# MORPHOMETRIC STUDY OF HUMAN STERNUM TO DETERMINE THE STATURE IN MALES- AN AUTOPSY STUDY

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**ABSTRACT:**
**Background & objectives:** *Estimation of stature is one of the significant part of medico legal proceedings.The aim of the study was to obtain regression formula for determination of stature of adult males by measuring the length of manubrium and meso-sternum.*
**Methods:** *Sterna were procured from 53 males aged between 15 years to 75 years from known corpses during medico-legal autopsies at Tirunelveli Medical College, Tamilnadu, India by dissection and maceration of soft tissues.*
**Results:** *Regression formula derived for manubrium was Y=160.9 + 1.04 x length of manubrium with standard error of ±4.4 and coefficient correlation is 0.15. Regression formula for meso-sternum was Y=137.1+3.1 x length of meso-sternum with standard error of ±3.2 and coefficient correlation is 0.42.*
**Interpretation:** *The length ofmeso-sternum was foundto be theideal tool for estimation of stature since the coefficient correlationis high.*
**Conclusions:** *This study proves that meso-sternum is a reliable tool to calculate the stature of a person.*

**Keywords:***Meso-sternum, Manubrium, Stature, Male, Identification.*

## INTRODUCTION

Identification of an individual whether living or dead is one of the most crucial tasks in medico-legal practice. The services of forensic medicine experts are sought in establishing the identity of the dead, especially in mass disasters like fires, explosions, ship wrecks, air crash and railway accidents. Extreme mutilation, advanced decomposition, skeletal and fragmentary remains make the process more confounding and complicated. The experts always face problems in identifying whether theskeletal remains are of human origin or not, as well as estimation of correct sex, age, stature etc.

Experts are often required to estimate the stature of a person from dismembered body parts and bones. Stature is very important criteria in establishing the identity of an individual. Therefore, given the complexities of such situations, it is highly essential that legal medicine experts should be well versed in various aspects of identity establishment and one of the accepted procedure is determination of the stature from the skeletal remains.

Stature of an individual is subjected to psychological, environmental, genetic and nutritional factors. Anyhow, lengths of different body parts bear more or less some constant relationship with the body length. Determination of stature is an easy task if a complete body or the entire skeleton is found. When only some parts of the body (or) if a skeleton is available, it is necessary to have different formulae for determination of stature from their osteometric measurements.

The present study is an earnest attempt to assess the stature of an individual from one of the skeletal remains, namely the STERNUM which is a superficial bone, and is often sparedeven in a highly decomposed body[1]. Moreover, it is a bone which can be easily procured from cadavers without damage during an autopsy procedure. Considering these factors, sternum was selected for the study as an identifying unit of stature.

## MATERIALS AND METHODS

Study was conducted on 53 Sterna collected from known corpses during medico-legal autopsies at Tirunelveli Medical College, Tamilnadu, India which included 53 males aged between 15years to 75 years. Sterna were removed by dissecting along the costo-chondral junction and disarticulating the sterno-clavicular joints.[2]The attached soft tissues were removed manually.

There are two methods for determination of stature from skeletal remains i.e., anatomical method and mathematical method. In anatomical method, the stature is determined by measuring the total length after arranging the bones together in anatomical position with addition of due allowance for the soft tissues. Though it provides more accurate estimate of stature, it is applicable only when whole skeleton is available for examination. The mathematical method is based on the proportions of long bones to the height of an individual. This method is applicable

even when a single bone is available. This method can be used in two ways, either by formulating prediction equation or by computing multiplication factor for reconstruction of stature[3].Hence mathematical method was the preferred choice for this study.Measurements (Fig.1) were taken by using digital vernier caliper.
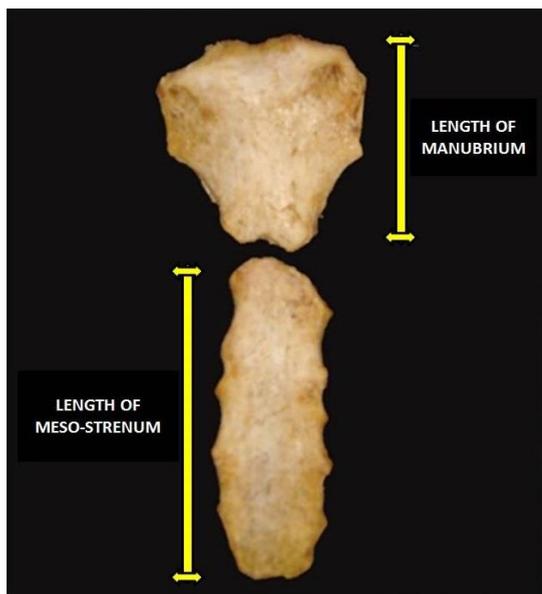


**Fig.1: Measurements of sternum**

## OSTEOMETRIC PARAMETERS USED FOR ANALYSIS

1. Length of Manubrium (Fig. 2)



**Fig.2: Measuring the length of Manubrium**

2. Length of Meso-sternum (Fig. 3)



**Fig.3: Measuring the length of Meso-sternum**

Data collected were recorded, tabulated and statistically analyzed.

