ESTIMATION OF STATURE FROM FOOT ANTHROPOMETRY AMONGST POPULATION OF NATIONAL CAPITAL REGION

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Abstract

Stature is one of the major parameters for ascertaining the identity of an individual. Mathematical correlation of extremities to the overall stature has been an established method of estimation of height for unidentified individuals. In the present study 200 individuals of either sex, above the age of 18 years were studied and their foot dimensions were correlated with overall stature. No significant differences were noted in the measurements of right and left sides, in the same individual. 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, Foot Anthropometry, 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.[1] 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.[2] 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.

Stature has been determined in the past from long bones, hands and feet. Ossification and maturation in the foot occur earlier than the long bones and therefore height could be more accurately predicted from foot measurements as compared to long bones in adolescence.[3] Forensic podiatry also gains significance, as often the dismembered foot and hands are the only body part to be recovered from explosions and other mass disasters. The present study may prove to be a useful tool for estimation of stature in mass disasters or in cases where only dismembered extremities are available for stature estimation. It may also provide a baseline on which further research can be built upon amongst the NCR population.

MATERIALS AND METHODS

The present study was conducted for a period of two months from June 2022 to July 2022 in the Department of Forensic Medicine, 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, above the age group of 18 years, in the National Capital Region after obtaining a written informed consent.

The standing height was measured using a stadiometer with a movable headboard. The subject was be 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.

Foot length was measured on both sides using a Vernier calipers and further confirmed by using a metric tape. This extends from the most backward point on the heel ie. pternion to the tip of longest toe of the foot ie. acropodian.

Foot width was measured on both the sides using a Vernier calipers and further confirmed by using a metric tape. This extends from the distal anterior epiphysis of the first metatarsal to the joint of anterior epiphysis of the fifth metatarsal.

Inclusion criteria: Consenting individuals above 18 years.

Exclusion criteria:

- Those with physical deformities and/ or/ with fracture of head, fracture of spine, fracture of lower limbs and pelvis.

- Individuals with endocrine abnormalities (dwarfism, gigantism etc).

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.

Table 1: Descriptive analysis of data

|	Male			Female		
	Height (cm)	Right Foot Length	Left Foot Length	Height (cm)	Right Foot Length	Left Foot Length
Age range	18 – 25 years			18 – 25 years		
Samples	100	100	100	100	100	100
Mean	172.95	25.97	25.979	159.83	24.145	24.162
Standard Deviation	5.928	1.108	1.108	5.637	0.64	0.64

