International Journal of Research in Medical Sciences
Ghosh T et al. Int J Res Med Sci. 2019 May;7(5):1767-1769
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012

DOI: http://dx.doi.org/10.18203/2320-6012.ijrms20191673

Original Research Article

Estimation of stature from percutaneous length of tibia amongst Bengali population

Tapas Ghosh[1], Sudipto Konar[2]*

[1]Department of Anatomy, Burdwan Medical College, West Bengal, India
[2]Department of Anatomy, Raiganj Government Medical College, West Bengal, India

Received: 28 February 2019
Revised: 19 March 2019
Accepted: 28 March 2019

***Correspondence:**
Dr. Sudipto Konar,
E-mail: sudipto@dr.com

ABSTRACT

Background: Stature of an individual can be estimated from long bones as these have a direct correlation to the height of an individual. The standing height is mostly contributed lower limb length. Hence regression equations which are best upon length of lower limb long bones are indicative very much. Secular differences of tibial length could be the reason for need of more accurate equation of stature estimation among Bengali population.
Methods: In this present study the maximum percutaneous tibial length and the corresponding standing height of adult 260 male and 210 female Bengali subjects were taken. The data were analyzed by parametric statistics and the regression equations were derived.
Results: The mean standing height of subjects was 159.15 cm in males and 157.12 cm. in females. It was determined that percutaneous tibial length and stature were positively correlated; the formulated regression equations were seen to be statistically significant ($p < 0.05$) in both the sexes.
Conclusions: The present study revealed that there is high degree of correlation between percutaneous tibial length and standing height of Bengali subjects. Hence applicability of the present equations is critically discussed as these will be very much useful for various practical aspects.

Keywords: Anthropometry, Bengali, Percutaneous tibial length, Stature, Tibia

INTRODUCTION

Stature is defined as body height in standing position.[1] Establishing identity in mutilated corpses from body parts or skeletal remains is always a challenging task for medico legal experts.[2] Thus identification of an individual by stature estimation has impact in various medico-legal purposes, anthropological research and can be applied during mass disasters.

Extensive works have been conducted on different populations on stature estimation from various body parts.[3,4] Physical anthropologists and forensic pathologists have given utmost importance to the methods of stature estimation from long bones as these have a direct correlation to the individual height.[5] The lower limb length is the greatest contributor to the standing height; therefore the most predictive equations are based on length of lower limb bones.[6] Works of Pearson have been monumental and invoked subsequent research on the subject.[7,8] The tibia is ideal in this application as it is subcutaneous and can be measured easily.

Stature of an individual is influenced by several factors including race, geographical climate, nutrition and genetic factors.[9] Hence the correlation factor of one region will not hold good for other; this necessitates

researches to be done for specific population. This study was planned to establish a relationship between percutaneous length of tibia and stature of Bengali population and to estimate the stature from the percutaneous tibial length.

METHODS

In this study total 470 apparently healthy Bengali individuals (260 males and 210 females) were included by random sampling. Only who were willing to participate by giving proper informed consent were included in the study. This observational study was cross sectional in design which was conducted from March 2018 to February 2019.

Age range of 20 years - 59 years was set as inclusion criteria which were verified by birth certificate or school leaving certificate of the subjects. The rationale behind selecting this age limit is that, by 20 years all the epiphyses of tibia are fused and normally no further growth is expected. Furthermore, by 59 years the decrease in stature because of degenerative changes of vertebral column is not significant enough to affect the regression equation. The inclusion of a wider range of age groups could overcome the drawback for applicability of the regression equation. Moreover, subjects were from various localities and socioeconomic backgrounds. This multi-centric approach in will also supplement the findings in the Bengali population in future.

Subjects whose ethnicity is other than Bengali and those were having grossly visible or history of trauma or fracture leading to skeletal deformities of spine, skeleton of limbs and pelvis were rejected beforehand from the study. Subjects who had congenital or developmental bony diseases, significant systemic or metabolic diseases affecting stature, orthopaedic deformities were also excluded from this study. In addition, individuals who were visibly overweight were not considered due to the difficulty for percutaneous measurement of the tibia.

The following parameters were noted- age in years, gender, height in cm, percutaneous tibial length of right and left side in cm. Standing height was measured by standard stadiometer. For measuring the tibia length subjects were asked to stand erect and then keep one foot on a tool by flexing the knee at 90^0. Then two points were marked on the leg by skin marking pencil. Upper Point was the medial most point on the upper border of medial condyle of the tibia and lower point was at the tip of medial malleolus. Tibial length was determined by measuring the distance between these two points with the help of a spreading calipers. The correlation coefficient (r) was calculated to find out relationship between stature and percutaneous tibial length. As tibial length and stature were positively correlated, the regression equations were formulated and tested for statistical significance.

Statistical analysis

The data was computed, tabulated and statistically analyzed using Microsoft Excel Windows 2007 and SPSS version 20.0 software to calculate mean, sample standard deviation, population standard deviation, correlation coefficient, 't' test for correlation coefficient, regression coefficient, value of constant and standard error of estimate. p value was used for the probability of significance. For the purpose of the present study, a $p < 0.05$ is considered significant; and $p > 0.05$ is considered not-significant.

RESULTS

Descriptive statistics of the sample are shown in Table 1. For standing height, the sample standard deviation for both males and females closely approximated the population standard deviation. This indicates the sample very closely represented the actual population from which it was drawn. Tibial length and stature were highly correlated as correlation coefficients are approaching +1 for both males and females. Null hypothesis was set up to test significance of correlation coefficients. The computed value was found to be much greater than the critical 't' value at the chosen level of significance. So, null hypothesis was rejected. The computed r for both males and females was thus considered significant at the 0.05% of significance ($p < 0.05$).

