Study for Estimation of Stature from Foot Length in Medico Legal Autopsies based

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Abstract— *The present study are conducted on 100 dead bodies of (males and females) aged between20 and 60 years. The correlation coefficient calculated in males for the stature and right foot length (0.779) and left foot length (0.778); and the right foot length (0.653) and left foot length (0.638) in females were significant at 0.01 level. Males had significantly higher mean values for both stature and foot length compared to females. Regression equations were derived from right and left foot length for estimating stature in males and females. Stature (Y) could be calculated from the right foot length (X1) in males with the equation Y= 53.050 + 4.802 X1. For the left foot length (X2) in males, the equation was Y = 53.618 + 4.7762 X2. In females, the equations were Y = 78.538 + 3.597 X1 & Y = 78.724 + 3.601 X2 respectively.*

Keywords— Foot Length, Forensic Stature Estimation, Human Identification, Physical Anthropology.

I. INTRODUCTION

An important role of forensic anthropologists is their contribution for identification of individuals.[1] Stature and gender are primary attributes of biological profiling utilized for identification in medico legal cases from pool of potential matches. In mass disaster cases such as warfare, aircraft crashes, and explosions, body parts and extremities are the only remnants recovered.[2,3] Feet dimensions have been often utilized for prediction of stature and gender and their relationships have been established in various studies.[4,5] Studies have shown that the foot can be reliably utilized to predict the stature and sex of an individual with reasonable accuracy. Among the various dimensions of foot, foot length is considered to be a better predictor of stature and sex.[6] However, the regression equations for estimating stature and sectional points for identifying sex are considered to be population specific.[7] Due to strong influence of genetic and environmental factors on the height of the individual, homogeneity of the study population is vital in formulating the regression equations.[8] Although stature and sex studies have been conducted in various populations including Central India, but most of these studies are on ethnically mixed groups.[9,10] Hence, the present study was planned to create a baseline data for ethnically identical group of residents of Central India for two generations.

Establishing the identity of a person is a major concern in Forensic medicine and Forensic Anthropology. Identity means the determination of individuality of a person[11]. The primary characteristics of identity are those of sex, age and stature and they may at once serve to disprove a supposed identity. Recovering of unknown bodies either in full or in part, as remnants or fragments or bodies in charred or putrefied state is a day to day affair in medico-legal practice.

Stature of an individual is an inherent characteristic, the estimate of which is considered to be an important assessment in the identification of unknown human remains. Most of the body parts bear a more or less constant relationship with stature.

Identification of an individual means determination of individuality of a person based on certain physical characteristic features such as name, age, sex, religion, race, anthropometry (stature), fingerprints, footprints, DNA typing, congenital or acquired

malformations etc. The etymology of word identity is derived from Latin word "idem" which means – the same, i.e. identical. The challenging need of identification of an individual arises in situations like railway , motor vehicle and aircraft accidents , bomb explosions , in terrorist attacks (which are becoming more and more common now-a-days), tsunamis. In such conditions, only mutilated body parts, especially the peripheral body parts like hands or feet are available. So as to develop an anthropological profile of an individual, estimation of stature is an important component .The stature of an individual can be measured in living or dead and it can be correlated with lengths and breadths of body parts to deduce the regression equation. Such regression equations can be used for establishing stature in case where only body parts of the body are available. It has been shown that dimensions of the lower extremity show greater association with stature than those of upper extremity. Many researchers have worked to find out regression equations for stature estimation of an individual by measuring lengths of different body parts such as arms, phalanges, hands, feet etc and have developed regression equations. However most of these studies are applicable to a specific population residing in a specific geographic area.

1.1 Aim and Objective

1. To assess the stature and foot length of the population under study.
2. To correlate foot length of booth side with stature.
3. To predict the stature of the individual by foot length using regression analysis.
4. To see any difference in correlation of foot length and stature in different gender, in different age groups, in different religion, in different occupation, in different residential places and because of change after death.

II. MATERIAL AND METHODS

The study will conducted on 100 dead bodies brought for autopsy in the Department of Forensic Medicine at, J.L.N Medical College and attach hospital.

- **The period of study** will take from May 2023 to April 2024.
- **Sampling method:** Simple random sampling
- **Sample size:** 100 (50 male and 50 female)

2.1 Inclusion criteria:

Dead bodies coming for post-mortem examination in department of forensic medicine and toxicology.

The dead bodies aged 21 year and above will considered for examination because by 21 years of age there is completion of skeletal growth.

2.2 Exclusion criteria:

Dead bodies having any significant congenital or acquired deformities including fractures of spinal column or long bones and segmented, charred, mutilated or decomposed bodies are excluded.

