



ESTIMATION OF STATURE FROM LEG LENGTH- A PROSPECTIVE REGIONAL STUDY IN WESTERN UTTAR PRADESH POPULATION

Sanjay Singh*, Dr. Md. Tabrej Alam and Rahul Rai

Department of Anatomy, Hind Institute of Medical Sciences, Mau Ataria, UP.

*Author for Correspondence: Sanjay Singh

Department of Anatomy, Hind Institute of Medical Sciences, Mau Ataria, UP.

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ABSTRACT

Introduction: Stature estimation is an important part of the identification process of human skeletal remains or body parts to establish individuality of an unidentified dead, body or any mutilated part of such body by the Medico-legal expert. **Aim:** The present study made an attempt to estimate the stature from leg length by formulating simple regression equation. **Method:** Subjects of 200 male and 200 female students of Teerthanker Mahaveer University Moradabad between the age group of 18-25 years was chosen. Leg length of right and left leg were measured with the help of flexible steel tape and stature was measured with the help of stadiometer. Stature was estimated from leg length statistically using simple regression analysis. **Result:** The mean of the right leg length for the male subjects was 89.55 ± 4.43 cm. and left leg was 89.58 ± 4.42 cm. The height was 168.13 ± 5.89 cm. for male. The mean of the right leg length for female subjects was 85.86 ± 3.96 cm. and left leg mean was 85.80 ± 4.03 cm. The height was 156.00 ± 5.61 cm. for female. The regression equation. For male was $Y = 4.93 + 0.50(168.13)$ and for female was $Y = 32.11 + 0.34(156.00)$. **Conclusion:** total leg length is important comparison of the population from different racial backgrounds, assessing growth, development of an individual and in diagnosis of any abnormalities in size and shape.

KEYWORDS: Stature, leg length, correlation coefficient, regression equation.

INTRODUCTION

The body shape of people may have a genetic basis, especially for human groups who have resided in the same environment for many generations. The general pattern of human body shape development is a species-specific characteristic. There are also biologically and statistically significant variations between human populations in body shape.^[1]

Personal identification means determination of individuality of persons. It may be complete (absolute) or incomplete (partial). Complete identification means absolute fixation of individuality of a person. Partial identification implies ascertainment of only some facts about the identity of the person while others still remains unknown. Age, sex and stature are the primary characteristics of identification. Stature is one of the various parameters of identification of a person. It is well known that there is a definite relationship between the height of the person and various parts of lower limbs. Assessing the height of an individual, from measurements of different parts, has always been of immense interest to the anatomists, anthropologists and forensic medicine experts^[2-3]

The mutilation of dead body is done intentionally by criminals who wants to destroy all traces of identity and

thus facilitates the disposal of dead in a country like India animals and vultures may attack a dead body and mutilate in a very short time when exposed in open fields.^[4] Estimation of stature is an important step in developing a biological profile for human identification. It may provide a valuable indicator for unknown individual in a population.^[5]

The development of the stature as a very sensitive trait depends on a number of factors such as sex, age, race, body composition, social stratum and secular trend. The proportions of its particular components (extremities, trunk) also reveal great variability in relation to the overall stature within a population and between populations.^[6-7] In this present study on leg length of 400 adult subjects (200 male and 200 female) was carried out to estimation stature of these individuals having from the western Uttar Pradesh region. This study looks into the possibility of estimation of stature from leg length in adult subject of western Uttar Pradesh region. in this study we use stadiometer to measure height of an individual and flexible tape to measure leg length the measurement of leg length were taken from both leg.

