Role of Foot Dimensions in Predicting Stature among Medical Students in Smims, Smu, Sikkim

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Abstract

Establishing the identity of an individual is the foremost criteria for law agencies, medicolegal experts and experts in forensic science to correlate evidences and find motive behind the crime. Forensic science has made an astonishing progress in the field of forensic science from blood grouping to D.N.A fingerprinting& Anthropometry to Dactylography. Nevertheless, the most commonly used tool for identification beyond the forensic laboratories still remains the same i.e. built, complexion, stature, colour of eye, mole, scar mark etc. Hence, the aim of this current study is to establish a relationship between the dimension of foot and stature estimation. The present study was conducted among 200 medical students, out of which 100 were male students and 100 were female students. All the students were between the age group of 20-30 years. The data was analyzed using S.P.S.S (I.B.M version 20, Armonk, NY, U.S.A). The regression analysis showed that there is significant correlation between the foot parameters and stature.

Keywords: *Foot dimension, stature estimation, medical students, establish, correlate, identity.*

Introduction

An individuality of a person can be determined either absolutely/partially.(1) Few of the commonly used identification data are physical features, complexion, colour of iris, hair, built, speech, gait, age, sex, stature, race, etc. The anthropometric measurements and identification data of a diverse population across the vast geographic area of Indian subcontinent varies regionally.

The establishment of identity based on height is not very uncommon while determination of height from long bones is an established and most frequently used method for identification of skeletal remains. However, preparation of long bones for anthropometric and morphologic study can be cumbersome and time-consuming. Hence, establishment of an individual from foot dimension could be an alternative as it is less tedious and saves time.

Trotter and Glesser(2) studied the long bones for estimation of stature among Black Americans and Whites. Rutishauser,1968(3); Kulthanan et al,2003(4); Ozden et al,2005(5); Jitender et al,2007(6); studied the reliability of prediction of height from foot length which was almost equivalent to stature estimation from long bones.

The present study focuses on stature estimation from foot dimension along with their linear regression equation derivation for stature estimation.

Materials and Method

This cross-sectional study comprised of 50 male & 50 female medical students of Sikkim Manipal Institute of Medical Sciences, Gangtok, East Sikkim, India. After

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acquiring their consent under free will, the students between the age group of 20-23years were included in our study. While students who declined to give their consent, students with bony deformities & illness were excluded from this study.

Using stadiometer, the height was measured with the head on the Frankfort Horizontal Plane from heel to vertex. The foot length was measured using a sliding caliper between the acropodian & the pternion. The foot breadth was measured as the distance between the head of the 1st& 5th metatarsal. All foot dimensions were measured using sliding caliper. The measurements recorded were Length of right foot (LRF), Breadth of right foot (BRF), Length of left foot (LLF), Breadth of left foot (BLF) & Height (Ht).

The data was analyzed using SPSS (IBM version 20, Armonk, NY,USA). Sex specific linear regression equation were derived from foot dimensions to determine the stature. Analysis with $p < 0.05$ were considered statistically significant.

Results

Linear regression was derived independently in males (Table1), females (Table2) & both (irrespective of their sex i.e. Table3) from different variables i.e. LRF, BRF, LLF & BLF (Table4). The linear regression is statistically significant for all variables in males i.e. LRF ($R=0.544$, $p <0.05$), BRF ($R=0.358$, $p <0.05$), LLF ($R= 0.535$, $p <0.05$) and BLF ($R=0.311$, $p <0.05$). In females, LRF ($R=0.512$, $p <0.05$), BRF ($R=0.118$, $p >0.05$) & BLF ($R=0.182$, $p >0.05$) were considered for derivation of linear regression equation& among all the four variables only LRF &LLF were found to be statistically significant for all the variables namely LRF ($R=0.752$, $p <0.05$), BRF ($R=0.465$, $p < 0.05$), LLF ($R=0.750$, $p <0.05$) & BLF ($R=0.446$, $p <0.05$).

