Original Research

Estimation of Stature from Length of Body of Sternum-An Autopsy Based Study

KJM Karthikeyan[1a], Punitha R,[2b] Jagadeesh NH[2b]

Abstract

Estimation of stature is one of the important initial steps during forensic examination of human skeletal remains. Stature reconstruction is important as it provides a forensic anthropological estimate of the person's height in the living state, thus playing a vital role in the identification of individuals. Stature is the natural height of the person in an upright position. The anthropologists and the forensic experts have given much importance to the various methods of estimating stature. Until recent past, there has been no reliable method for estimation of stature based on measurements of the sternum. Hence there is a need to derive a linear regression formula for estimating stature of males and females based on the sternal length.

Key words:Sternum; Stature; Anthropology.

Introduction:

Estimation of stature is one of the important initial steps during forensic examination of human skeletal remains. Stature is the natural height of the person in an upright position.[1] Forensic anthropology is usually defined as the application of the science of physical anthropology to the legal process. The anthropologists and the forensic experts have given much importance to the various methods of estimating stature. Forensic anthropology may be extremely helpful in mass disasters, military casualties with considerable skeletal remains or in cases of mass burials. The possibility of using bones other than the long bones have to be explored for predicting stature. The length of the long bones such as femur, tibia, humerus and short bones such as clavicle, radius and ulna are being consistently used for estimation of stature. Sternum is one of the bones that could be used to determine stature, when skeletal remains are recovered without the limbs being present.

[1] Assistant Professor, [2] Associate Professor, Department of Forensic Medicine and Toxicology, [a]KAPV Government Medical College, Tiruchirapalli, [b]Rajarajeshwari Medical College and hospital, Bangalore.
Correspondence:Dr.Punitha R
Email id- punitharaju@yahoo.com
Cell- +91 8971680099

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Objective: To estimate the stature of males based on the sternal length

Materials and methods:

The data for the particular study is collected from the Medico-legal autopsy cases conducted at a post graduate institute. The age of the individuals autopsied was retrieved from the inquest documents furnished by the Police and confirmed on interviewing the legal heirs. A total of 100 cases were studied.

Inclusion criteria: Males aged more than 1 year and less than 45 years is taken as the study material

Exclusion criteria:

1) The bodies with acquired or congenital physical deformities affecting the

measurement of stature were excluded from the present study.
2) The bodies with deformities of the chest wall affecting the measurement of the length of sternum were excluded from the study.
3) Sternums with ossified proximal end of the Xiphoid process were not included in the study.
4) Subjects less than 1 year of age and female gender were also not included in the study.

Results:

The present study is an observational correlation study on autopsied cases of 100 males aged more than 01 year and less than 45 years. The cases for the study were selected based on the objectives of the study that have been highlighted in the inclusion and exclusion criteria. The present study was undertaken to assess the correlation between length of sternum and stature and to derive a linear regression equation for stature estimation.

The study witnessed the wide range of age groups. The youngest autopsied cases in our study, being 6 years of age and the oldest case was of 43 years of age. Most of the cases belonged to the age group of 21-30 years (48.0%) followed by 31-40 years (30.0%). (Table 1) The present study was that only 04 individuals belonged to high socio-economic status, 47 individuals belonged to middle class and 49 individuals belonged to lower class. (Table 2) In 89 cases (89%) have their sternal body lengths ranging from 10.1 cm-15.0 cm followed by 11 cases (11%) with their sternal body lengths ranging from 5.1cm - 10.0cm. (Table 3) 54 cases (54%) have their stature ranging from 161.0 cm-170.0 cm followed by 28 cases (28%) with their stature ranging from 171.0 cm-180.0 cm and the least where 01 case (01%) had his stature more than 180.0 cm. (Table 4)

The linear regression equation devised for the estimation of stature from length of body of sternum was;

Table 1: Age distribution of patients studied

Age in years	No. of patients	%
1-10 years	3	3.0
11-20 years	17	17.0
21-30 years	48	48.0
31-40 years	30	30.0
41-45 years	2	2.0
Total	100	100.0

Table 2: Socio economic status

Socio economic status	No. of patients	%
Lower Class	49	49.0
Middle Class	47	47.0
Upper Class	4	4.0
Total	100	100.0

Stature=41.05+11.83*BL (Body length). (Table 5)

Statistical Methods: Descriptive and inferential statistical analysis has been carried out in the present study. Pearlson correlation between study variables is performed to find the degree of relationship and regression analysis to predict the Stature using body length. Statistical software: The Statistical software namely SAS 9.2, SPSS 15.0, Stata 10.1, MedCalc 9.0.1, Systat 12.0 and R environment ver.2.11.1 were used for the analysis of the data.

