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ORIGINAL RESEARCH

Estimation Of Stature From Length Of Femur In Adult Population Of Jammu And Kashmir

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ABSTRACT

Introduction: Stature estimation by analyzing skeletal remains or body parts is an essential part of human identification. One critical role of stature estimation today lies in the forensic identification of crime victims and missing persons. Femur, being the longest and strongest bone in the body, plays a crucial role while estimating stature of an individual. In this study, we tested a new approach to predict the stature of a person by measuring the femur length.

Material and methods: Our study was conducted on 200 medical students (100 males and 100 females) between age group of 18-25 years from Government Medical College, Jammu and Government Dental College, Jammu, with an aim of obtaining regression formulae for estimation of stature of males and females, from maximum femur length.

Results: It was observed that femur length showed statistically significant correlation with stature in both the groups ($p<0.001$). Regression equations specific to geographical (Jammu and Kashmir) population were statistically analyzed for femur lengths in males ($r=0.620$) and females ($r=0.602$) and significantly proved reliable in estimating the living stature of an individual.

Conclusion: In our study, the mean stature value of males was higher than that of females contributing to the inference that males are generally taller than females. Thus proving that length of femur can be used as a reliable predictor for estimating living height of an individual.

Keywords: Anthropometry, Femur Length, Human Identification, Stature etc

INTRODUCTION

Anthropometry has a prime role to play in the identification of human materials in the field of forensic anthropology. The estimation of stature from extremities forms an integral part in the process of identification of deceased individuals and it has been observed that dimensions from the lower extremity of the body have greater association with body height than those from the upper extremity (1).

Within specific population groups, the body ratios change over time due to changes in diet, lifestyle and socio-economic status. This means it is necessary to periodically verify equations viewing to fix height when alive (2). However, lack of up-to-date information on the population groups of South India makes estimation of stature from bones in this area

subject to possible error. It is essential to fill this lacuna in order to achieve more accuracy in stature estimation, which directly shall aid in achieving the goal of personal identification.
Femur invariably is one of the long bones that constitute greatest proportion of stature. Nevertheless, it plays a crucial role while estimating stature of an individual. Regression analysis is a more appropriated method to define relationships between length of long bones and living height of individuals, and between length of measurements of long bones fragments and their maximum length (3). This study aimed to obtain regression formulae for estimation of height of males and females, from maximum femur length, and to assess their validity in different stature categories- short, medium and tall.

MATERIAL AND METHODS

A sample of 200 medical students (100 males and 100 females) between age group of 18-25 years from Government Medical College, Jammu and Government Dental College, Jammu were taken. The objectives and methods of study were explained to the sample population and informed consent was obtained, by taking their signatures on a consent form. All measurements were taken at a fixed time of day to eliminate any diurnal variations. Apparently healthy and asymptomatic subjects were included. Subjects with physical deformities and/or having systemic illnesses affecting stature and lower limb bone measurements, and having age below 18 years and above 25 years, were excluded. Stature was measured when the subject stood barefoot and erect on a level platform against the Stadiometer bar with upper back, hips and heels touching the bar; while feet placed close to each other, arms hanging by the side and the head resting without any strain in eye-ear plane or Frankfurt's plane. The measurements were obtained as distance between the highest point on vertex and the platform of stadiometer. Femur length was measured when the subject stood erect with one leg placed slightly ahead of other leg, and foot partly inverted to relax the soft tissue. The measurement was obtained as distance from the uppermost point palpable on greater trochanter to the lowermost point palpable on the lateral femoral condyle.

STATISTICAL ANALYSIS

The data obtained was analyzed using SPSS 18 software as follows: unpaired and paired t-tests, linear regression analysis and ANOVA. Regression formulae were obtained separately for male and female group. Pearson's correlation coefficient and standard error of estimate were obtained.

RESULTS

The study group included 100 males and 100 females, aged above 18 years and below 25 years. The mean age differences between the sexes were statistically insignificant. The mean stature value in males being 168.27±5.384 cm and in females it was 160.43±4.813cm, with statistically significant difference ($p<0.001$).

Table 1: Descriptive statistics of stature and lower limb dimensions on right and left side in male subjects.

	Mean	SD	Range	Min.	Max.	95% confidence interval
Stature	168.27	5.384	21.5	159.0	180.5	167.21-169.32
Right Femur Length	41. 219	2.779	11.6	36.1	47.7	40.674- 41.764
Left Femur Length	41.176	2.795	11.22	35.9	47.1	40.628-41.724

Table 2: Descriptive statistics of stature and lower limb dimensions on right and left side in female subjects.

	Mean	SD	Range	Min.	Max.	95% confidence interval
Stature	160.43	4.813	22.0	149.0	171.0	159.48- 161.37
Right Femur Length	39.986	2.781	10.9	34.1	45.0	39.441- 40.531
Left Femur Length	40.073	2.884	11.5	34.0	45.5	39.508-40.638

The mean femur length in males on right side was 41.219 ± 2.779 cm whereas on left side it was 41.176 ± 2.795 and in females the mean length on right side was 39.986 ± 2.781whereas on left side it was 40.073 ± 2.884 cm with statistically significant difference (p=0.0001).

Table 3: Showing correlation between stature and lower limb dimensions in male and female subjects.

	Pearson correlation coefficient	Sig. (2-tailed)
Right femur length in males	0.553	0.000*
Left femur length in males	0.620	0.000*
Right femur length in males	0.602	0.000*
Left femur length in males	0.599	0.000*

*: correlation is significant at the 0.01 level (2-tailed)

Pearson's correlation coefficient between stature and femur length in males and females showed that femur length is statistically significant in correlation with stature in both the groups.

