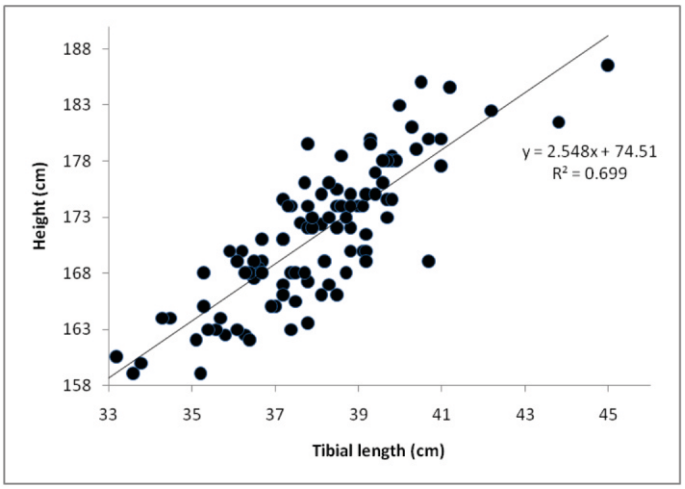
Age	Mean Height (cm)		Mean Tibial length (cm)	
	Male	Female	Male	Female
18	171.73	157.90	37.70	33.85
19	172.88	162.41	38.87	34.53
20	168.87	158.09	37.39	34.13
21	170.35	159.19	37.98	33.57
22	170.04	157.89	37.78	33.74
23	172.50	156.00	37.80	33.49

Table 2: Height, Tibial length, Correlation coefficient (r), Regression coefficient (b) and Value of constant (a) in males and females.

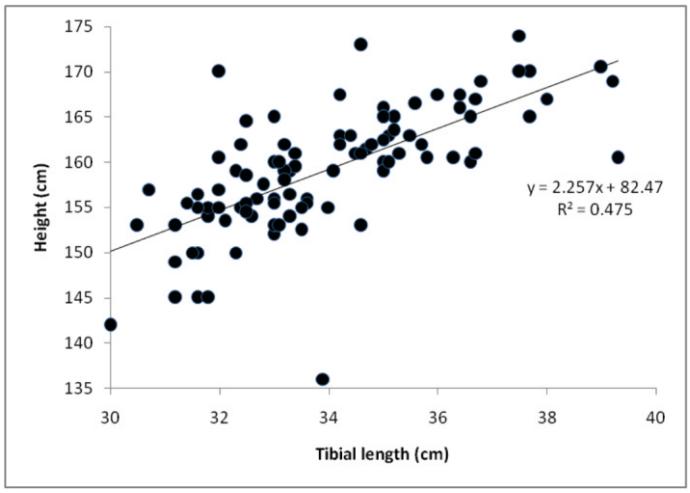
Age	Male	Female
Total Number	110	100
Height range (cm)	157.0-186.5	136.0-174.0
Mean height (cm)	171.185	159.095
S.D.of height	6.34	6.75
Tibial length range (cm)	32.5-45.0	30.0-39.3
Mean tibial length (cm)	37.93	33.94
S.D.of tibial length	2.08	2.06
Correlation Coefficient (r) (Height and Tibial length)	0.836	0.690
Regression coefficient (b)	2.548	2.258
Value of constant (a)	74.519	82.471

a] S.D.= Standard Deviation

Graph 1: correlation between height and tibial length of males.



Graph 2: correlation between height and tibial length of females.



3. Discussion:

Stature estimation is the general problem faced since long. In forensic anthropology it is vital to accurately state the exact stature of an individual. Trotter and Glesser were among the first who researched on the subject of stature estimation and highlighted the inaccuracy issues in 1950s [2]. Harsh M.P. indicated that head length is correlated with stature in both sexes aged between 8-12 years. Correlation coefficient between head length and height was 0.45 (male) and 0.49 (female). They carried out regression analysis and had shown positive correlation between head length and body height [3]. Patel, Joshi and Dongre have derived regression equation between tibia and total height in Gujarati population [4]. Also, regression formulae are both population and sex specific and thus it is important to first identify the recovered remains and then relevant measurements should be taken to reconstruct the stature [5]. Stevenson P.H. (1929) suggested that better results from regression formulae will be obtained by applying a formulae peculiar to race itself than by applying a formulae based on the other race [6].

Estimation of stature is affected by the age, race, sex and many other unknown variables. The regression equations put forwarded from the study of western population may not be useful for the Indian population. Even in India there are many racial groups like the Dravidians, the Indo-Aryans the Mongoloids etc [7]. So, the studies on stature estimation should be carried out in all these racial groups. Gujarati population has many genetic traits common to the population of West-Asia. Another important factor is the age group of the population. The fact that stature estimation formulae are affected by the extremes of the population is well established. We have taken a comparatively smaller age group of young population i.e. 18-23 years of age. However we have taken a sufficiently large sample of 210 person and secondly it includes 100 female population. We attempted to strike a balance between the accuracy of the regression equation that need to be derived and the sample size that is require for the same.

The mean tibial length (cm) was 37.93 ± 2.08 (male) and 33.94± 2.06 (female). This is different from the some earlier studies that has calculated the tibial length as 35.77 cm in male and 32.19 cm in female (Ashita Kaore) [8], 37.32 cm in male and 34.44 cm in female (Chavan S.K.) [9] etc. Similarly, there is the variation in the mean height of the subjects of our study and the various other studies of India and abroad.

Thus, the regression equation that we have derived i.e.

For Male Y= 74.519 + 2.548*X, and

For Female Y1= 82.471 + 2.258*X1 is of particular importance to find out the stature in our population. As our population was young Gujarati persons, the regression equations are useful in this setting. There is only the need to identify so as to which age group and to which race and area a particular person belongs, after that identification the regression equation particular to that area and to that age group can be applied to identify the stature of the individual from the bone that is collected.

4. Conclusion:

The result of present study shows that there is a positive correlation between stature and tibial length. The linear regression equation can be used for estimation of stature. If either of the measurement (stature or tibial length) is known, the other can be calculated and this would be very much useful for anthropologist and forensic medicine experts.

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