

## Stature Estimation by Radiological Length of Femur in Adult Male of Jaipur

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### Abstract

**Background:** Body Stature is defined as height of the body in upright position and is an inherent character, so considered as one of the important parameters of personal identification. To know stature of individual, length of long bones is needed and use of more than one long bone gives accurate result.

**Aims & objective:** Stature Estimation By Radiological Length Of Femur In Adult Male Of Jaipur.

**Material & methodology:** A cross sectional analytical type observational study that used inclusion and exclusion criteria was conducted. 30 males were taken in the study whose radiological measurement of femur length was conducted by X-ray imaging of right femur bone. The present study had been conducted in Department of Forensic Medicine in association with Department of Radiology, SMS Medical College and Attached Hospitals, Jaipur.

**Result & observation:** In current study majority of subject having height ranging from 166 cm - 175 cm (Medium Stature ) with a mean height of 170.43 cm with a standard deviation of  $\pm 8.14$ . The mean height in short stature male is  $160.37 \pm 3.81$  cm, the mean height in Medium stature male is  $170.96 \pm 3.20$  cm and the mean height in Tall stature male is  $181 \text{ cm} \pm 3.65$  cm. Majority of male subjects had femur length ranging from 44.1 cm - 46.0 cm with a mean femur length of 46.39 cm with a standard deviation of  $\pm 2.71$ . The regression formula for male of native population of Jaipur is  $y = 2.8744x + 36.189$ .

**Conclusion:** There is a positive correlation between stature and femur length in male native population of Jaipur.

**Key word:** Stature, Femur Length, Radiological, X- ray , Regression Formula.

### Introduction

Body Stature is defined as height of the body in upright position and is an inherent character, so considered as one of the important parameters of personal Identification.<sup>1</sup> Anthropometric characteristic have direct relationship with sex, shape and form of an individual and these factors

are closely linked with each other and manifestation of internal structure and tissue components which in turn are influenced by environmental and genetic factors.<sup>2</sup> Establishment of stature plays an important role in the determination of identity of deceased person. To know stature of individual, length of long bones is needed and use of more than one long bone gives accurate result.<sup>3</sup> From the results of previous

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studies it can be concluded that femur in the intact state is one of the bones with highest correlation with stature and It has also been shown to yield the best accuracy in the estimation of stature for any unidentified skeletal element.<sup>4</sup>After exhaustive literature search, it was found that no documented study on estimation of stature from radiological length of femur has been conducted in Jaipur city. So, this study was planned to obtain the statistical data of stature and radiological length of femur in individuals of Jaipur region and to determine their correlation for application in calculation of stature in skeletal remains with availability of intact femur.

### Aim & objectives

Study was conducted to correlate stature to Radiological Length of Femur among adult population of Jaipur city.

### Materials & Method

All the patients coming in OPD, Department of

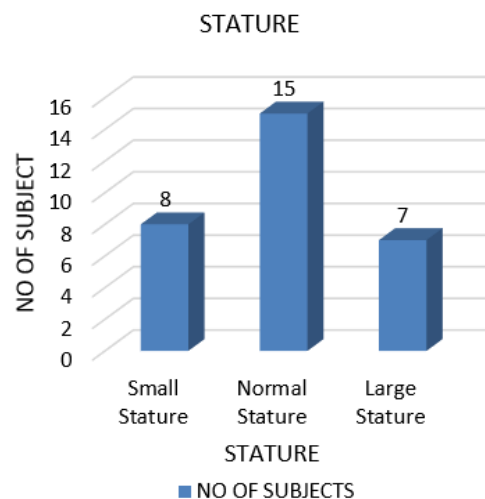
Forensic Medicine, SMS Medical College and Attached Group of Hospitals, Jaipur, between age group of 20 to 49 years, domicile of Jaipur and who gave written informed consent for participation in the study were included in the cross – sectional analytical type observational study. We excluded cases of Chronic illness and with bony disease. Sample Size Of 30 Cases was Required At 80% Study Power & Alpha Error 0.05 Assuming Pearson's Correlation Coefficient Of 0.880 Between Femur Length & Stature In Male. Radiological measurement of femur length was conducted by X-ray imaging of right femur bone. The true maximum length of femur was measured on the AP view of the X-ray digital image as the maximum distance from the uppermost margin of the head of the femur to the lowest margin of the medial condyle.<sup>3</sup>All data was collected as per pre proposed pro forma and was entered in Microsoft excel sheet using which it was tabulated to obtained inferences and statistical analysis was done.