METHODS

After obtaining an institutional ethical clearance of TMMC & RC and informed consent from all the

subjects, a total no. of 400 students (200 males and 200 females) of Teerthanker Mahaveer University were examined for this study. Subjects taken for this study were studying in different college of Teerthanker Mahaveer University belongs to Western U.P region in India. The participant who volunteered in the study were healthy and without any abnormality like kyphosis, scoliosis, shortening of limb and any spinal disease. The sampling technique used for collection of data was by Simple random sampling. Source of data was the students of different colleges of Teerthanker Mahaveer University. A study subject was Male and Female students, 200 each, age range 18-25 yrs. The inclusion criteria was the Healthy adult males and females with the ability of stand erect for measurement of standing height, absence of any spinal and skeletal deformity of the limbs. The criteria for excluding the Individuals of Physical deformities that can effect body height or leg length. Students not of western UP region were also excluded. The equipments used in the study was stadiometer and flexible steel tape. Stature and leg length were measured for all the participants according to the standard anthropometric methods of the International Society for the Advancement of Kinanthropometry. Stature was measured to the nearest .1 centimeters (cm) in bare feet with the participants standing upright against a stadiometer. The respondent's head had to be in the Frankfort horizontal plane. The vertex was the highest point on their head, otherwise the respondents had to raise or lower their Chin until it was in the Frankfort horizontal plane to align their head properly. The subjects were said to stand erect with heel together and backs straight as possible so that his heels, buttocks, shoulders and the head touched the rod of stadiometer. The arms were hung freely by the sides. And asking the subject to take a deep breath and holding it, and take a reading from the stadiometer scale at his vertex point.

Measurement of leg length the leg length is the anthropometric measurement of the length from the tip of the anterior superior iliac spine to medial malleolus of both left and right leg. It was measured using a calibrated steel tape to the nearest (0.1 centimeters) in bare feet on a level concrete floor. The participants head was also in the Frankfort horizontal plane.

STATISTICAL ANALYSIS -The analysis was carried out using a computer based programmed. Mean and standard deviations were obtained for both anthropometric variables. The relationships between body height and Leg length were determined using simple correlation coefficients. Then a linear regression analysis was evaluated to examine the extent to which leg length can reliably predict body height. Finally, these relationships were plotted as scatter diagram. Statistical significance was set at $p < 0.05$.

RESULT

In the present study as mentioned in methods that measurement of stature and leg length were taken using direct physical procedure in 400 subjects (200 males and 200 females) of Western U.P region of Teerthanker Mahaveer University. Mean and Standard Deviation were calculated for each variable. Gender wise distribution of leg length and height was studied. Correlation of leg length with stature was also assessed. A summary of the anthropometric measurements in both genders is shown in table 5 The mean of the right leg length for the male subjects was 89.55 ± 4.43 cm. and left leg was 89.58 ± 4.42 cm. The height was 168.13 ± 5.89 cm .for male The mean of the right leg length for female subjects was 85.86 ± 3.96 cm. and left leg mean was 85.80 ± 4.03 cm. The height was 156.00 ± 5.61 cm. For female.

Table 1 : Descriptive statistics for Males.

Male	N	Range	Minimum (c.m.)	Maximum (c.m.)	Mean \pm SD
Stature	200	31	152	183	168.13 \pm 5.89
Right leg length	200	24	79	103	89.55 \pm 4.43
Left leg length	200	24	79	103	89.58 \pm 4.42

Table 2: Descriptive statistics for Females.

Female	N	Range	Minimum (c.m.)	Maximum (c.m.)	Mean \pm SD
Stature	200	40.5	143.5	184	156.00 \pm 5.61
Right leg length	200	20	76	96	85.86 \pm 3.96
Left leg length	200	21.9	74.1	96	85.80 \pm 4.03

- (Table 1 or Table 2 shows the mean and standard deviation of stature and leg length in male and female separately). Table 3 and Table 4 showed the regression statistics of males and females

Table 3: Regression Statistic of Males.

Regression	Statistics
Multiple R	0.67
R Square (%)	0.45
Adjusted R Square	0.44
Standard Error	3.29
Observations	200

Table 4: Regression Statistic of Females.

