

■ ORIGINAL ARTICLE

## Estimation of Stature from Per-Cutaneous Tibial Length Measurement Amongst Students of S M S R, Sharda University

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### ABSTRACT

Stature is one of the major parameters for ascertaining the identity of an individual. Mathematical correlation of length of long bones to the overall stature has been an established method of estimation of height for unidentified individuals. In the present study 100 individuals of either sex, in the age group of 20 – 25 years were studied and their percutaneous tibial lengths were correlated with overall stature. Differences were noted in the tibial lengths of right and left sides in the same individual and also among tibial length in individuals with similar height. Regression analysis was carried out and formulae were developed for stature estimation. Comparisons were made with different regional studies and it was concluded that with varying statures in different populations, region specific studies need to be carried out for every population group.

**KEYWORDS** | Identification; Stature; Tibia; Regression analysis.

### INTRODUCTION

The necessity of identification of an individual is utmost important from birth to death as mistaken identity can result in various medico legal problems.<sup>1</sup> Identification can be complete, when an absolute identity is established or partial when only certain facts of identity are determined like race, age, sex, stature, so called “Big Four” factors of identity.

The height/stature of a person is an inherent character and it is considered to be one of the important parameters of personal identification.<sup>2</sup> Stature is defined as “height of body in upright position”. Estimation of stature is an important tool in forensic examination for identification especially in unknown, highly decomposed, fragmented and mutilated human remains.

A lot of investigative work has been done in this field, but only a few works have been done using the percutaneous length of long bones for

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estimation of stature. Keeping this view in mind, the present study aims to calculate the stature from the surface length of tibia measured from the surface anatomical landmarks in living individuals. The study may prove to be a useful tool for estimation of stature in mass disasters or in cases of skeletal remains found in remote places where only tibia is present as a long bone.

**MATERIALS AND METHODS**

The present study was conducted for a period of one year from December 2019 to November 2020 in the Department of Forensic Medicine in School of Medical Sciences & Research, Sharda University. Ethical clearance for the study was sought from Institutional Ethical Committee. The study group comprised of 200 individuals, of either sex, from amongst students of S.M.S.R, Sharda University in the age group of 20 – 25 years after obtaining a written informed consent.

The standing height was measured using a stadiometer with a movable headboard. The subject was made to stand bare foot on the horizontal platform with the heels of both feet together. The head of the subject was aligned in the Frankfort horizontal plane. The subject was looking straight ahead, with the shoulders relaxed, arms at the sides, legs straight and knees together and foot flat with the heels almost together and feet pointing outwards. The heels, buttocks and the back of the head were in contact with the vertical backboard. The headboard was firmly positioned on top of the head with sufficient pressure to compress the hair. The height was

documented in centimeters.

The percutaneous tibial length was measured for both limbs using a Vernier calipers from the most prominent palpable portion of the medial condyle of tibia to the tip of medial malleolus. This was accomplished by fixing the knee and inverting the foot partly so as to relax the soft tissue and render the bony landmark more prominent. Further, the measurement was confirmed using a metric tape.

**Inclusion Criteria**

Individuals between the age 20 – 25 years.

**Exclusion Criteria**

- Those with physical deformities and/ or with fracture of head, fracture of spine, fracture of lower limbs and pelvis.
- Individuals below 20 years of age.

**RESULTS**

A total of 200 subjects were studied and observations were noted. The gender based descriptive analysis of the data obtained, is mentioned in Table 1 through Table 5.

The data was analysed using SPSS software (version 27) and regression analysis was carried out. Gender specific formulae were derived for each side, as follows

**Males**

$$\text{Height (cm)} = 87.198 + 2.307 * \text{Right tibial length (cm)}$$

$$\text{Height (cm)} = 90.430 + 2.200 * \text{Left tibial length (cm)}$$

**Table 1:** Descriptive analysis of data

	Male			Female		
	Height (cm)	Right Tibial Length	Left Tibial Length	Height (cm)	Right Tibial Length	Left Tibial Length
Age range		years 25 – 20			years 25 – 20	
Samples	100	100	100	100	100	100
Mean	172.95	37.181	37.532	159.826	33.066	33.279
Standard Deviation	6.038	2.109	2.122	5.640	1.681	1.747

Fig. 1: Correlation of height with right tibial length in males.

