Journal of Advanced Medical and Dental Sciences Research

@Society of Scientific Research and Studies

Journal home page: www.jamdsr.com doi: 10.21276/jamdsr UGC approved journal no. 63854

(e) ISSN Online: 2321-9599; (p) ISSN Print: 2348-6805 SJIF (Impact factor) 2017= 6.261; Index Copernicus value 2016 = 76.77

Original Article

Estimation of Stature from Femur Length- A Forensic Study

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***ABSTRACT*:**
Background: Stature estimation forms a major domain of medico-legal investigations used in the identification of unknown fragmentary and mutilated remains. The present study was conducted to assess the stature of person from femur length. **Materials & Methods:** The present study was conducted on 140 subjects of both genders. Subjects were measured for femur length and stature was assessed in accordance with the standard measurement techniques recommended. All observations were recorded in centimetres (cm). **Results:** Out of 140 subjects, males were 80 (57.14%) and females were 60 (42.85%). The mean femur length on left side was 45.12 cm and on right side was 45.24 cm. A positive correlation was observed between the stature and the femur length and the correlation was highly significant ($p<0.05$). **Conclusion:** Determination of stature of human being through length of femur is quite interesting phenomenon. The present study revealed a positive correlation between femur, one of the long bones of the lower limb, with the stature.
Key words: Bones, Femur, Stature.

Received: 10 September 2018 Revised: 22 October 2018 Accepted: 25 October 2018

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This article may be cited as: Arora BS, Khan MW. Estimation of Stature from Femur Length- A Forensic Study. J Adv Med Dent Scie Res 2018;6(11):23-26.

INTRODUCTION

Stature estimation forms a major domain of medico-legal investigations used in the identification of unknown fragmentary and mutilated remains. A number of multiplication factors and regression equations have been developed to reconstruct stature from long bones throughout the world. Various long bones have been employed for stature estimation using variety of methodologies.[1]

Height of a person, which itself is a sum of the length of certain bones and appendages of the body represent certain relationship with form of proportions to the total stature. It takes a very important role both in anthropological research and identification necessitated by medico legal experts. Height estimation by measurement of various long bones has been attempted by several workers with variable degree of success. One exhaustive work was done by Pan for estimation of stature from long bones including tibia.[2]

However, long bones of lower limb contribute most to the standing height, hence, most predictive equations are based on length of lower limb. Existing equations given by western workers involves an error of 5 to 8% while doing the estimation of stature for Indian population. This is because variations in length of limb bones, relative to stature, have been observed according to race. Stature prediction from measurement of long bones with the help of correlational calculus was first introduced by Professor Pearson.[3] The present study was conducted to assess the stature of person from femur length.

MATERIALS & METHODS

The present study was conducted in the department of forensic medicine. It comprised of 140 subjects of both genders. All were informed regarding the study and written consent was obtained. Ethical clearance was obtained prior to the study.

General information such as name, age, gender etc. was recorded. Subjects were measured for femur length, in accordance with the standard measurement techniques recommended. All observations were recorded in centimetres (cm).

Stature (S): It was obtained as the vertical distance between the standing surface and the highest point on the head (vertex) when the subject was standing in the standard standing position, using anthropometer (stadiometer).

Femur Length (FEML): The measurement was obtained as the distance from the upper most point on the greater trochanter to the lower most point palpable on the lateral femoral condyle, using rod compass.

Results thus obtained were subjected to statistical analysis using chi- square test. P value less than 0.05 was considered significant (P< 0.05).

RESULTS

Table I Distribution of subjects

Male	Percentage	Female	Percentage
80	57.14	60	42.85

Table, I, Graph I shows that out of 140 subjects, males were 80 (57.14%) and females were 60 (42.85%).

Graph I

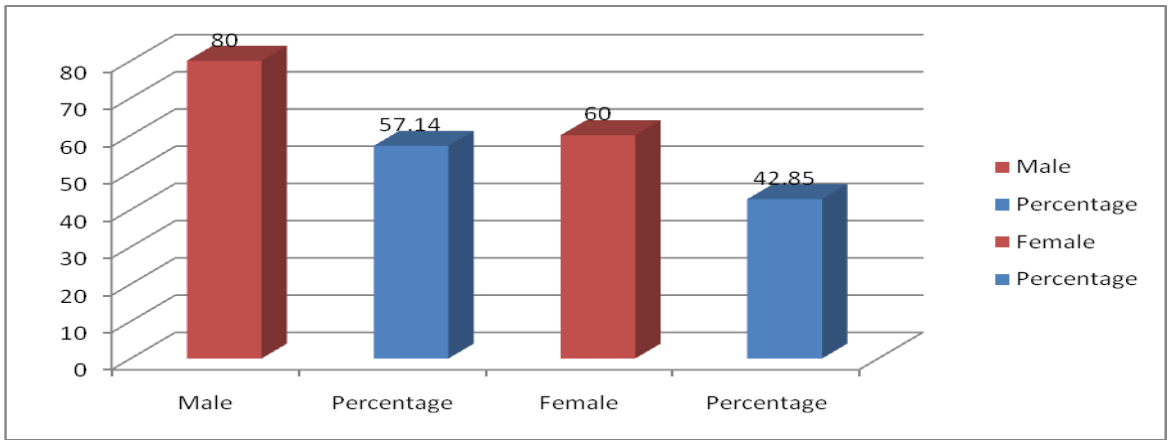

Table II Determination of femur length

Left		Right	
Mean	**SD**	**Mean**	**SD**
45.12	4.5	45.24	4.2

Table II shows that mean femur length on left side was 45.12 cm and on right side was 45.24 cm.

