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Cross Sectional Study on Estimation of Stature from foot Length in Telangana

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Abstract

Height is an important factor for identification. Estimation of height from mutilated bodies has significance in medico legal investigations. Foot length is equally significant for estimating the stature like other body parts by using linear regression equation. A cross sectional study on correlation of foot length in relation to the height of an individual was conducted in the age group of 18-25 years in Telangana population during the period from 1st January 2019 to 31st December 2019. A total of 150 subjects, among which 75 male and 75 female were included in the study. Measurement of foot length has been taken as length between the heel to the tip of longest toe, measured by using Vernier caliper. All the study subjects were healthy individuals without any abnormalities. The data was statistically analyzed by using SPSS (version 25) software.

The linear regression formula for estimating the height is y = a + (bx), y = dependent variable (height), a = constant, b = independent variable coefficient, x = independent variable i.e length of foot. For total population the right foot formula is y = 39.25 + (5.18 x), for left foot the formula is y = 37.08 +(5.24 x). The formula for male population for right foot is y = 64.38 +(4.22 x) and for left foot is y = 62.23 + (4.30 x). The formula for female population, right foot is y = 52.47 + (4.54x) and left foot is y = 48.18 + (7.95x). The separate formula for male and female individual gives more accurate results.

Calculated stature is almost close to the height of the individual; ±5 cm difference was observed in most of the individuals. The stature as per our study is approximately 7 times more than the length of the foot.

Key words: Stature, foot length, linear regression.

Introduction

Human height, weight, foot length are variables that differ among individual to individual, and among various ethnicities and races. Anthropometry is an age old study of systemized measuring techniques that express the dimensions of human body. The study of anthropometry has proven an increased significance in forensic medicine. Relation between different parts of the body with height has been of great importance,

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due to an increase in the number of catastrophic events leading to mass disasters. Identification of human beings for legal or humanitarian reasons are performed by various methods in which height constitutes a vital element particularly in those involving mutilated, decomposed or amputated bodies due to catastrophic events like bomb blast, earthquakes, terror attacks, mass accidents etc.

Vitruvius[1], says in his work on architecture that the measurements of human body are distributed by nature as follows, that is 4 fingers make 1 palm and 4 palms make 1 foot, 6 palms make 1 cubit and 4 cubits make a man's height. He used these measurements and concluded that man's outspread arms are equal to his height.

Height is an important factor in identification of the biological profile of an individual. Ruthishauser[2], for the first time showed that the reliability of prediction of height from foot length was as high as that from long bones, as ossification and maturation in foot occurs earlier than the long bones. The foot size along with the other anatomical structures of the body like the head, trunk and lengths of upper and lower limbs is assumed to influence a definitive biological correlation with stature.

Various authors, T.A. Philip 1990[3]; H. Ozden 2005[4]; ozasalan et. al., 2003[5] turks residing in Istanbul; sanli et. al., 2005[6]; grivas et. al., 2008[7] have made use of regression equation, has been found more reliable in estimating stature from foot dimensions.

Several studies conducted in India, O.P. Jasuja, 1987[8]; V K Sharma 1978[9]; agnihotri et. al. 2007[10]; krishan and Sharma 2007[11]; estimated foot length is a reliable indicator of stature.

The aim of the present study is to correlate the height of the individual from foot length in the specified population of Telangana. This study would also assist in development of a linear regression equation for the estimation of stature from foot length.

Materials and Methods:

A Cross sectional study on correlation of length of the foot in relation to the height of an individual was conducted in Medical students of Telangana region in the age group of 18 to 25 years, during the period of January 2019 to December 2019. A total of 150 individuals, 75 male and 75 female were taken as participants in this study. Foot length of right and left foot measured separately in male and female individuals. We took informed consent from the participants and the names of the participants were kept anonymous.

Inclusion and exclusion criteria: A healthy individual of normal skeletal growth and without any deformities were included in this study. Individual with genetic or hormonal abnormalities, nutritional disorders and skeletal abnormalities were excluded.

The instruments used in this study are vernier calipers, divider, scale, Tape, stadio-meter (Height stand) and weighing machine.

Measurements of the Body part, foot length was taken as distance between the heel and the longest toe centered by the line and measured by using vernier calipers.

