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Original Article

Determination of Human Stature from Foot Dimensions in Peshawar

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ABSTRACT

One of the accepted methods for identifying unknown individuals is estimating their stature from the body components and remnants. **Objective:** To establish regression formulas for determining stature from foot dimensions in Peshawar. **Methods:** The study was carried out in Jinnah Medical College Peshawar from March 2021 to August 2021 including 62 males and 72 females (total 135) and the age range was between 17 to 55 years. Age, stature, foot length (FL) and the width (FW) was measured. **Results:** The stature, foot width, mean age, and foot length were 30.23, 1835.248.11 mm, FL=272.553.20 mm, FW = 85.00 1.0 mm for males and for females 28.05, 1734.556.52 mm, FL = 234.67 2.08 mm, FW = 77.11 0.64 mm. Males stature (r = 0.70, *p 0.01*) had the highest correlation with foot length (r = 0.61, *p 0.01*) than females (r = 0.61, *p 0.01*). The female's regression formula for stature is St =3.428 FL+1120 and Stature =3.538+1522.2 while for male it was St = stature = 4.2129 FL +100.52 and stature 5.2106 FW +1686.4. **Conclusion:** For determining stature, the foot length is more reliable

INTRODUCTION

While someone is described as having a "stature," it refers to their natural height when standing straight up. Forensics places a high value on physical size [1]. Because in forensic anthropology, questions such as sex, age, and ancestry are asked to determine an individual's identity [2,3]. To help in the process of identifying people, researchers have been working on developing techniques for calculating the identification of individuals of height. Anatomical or mathematical techniques could be used [4,5]. Dwight 1894 initially invented the anatomical methods of determination of the total height, it was further modified by Fully [6]. The height of the tibia, cranium, femur, vertebra column, talus, and calcaneus was summed together. The drawback to this method is an estimation of the required stature are not obtainable in most case. The mathematics procedure includes the use of 1 or even more bones to determine a person's stature by formulating regression formulas [5,7]. In forensic anthropology, predictive regression models are

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often used because certain body parts may be used to predict the stature of others, such as the measurements of a person's hands or feet [8,9]. Depending on the interaction of genes and environmental influences that can create variances within and between populations, some research has demonstrated that the regression formula needs be sex and population-specific for it to be effective [10,11]. In Pakistan, the nutritional quality is exceedingly low; approximately 40% of people are short-statured, which can have long-term effects, such as reduced skeletal growth [12]. The development of a regression model would greatly enhance the ease with which the population could be identified. The purpose of the study was to develop the regression formulas to determine the association between human stature and foot dimension.

METHODS

In a cross-sectional study, the total number of individuals (135) from Jinnah Medical College, Peshawar from March 2021 to August 2021 consisted of 62 males and 72 females. The breadth of the feet was measured in a series of consecutive samplings, including age, stature, and foot length. The participants ranged in age from 17 to 55 years old. Individuals' parents and grandparents had to be from Peshawar to be included in the study. Individuals with foot deformities were excluded from the study, as were those under the age of 17 and those over 55 years. Informed permission was provided by participants after the study's purpose and data collection procedures were explained.

The parameters which were measured are as followed:

Stature: A stadiometer was used to take this measurement. On the stadiometer's platform, each participant stood straight, barefoot, and positioned their heads, buttocks, shoulders, and heels on the bar. Individuals were instructed with arms hanging by the side in a relaxing position. The sag position was avoided.

Foot Length: A digital Vernier caliper was used to measure the foot length. It's the distance between the heel's most prominent area and the longest toe's most distal component.

Foot Width: A digital Vernier caliper was used to measure the width of the foot at its broadest point. The first metatarsal head to the fifth metatarsal head distance is the distance between the two most prominent points on the medial and lateral sides of each metatarsal head. All measures were taken on the right foot, three times, and the average was recorded to reduce mistakes.

Statistical Program for the Social Sciences version 23 and Microsoft Office excel Tool Pak version 2011 was used to analyze the data. For determination of stature and correlations tests, descriptive analysis and regression models were used.

RESULTS

Table 1 shows all individuals, the mean age of (29.45 years), Stature (1799.22 mm), Foot length (231.11mm), and Foot width (81.88 mm), regardless of gender.

Parameters	Mean	SE of Mean	SD	Variance	Minimum	Maximum
Age (years)	29.45	0.75	7.45	71.22	17	54
Stature mm	1799.22	7.55	84	8346.79	1550.51	1880.23
Foot length FL mm	231.11	2.00	19.66	345.67	91.60	310.44
Foot width FW mm	81.88	0.75	7.22	69.65	58.22	102.55

Table 1: Parameters of all participants measured with descriptive statistics

The parameters of male and female participants measured with descriptive statistics are shown in Tables 2 and 3.