## OBSERVATIONS

The lowest stature for males in this sample was 155cm and the highest stature was 179cm. The mean was 161.5cm with a standard deviation of 6.8cm and the median was 166cm. The regression formulae used were as follows:

1) $Y = 137.1 + 3.1X$(For length of Meso-sternum)
2) $Y = 160.9 + 1.04X$ (For length of Manubrium)

In the above formulae the 'Y' is the calculated stature. 'X' are the measurements of sternum.

Table.1.shows the correlation between the stature and the sternal measurements in males.

Stature can be determined from the length of meso-sternum by using the regression formulae in $Y = 137.1 + 3.1X$ in males with a range of standard error of $\pm 5$. The standard error of estimate obtained in this study with the length of meso-sternum was $\pm 3.2$. By applying the above error, we can determine the stature of an individual with 68% confidence. If we multiply the standard error of estimate by 2, stature can be estimated with 95% confidence. Determination of stature with 98% confidence can be acquired by multiplying the standard error of estimate by 3. The coefficient of correlation was 0.42.

Stature can be determined from the length of manubrium by using the regression formulae in $Y=160.9 + 1.04X$ in males with a range of standard

error of ±11. The standard error of estimate obtained in this study with the length of manubrium was ± 4.4. By applying the above error, we can determine the stature of an individual with 68% confidence. If we multiply the standard error of estimate by 2, Stature can be estimated with 95% confidence. Determination of stature with 98% confidence can be attained by multiplying the standard error of estimate by 3. The Co-efficient of correlation is very much restricted with 0.15.

Determination of stature from length of body of sternum seems to be more reliable than from length of manubrium as the range of standard error of estimate is narrow.

Table.1. Correlation between the stature and the sternal measurements in males.

| Sex | Stature (cm) | Length of Meso-sternum (cm) | Regression Y=137.1+3.1X | S.E | Length of Manubrium (cm) | Regression Y=160.9+1.04X | S.E |
|-----|-----|-----|-----|-----|-----|-----|-----|
| M | 171 | 10.6 | 170 | +1 | 5.1 | 166 | +5 |
| M | 170 | 9.8 | 167 | +3 | 5.5 | 167 | +3 |
| M | 164 | 8.5 | 164 | 0 | 4.8 | 166 | -2 |
| M | 162 | 7.9 | 162 | 0 | 4.2 | 165 | -3 |
| M | 161 | 7.6 | 161 | 0 | 4.3 | 165 | -4 |
| M | 176 | 10.8 | 171 | +5 | 5.0 | 166 | +10 |
| M | 173 | 10.7 | 170 | +3 | 4.1 | 165 | +8 |
| M | 155 | 7.2 | 159 | -4 | 5.0 | 166 | -11 |
| M | 160 | 9.1 | 165 | -5 | 6.0 | 167 | -7 |
| M | 166 | 8.4 | 163 | +3 | 5.5 | 167 | -1 |

M-Male, Meso-sternum=Body of sternum, S.E-Standard error, Y-Calculated stature, X-Sternal parameters

Table 2: Comparison between the study of T.H.Bijoy Singh and present study.

| Results of study by T.H.Bijoy singh and A.Momochand | | | Present Study | |
|-----|-----|-----|-----|-----|
| Study Group | Regression Formula | S.E. | Regression Formula | S.E. |
| Males | Y=150.2 + 1.4X | ± 6.0 | Y=137.1 + 3.1X | ± 3.2 |
| Co-efficient of Correlation :    Male    = 0.40 | | | Co-efficient of Correlation :    Male    = 0.42 | |

Y=Stature of the individual, X= length of the body of sternum      S.E – Standard Error,

## DISCUSSION

Determination of stature from long bones hasbeen carried out by variousresearchers[4,5,6]and they have succeeded in that by finding various mathematical solutions.

But as far as other flat bones are concerned, it is still incomplete.Stature determined from the length of manubrium by using the regression formula Y=160.9 + 1.04X in males with a range of standard error of ±11and the Co-efficient correlation of 0.15 is not significant compared to the regression formulae derived from the length of meso-sternum.

Regression formula derived in the present study to determine the stature from the length of meso-sternum Y = 137.1 + 3.1X in males is more reliable compared to the formulae derived by T.H.Bijoy singh and A.Momochand from Imphal, India[9] (Table 2)

## CONCLUSIONS

There are regional and biologicalvariationsas far as determination of individuality of a person is concerned which have been proved in the past[8,9]and present studies. Hence, this study strongly recommends regional wise in-depth studies in estimation of stature. However, this study proves that sternum isone of the tools to calculate the stature of a person in addition to or in the absence oflong bones[10].

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