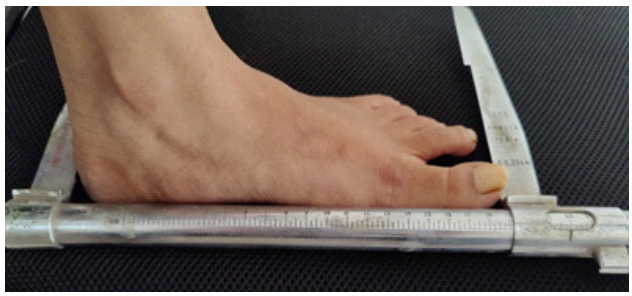

Figure 1: Measurement of foot length using vernier caliper.

Statistical Analysis

Analysis was done by descriptive statistics like mean standard deviation and range. Correlation coefficient and linear regression equations were used for estimating stature from foot length dimensions. P value< 0.05 was considered as statistically significant. The data was statistically analyzed using SPSS (version-25) software. The formulae for linear regression for estimating the height is y = a + (b x), (y = dependent variable (height). a = constant. b = independent variable coefficient. x = independent variable i.e. length of the foot).

Results

A cross sectional study on estimation of stature from foot length was conducted in Telangana region during the period from 1st January 2019 to 31st December 2019, the following results were found.

Table 1: Anthropometric measurement data for total population:

Anthropometric measurements(mean ± SD)	Men	Female	Total	P value
Ht(mean ± SD)	169.74 ± 7.14	156.80 ± 6.80	163.40 ± 9.51	<0.001
Weight (mean ± SD)	57.05 ± 10.49	50.42 ± 11.45	53.80 ± 11.43	<0.001
Rt foot length (mean ± SD)	24.93 ± 1.31	22.94 ± 1.25	23.96 ± 1.62	<0.001
Lt foot length (mean ± SD)	24.95 ± 1.31	22.92 ± 1.22	23.95 ± 1.62	<0.001

The mean height of total population in our study group is 163.40 ± 9.51. Length of right foot is 23.96 ± 1.62 and left foot length is 23.95 ± 1.62. For male population the right foot length is 24.93 ± 1.31 and the left foot length is 24.95 ± 1.31. For female population the right foot length is 22.94 ± 1.25 whereas the left foot length is 22.92 ± 1.22. Foot length is approximately 2 cm less in female population compared to male population, the p value less than 0.001 shows significance of the data.

Table 2: Prediction for total study population:

Independent Variables (Length)	Formula (y = a + bx)	R square	P value	Standard Error	95% Confidence Interval (CI)
Right Foot (cm)	y = 39.25 + 5.18 x	0.78	<0.001	0.22	4.73 – 5.62
Left Foot (cm)	y = 37.08 + 5.24 x	0.79	<0.001	0.21	4.81 – 5.67

Formula for linear regression: y = a + (b x) where y = Dependent variable (height); a = constant; b = Independent variable coefficient; x = Independent variable (length of the foot)

P value <0.01 is significant. R Square 0.78 for right foot and 0.79 for left foot, standard error 0.22 shows the data is more significant. 95% confidence interval within the range of 4.73-5.62 for right foot and 4.81 – 5.67 for left foot revealed that the results are almost accurate.

Table 3: Prediction for Male study population.

Independent Variables (Length)	Formula (y = a + bx)	R square	P value	Standard Error	95% Confidence Interval (CI)
Right Foot (cm)	y = 64.38 + (4.22 x)	0.60	<0.001	0.40	3.42 – 5.02
Left Foot (cm)	y = 62.23 +(4.30 x)	0.62	<0.001	0.38	3.53 – 5.08

Table 4: Prediction for Female study population

Independent Variables (Length)	Formula (y = a + bx)	R square	P value	Standard Error	95% Confidence Interval (CI)
Right Foot(cm)	y = 52.47 + (4.54x)	0.70	<0.001	0.35	3.84 – 5.24
Left Foot (cm)	y = 48.18 + (4.73x)	0.72	<0.001	0.34	4.04 – 5.42

Discussion

A cross sectional prospective study on estimation of stature from foot length conducted in Telangana region in the year 2019, in the age group of 18 to 25 years. Results are revealed that there is a significant correlation between foot length and stature. The linear regression formula developed from the above data collected in the region of Telangana is more appropriate in estimating the height of the individual

of this area.

