Original Article

Estimation of Stature from Percutaneous Tibial Length in Male Cadavers of the Lahore Population Aged 20-50 Years

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ABSTRACT

Objective: To determine the correlation coefficient between tibial length and body stature and regression model for estimation of body length from tibial length in males.

Study Design: Comparative cross-sectional study

Place and Duration of Study: This study was conducted at the Department of Forensic Medicine and Toxicology KEMU, Lahore. The study duration was from January 2023 to November 2023.

Methods: In this study percutaneous tibial length was measured along with body length in 62 dead bodies (31 males). It was a comparative cross sectional study. Non probability consecutive sampling technique was used. It was carried out in Forensic Medicine & Toxicology Department of KEMU, Lahore.

Results: Data was analyzed by using SPSS version 26. Correlation coefficient was calculated between percutaneous tibial length and body length of dead bodies. Pearson correlation coeffient was 0.933 respectively. Regression equations were obtained along with regression lines.

Conclusion: Very strong statistically positive and significant results were found.

Key Words: Percutaneous tibial length, Body length, Correlation coefficient, Male Cadavers

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INTRODUCTION

Uniqueness means the quality of being only one of a kind. There is an innate attribute of every individual is to be treated with equality and respect. This inborn quality is basic component of uniqueness. Individuality means presentation of an individual' s uniqueness, which is constituted by two elements.[1] One is the ability to make decisions and then struggle to fulfill these decisions. This ability differentiates that individual from other living things. The second is someone's identity which is collection of certain features that give uniqueness. These are three types of features: inherent, acquired with passage of time and uniqueness, being awarded by the people among whom that person leads his life.[2] When a person dies, decision-making element is lost but the element of uniqueness remains there. Therefore, as a basic human right, the dead must be given identity.

Human beings can be uniquely identified through techniques like fingerprinting and DNA analysis.[3] In situations where bodies are mutilated or fragmented due to disasters or violence, identifying the deceased becomes crucial. Forensic methods that utilize both hard biometrics, such as fingerprints and retinal patterns, and soft biometrics, such as height and weight, play a vital role in this process.[4]

The measurement of stature has been practiced for centuries, with documented methods dating back to the late 19th century in France, where bone length was quantified separately for males and females.[4] These measurements were later used to develop regression equations for estimating height.[5] Studies conducted worldwide have consistently shown a strong positive correlation between long bone lengths, particularly the femur and tibia, and height.[6] The femur and tibia, being more robust than other bones like the humerus, provide more accurate measurements for height estimation, especially in fragmented or mutilated bodies.

Anthropometry, the measurement of body parts, has a long history and is used in various fields, including forensic science. It allows for the identification of individuals based on quantifiable qualities, which can change over time or due to pathological conditions.[7]

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The Bertillon system, developed in the 19th century, was one of the earliest methods to use body measurements for individualization.[8]

Height is a crucial biological trait that aids in the identification of individuals, especially in forensic contexts.[9] It helps narrow down the list of possible identities, although it may not always provide conclusive results. Factors such as genetics, nutrition, and environmental conditions influence stature. Research has shown that long bones, finger lengths, and arm spans all have strong correlations with height, making them useful for estimating stature in various populations.[10]

Forensic methods for estimating height from body parts include mathematical and anatomical approaches. The mathematical method, particularly regression analysis, is widely used and provides accurate results.[11] The tibia, a strong and resilient bone, is particularly important in forensic investigations due to its ability to withstand decay and environmental factors, making it a reliable indicator for estimating height in both living and deceased individuals.[12]

METHODS

It was a comparative cross-sectional study, conducted in the department of Forensic Medicine and Toxicology KEMU, Lahore. The study duration was from January 2023 to November 2023. The sample size of 31 males with age between 20-50 years as taken by using non-probability consecutive sampling technique. The data was analyzed by using SPSS version 26.0, descriptive data was showed as Mean±SD, Pearson correlation coefficient was driven between tibial length and dead body stature and linear regression was performed. The sample collection involved measuring percutaneous tibial length by marking the medial upper border of the condyle to the lower medial malleolus and using a spreading caliper to measure in centimeters. Stature was measured on the autopsy table by marking lines at the head and heel, then recording the distance between them.

Inclusion Criteria:

- Dead bodies with healthy normal limbs without any deformity or disease (local skin disease, ulcer).
- Age between 20 -50 years.

Exclusion Criteria:

- Fracture of tibia.
- Amputation of limb.
- Congenital anomalies of lower limb.
- Age below 20 years.
- Age above 50 years.