Past history of the cases were recorded in detail to rule out nutritional deficiency, abnormal growth pattern and hormonal imbalance. Whenever such abnormalities were noted.

2.3 Cases of age less than 21 years:

Those cases were omitted from the study. The inquest reports were scrutinised and relevant data were recorded in the Performa.

2.4 Methods of collection of data:

The subject chosen for this study are as mentioned above. After receiving

Police-paper necessary for post mortem examination, detailed history about the deceased are taken from close relative about age, sex, religion, place to which they belong, occupation, time since death, any particular disease or deformity etc.

Stature of the dead body is estimated in cm by measuring tap with dead body is in lying down supine position on dissection table. Stature is measured after all limbs are straight and parallel to body. One straight metallic scale is placed over heel. The distance between both the scales reflects the exact stature of the individual.

Foot length is measured in cm on right foot with the help of sliding calliper as a straight distance between the most posterior projecting of the heel to the most anteriorly projecting point of the first or second toe whichever are bigger. Then by same technique left foot length is also measured.

All above measurements and findings were noted by myself to avoid any inter observer bias and recorded in Performa and filled.

2.5 Equipment's:

The following standardized anthropometric measuring equipment's are used for taking various body measurements:

1 standard measuring taps

2 sliding vernier calliper (Dial)

3 two straight metallic scales

2.6 Statistical Analysis:

The collected data are analysed using multiple regression analysis to derive formulae to estimate stature from foot length. As part of regression analysis, Pearson's product moment coefficient of correlation (r), Analysis of Variance (ANOVA) and Multiple Correlation Analysis (R) were done. In addition, paired sample 't' test and independent sample t-test (student t-test) was also applied in order to find out whether there is any significant difference between right and left foot length. Data were analysed separately for males and females.

FIGURE 1: Measuring foot length using digital sliding calliper

III. RESULTS

The data collected was statistically analysed and the results of the study were tabulated and are given in Table 1

TABLE 1

RANGE, MEAN, STANDARD DEVIATION AND CORRELATION COEFFICIENT (R) VALUES OF ANTHROPOMETRIC MEASUREMENTS IN ADULT MALES AND FEMALES.

Sl. No.	Gender	Parameters	Range (cm)	Mean	Standard Deviation	Correlation Coefficient
1	Males	Stature	149-185	165.71	7.68	
2		Right foot length	19.87-26.70	23.46	1.25	0.779*
3		Left foot length	20.15-27.05	23.48	1.25	0.778*
4	Females	Stature	145-175	155.39	5.71	
5		Right foot length	19.32-23.44	21.36	1.04	0.653*
6		Left foot length	19.02-23.36	21.29	1.01	0.638*

TABLE 2

REGRESSION EQUATIONS DERIVED

	Gender	Regression model highly significant at the F value	The regression equation obtained
From rt. foot length	Males	$F = 254.62$; $p < 0.01$	Y* = 53.050 + 4.802 X1**
From lt. foot length		$F = 252.48$; $p < 0.01$	Y = 53.618 + 4.7762 X2***
From rt. foot length	Females	$F = 40.81$; $p < 0.01$	Y = 78.538 + 3.597 X
From lt. foot length		$F = 37.71$; $p < 0.01$	Y = 78.724 + 3.601 X2

IV. DISCUSSION

From the above findings, the feet are observed to be longer in males compared to females. This finding is in agreement with the findings of Giles and Vallandigham (1991), who used measurements obtained from young adult male and female recruits in the US army[2]; Baker and Scheuer (1998) who studied UK residents[3]; Ashizawa et al. (1997) who studied Javanese, Filipinas and Japanese4; Ilayperuma et al. (2009) who studied Sri Lankans[5] and Rani et al. (2011) who studied Indian subjects[6]. Prior studies as those done by Philip (1990),

who studied Indian subjects[7]; Sanli et al. (2005) who conducted a study on Turkish subjects[8]; Patel et al. (2007) who studied the inhabitants of Gujarat region in India[9]; Ilayperumana et al. (2009)[5]; Chavan et al. (2009) who studied the inhabitants of Maharashtra region[10] and Rani et al. (2011)[6] had showed a high positive correlation between stature and foot length. The present study showed results in line with the published data. The present study derived regression equations for estimating stature from right and left foot length which can be applied for forensic stature estimation to help law enforcement. Further study on the same population is recommended to validate the findings of the study.

ETHICAL CONCERNS

Human Ethics Committee, Medical College, Ajmer, through Institutional Ethics Committee (IEC) and Institutional Review Board (IRB) approved the study. The data was collected during routine medico-legal autopsy examination and no information which could reveal the identity of the deceased are published.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest. The research was self-funded.

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