Regression Statistics	
Multiple R	0.48
R Square %	0.23
Adjusted R Square	0.23
Standard Error	3.46
Observations	200

The Multiple R and their 95% confidence interval analysis between the anthropometric measurements are presented in table no.5. It shows that the relationship between body height and leg length.

Table 5: Correlation between body height and leg length of the subjects.

Sex	Multiple R	Lower 95% confidence Interval	Upper 95% Confidence Interval
Male (n=200)	0.67	0.42	0.58
Female (n=200)	0.48	0.25	0.43

(The results of the linear regression analysis are shown in table 6 and in table 7 for male and female respectively. The high value of the regression coefficient shows that the leg length may clearly predict the body height in both sexes)

Table 6:- Equation for estimating stature from leg length in males.

Male	Coefficients	Standard Error	t Stat
Intercept	4.93	6.67	0.73
169	0.50	0.03	12.69

Table 7: The descriptive statistical equation for estimating stature from leg length in females.

Female	Coefficients	Standard error	t-stat
Intercept	43.08	9.42	4.57
146	0.74	0.06	12.31

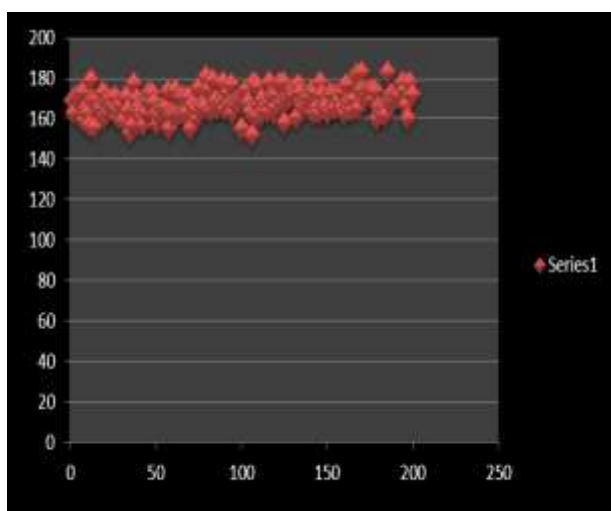


Fig. no: 1 Scatter diagram shows the relationship between total numbers of males and their stature.

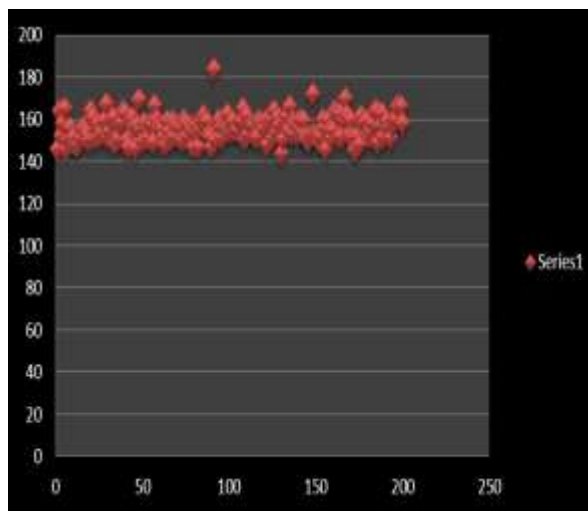


Fig.no: 2 Scatter diagram shows the relationship between total numbers of females and their stature.

We have used computer based programmed for our calculations and have considered a linear relationship between X and Y and as such have calculated a linear regression equation of the form $Y = A + BX$.

The linear regression equation derived from leg length for estimating height showed statically non significant relationship [$P > 0.05$] in both genders. In males the P-value is 2.53 which shows that the result is statistically non-significant. In females the P-value is 2.21 which shows that the result is statistically non-significant also. The formulae have been obtained by using the statistical equation in both male and female separately, and the formula is:

$$Y = A + BX$$

Where :- $Y =$ Value of stature,
 $A =$ value of constant
 $B =$ Regression Coefficient.