Table 1: Descriptive statistics of the sample.

Statistical parameters		Males	Females
Sample size (n)		260	210
Age (years)	Range	20 - 59	20 - 49
	Mean	31.3	27.18
Standing height (cm.)	Mean	159.15	157.12
	Range	141.6-176.2	139-175.5
	Sample S.D.	±7.76	±7.60
	Population S.D.	±7.593	±6.011
Percutaneous tibial length (cm.)	Mean	34.14	32.72
	Range	27.2-41.8	26.8-39.8
	Sample S.D.	±3.06	±2.65
	Population S.D.	±2.730	±2.118
Correlation coefficient (r)		0.94	0.94

The regression equations as calculated are shown in Table 2. The standard error of estimate of these equations was quite low (males ± 0.19 and females ± 0.18). These low values of standard error of estimate in case of males and of females also give enough statistical justification for the formulation of equations suggested in the present study. To determine reliability of these equations the confidence limits were calculated and tests of

significance were carried out. Hypothesis testing of regression coefficient was carried out. 5% significance level was chosen for testing the hypothesis. 't' value calculated for males and females was much higher than the critical values of 't' (0.05) with according degree of freedom (n-2). Hence the null hypothesis was rejected. Height is indeed related to stature in the present sample.

Table 2: The regression equations.

Side	Male	Female
Irrespective of side	S= 77.77 + 2.38T	S=69.11 + 2.69T
Right tibia	S = 77.74 +2.38 T	S = 69 + 2.69 T
Left tibia	S= 77.81 + 2.38 T	S = 69.11 + 2.69 T

Where, S = stature and T = tibial length

DISCUSSION

The main aim of the present study was to derive the regression equations to estimate the stature from the percutaneous tibial length in Bengali population. Recent studies on Indian population regarding stature estimation from percutaneous length of tibia show that Oriya female population, Gwalior female population were shorter than the present study population; whereas Oriya male population, Moradabad population were taller than the present group.[10-12] This necessitates separate regression equations to be deduced for Bengali population.

This study tried to justify the formulation of two separate equations for males and females. This was important more so because most Indian researchers had formulated single regression equation or multiplying factor taking both sexes together into account.[13,14] By comparing the squared standard error of males and females using an F test it was found that the computed F exceeded the critical F value. The null hypothesis was rejected and thus the regression coefficient of males was significantly ($p < 0.05$) different from females. Thus, the same formula cannot be used and separate formulae as suggested for males and females has to be used for the estimation of stature.

The present study revealed that there is a positive correlation exists between the stature and percutaneous tibial length. Different formulae for males and females are needed for the estimation of stature. Thus, two regression equations, which has taken into consideration the racial, geographic, secular and gender differences of tibial length, could be employed for more accurate estimation of the average Bengali population. Hence, this study is very much useful for forensic expert as well as for the anthropologist.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Krogman WM, Isçan MY. The human skeleton in forensic medicine. Charles C. Thomas; 2nd ed., Springfield, IL. 1986:413-57.
2. Waghmare PB, Chikhalkar BG, Nanandkar SD. Establishing Identity and Cause of Death in Mutilated and Un Identifiable Corpses: A Challenging Task for Medico Legal Expert. J Foren Biomech. 2015;4(120):2.
3. Özaslan A, İşcan MY, Özaslan I, Tuğcu H, Koç S. Estimation of stature from body parts. Foren Sci Int. 2003;132(1):40-5.
4. Ghosh T, Konar S, Mondal MK, Singha KB, Dey A, Das J. Estimation of stature from fragment of femur (Popliteal Length) in Bengalee population. Int J Anat Res. 2015;3(3):1245-48.
5. Trotter M, Gleser GC. Estimation of stature from long bones of American Whites and Negroes. Am J Physical Anthropol. 1952;10(4):463-514.
6. Bogin B, Varela-Silva MI. Leg length, body proportion, and health: a review with a note on beauty. Int J Environment Res Public Health. 2010;7(3):1047-75.
7. Pearson K. Mathematical Contributions to the Theory of Evolution. V. On the Reconstruction of the Stature of Prehistoric Races. Proceed Royal Soc London. 1898;63:417-20.
8. Pearson K. IV. Mathematical contributions to the theory of evolution.-V. On the reconstruction of the stature of prehistoric races. Philosophical Transactions of the Royal Society of London. Series A, Containing Papers of a Mathematical or Physical Character. 1899 Dec 31(192):169-244.
9. Beddoe J. "On the Stature and Bulk of Man in the British Isles." Asher, London. Reprinted Mem Anthrop Soc Londan. 1867-9.
10. Mohanty NK. Prediction of height from percutaneous tibial length amongst Oriya population. Foren Sci Int. 1998;98(3):137-41.
11. Trivedi A, Saxena S, Morya R, Jehan M, Bhadkaria V. Stature estimation using percutaneous tibial length in people of Gwalior region. J Dent Med Sci. 2014;13(5):65-70.
12. Khatun SS, Sharma N, Jain SK, Gupta A. Estimation of stature from percutaneous tibial length in Indian population. Int J Anat Res. 2016;4(3):2571-6.
13. Agnihotri AK, Kachhwaha S, Jowaheer V, Singh AP. Estimating stature from percutaneous length of tibia and ulna in Indo-Mauritian population. Foren Sci Int. 2009;187(1-3):109-e1.
14. Mehta AA, Mehta AA, Gajbhiye VM, Verma S. Correlation of percutaneous tibial length with body height and estimation of stature in living Central India population. Int J Anat Res. 2015;3(2):1159-61.

Cite this article as: Ghosh T, Konar S. Estimation of stature from percutaneous length of tibia amongst Bengali population. Int J Res Med Sci 2019;7:1767-9.