

## Original Research Paper

# Estimation of Stature from Inter-Acromial Length in Western Indian Population: A Pilot Study

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### Abstract

Stature estimation is a standard practice in the fields of Bio-Archaeology, Forensic, Biological and Palaeoanthropology. It can be accomplished most accurately by anatomical reconstruction, followed by type I regression equations using long bones of the lower limb. The skeletal remains presented to the Forensic departments are often incomplete and thus Forensic experts have to rely on other elements.

As no existing equations are clearly appropriate, this study aims to formulate a regression equation to establish relationship between stature and inter-acromial length of living individuals. Measurements were taken from 100 randomly selected medical students between 22-29 years of age, native to Gujarat, India, using spreading calliper (least count 1 mm). The documented measurement data was analyzed using SPSS software version 11. Three sets of regression equations were derived which revealed that predictive value from the equations was unsatisfactory. The study concluded that inter-acromial length is not a good parameter for stature estimation. Further detailed studies are recommended to support or negate the finding.

**Key Words:** Inter-Acromial Length, Stature, Correlation, Regression Equation

### Introduction:

Stature estimation is one of the four attributes of the biological profile obtained from human skeletal remains. It contributes significantly in developing a biological profile for Forensic identification. The most common method employed for stature estimation is use of regression equations derived from length of long bones. The Karl-Pearson, Dupertius & Hadden and Trotter & Glesser formulae have been derived from predominantly Western populations. [1] However, little previous work has been done on stature estimation among modern Indian population, despite a growing number of Forensic cases in recent years. In India, Siddiqui & Shah, Singh & Soha and Mehta & Thomas have attempted to determine the stature with limited success. [2]

The problem of stature estimation has been addressed by the Athwale et al, Patel et al, Joshi et al, Lal and Lala etc. [1]

It poses a great challenge in commingled mutilated remains to Forensic experts and hence, there is a need felt for studies on estimation of stature from various body parts in different population groups.

Such studies can help in narrowing down the pool of potentially matching identities in cases of dismembered remains.

As no existing equations are clearly appropriate, new sample-specific regression equations formulation is always recommended. An approach is utilized in this study to establish the relationship between statures of western Indians population and their inter-acromial lengths; to develop regression equation formulae from these two variables by simple regression analysis. The formula thus obtained could be used for the determination of stature of individuals of this region.

### Method:

The study sample comprised of randomly selected one hundred medical students of a tertiary care institute at Karamsad, Anand, during the period from 1<sup>st</sup> - 31<sup>st</sup> Jan 2102. The participants' age was between 22- 29 years with a mean age of 23.21 years (by this age, skeletal growth is presumed to be completed). M: F ratio of the participants was 39:61. The participants constitute mixed

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population (caste and region) of western India. Those with stunted or enhanced bone growth or with history of skeletal injury were excluded from the study. The participants were explained about the purpose and procedure of the study and informed consent was obtained.

The data for the present study were stature and inter-acromial length. The measurements were taken with procedures and landmarks as by Krogman. [1]

#### **Stature:**

Participant were asked to stand up erect against the wall with hands hanging down, feet axes parallel or slightly divergent, and head in the Frankfurt horizontal plane, without any headgear or footwear being worn; and stature recorded using an anthropometer rod set. No pressure was exerted since this is a contact measurement.

#### **Inter-acromial length:**

Inter-acromial length is the distance between two bony landmarks, i.e. acromial process of scapula on each side. Acromion is the most lateral point on the lateral margin of the acromial process when the subject stands in normal position with his arms hanging by the sides. The measurement from the vertex of head to the ground was taken after bringing down the adjustable cross-bar to the head and the measurement was read from the vertical scale.

Next, keeping point of one static arm of the anthropometer rod on right acromion, the tip of adjustable arm of the anthropometer rod was brought to the left acromion to measure the inter-acromial length in centimetres with the person in the same erect position.

The data were entered in MS Excel Sheet and analyzed statistically (using basic bivariate statistics and simple and multiple regression analyses) by SPSS software, version 11 to formulate regression equation.

The observer bias was reduced as they underwent training for measurement of the parameters. Then 5 cases were measured in front of the 4<sup>th</sup> author and the findings were confirmed by 4<sup>th</sup> author and the observer. The difference between both of them was negligible [ $< \pm 0.2$  cms]. The degree of measurement error [ $< \pm 0.2$  cms] and reliability are well within accepted standards.

#### **Observations and Result:**

Two variables were taken into consideration i.e. stature and inter-acromial [IA] length. Basic bivariate statistics and linear regression analyses was applied to find out correlation between the variables. Three regression equation formulae were obtained by

statistical analysis from the relationship between statures and inter-acromial lengths for females only, males only and males and females combined. (Table 1) As all the subjects were of nearly same age, correlation between age and inter-acromial length was not sought.