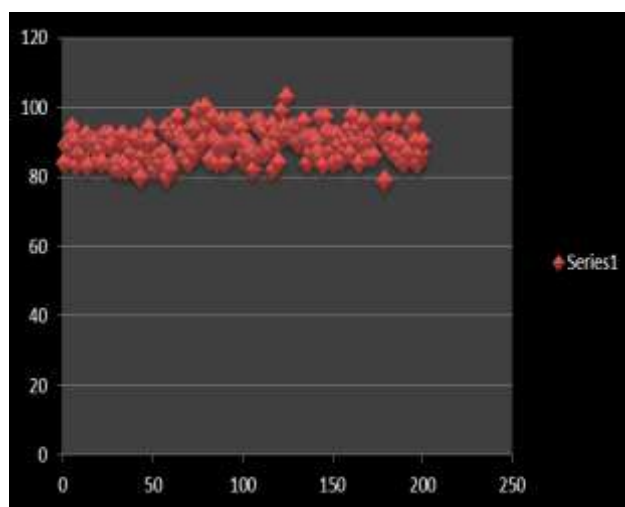


Fig.no. 3 :- Scatter diagram showing the relationship between the stature and leg length of right side in Males.

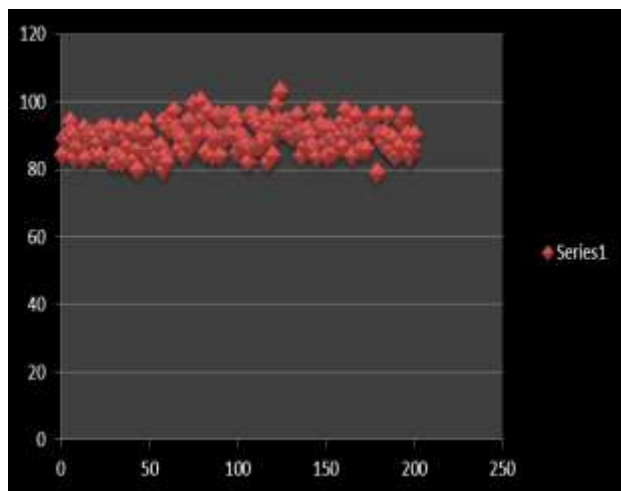


Fig. no. 4:- Scatter diagram showing the relationship between the stature and leg length of left side in Males.

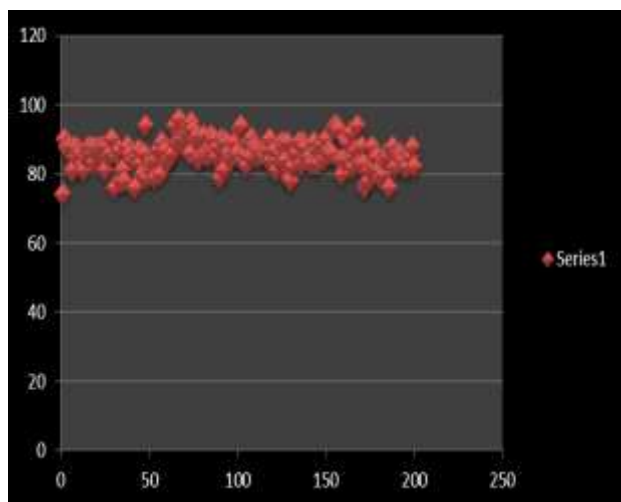


Fig.no. 5 :- Scatter diagram showing the relationship between the stature and leg length of right side in Females.

