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Original Article

Estimation of Stature from Percutaneous Tibial Length amongst Nepalese Students in Nobel Medical College Teaching Hospital

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Abstract

Background
Estimation of stature is an integral part of forensic anthropology and identification process in dead bodies. Mutilated and skeletonized body parts, which are generally received during disasters and mass casualties, carries significant burden of identification for a forensic expert. This study is aimed at estimating stature from percutaneous tibial length.

Material and Methods
A cross sectional study was conducted from February 2020 to February 2021 in Nobel Medical College Teaching Hospital. 350 Nepalese medical students, 183 males and167 females, who were between 18 – 30 years, were included in the study. Their height and percutaneous tibial length was measured. Simple regression analysis was done using SPSS software version 20 to obtain a correlation between two parameters.

Results
The results showed a significant correlation between the stature and percutaneous tibial length in both sexes. The regression formulae derived for calculation of stature was 104.80 + 1.81 * percutaneous tibial length (cm) for male and 93.58 + 1.91 * percutaneous tibial length(cm) for female. All the measurements were higher in males than in females.

Conclusion
The study revealed a significant correlation between stature and percutaneous tibial length for both sexes in Nepalese population. Hence stature can be estimated from tibial length in both sexes which can aid in identification process and anthropological studies in Nepal.

Keywords: *Forensic anthropology, Tibia, Autopsy*

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Introduction

Anthropometry is derived from two Greek words, 'anthropos' meaning "man" and 'merton' meaning "measure". In short, anthropometry is the measurement of an individual. Variations occur due to the differences in age, sex, race, ethnicity, geography, nutrition etc., both between the populations as well as within populations[1].

Personal identification is the act of establishing the individuality of a person. In situations when there are minimal external clues to identify a person; determination of age, race, sex and stature can significantly narrow down the process. Stature estimation of unidentified human remain is very important in forensic anthropology[2]. Various studies in this regard had been done for different populations all over the world. Due to population variation, a study of the Nepalese population pertaining to these parameters is a necessity [3].

It is an established fact that stature bears a direct relation to the length of various bones. The examination of long bones provides the most precise stature estimation potential. As the lower limb length is the greatest contributor to the stature of an individual, an attempt has been made, to estimate the stature from the percutaneous length of the tibia amongst an adult Nepalese population [4].

Materials and Methods

This is a cross sectional study done in department of Forensic Medicine, Nobel Medical College Teaching Hospital, Biratnagar, Nepal from February 2020 to February 2021. The ethical approval was received from Institutional Review Committee of NMCTH. With 95% confidence level, 5% margin of error and total population as 615 (considering total number of Nepalese medical students at the time of study), using $n = [z^2p(1-p)/e^2]/[1+\{z^2p(1-p)/e^2N\}]$, the estimated sample size was 237.Total of 350 Nepalese medical students between the age of 18 - 30, who were born and brought up in Nepal, were included in the study after obtaining informed expressed consent.Participants who have a history of major trauma or fracture of leg, achondroplasia, any other congenital or hereditary bone disease and any pathological process in the medical history that might have influenced the length of the long bones, were excluded from the study. Age of the participants was confirmed by observing their citizenship card, voter'sID card, driving license, academic certificates etc. and reconfirmed by asking whether those documents were genuine.

The standing height (stature) of each participant was measured standing bare boot, on a standard stadiometer with both feet touching each other, trunk straight along the vertical board and the head in the Frankfurt plane. The measurement was taken from heel to vertex in centimeters [5].For measuring the percutaneous tibial length (PCTL), the participant were asked to sit on a chair with the knee flexed at 90 degrees and the foot laterally rotated to make the landmarks more prominent. Two points are then marked on the skin with a skin-marking pencil. Upper point was marked on the medial most point on the upper border of the medial condyle of the tibia. Lower point was marked on the tip of the medial malleolus of the tibia. The distance between the two points was measured with the help of a sliding caliper to determine the tibial length. Measurements were taken on both sides and the average measurement of both sides was taken as the final length to avoid minor discrepancies between the lengths of two legs. All the measurements were taken by single examiner to avoid any inter observer error. No any intra observer variability was seen during measure-ments

The data was analyzed using the Statistical Program for Social Sciences (SPSS) Version 20. To estimate stature from PCTL, linear regression equations were derived. To assess the correlation between the stature and the length of the tibia, Pearson's correlation coefficient was calculated and its significance was tested by the Students t-test. A P-value of less than 0.05 was considered to be significant.

Results

Out of 350 cases included in this study, 183 were males and 167 were females. The age range was 18-29 years for male with mean age 21.96 and standard deviation1.39. Similarly females were between 19-24 years with mean age 21.37 and standard deviation 0.88. Mean values of both stature and PCTL were greater in males than females. The distribution curves for all the measurements showed uniform distribution for both sexes. The descriptive data for stature and PCTL are shown in Table 1. Pearson's correlation coefficient showed strong correlation between PCTL and stature in both males and females, with values 0.635 and 0.736 respectively, both of which were statistically significant at p value < 0.05. The regression equation for calculation of stature from PCTL for both male and female are included in Table 2.The scatter diagram shows a strong, linear and positive correlation between percutaneous length of tibia andstature,for both

male and female populations (Fig 1 and Fig 2).