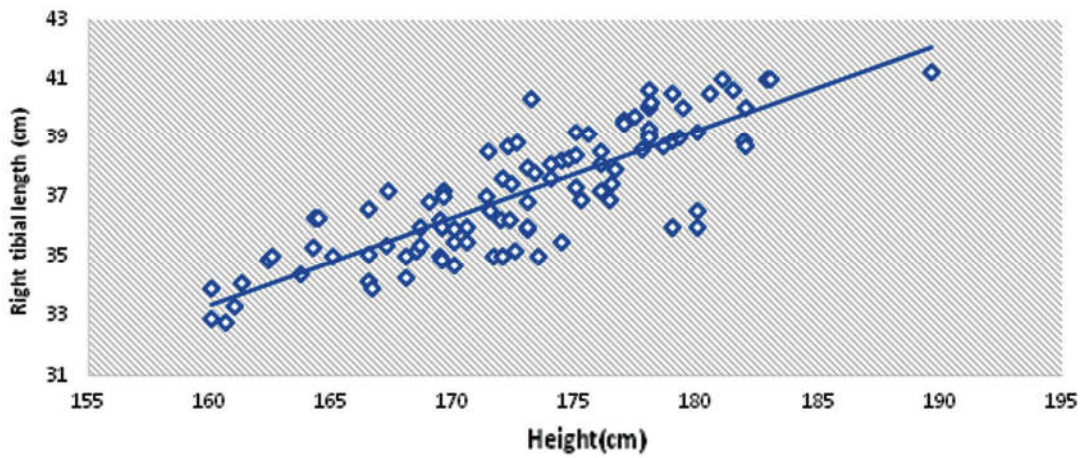


Fig. 2: Correlation of height with left tibial length in males.

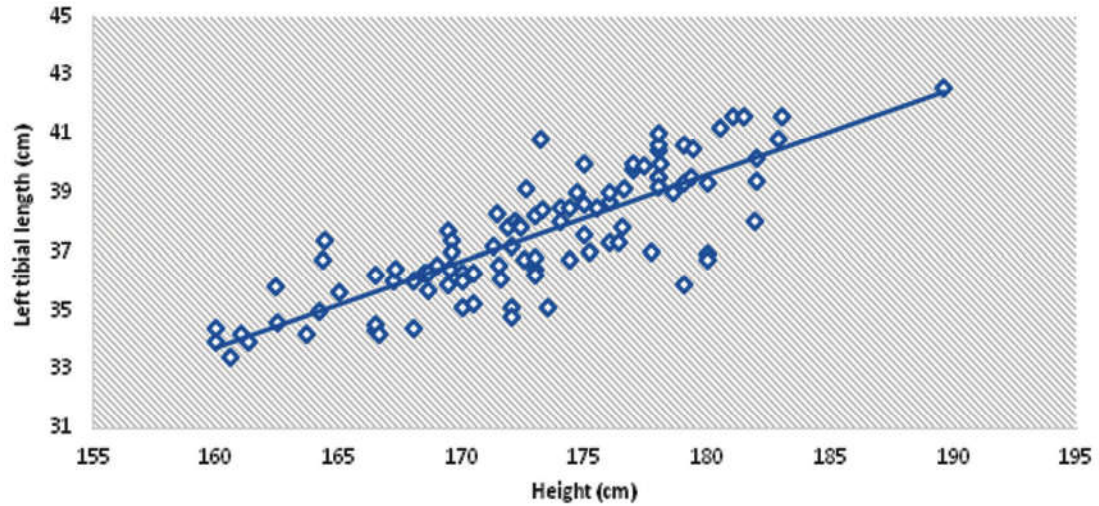
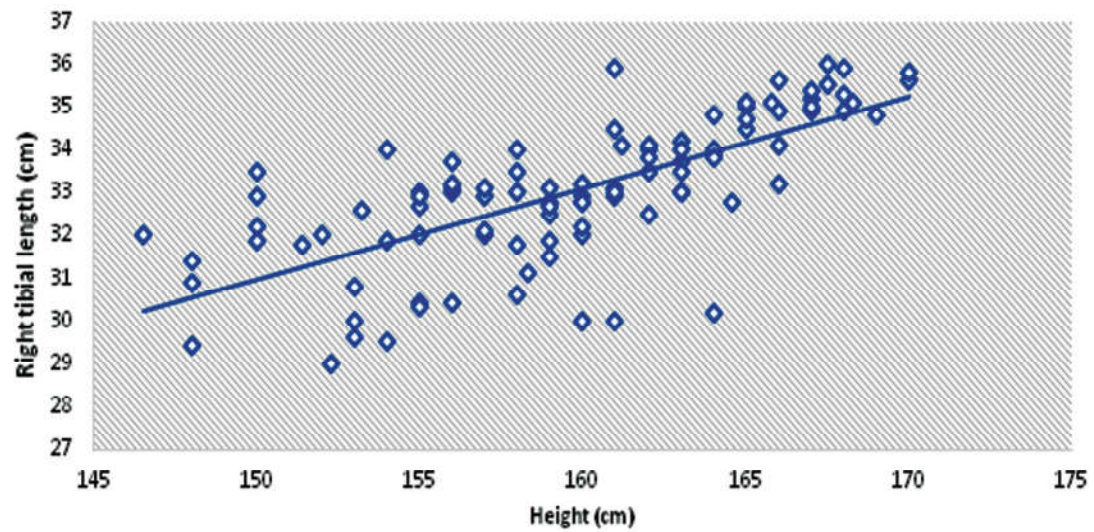
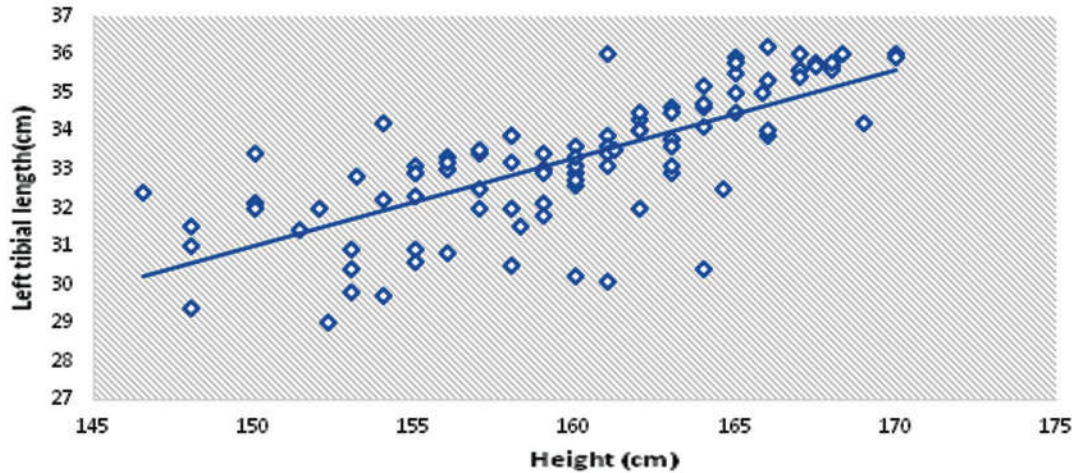