When combined data was used, positive correlation between stature and inter-acromial length was found which was statistically significant. (Scatter plot 1) On the other hand, there was insignificant correlation found between stature and inter-acromial length in either of the sexes. (Scatter plots 2 & 3)

#### **Discussion:**

Population variations in anthropometric dimensions do exist and are attributed to genetics, dietary habits and environmental factors. This indicates that specific formulae or regression equations used in prediction of stature are only applicable to the population from which the data were collected. [3]

Various researchers have attempted the estimation of stature from long bones by using different statistical methods with variable degree of success. Limitations have always existed in conducting such studies in terms of availability of adequate quantities and choice of bone and trained personnel. [4] Nevertheless, very little work has been reported on the use of these statistical methods to calculate the stature from the inter-acromial length in living.

A study reveals that the standard errors was  $\pm 8$  cm (males) and  $\pm 5$  cm (females). [5] In yet another study, it was  $\pm 6$  (males) and  $\pm 4$  (females). [6] The coefficient of correlation was poor in studies for males and females separately. There was some positive correlation when combined data was used but all were not satisfactory. Furthermore, when our data was used to determine stature from formulae derived from above two studies, both failed.

Aforementioned studies were conducted in different parts of India, but a notable difference in the regression equations in these studies is observed. This implies that inter-acromial length is probably not a good indicator for estimation of stature. The most suitable explanation can be that, inter-acromial length is not a fixed parameter, and the distance between the two landmarks varies considerably depending upon the position of the subject.

Furthermore, as the position of scapulae in an individual are predominantly determined by its muscular attachments, and is highly movable, any attempt to measure its distance and thereby formulating a regression equation to estimate

the stature will tend to give an erroneous correlation.

Our study re-emphasizes the fact that, estimating stature from long bones may continue to remain the gold standard in years to come.

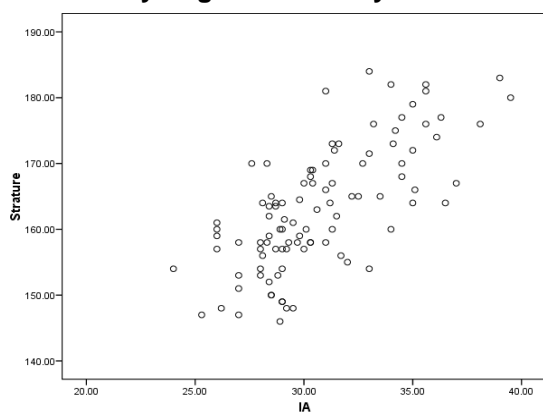
**Conclusion:**

It is concluded that inter-acromial length has limited forensic value and relatively low reliability in estimating stature in living individuals. Nevertheless, we recommend similar studies in other geographical areas and racial groups to be conducted. Since it is not a comprehensive study but it is aspired that the results may be viewed more as indicative of the feasibility of the technique in providing formulae applicable in the Forensic science work.

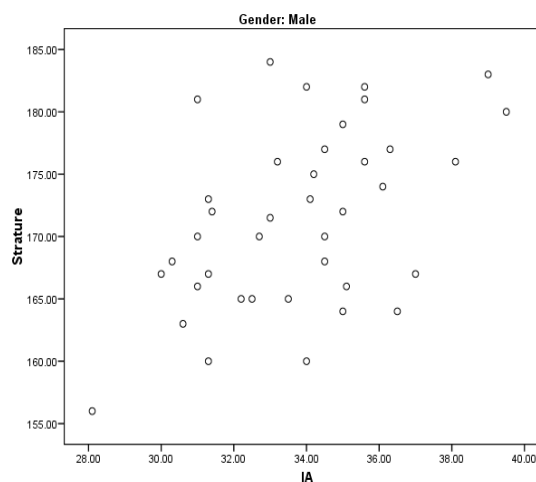
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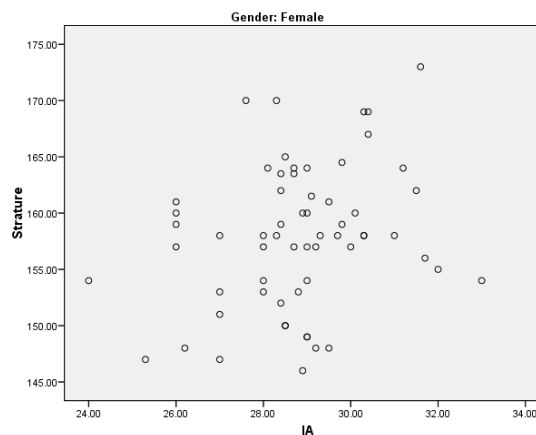
**Scatter plot 1: Positive Association confirmed by Regression Analysis**



**Scatter Plot 2: Insignificant Correlation in Males**



**Scatter Plot 3: No or Very Little Association in Females**



**Table 1**

**Prediction of Stature from Inter- acromial length**

Variable	Regression formula for stature (y)	Correlationcoefficient	R <sup>2</sup>
Females	129.03+ 1.00 x	0.27	0.072
Males	126.10 + 1.34 x	0.48	0.233
Combined	99.06 + 2.09 x	0.71	0.504

# Where x = IA length