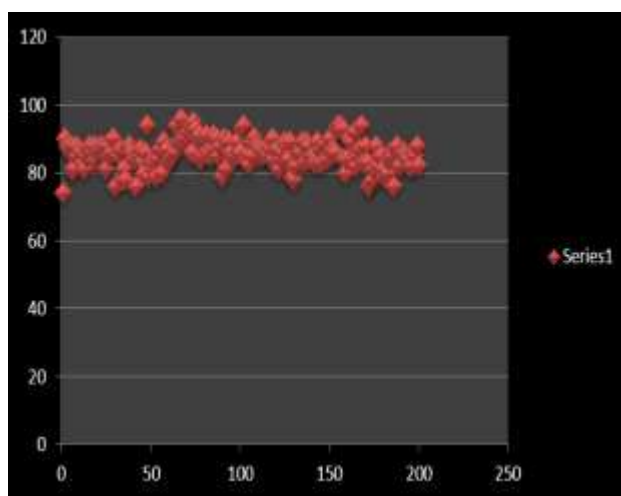


Fig. no. 6:- Scatter diagram showing the relationship between the stature and leg length of left side in Females.

DISCUSSION

Estimation of stature is an important parameter in medico-legal examination and also anthropological studies. Morphology of leg length helps in estimation of stature therefore the study was carried out to investigate the relationship between stature and leg length. The multiplication factor as calculated and the accuracy of the estimated height were checked by comparison with the actual stature. Similarity of results indicates that the leg length provides an accurate and reliable means for estimation of stature of mutilated body of an unknown individual.

In a study done by Bhavna and Surinder Nath concerning estimation of stature based on lower limb measurements on 503 Shia Muslim in age groups of 20-40 years of New Delhi. She presents the mean values (s.d.) and standard error of mean for all the five lower extremity measurements and stature among the male Shia Muslim. The mean stature was 167.66 cm and standard deviation (S.D.) was 5.69 for male and for female mean stature was 154.40 and standard deviation (S.D.) was 4.91. In the present study the mean stature is 168.13 and standard deviation (S.D.) 5.89 for male and for female mean stature is 156.00 and standard deviation (S.D.) is 5.46. The mean of male stature and female stature is highly correlated which is the study of Bhavna and S Nath.^[4]

A study was done by Mohanty S.P.^[8] on leg length and arm span as a predictor of height on South Indian women. This study was done on 505 healthy women. In this study the very good correlation between leg length and standing height. In this study standing height mean was 156.88 cm and standard deviation was 5.84 cm. And leg length was 77.53 cm and standard deviation was 3.94 cm. In present study height mean for female is 156.00 cm and standard deviation is 5.61 cm. In leg length mean is 85.80 cm and standard deviation is 4.03 cm. Present study is in good correlation with Mohanty S.P. study.

A study done by Koley S *et al.*^[9] on correlation of back strength with selected anthropometric traits in Guru Nanak Dev University in Amritsar. This study was done on 90 students (53 male and 47 female) aged 18-25 years. In this they use anthropometric traits height and leg length. In this study mean of height and standard deviation for height was 181.39 and 7.33 cm. For male and leg length mean and standard deviation for leg length is 106.92 and 8.67 cm. and for female height mean and SD was 162.30 and 5.83 cm. While leg length mean was 91.00 and SD was 3.81 cm. In present study mean and SD for height for male is 168.13 cm and 5.84 cm. and leg length mean and SD is 89.55 and 4.43 cm. While for female mean and SD for height is 156.00 and 5.61 and for leg length mean and SD is 85.80 and 4.03 cm.

A study was done to estimate stature based on lower limb dimensions in the Malaysian population done by Nor

F.M. et al^[10] of 100 subjects which include 69 males and 31 female between age ranges of 20 to 90 years old. In this study mean of height for male was 164.8 and standard deviation was 7.2 cm and for female mean for height was 152.60cm and standard deviation (S.D) was 6.3 cm and correlation coefficient for male 0.72 and for female correlation coefficient was 0.53. in present study the mean for height is 168.13 and (S.D) is 5.89 for male and for female mean for height is 156.00cm and (S.D) is 5.46 cm and correlation coefficient for male is 0.67 and for female it is 0.48cm. In this present study is less correlate with NOR. F.M study.

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