Table 1: Regression equation for stature prediction in males (in centimeters)

Foot dimensions*	Regression Equation	p value**	S.E.E
LRF	105.845+2.657(LRF)	0.000	5.97
BRF	149.181+2.516(BRF)	0.000	6.64
LLF	106.006+2.653(LLF)	0.000	6.01
BLF	153.575+2.055(BLF)	0.002	6.76

* Length of right foot (LRF), Breadth of right foot (BRF), Length of left foot (LLF), Breadth of left foot (BLF).

**p <0.05 is considered to be statistically significant and p >0.05 is considered insignificant.

Table 2: Regression equation for stature prediction in females (in centimeters)

Foot dimensions*	Regression Equation	p value**	S.E.E
LRF	98.051+2.685(LRF)	0.000	5.26
BRF	151.914+0.907(BRF)	0.242	6.08
LLF	97.051+2.724(LLF)	0.000	5.18
BLF	147.303+1.431(BLF)	0.071	6.02

*** Length** of right foot (LRF), Breadth of right foot (BRF), Length of left foot (LLF), Breadth of left foot (BLF).

**p <0.05 is considered to be statistically significant and p >0.05 is considered insignificant.

Table 3: Regression equation for stature prediction in pooled sample (inclusive of all samples irrespective of sex in centimeters)

Foot dimensions*	Regression Equation	p value**	S.E.E
LRF	69.224+4.025(LRF)	0.000	6.20
BRF	126.601+4.379(BRF)	0.000	8.33
LLF	68.512+4.053(LLF)	0.000	6.22
BLF	128.736+4.136(BLF)	0.000	8.42

* Length of right foot (LRF), Breadth of right foot (BRF), Length of left foot (LLF), Breadth of left foot (BLF).

**p <0.05 is considered to be statistically significant and p >0.05 is considered insignificant.

Table 4: Correlations between stature and foot dimensions

Foot dimensions*	Pooled sample	Female	Male
LRF			
Correlation Coefficient (R)	0.752	0.512	0.544
Regression Coefficient (B)	4.025	2.685	2.657
Value of Constant (A)	69.224	98.051	105.845
BRF			
Correlation Coefficient (R)	0.465	0.118	0.358
Regression Coefficient (B)	4.379	0.907	2.516
Value of Constant (A)	126.601	151.914	149.181
BLF			
Correlation Coefficient (R)	0.446	0.182	0.311
Regression Coefficient (B)	4.136	1.431	2.055
Value of Constant (A)	128.736	147.303	153.575
LLF			
Correlation Coefficient (R)	0.750	0.532	0.535
Regression Coefficient (B)	4.053	2.724	2.653
Value of Constant (A)	68.512	97.051	106.006

* Length of right foot (LRF), Breadth of right foot (BRF), Length of left foot (LLF), Breadth of left foot (BLF).

Discussion

Determination of stature from foot length is fairly common & as mentioned by Ashizawa K et al (2017) in their study that society does attribute in all morphometric studieswhich causes the variation among individuals of different region & society. Hence the present study was conducted among 200 medical students of SMIMS, Gangtok, Sikkim. (7)

In our study, the bilateral variation of foot length was negligent on stature similar to studies done by Kanchan T et al(8) and M.C. Meena et al (2013).(9) Contrary to our study Jitender et al (2010) concluded that the right foot length has lesser predictability of stature as compared to left foot length.(6)

The linear equation derived from foot length & breadth were statistically significant in males while in female only foot length derived linear equation were statistically significant. The correlation coefficient is positive between foot length and stature estimate. Hence, the foot length is definitely a better predictive parameter as compared to the breadth of the foot for estimating the height of an individual. Similar views are shared by Mukta Rani et al (2011)(10)& Rameswarapu Suman Babu et al (2013)(11) in their studies.

In the present study, the Correlation Coefficient (R) value in the pooled sample are higher in comparison to correlation coefficient values in males & females respectively. Concurrent findings were also observed by T. Nataraja Moorthy et al (2013)(12) in their study.

Conclusion

The regression equation derived from pooled sample after the analysis of foot parameters correlated positively &significantly for estimating the stature of an individual. The length of the foot is the best predictor (Left foot R^2= 56.3% and Right foot R^2= 56.5%) among the rest of the parameters. This study can help in estimating stature among the Sikkimese diaspora. It can also aid law enforcement agencies in establishing the identity of an individual & solving crimes.

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