### Observations and Results

**Table 1: Distribution of Subjects According to Stature**

Class	Height (cm)	No. Of Subjects	Percentage	Mean Height (cm)
1	Short Stature (< 165 cm)	08	26.67 %	160.37 ± 3.81
2	Medium Stature (166 -175 cm)	15	50 %	170.96 ± 3.20
3	Tall Stature (>175 cm)	07	23.33 %	181.00 ± 3.65
	Total	30	100%	170.43± 8.14

The study participants were distributed into three categories on the basis of their Stature / Height – For males the medium stature range was considered as 166 -175 cm and those with height < 165 cm were categorised as Short Stature and remaining with height > 175 cm were categorized as Tall Stature. In current study majority of subject having height ranging from 166 cm – 175 cm (Medium Stature ) with a mean height of 170.43 cm with a standard deviation of ± 8.14. The mean height in short stature male is 160.375 ± 3.81 cm, the mean height in medium stature male is 170.96 ± 3.20 cm and the mean height in Tall stature male is 181 cm ± 3.65 cm.

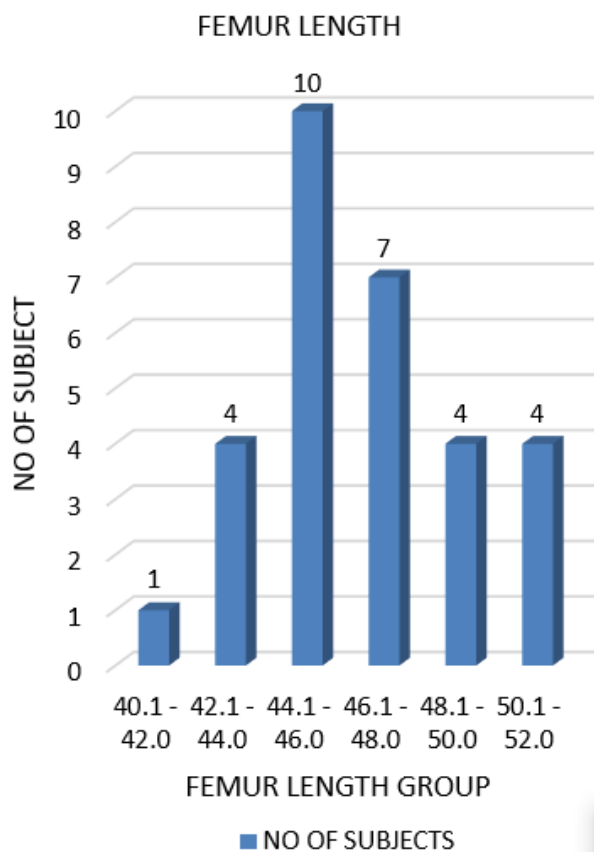


**Figure 1: Distribution of Subjects According to Height in Male**

**Table 2: Distribution Of Subjects According To Femur Length In Male**

Class	Femur Length (cm)	No. Of Subjects	Percentage
1	40.1 - 42.0	01	03.33 %
2	42.1 - 44.0	04	13.33 %
3	44.1 - 46.0	10	33.33 %
4	46.1 - 48.0	07	23.33 %
5	48.1 - 50.0	04	13.33 %
6	50.1 - 52.0	04	13.33 %
	Total	30	100%

The range of femur length for male study subjects was found to vary between 40 cm to 52 cm in the present study which was further categorised into groups of 2 cm each and number of study subjects in each group was found. Majority of male subjects had femur length ranging from 44.1 cm - 46.0 cm with a mean femur length of 44.38929 cm with a standard deviation of  $\pm 2.707438$ .

