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Original Article

Estimation of Stature by Foot Length in Adult Males in a Tertiary Centre in Bihar

R.B. Gupta[1], Jyotish Guria[2], Mohammad Intekhab Alam Chand[3] and Fakhar Alam[4]*

[1]Professor, [2,3]Assistant Professor, [4]Associate Professor, Department of FMT, Katihar Medical College Katihar, Bihar, India
*Corresponding author email id: drfakhar786@gmail.com

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ABSTRACT

Identification of an individual is one of the main objectives carried out in day to day medico legal work. Fixing the individuality of a person requires different characteristic features specific to the person. Stature of a person is one among the many features helping in the identification of a person. In the past, many studies have been conducted showing the positive correlation between stature of an individual and other anthropometric measurement. Aim of the present study is to find a relation between height and foot length and derive a regression equation that can be helpful to estimate the height of a person from the foot length. This study was conducted on 100 male students. The mean left foot length and right foot length were 26.15 and 26.25 respectively. Height of the subjects varied from 158 cm to 185 cm. A significant correlation was found between the foot length and the height.

Keywords: Foot length, Stature, Right foot length, Left foot length

INTRODUCTION

Identification is the determination of the individuality of a person- living or dead [1]. It is almost always required in criminal as well as civil cases. It is needed in cases of living as well as dead and in mutilated bodies. There are various features which help in exact fixation of the individuality of a person like race, age, sex, stature, colour of eyes, skin and hair, teeth. etc. Stature is one of the important criteria that is specific for a given person. Various body measurements have been used in past for estimating the height of a person. Foot length is known to be in biological correlation with stature. It has been also shown that the reliability of prediction of stature from foot measurements was as high as that from long bones. Footprints and shoe prints are routinely encountered evidences in crime scenes. Estimation of stature from foot measurements is helpful in narrowing down the number of suspects. Also, in cases where only the body remains or disintegrated parts are available, dimensions of foot can be used to estimate the height of a given person. Ossification and maturation occur earlier than long bones, therefore, it can be used for estimation of stature more accurately during adolescence as compared to that from the long bones [2].

MATERIALS AND METHODS

The study was carried out in Katihar Medical College, Katihar, Bihar. 100 male MBBS students from 29th to 31st batch (2018-19 batch to 2020-21 batch) were included in the study. Subjects with abnormality of either

feet/ lower limb or any spinal deformities were excluded from the study. The aim and objective of the study was properly explained to the participants and consent is obtained on a proforma. Approval from Institutional Ethics Committee was obtained prior to the study. Length of both foot and stature were taken separately for each student. Both the foot length and height of individual subject was measured in centimetres.

Foot length are obtained by measuring the distance from the outer most margin of heel to the tip of extension of longest toe in both the feet; using a Vernier's calliper. For taking measurement of height, Subjects were asked to stand bare foot in anatomical position on a height-weight scale. The height is measured with a thin cardboard kept horizontally at the vertex of the head.

Data collected is analysed with the SPSS ver.20 SOFTWARE and correlation between foot length and height is statistically determined. Regression formula is derived for calculation of height using left and right foot separately in Table 1 and 2.

RESULTS

In our study, Right foot length varied from 23 cm to 29 cm. Out of the 100 students, 31(maximum) were having right foot length in the range of 26.1-27 cm with average height of 175.97 cm and S.D. of 3.15. Average height of students for right foot length varied from 163.56 cm for RFL 23-24 cm to 182.11 cm for RFL 28.1-29 cm.

Left foot length varied from 23 cm to 29 cm. Maximum 29 students were having left foot length in the range of 26.1-27 cm with average height of 176.20 cm and S.D. of 3.09.

Average height of students for left foot length varied from 163.9 cm for LFL 23-24 cm to 182.12 cm for LFL 28.1-29 cm.

Both left and right foot length were compared, and the difference is found to be statistically insignificant, with Z = 0.61 and P >0.05.