Table 2: Correlation of height with right foot length in males
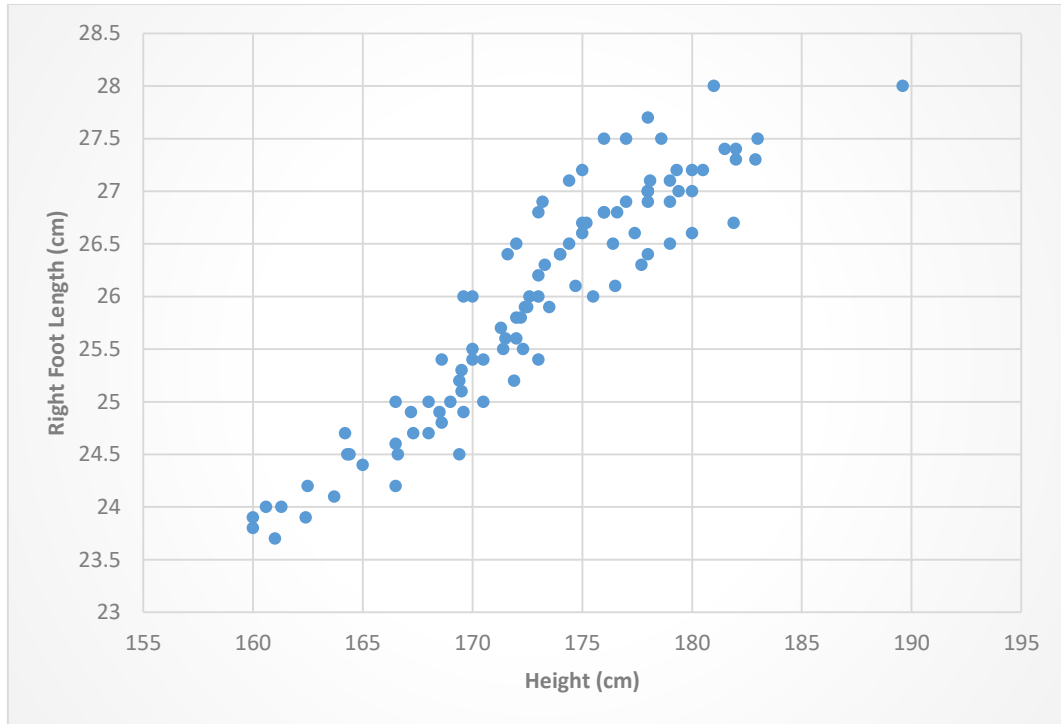
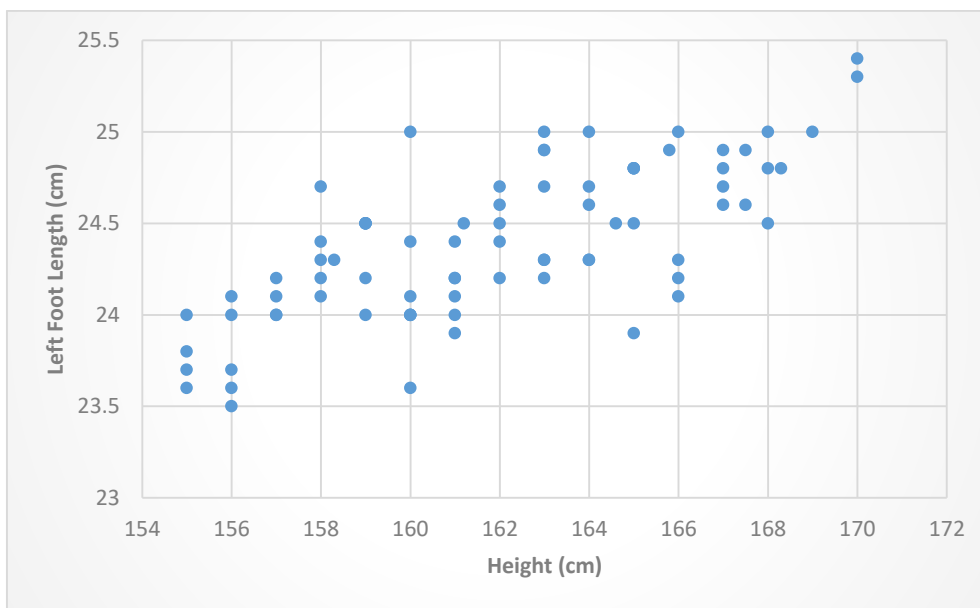

Table 3: Correlation of height with left foot length in males
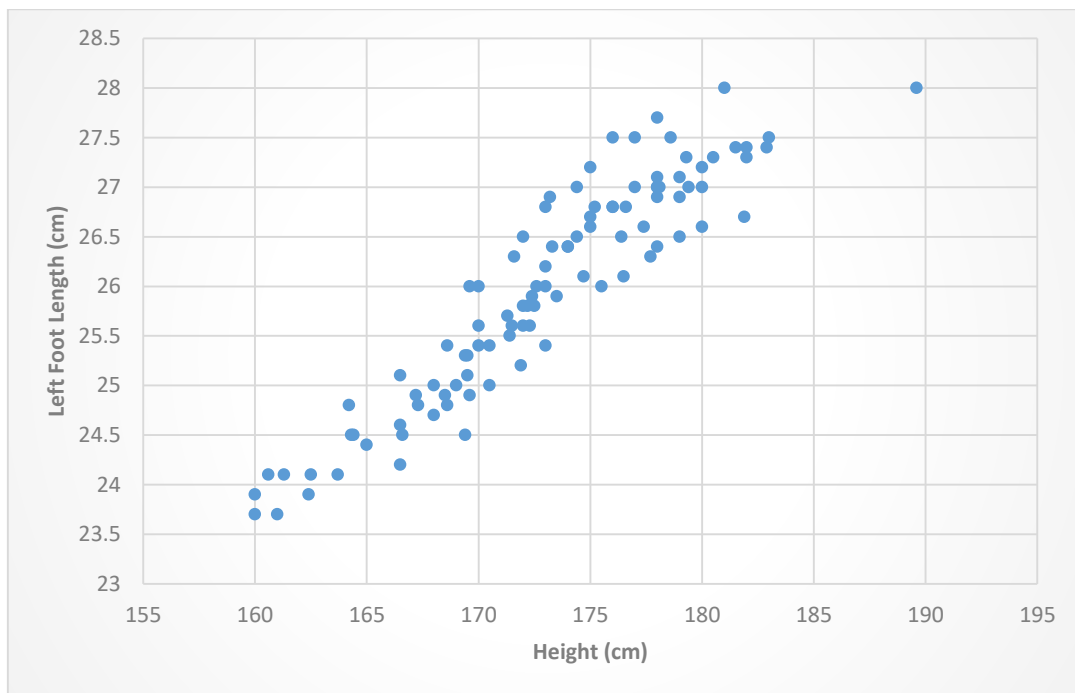
Table 4: Correlation of height with right foot length in females
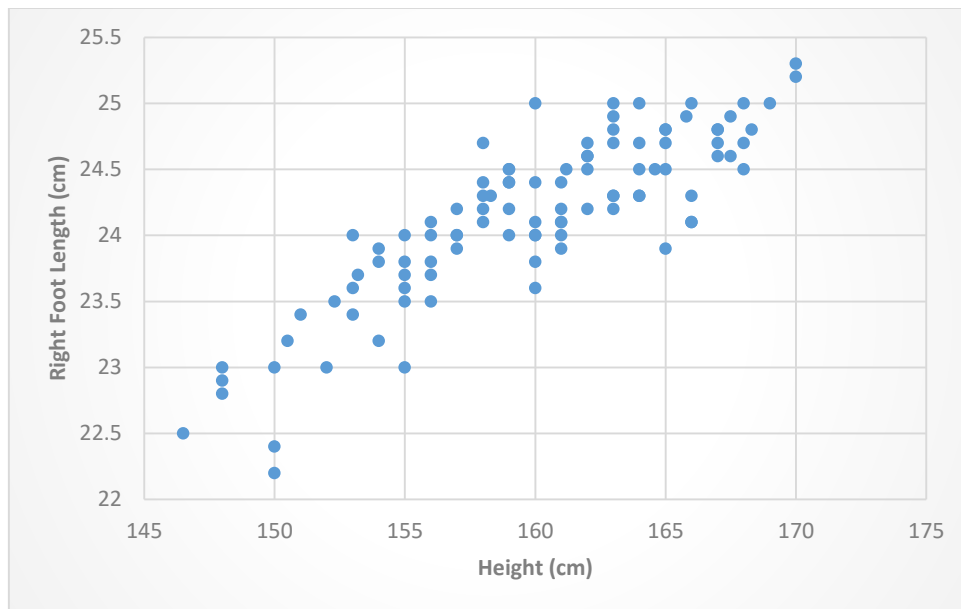
Table 5: Correlation of height with left foot length in females