Graph II

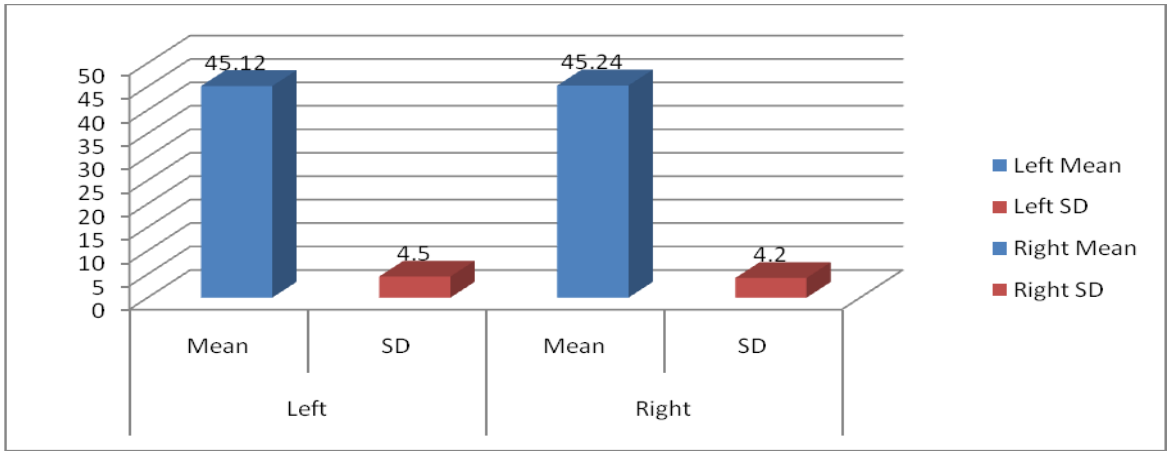

Table III Statistical regression analysis of the femur length with stature of population sample

	Right	Left
Slope	2.90	2.91
Intercept	38.15	38.19
SEE	3.17	3.28
Pearson correlation	0.82	0.85
P value	0.01	0.02

Table 3 depicts regression analysis and correlation of the percutaneous femur length with stature of the population sample studied. A positive correlation was observed between the stature and the femur length and the correlation was highly significant ($p<0.05$).

Table IV Regression equation for stature estimation from femur length

Regression equation	Left	Right
Value	Y= 38.92+ 2.94X	Y= 38.07+ 2.92X

Table IV shows regression equation for stature estimation from femur length. Y is stature of individual and X is length of femur.

DISCUSSION

Determination of stature of human being through length of femur is quite interesting phenomenon. Human bones just lie in the ground slowly degrading to atoms from which they were originally created, often the only reminder of past life. Height of a person, which itself is a sum of the length of certain bones and appendages of the body represent certain relationship with form of proportions to the total stature.[4]

In present study, out of 140 subjects, males were 80 (57.14%) and females were 60 (42.85%). Viqar et al[5] stated that stature is one of the important criteria for establishing identification of unknown person/dead body. Evaluation of stature is difficult in mutilated dead bodies which may be burnt or completely skeletonised. In this study on male subjects, stature was determined through the determination of percutaneous measurement of femur length. This study utilized simple linear regression and multiple regression analyses to estimate stature. Regression formulae and multiplication factors were developed for various combinations to reach the best estimate possible.

In our study, analysis and correlation of the percutaneous femur length with stature of the population sample studied. A positive correlation was observed between the stature and the femur length and the correlation was highly significant ($p<0.05$).

Trotter and Gleser's[5] found that considering the regression equations for Westerners, it was found that the application of Pearson's male formulae was not at all feasible for estimation of stature of this part of the country as it overestimated the stature by a wide margin of 36.24 cm, though its equation for females was quite close. This is quite in contrast to Trotter and Gleser's regression equation for Black Negroes whose formula for males overestimated the stature by only 0.84 cm and its formula for female underestimated stature by 1.27 cm.

Anirban et al[6] determined the measurements of tibial length and body height of total 518 cadavers between 23 to 75 years of age. The maximal tibial length was measured by oblique caliper. The supine length was measured by steel tape. A good correlation of stature was observed with tibial length and it was statistically highly significant. The regression equation for Eastern Indian males is S=71.2333+2.5792 T and that of Eastern Indian females is S = 65.345 + 2.6914 T. The difference between the estimated stature of males by application of the present regression equation and that of Nath[7] was much less (underestimation of 2.8202 cm and 0.2202 cm respectively). However for females, Nat did not offer any multiplying factor and applying the Pan's[8] factor and adjusting for the wet tibia, an underestimation of 3.27 cm was obtained. Thus, while Pan's factor for males closely followed the present regression estimations, which for females yielded a wider difference. Quite paradoxically, Trotter's and Gleser's regression equation for black negroes was the closest approximation (apart form the Pan's multiplication factor for male) of our regression equation and applicable for the population of Eastern India. In conclusion the author(s) opine that to calculate the stature of eastern Indian females, the present regression equation should be used.

CONCLUSION

Determination of stature of human being through length of femur is quite interesting phenomenon. The present study revealed a positive correlation between femur, one of the long bones of the lower limb, with the stature.

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Source of support: Nil **Conflict of interest:** None declared