Parameters	Mean	SE of Mean	SD	Variance	Minimum	Maximum
Age	28.05	1.0	8.11	64.65	17	54
Stature mm	1734.55	8.14	69.20	4762.99	1550.02	1944.00
Foot length FL mm	234.67	1.90	17.66	272.44	200.00	286.45
Foot width FW mm	77.11	0.83	6.45	43.34	58.22	93.99

Table 2: Parameters for female participants measured with descriptive statistics

In Table 3 the mean value of males was greater than females regarding Stature mm, foot length mm, and foot width mm.

Parameters	Mean	SE of Mean	SD	Variance	Minimum	Maximum
Age	30.23	1.02	9.65	72.58	17	54
Stature mm	1835.24	10.22	78.44	7221.45	1690.01	20.22.03
Foot length FL mm	272.55	2.05	17.44	281.55	232.33	302.55
Foot width FW mm	85.00	0.99	8.44	62.21	68.12	101.66

Table 3: Parameters for male participants measured with descriptive statistics

Table 4 shows the correlation coefficient, regression equations, and correlation test.

Parameters	Correlation value (R-value)	p-value	Interference	Regression formulas
All participants				
Stature/ foot length	0.20	0.004	R-value is significant	Stature =4.3169 FL+992.01
Stature / foot width	0.49	0.001	R-value is strongly significant	Stature =6.44 FW +1325.4
Female participants				
Stature/ foot length	0.61	0.01	R-value is strongly significant	Stature =3.428 FL+1120
Stature / foot width	0.22	0.05	R-value is significant	Stature =3.538 +1522.2
Male participants				
Stature/ foot length	0.70	0.01	R-value is strongly significant	Stature = 4.2129 FL +100.52
Stature / foot width	0.54	0.01	R-value is significant	Stature 5.2106 FW +1686.4

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Table 4: Stature Evaluation from Foot Length and Foot Width

DISCUSSION

The association between living human stature and foot width and length in Peshawar Pakistan was explored in this study. Both genders [13] and various populations [14] show the difference in stature and anthropometric measures. To determine stature from isolated parts of the body in males and females individually, gender-specific regression models must always be developed. In the study population, stature, foot length, and breadth were shown to have a statistically significant positive correlation. In a number of studies, the human feet have been shown to be a reliable indicator of stature when it comes to determining height [15,16]. Analyzing anthropometric measurements like foot length and width, anthropologists have used predictive regression models to determine a person's height [10]. In this study anatomical dimensions of Males had greater dimension than females that is (Stature = 1835.248.11 mm, FL=272.553.20 mm, FW = 85.00 1.0 mm for males and stature = 1734.556.52 mm, FL = 234.67 2.08 mm, FW = 77.11 0.64 mm for females. A study carried out in 2018 by Ibeabuchi NM et al., had similar results [17,18]. As a result of pubertal changes, the females' limb development slows down more rapidly than the boys. This might explain the differences. The foot dimension in 2006 EN Obikili et al., had a similar finding [19], they observed that the mean right foot length and breadth for Nigerians were 27 1.3 cm and 251.1 cm for males and females, accordingly, and the right foot breadth was 9.8 0.5cm and 8.9 0.5cm for males and females. In our study Males stature (r = 0.70, p 0.01) had the highest correlation with foot length (r = 0.61, p 0.01) than females (r = 0.61, p 0.01). In 2016 Dhaneria et al., Earlier studies had found that foot length was highly reliable in determining stature; although, this research had lower correlations for both sexes than similar studies, which could be attributable to ethnic and population differences [20]. In this study, females' foot width (breadth) had the lowest correlation with stature (r=0.22). There was a statistically significant r = 0.54 (p = 0.001) correlation between male height and foot width. RA Saharan in 2016 has similar findings [21]. When assessing stature, foot length is more accurate than foot breadth, and the reasons that influence this finding may need to be researched further. The female's formula for stature is St = Stature =3.428 FL+1120 and Stature =3.538+1522.2 while for male it was St = Stature = 4.2129 FL +100.52 and Stature 5.2106 FW +1686.4. As of 2016, Saharan RA stated that the regression formula used to estimate stature from the left foot for men was 89.63 3.36 (FL) for females and 101.96 2.6 (FL) for males.

CONCLUSIONS

Because foot length and breadth are linked to stature, these anthropometric measures may be used to compare one another. In comparison to females, males' foot length is far more important in determining stature. The linear regression technique used in this work can be used to estimate the stature of Peshawar in Pakistan.

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