RESULTS

In current study 31 cadavers were brought to mortuary of Forensic Medicine & Toxicology Department of KEMU, Lahore. Descriptive statistics of body stature and tibial length of male samples is depicted in *Table 1*. Maximum, minimum value of tibial length was 53, 46 with mean and standard deviation of 49.6±82.34 cm. Minimum, maximum value of body stature was 165 ,182 with mean and standard deviation of 176.39±4.63cm. The results of regression coefficients i.e., constant and tibial length have values of 84.77,1.844 respectively. Their t values were 12.93 and 13.996 with 0.000 *p* values depicted in *Table 2* with regression equation of

$$Body\ Stature\ (Y) = 84.774 + 1.844\ Tibial\ length\ (X)$$

The correlation coefficient between tibial length and body stature for study samples (males) with r value of 0.933 and *p* value <0.001.

Table No.1: Statistics of tibial length and body stature

Variable	Minimum	Maximum	Mean ± SD
Tibial Length	46	53	49.68 ± 2.34
Body Stature	165	182	176.39 ± 4.63

Table No.2: regression model for tibial length

Variable	Regression Coefficient	t-statistic	*p*-value
Constant	84.774	12.937	.000
Tibial Length	1.844	13.996	.000

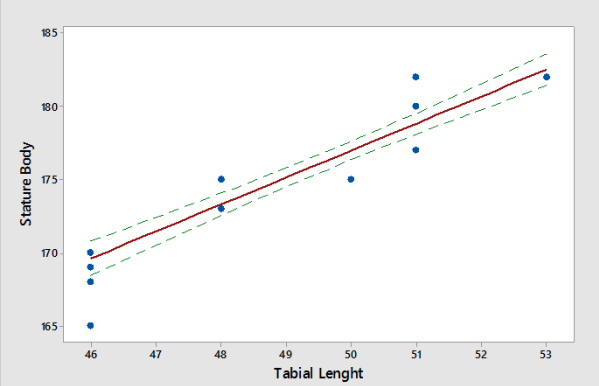

Figure No.1: Graphical representation of regression equation of study subjects.

DISCUSSION

Every person is born with a fundamental right of being so distinctive that his/her entity never ends till death. Rather it remains there even after death. This unmatched collection of characteristics is not only required in routine work but also in time of extreme need. Such extreme needs originate during catastrophic occurrences as floods, earth quack, bomb blast, war etc. Such occurrences enhance the working of personal identification experts.

Weather, family ties, community connections, food, cleanliness, and genetics all affect height. People in

different places therefore have different statures. In the current study, mean standing height for males was 176.39 cm, with a standard deviation of 4.63 cm(176.39±4.63cm). The minimum standing height was 165 cm, and the maximum was 182 cm. In contrast, research conducted in Punjab revealed that boys' average height was 170.5 cm,[13] whereas Lahore's average was 173.16 cm and the twin cities' average was 171 cm. The average male height in adjacent nations was 165.5 cm and 174.74 cm.[14] The average male height in Malaysia was 168.24 cm[15], whereas the average male height in Kosovo was 178.79 cm[16]. In Iranian males averaged height was 171 cm[17], Croatian males was 182.7 cm[18], and USA studies showed height of 169 cm for white males and 167.7 cm for Black males.[19]

The tibial length in males showed maximum value of 53 cm with a minimum value of 46 cm and a mean length of 49.68 cm with a standard deviation of 2.34 cm (49.68±2.34 cm). In the one of the previous studies in Belgium and Mexico, the results showed mean tibial length of 38.05 cm and 36.23 cm respectively.[20,21] The previous studies on cadavers showed a mean body length and tibial length of 164.02 cm and 35.99 cm respectively.[22] In Turkey, the study on male cadavers had a body length and tibial length of 170.4 cm and 36.9 cm respectively.[23] In Romania, a study showed a male mean body length and tibial length of 172.01 cm and 38.02 cm respectively. The correlation coefficient (r) between tibial length and body stature in the current study was 0.933, indicating a strong positive relationship, consistent with studies from India and Romania.[24-25]

In regression analysis, the equation for predicting male body stature was: **Body Stature (Y) = 84.774 + 1.844 Tibial Length (X)**. The relationship between tibial length and stature was statistically significant, with a t-value of 13.99 for tibial length and a p-value of 0.000.

CONCLUSION

Establishment of uniqueness is a basic need of medicolegal system. Various criteria have been used. Estimation of height can be done by various methods. Different body parts have been used to estimate body stature. The results of this study indicate that percutaneous tibial length can be utilized to develop regression equation. The value of Pearson correlation coefficient indicates that there exist a very strong positive and statistically significant correlation between percutaneous left tibial length and stature. This regression equation can be used to estimate body stature in dead bodies from percutaneous tibial length.

Author's Contribution:

Concept & Design or acquisition of analysis or interpretation of data:	Riasat Ali, Ahmad Raza Khan, Fariha Tariq
Drafting or Revising Critically:	Khalid Mahmood, Aatiqa Abbas, Noreen Kashif
Final Approval of version:	All the above authors
Agreement to accountable for all aspects of work:	All the above authors

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