The linear regression formula for entire study population y = a + (bx). For right foot the formula is y = 39.25 + 5.18 x and for left foot the formula is y = 37.08 + 5.24 x. The formula for male population for right foot is y = 64.38 + 4.22 x and for left foot is y = 62.23 + 4.30 x. The formula for female population for right foot is y = 52.47 + 4.54x and left foot is y = 48.18 + 7.95x. The separate formula for male and female individual gives more accurate results because the mean height difference for male and female population is about 13cm and the mean foot length difference of 2 cm was observed in study population. The stature as per our formula is approximately 7 times more than the length of the foot.

Study conducted by Potturi BR[12] in Telangana population in the year 2013 also found similar results.

Study conducted by Nath[13] et. al., in 1999 has derived a multiplication factor for estimation of stature from foot length in Srinagar and Garhwal, UP with reasonable accuracy. These were 6.87 for males and 6.73 for females. These results are almost similar to our study.

A study conducted in north Indian population by Jain[14] et. al., they formulated multiplication factor as 6.59 for reconstructing of stature in the age group of 17-20 years shows different results.

Conclusion

The present study has established definite correlation between stature and foot length. Linear regression formula derived from the data gave accurate results for estimating stature. A separate formula for male and female individuals provides more accurate results. Statures calculated with these equations are close to the normal height. ±5 cm difference was observed in the study group. The height of the individual is approximately 7 times the foot length. Several previous studies conducted in various parts of India and our present study establishes a correlation with foot length and height of the individual.

Conflict of interest: Nil

Ethical clearance: Yes

Source of funding: Self

References

1. Vitruvian Man-wikidoc.*VitruvianMan - wikidochttps://www.wikidoc.org › index.php › (accessed).*
2. Rutishauser IH. Prediction of height from foot length: Use of measurement in field surveys. Arch Dis Childhood 1968; 43(229):310.
3. T.A. Philip, Formulae for estimating stature from foot size by regression method, J. Ind. Acad. Forensic Med. 1990; 12: 57–62.
4. Ozden H, Y. Balci, C. Demirustu, A. Turgut, M. Ertugrul, Stature and sex estimate using foot and shoe dimensions, Forensic Sci Int. 2005; 147: 181–184.
5. Ozaslan A, Iscan MY, Ozaslan I, Tugcu H, Koc S. Estima-tion of stature from body parts. Forensic Sci Int. 2003; 132(1): 40-45.
6. Sanli SG, Kizikanat ED, Boyan N, Ozsahin ET, Bozkir MG, Soames R, Erol H, Oguz O. Stature estimation based on hand length and foot length. Clin Anat. 2005; 18(8): 589-96.
7. Grivas TB, Mihas C, Arapaki A, Vasiliadis E. Correlation of foot length with height and weight in school age children. J Forensic Leg Med. 2008; 15(2): 89-95.
8. O.P. Jasuja. Calculation of stature from foot and shoe impressions, PhD Dissertation, Punjabi University, Patiala, India, 1987.
9. V.K. Sharma, R.K. Garg, P.K. Chattopadhyay. Calculation of stature from foot measurements: a study of Gaur Brahmins, Coll. Antropol. 1978; 2: 194–195.
10. Agnihotri AK, Purwar B, Googoolye K, Agnihotri S, Jee-bun N. Estimation of stature by foot length. J Foren-sic Leg Med. 2007; 14(5): 279-83.
11. Krishan, A. Sharma. Estimation of stature from dimensions of hands and feet in a North Indian population. J. Clin. Forensic Med. 2007; 14: 327–332.
12. Babu, Deepika.V, Potturi.BR. Estimation Of Stature From Foot Length. International Journal of Pharmacy and Biological Sciences. 2013; 3(3):266-270.
13. Nath S, Kaur S, Jain P, Joshi PC. Reconstruction of stature among Rajputs and Brahmins of Srinagar Garhwal (U.P.). South Asian Anthropologist. 1999; 20(2): 63-66.
14. Jain P, Roy S, Nath S. Estimation of stature through measurements of hand and foot among female Jats of Delhi. Anthropologists. 1999;1(3):171-173.