Discussion:

Identification of human remains is of paramount importance in forensic practice.[2] The probabilities and possibilities of apprehending a criminal are greatly increased once the identity of the victim has been established. With the increasing frequency of mass disasters, estimation of stature from fragmented and dismembered human remains has created problems in the investigation of the identity of some of the victims. Most methods of estimating stature from the skeleton are based on the long bones of the lower and upper extremities.

In the South Indian male population, linear regression equations to estimate stature from various parameters like the vertebral column length, hand dimensions, middle finger length and the coronal suture length are studied in the recent past. Nagesh and Kumar estimated stature of South Indian males from the vertebral column length.[3] Rastogi estimated stature of South Indian males from hand dimensions and the middle finger length.[4] Rao attempted to estimate stature of South Indian males from the length of cranial sutures.[5] Dwight's study, in the late 19th century, the sternum has received very little attention as a means to estimate stature from skeletal remains.[6] The very fact that linear regression equations to estimate stature from the length of the sternum are not available for the South Indian male population, underlines the importance of the present study.

In our study wherein stature is estimated from the length of body of sternum. In our study comprising of males aged above 01 year and below 45 years, the mean (±S.D) calculated for the length of body of sternum was 10.55±0.96 cm and the mean(±S.D). The mean(±S.D) calculated for the stature was 165.82±11.52 cm. In comparison with other recent studies done in South Indian males, wherein Nagesh and Kumar reported 166.01±6.90cm, Rastogi reported 171.95±7.05cm and Rao reported 166.83±6.74cm. The slight increase of variability in our study compared to others can be explained due to the fact that 20 cases belonged to age group less than 20 years out of which 03 cases are less than 10 years and 17 cases between 11-20 years of age.[3, 4, 5] Whereas in other studies the cases taken up for their respective studies were purely of adult male population and also the observations were made from dry sternum rather than fresh ones which were taken up for our study.

The length of the sternum showed better correlation coefficient than hand breadth, coronal suture length and sagittal suture length while estimating stature in South Indian males. Rastogi reported a correlation coefficient of 0.594 and 0.592 while estimating stature from right hand breadth and left hand breadth, respectively, in South Indian males.[4] The observation of the present study that sternal lengths have a significant positive correlation with stature corresponds to that reported by other researchers from India.[7,8] On overall comparison, the correlation coefficient of stature and length of sternum is significantly higher than in other studies. The P value for stature calculated from mesosternal length were found to be <0.001 indicating strong positive significance.

Conclusion: Stature is an important parameter in determining the partial identity of mutilated bodies and skeletal remains. In our study, the length of the sternum was found to be well correlated to stature in males. The present study concludes that the sternum can be a useful tool in the estimation of stature. Our study indicates that stature can be predicted from the sternal length by linear regression analysis.

Conflict of Interest: None

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Table 3: Length of body of sternum (BL) in cm according to age in years

Length of body of sternum (BL) in cm	Age in years					Total
	1-10 years	11-20 years	21-30 years	31-40 years	41-45 years	
1-5	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)
5.1-10	3(100%)	0(0%)	3(6.3%)	5(16.7%)	0(0%)	11(11%)
10.1-15	0(0%)	17(100%)	45(93.8%)	25(83.3%)	2(100%)	89(89%)
Total	3(100%)	17(100%)	48(100%)	30(100%)	2(100%)	100(100%)

Table 4: Stature (S) in cm according to age in years

Stature (S) in cm	Age in years					Total
	1-10 years	11-20 years	21-30 years	31-40 years	41-45 years	
100-150	3(100%)	0(0%)	0(0%)	1(3.3%)	0(0%)	4(4%)
151-160	0(0%)	0(0%)	4(8.3%)	9(30%)	0(0%)	13(13%)
161-170	0(0%)	14(82.4%)	22(45.8%)	16(53.3%)	2(100%)	54(54%)
171-180	0(0%)	3(17.6%)	21(43.8%)	4(13.3%)	0(0%)	28(28%)
>180	0(0%)	0(0%)	1(2.1%)	0(0%)	0(0%)	1(1%)
Total	3(100%)	17(100%)	48(100%)	30(100%)	2(100%)	100(100%)

Table 5: Pearlson correlation of stature with Length of body of sternum (BL) in cm

Pair	r value	P value
Stature (S) in cm vs Length of body of sternum (BL) in cm	0.982	<0.001**

** Strongly significant (P value: P≤0.01)