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

Height (cm) = 43.55 + 4.983 * Right foot length (cm)

Height (cm) = 43.46 + 4.984 * Left foot length (cm)

Females

Height (cm) = 7.600 * Right foot length (cm) - 23.68

Height (cm) = 7.620 * Left foot length (cm) - 24.29

For males, the Pearson co-efficient derived was 0.931 and 0.932 for the right and left sides respectively, while for females it was 0.860 and 0.861 respectively. Correlation was found to be significant at the 0.01 level (2-tailed) for both the sexes.

DISCUSSION

An essential element for establishing identity is stature. The anatomical technique can be used to estimate the skeleton when it is accessible in its entirety, but this is uncommon. Most of the time, just a small portion of the skeletal remains are visible, and occasionally even the individual bones are fragmented. Therefore, it is quite helpful to utilize the mathematical method that links stature to the length of bones. Estimating stature using measurements from long bones especially lower limb bones has got higher correlation when compared to upper limbs.[4] 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.[5]

In the present study stature was correlated with foot length from both right and left sides. The mean stature measurements were observed to be 172.95 cm and 159.83 cm respectively for males and females. This is in accordance with statistics as studies have shown that generally males have higher stature than females. The mean values of right and left feet were respectively 25.97 cm and 25.979 cm in males and 24.145 cm and 24.162 cm in females. There was minimal variation between the measured values in the right and left feet. These findings are similar to Krishan and Sharma[6] who found no significant asymmetry amongst either males or females. Some individuals have varying foot lengths despite being of comparable height. Additionally, this has been noted by earlier scholars. Significant correlation was observed between stature estimation and foot length parameter in both males and females. Similar conclusions have been noted in studies by Hemy et al[7] in western Australian population and Igbigbi et al[8] in ethnic Nigerian population.

The regression formulae hence developed can be used to extrapolate findings when fragmented body parts or unknown skeletons are provided for stature estimation to Forensic Medicine experts.

India has a multicultural population where different ethnic groups coexist. Numerous anthropometric investigations have shown that various population subgroups differ in stature. Due to this variability, it is necessary to apply regionally specialized equations for various demographic groupings.

CONCLUSION

The current study establishes a valid link between foot length and an individual's overall stature. Numerous research have been conducted in various locations to estimate stature using the bones of the lower limb, however the formulae discovered vary greatly. This demonstrates how diverse body characteristics have evolved in various places and how they are also constantly evolving as the population continues to get taller over time. When assessing stature for a certain ethnic group, it is crucial that specific data from that region be used.

Conflict of interest: None to declare.

Ethical Clearance: Taken from the Ethical Committee of the Institute.

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