Fig. 3: Correlation of height with right tibial length in females.



**Fig. 4:** Correlation of height with left tibial length in females.



length (cm)

**Females**

$$\text{Height (cm)} = 82.723 + 2.329 * \text{Right tibial length (cm)}$$

$$\text{Height (cm)} = 82.714 + 2.317 * \text{Left tibial length (cm)}$$

For males, the Pearson co-efficient derived was 0.821 and 0.816 for the right and left sides respectively, while for females it was 0.703 and 0.738 respectively. Correlation was found to be significant at the 0.01 level (2-tailed) for both the sexes.

**DISCUSSION**

Stature is an inherent parameter for identity to be established. When the complete skeleton is available, it can be estimated using the anatomical method but this is seldom the case. In most cases, a part of the skeletal remains are available and at times even the individual bones are fragmented. Hence the mathematical method of correlating stature with the length of long bones is very useful. Estimating stature using measurements from long bones especially lower limb bones femur, tibia etc. has got higher correlation when compared to upper limbs.<sup>3</sup> Between femur and tibia, tibia has been widely used for stature estimation as its surface anatomy can be marked more accurately and hence percutaneous measurements are more feasible.

Indians stop growing in height on

completion of union of epiphysis and diaphysis by the age 20 which has been confirmed by several research workers.<sup>4</sup> In the present study stature was correlated with tibia from both right and left sides. The mean values of right and left tibia were respectively 37.18 and 37.53 in males and 33.06 and 33.28 in females. Length of the left tibia was found to be mostly greater than that of the right side for both the sexes.

For similar height, different tibial lengths were found amongst certain individuals. This has been observed by previous researchers also. The mean stature measurements were observed to be 172.95 cm and 159.82 cm respectively for males and females.

India has a diverse population with coexistence of varied ethnicities. Stature differs in these population subgroups as has been exemplified by multiple anthropometric studies. Sreya Moitra found the mean stature for Bengali population to be 167.62 cm and 157.44 cm respectively for males and females.<sup>5</sup>

In comparison Gaurang N et al found the mean statures in Gujarati population to be 169.94 cm and 159.64 cm for males and females respectively, while in South Indian population Anitha MR et al found it to be 161.93 cm.<sup>6-7</sup> This diversity necessitates region specific formulae to be used for different groups of population.

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### CONCLUSION

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The present study proves that there is a positive correlation between tibial length and the overall stature of an individual. Numerous studies have been carried out at varied places for stature estimation using long bones of the lower limb but there are wide variations in the formulae obtained. This shows that different body parameters have developed at different regions and this too keeps changing as the

population keeps getting taller with time. It is important that specific data, relevant to that region, be used when estimating stature for a particular ethnic group.

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