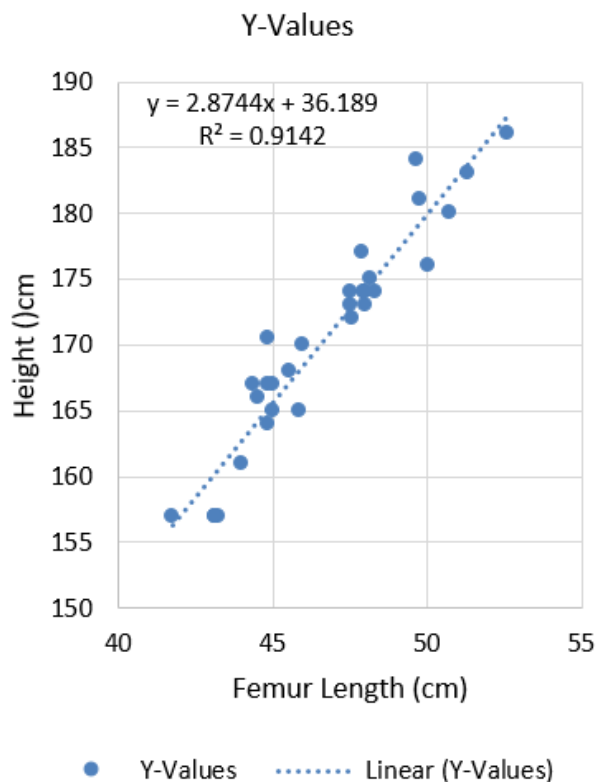


**Figure 2: Distribution Of Subjects According To Femur Length In Male**

**Table 3: Distribution Of Subject According to Stature and Mean FemurLength in Male**

Class	Stature	Mean Femur Length (cm)
1	Short Stature (< 165 cm)	43.89 $\pm$ 1.315
2	Medium Stature (166 -175 cm)	46.55 $\pm$ 1.541
3	Tall Stature (>175 cm)	50.3 $\pm$ 1.474

According to Stature and Mean FemurLength in Male



**Figure 3: Regression Formula For Males.**

$$y = 2.8744x + 36.189 \quad R^2 = 0.9142$$

$$y = \text{Stature}, \quad x = \text{Femur Length}$$

**Table 4: Regression Formula in Different Sub Groups**

Category	Regression Formula	R Value	R <sup>2</sup> Value
Male	2.8744x + 36.189	0.956	0.9142
Short Stature Male	2.6654x + 43.391	0.918	0.8443
Medium Stature Male	1.9669x + 79.392	0.944	0.8918
Tall Stature Male	1.6975x + 95.614	0.685	0.4698

The R values of all categories was positive and  $> 0.5$  which show that the height of an individual bears a strong positive correlation with the length of Femur. The  $R^2$  value is near to 1 for study participants cumulative & also for male & females which indicates that Femur Length is a good predictor of Stature in study population

### Discussion

The present study revealed a positive correlation between femur length and height of the study subjects for males, it is variable for studies and the regression equation for determining stature from femur length were calculated for male. In the present study linear regression equation was derived  $2.8744x + 36.189$ . The  $R^2$  value in the present study 0.9142 indicates that the femur length in the present study is an effective predictor of stature for the study population.

In the present study the mean Male Height of the study population study was  $170.43 \pm 8.14$  cm. The mean height of native male study population of Jaipur was smaller to **Viqar A, et al. (2018), Mullana<sup>5</sup>** (173.89 cm) and **Erkman, et al. (2021), Antonian Population<sup>8</sup>**(173.54 cm) and comparable to **Shobha, et al. (2019), South India<sup>6</sup>** (170.22 cm); **Mulenga C, et al., (2019), Zambia<sup>7</sup>**(171.6 cm). The mean Height of Male in population of Rajasthan is comparable to other southern parts of country and lower than other parts of world which is attributable to the difference in study population & region. Also these differences occur due to the variations in the study population in the various studies as there is no common selection criteria for selection of study subjects in these different studies. Thus although there is a notable difference in mean stature of various population; yet the chance variation in selected study subject may yield variable results. As different studies are conducted on different populations, many variable may not be comparable in all cases.

In the present study the mean Male Femur Length of the study population study was  $44.38929 \pm 2.707438$  cm. The mean Male Femur Length in study population of Jaipur was slightly smaller to **Viqar A, et al. (2018), Mullana<sup>5</sup>** (45.75 cm) and **Shobha, et al. (2019), South India<sup>6</sup>** (45.732 cm), much smaller to **Erkman, et al. (2021), Antonian Population<sup>8</sup>**(47.89) and slightly higher to **Mulenga C, et al., (2019), Zambia<sup>7</sup>**(44.20 cm).

### Regression formula for Male in Different Studies

Study	Regression Formula
Viqar A, et al. (2018), Mullana	Height = $2.950 \times$ Femur Length + 38.940
Shobha, et al. (2019), South India	Height = $2.510 \times$ Femur Length + 55.160
Mulenga C, et al., (2019), Zambia	Height = $2.610 \times$ Femur Length + 44.201
Erkman, et al. (2021), Antonian Population	Height = $2.049 \times$ Femur Length + 75.424
Present Study	Height = $2.8744 \times$ Femur Length + 36.189

### Conclusion

The present study establishes a positive correlation between stature and femur length in male native population of Jaipur. The regression equation have been derived for males thus indicating that femur length can be a prediction of stature or height in males native population of Jaipur.

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**Ethical approval:** From the institutional ethical committee.

**Conflict of interest:** Nil

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