DISCUSSION

The Stature of an individual is an inherent characteristic; its estimation is considered to be an important assessment in human identification. Stature provides insight into various features of a population including nutrition, health and genetics; geographical location, environment and climatic condition. Forensic anthropologists have taken interest since long in determining the heights of individuals from dimensions of bones. Identification becomes necessary in the living, recently dead persons, decomposed bodies, mutilated and skeletal remains and is required in civil and criminal cases. Many studies have been conducted on the estimation of stature from the human skeleton/ Percutaneous measurements. There are various methods of estimating Stature but the easiest and reliable method is by regression analysis.

The present study was done to find out any correlation between Stature and lengths of lower limb bones (viz. Femur) and formulate a regression-equation depicting the same. The study, base was chosen as 200 medical students (100 male and 100 female of Govt. Medical College Jammu, in age range of 18 to 25 yrs, who were born and brought up in the Jammu and Kashmir state. This age group was chosen, as the person gains maximum stature at 20 yrs of age and senile changes affecting the stature occur after 30 yrs of age.

As it is not always possible to measure all the variables, so it is useful to have separate regression equations available for each variable. The predictive function was derived through linear and multiple regression equations, from each parameter of both males and females separately. The Regression equations and 'r' values thus obtained were analysed in relation with corresponding values obtained in various studies are presented in following tables.

Table.4: Relation between Stature (S) and Femur Length (FL) in Males

S. No	Population/Region	Author	Regression Equation	'r' value
1	Punjabi/Amritsar	Kate & Majumdar	S=52.02+2.59(FL)	-

		(7)		
2	Maharashtrians/Nagpur	Kate & Majumdar (7)	S=51.25+2.59(FL)	-
3	Muslims / Delhi	Bhavna & Nath (8)	S=77.99+2.15(FL)	0.743
4	North Indian Population/ Ambala	Viqar & Khanna (9)	S=39.05+2.95(FL)	-
5	Nepali population/Dhulikhel	Karki et al. (10)	S= 75.51+2.13(FL)	0.723
6.	Ghanaians/ Ghana	Tetteh et al. (11)	S=85.174 +1.996(FL)	0.727
7.	North-West Indians/ Haryana	Chawla et al. (12)	S= 158.211+0.652(FL)	0.342
9	GMC jammu	Present Study	S=124.13+1.207(RFL)=4.1 5 S=119.07+1.20(LFL)=4.25	0.553 0.620

Table 4. Presents a comparative account between various studies done for estimation of stature from Femur length in males. A positive correlation is evident between Femur length and Stature in all the studies, and ranges between 0.342 and 0.743. The value of coefficient of correlation between stature and Femur length in our study was found to be 0.533 on right side Femur and 0.620 on left side femur. The correlation coefficient derived in the current study was more or less ranging near the above mentioned studies with slight deviation towards right and this difference could be attributed to different genetic and environmental factors.

Table 5: Relation between Stature (S) and Femur length (FL) in females

S.NO	Population	Author	Regression Equation	'r' value
1	Punjabi/ Amritsar	Kate & Mujumdar (7)	S=50.34+2.60(FL)	-
2	Maharashtrians/Nagpur	Kate& Mujumdar (7)	S= 51.25+2.59(FL)	-
3	Nepali population/Dhulikhel	Karki et al. (10)	S=55.238+2.581(FL)	0.869
4.	Ghanaians/ Ghana	Tetteh et al. (11)	S=124.98+0.857(FL)	0.342
5.	North-West Indians/ Haryana	Chawla et al. (12)	S=107.977+2.288(FL)	0.626
6.	GMC/ Jammu	Present study	S=118.74+1.04(RF)L=3.86	0.602
			120.35+1.00(LFL)=3.87	0.599

Table5. Presents a comparative account between various studies done for estimation of stature from Femur length in females. A positive correlation is seen wherein the value of correlation coefficient ranges between 0.342 and 0.869. The value of correlation coefficient derived in our study was found out to be 0.602 on right side femur and 0.599 on left side femur. The correlation coefficient quoted by Tetteh et al. (11) is quite low as compared to the afore mentioned study which can be attributed to the ethnic, racial, environmental, genetic and geographical factors. Further, Karki et al (10) also reported way too high correlation coefficient.

CONCLUSION

Estimation of stature is a major forensic and anthropological concern used in the personal identification from human remains. The procedure to estimate body height is to use its components. Accuracy of measurements becomes more reliable when the parts used are situated along the long axis of body such as the length of Femur. The present study takes this into consideration and uses similar measurements from living people.

The results thus concluded are summarized as follow:-

- Males, on an average exhibit greater dimensions than females, with respect to all the measurements of length femur and Stature.
- The t-test reveals highly significant sex difference for all the measurements, including Stature.
- In Males, left Femur exhibits the highest correlation (r=0.620), with Stature.
- In Females, right Femur exhibits the highest correlation (r=0.602), with Stature.
- The Regression equations derived for the sample population show significant differences from those derived for other populations. The values of intercept and slope derived in our study for all the variables are different from those derived in other studies.
- This indicates that on a macro level, the population trends are similar for a broader region with similarities in environment, diets and core genetics, albeit being significantly and erroneously different for an individual population on a micro level.
- So, the equations or multiplication factors should be formulated for an individual or a small group level, and further they must be revised, so as to account for various ongoing changes.

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