Table 3 and 4 shows the correlation between foot length and height (left and right foot respectively) among the

Table 1: Right Foot Length and Height

S.No.	Right foot length	Number of individuals	Minimum height	Maximum height	Average height	Standard deviation
1.	23-24	9	158	169	163.56	3.87
2.	24.1-25	16	164	172	168.31	2.15
3.	25.1-26	17	169	174	171.00	1.62
4.	26.1-27	31	171	181	175.97	3.15
5.	27.1-28	18	175	183	179.67	2.19
6.	28.1-29	9	180	185	182.11	1.61

Table 2: Left Foot Length and Height

S.No.	Left foot length	Number of individuals	Minimum height	Maximum height	Average height	Standard deviation
1.	23-24	10	158	169	163.9	3.81
2.	24.1-25	15	164	172	168.4	2.19
3.	25.1-26	18	169	174	171.0	1.57
4.	26.1-27	29	171	181	176.20	3.09
5.	27.1-28	20	174	183	179.50	2.50
6.	28.1-29	8	180	185	182.12	1.72

Table 3: Effect of minimum, maximum correlation coefficient

Variable	n	Mean ±SD	Minimum	Maximum	Correlation coefficient (r value)	Regression coefficient (b value)
Left foot length	100	26.15±1.42	23.10	28.90	+ 0.948	4.007
Height	100	174±6.01	158	185		

Table 4: Effect of minimum, maximum correlation coefficient

Variable	n	Mean ±SD	Minimum	Maximum	Correlation coefficient (r value)	Regression coefficient (b value)
Right foot length	100	26.25±1.40	23.3	28.9	+ 0.942	4.022
Height	100	174±6.01	158	185		

subjects. Average left foot length is slightly smaller than right foot length. Both LFL and RFL have a significant positive correlation with stature; (r = + 0.948) and (r = + 0.942), respectively. The difference in correlation coefficient is statistically significant (P<0.01). Regression coefficient for LFL and RFL are 4.007 and 4.022 respectively.

With this significant correlation an attempt was made to estimate stature based on any given right foot length and left foot length.

Table 5: Regression equation

Left foot	height = 69.185+ 4.007 x left foot length
Right foot	height = 68.411 + 4.022 x right foot length

Table 5 shows the regression equations derived for the estimation of height using left and right foot length.

DISCUSSION

Estimation of stature as a part of the identification process is necessary in routine forensic work. It helps in identification of unknown culprit among the group of suspected criminals. Also, in cases of the mass disasters, industrial accidents, bomb explosions etc. stature determination can narrow down the search for the specific individuals. Cases where mutilated bodies or body remains are presented before the forensic expert, estimation of stature is one major objective. Measurements of bones and other body parts are always used as tool to estimate the stature of an individual. With the help of regression equations these measurements can be used for calculating height of individuals in a specific population.

The present study was carried out to determine the correlation between foot length and height of the individual. Also, regression equations were derived that can be helpful in estimation of height from the known foot length.

It was observed that the left foot is slightly smaller than the right foot. However, the difference is not statistically significant, Z=0.61 and P>0.05. Similar results were obtained [3], while Vidya (2009) in her study found left foot length to be slightly more than right foot length [4].

Malik (2015) conducted the similar study using left foot length and derived regression equations for both sexes. A strong significant relationship (r= 0.807, p<0.001) between foot length and body stature of all subjects was concluded [2]. The present study also shows the similar significant relationship of left and right feet length with the stature of the subjects; (r = + 0.948) and (r = + 0.942) respectively and P<0.01.

Agnihotri AK in his study found highly significant (P<0.001) and multiple correlation coefficient (r=0.877) [5]. In present study correlation coefficient of +0.948 and +0.942 respectively obtained for left and right footprint lengths.

Kakkar A also concluded significant correlation between height and entire subjects mean foot length ($r = 0.5964$, $p< 0.01$) like the present study [6].

Moitra conducted similar study in southern parts of west Bengal on 400 subjects. The mean height of males (167.624 ± 7.059 cm) in the study group and, the mean foot length in males (26.564 ± 6.634 cm). The foot length showed high value of correlation ($r=0.522$) in males with stature [7].

In the present study, regression equations were derived in order to calculate height from left foot length and right foot length, as depicted in Table 5. The regression equation was then applied to 20 different data at random from the collection and was found to be appropriate.

CONCLUSION

The foot length has a good predictive value in estimation of stature. There is statistically insignificant difference in right foot length and left foot length when both are compared. Any available foot length (right or left) can be used for the prediction of height. With getting footprint measurements from the crime scenes this can be done easily using the regression equations. Also, it can be helpful in cases where only the body remains are available for examination. This method is easy, economical, convenient, with no specialization or training required. Thus, helping the investigating authorities to narrow down their search for the specific individual. Similar studies are required using other body measurements as a tool for deriving regression formula for this part of the country.

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