Table 1: Various parameters of stature and PCTL

Parameters	Stature (cm)		PCTL (cm)	
	Male	Female	Male	Female
Range	155-193	147-174	31.87-43.13	28.27-39.07
Mean	171.97	158.41	37.20	33.95
Standard deviation	6.05	2.48	2.12	2.47

Table 2: Regression analysis between stature and PCTL

Parameters	Male	Female
Linear regression equation	Stature (cm) = 104.80 + 1.81 * PCTL	Stature (cm) = 93.58 + 1.91 * PCTL
Correlation coefficient (r)	0.635	0.736
Coefficient of determination (R)	0.403	0.541
Standard error	4.692	4.365
p value	< 0.001	< 0.001

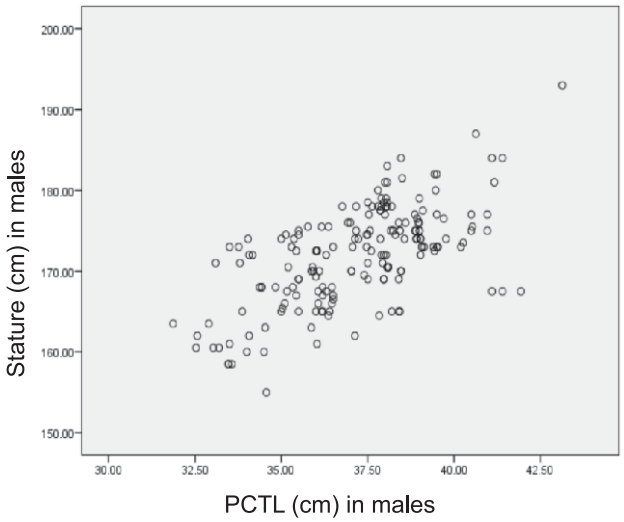

Figure 1: Scatter diagram showing correlation of stature and PCTL in males

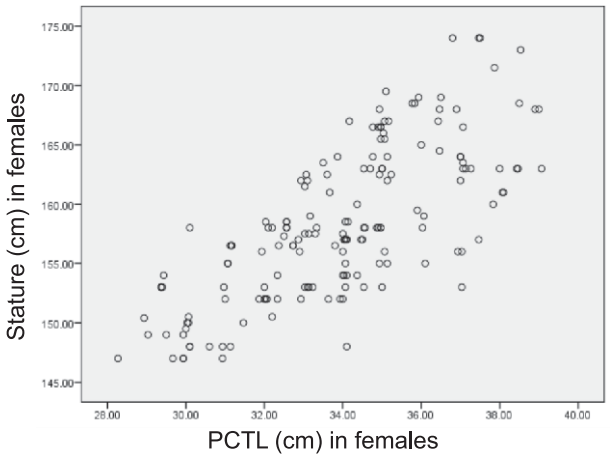

Figure 2: Scatter diagram showing correlation of stature and PCTL in females

Discussion

Stature estimation is an important part of identification process during anthropological studies and forensic examination. Identification refers to determination of individuality of a person. The estimation of stature along with age, sex and race, which are considered as primary characteristics of identification, are required to narrow down the process of identification. Problems arise especially when dismembered body parts, partial human skeleton remains, burnt bodies and mass graves are encountered. It is an established fact that long bones of the lower limbs are significant contributor of stature. Percutaneous length of tibia is selected as the landmarks on the other long bones are more difficult to identify in comparison to tibia and for its convenience of examination with partial undressing. Standing height is arrested after union of epiphyses especially of the long bones of lower limbs which usually occurs within the age of 18 and it starts to recede after 30 years due to degenerative changes in the bones. So 18 -30 years age group is considered for the study [1, 2, 4].

Following the Maoist insurgency and the major earthquake in Nepal, there have been numerous discoveries of unidentified human remains in isolated mass graves or in other situations. The identification of these bodies or body parts remains a very challenging task to the nation. One of the major hindrances in this regard is the lack of any anthropological data regarding the Nepalese population [6]. This lack of previous records in developing countries like Nepal is further compounded by the lack of facilities and resources for conducting various modalities that have now become absolutely necessary for the establishment of positive identity. Nepalese medical students who were born and brought up in Nepal were included in this study as there is negligible study on Nepalese population in this regard.

In the past, numerous studies have been undertaken with regards to the determination or estimation of stature, sex and age of the individual populations all over the world. Different populations require different formulae for the calculation of these anthropometric parameters due to the inherent population difference attributed to the genetic and environmental differences [3].

Various studies in different population have been done to find out correlation between the long bones with the stature. Trotter and Glesser (1952) were among the first to study on relationship between stature and long bones. They found a significant positive correlation between length

of long bones and stature and came up with regression equations which were afterwards used by many[7]. Kaore DA et al (2012) studied 200 males and 200 females of 18-21 years and found no significant difference between length of right and left tibia. They concluded that regression formula for PCTL is reliable in estimating the stature in both sexes [8]. Shah R et al (2014) studied on 300 adult Nepalese populations and found out significant positive correlations between PCTL and stature for both males and females and derived regressions equations. All the measurements were significantly longer in males than in females [9].Poudel A et al (2017) in another similar study in Nepalese males found out no significant difference between the length of left and right tibia, but a positive correlation was found between length of tibia and estimated height [10]. Sume BW (2019) studied on 572 under graduate students and found similar results where for both sexes PCTL had strong significant correlation with stature[11]. Similar to other studies present study also shows a strong correlation between the stature and PCTL both for males and females. As shown by many studies there is no significant difference between the lengths of right and left tibia, measured percutaneously. Hence in present study an average length of both sides was considered.

Conclusion

The study shows a significant correlation between stature and percutaneous tibial length for both sexes in Nepalese population. Hence stature can be estimated from tibial length in both sexes which can be helpful for medico-legal autopsy and anthropological studies in Nepal.

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Conflicts of interests: None

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