

# Correlation between Ages of Estimated and Observed Age of Fusion of Sternum Bone

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## Abstract

**Objectives:** This article documents the correlation between age of estimated and observed age of fusion of sternum bone, particularly when evaluating skeletonised human remains.

**Methods:** Soft tissues removed from the macerated sterna by blunt dissection and the findings in xiphisternal ending recorded.

**Results:** On statistical analysis for correlation between actual and estimated age correlation coefficient is 0.908 and p-value is 0.0001 that is statistically significant.

**Conclusion:** The correlation results indicate that there is statistically insignificant difference between the actual age of the subject and estimated age from fusion of sternal joints. None of studies assesses on determination of age from sternum has compared actual age of the individuals with estimated age devised from Sternal samples.

**Keywords:** Xiphisternum • Sternum • Mesosternum • Manubrium sterni • Morphological variation

## Introduction

During development age is typically estimated via assessment of the appearance, changing morphology, and fusion of ossification centers. Once adulthood is reached age estimation becomes more challenging but is still possible from a variety of joint areas throughout the skeleton including the pubic symphysis, auricular surface, cranial sutures, and sternal rib ends. This form of age assessment relies on the degenerative changes that occur at these areas of the skeleton and is less precise than age estimation in the juvenile [1]. Thus due to the progressive development of bones, aging of skeletons under the age of 25 can be more easily accomplished utilizing the order of epiphyseal fusion in the long bones [2]. Post-maturations, the adult skeleton is constantly degenerating. These degenerative changes are not as easily or as well documented as developmental changes; they can be influenced by factors including habitual activities and the health of an individual in addition to their age [3].

When estimating age, researchers assess a variety of developmental factors such as the analysis of suture closure for estimating age has been frequently utilized [4]. The fusion of cranial bones progressively with age has been in existence since at least the 16th century [5]. However, this fusion of cranial sutures is considerably variable in closure rates and patterns [6]. This variability leads to the question of the value of cranial suture closure as a method of estimating age at death [7]. Thus, its utilization as a method of age assessment has been quite controversial since the mid-20th century [8]. These

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studies are the result of a trend towards improvement in quantitative methods in forensic anthropology.

## Materials and Methods

The present study was carried using sternal bones removed during autopsy on a total of 100 cases above the age of 30 years at the Department of Forensic Medicine, Lady Hardinge Medical College, New Delhi. After removal of tissue and maceration, the sternum and xiphoid process was examined for any kind of variation in its morphology.

## Results

### Correlation between actual and estimated age

On statistical analysis for correlation between actual and estimated age correlation coefficient is 0.908 and p-value is 0.0001 that is statistically significant (Table 1).

## Discussion

### Comparison between actual and estimated age

In the present study, on examination of one hundred samples of sternums for the grades of fusion and estimation of age and correlating with actual age of individual 22 (22%) sternum samples are found equal to actual age of individual in each age group between 30-40 years and 41-50 years; 15 (15%) cases in age group 41-50 years and the estimated age is found equal to actual age in age group 51-60 years. Estimated age is found equal to actual age in 12 (12%) and 29 (29%) cases in age groups between 51-60 years and >60 years respectively. On statistical analysis done between actual and estimated age of fusion, the mean value with standard deviation for actual age is  $51.28 \pm 13.11$ , t-value is 39.10 and p-value is 0.001 that is statistically significant. Mean and standard deviation for estimated age is  $48.98 \pm 13.45$ , t-value is 36.42 and p-value is 0.0001 that is statistically significant.

The correlation results indicate that there is statistically insignificant difference between the actual age of the subject and estimated age from

**Table 1.** Correlation between actual and estimated age.

Variables	Mean ± SD	t-value	p-value
Actual age	51.28 ± 13.11	39.1	0.0001
Estimate age	48.98 ± 13.45	36.42	0.0001
Variables	Parameter	Correlation- Coefficient (R)	p-value
Actual age	Estimate age	0.908	0.0001

**Table 2.** Comparative analysis of Age wise distribution of no. of cases (%).

Studies	11-20 Years		21-30 Years		31-40 Years		41-50 Years		51-60 Years		>60 Years	
	M	F	M	F	M	F	M	F	M	F	M	F
Bruce	2.6	3.9	9.2	8.3	14.3	10.3	17.9	13.2	21.5	15.9	19.7	18.4
Das SK (2005)	-	-	-	68 (25-30)	150	-	138	-	134	-	106	-
Wadhawan M (2009)	5	20	6	12	18	10	12	12	10	10	18	6
Garg A (2011)	-	-	-	-	18.6 (35-40)	8.6 (35-40)	17.8	17.1	14.7	26	13.9	34
Chandresh I. Taylor (2013)	13.2	20	34.2	27.8	23.7	27.5	17.1	10	9.2	10	2.6	7.5
Present study (2018)	-	-	-	-	15.7	36.6	30	3.3	28.5	23.3	25.7	36.6

fusion of sternal joints. None of studies assesses on determination of age from sternum has compared actual age of the individuals with estimated age devised from Sternal samples.

### Comparison of regression analysis

In the present study regression equations for fusion of mesosternum with manubrium sterni (Grade M), fusion of mesosternum with xiphisternum (Grade X) and fusion of both Xiphisternum and manubrium sterni with mesosternum (Grade M and X) to establish relationship with estimated age were devised. On applying Chi-square test, it was found that occurrence of either grade of degree of fusion between manubrium and mesosternum and between xiphisternum and mesosternum was independent of sex. Similarly, Wadhawan M (2009) also devised regression equation to establish any relationship of fusion of manubrium and xiphisternum with mesosternum and they also found grades of fusion are independent of sex of individual (Tables 1 and 2).

### Conclusion

Majority of sternum samples retrieved from dead bodies of individuals brought for postmortem belonged to 51-60 years age group in males and 30-40 years age group in females. Males (70%) outnumbered the females (30%) in this study. Majority of sternum samples belonged to individual who were moderately built and had non-veg food habits. A good number of samples were retrieved from individuals who were businessman (17%) amongst males and housewife (16%) amongst females. Majority of sternum samples were of individuals from temperate climate and Delhi region. Fusion of xiphisternum starts earlier as compared to fusion of manubrium sterni with mesosternum. Fusion of xiphisternum with mesosternum starts at 30 years and completely fuses at 41 years in both the sexes. Fusion of manubrium sterni with mesosternum starts at 51 years and completely fuses at >60 years. There is significant correlation between fusion of both xiphisternum and manubrium sterni with mesosternum in both males and females. Though there is some

difference in fusion in both males and females but it is not statistically significant and females showed earlier fusion than males in some age groups. There is statistically insignificant difference between the actual age of the subject and estimated age from examination of sternum samples.

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