

Regression Equation Analysis on Inter-Acromial Length for Stature Estimation in South India Population

B. Vasant Nayak¹, Nishat Ahmed Sheikh²

Abstract

Background: Stature of Humans has acted as symbol for the authority, also physical prowess and there had been dominance of stature over other living things. Identity of individual or skeleton remains especially the stature also the body weight had acted as an important factor in its establishment.

Place of Study: Department of Forensic Medicine Gandhi Medical College Musheerabad, Secunderabad, Hyderabad.

Material and Method: The study is made on the Volunteers. Total 194 subjects were selected irrespective of their caste, religion, dietary habits & socio-economic status at Gandhi Medical College Musheerabad, Secunderabad, Hyderabad.

Observation and Discussion: Stature of Male is highly correlated to Inter-Acromial length (i.e. Correlation coefficient = 0.827) with p-value is 0.000000. Therefore, Regression equation of Male Inter- Acromial length on stature is, Inter-Acromial Length = 0.239 x Stature + 5.4532. Similarly for Female Stature is highly correlated to Inter-Acromial length (i.e. Correlation coefficient = 0.70) with p-value is 0.0000. Therefore, Regression equation of Female Inter- Acromial length on stature is, Inter-Acromial Length = 0.243 x Stature + 3.657 Combined Stature and Inter-Acromial length is highly correlated (i.e. Correlation Coefficient = 0.8163) with p-value is 0.00000. Therefore, the Regression equation of combined Inter- Acromial length on stature is, Inter Acromial Length = 0.2584 x Stature + 1.69481.

Conclusion: The present study has established definite correlation between stature and Inter acromial length and also regression equations have been established.

Keywords: Stature Estimation; Inter-Acromial Length; Regression Equation.

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Introduction

Scientific specialization that has evolved and emerged from the specialty of Forensic

Anthropology is Anthropometry, which deals with Identification of Human using the help of Metric Techniques, also it can be coined in other words as anthropometry means the human measurements irrespective of whether living or dead or reduced to skeletal remains[1].

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Important parameter in Medico legal forensic examination is an Stature, it is an important element when highly decomposed or sometime highly mutilated bodies or fragmentary remains of the human parts are brought for medico legal examination. In regards with day to day medico legal examination the common queries e.g. age, sex, race, etc, estimation of stature becomes equally important in such cases.

Great diversity in India with different regions, climate and dietary habits of the people including

racial and ethnic variations which do exist in diversified population of different geographical regions of India, hence conclusions cannot be derived from the studies done in single population and shall not be applicable entirely to other group of population [2].

Stature of Humans has acted as symbol for the authority, also physical prowess and there had been dominance of stature over other living things. Identity of individual or skeleton remains especially the stature also the body weight had acted as an important factor in its establishment. In regards with relation to overall weight and height of the individual the calculation and measurement of stature is based on the relative proportion of different body weight. For the stature estimation the multiple researchers had conducted studies and had derived stature from multiple parameters for example percutaneous measurement of various body parts which includes arm, forearm, leg, foot etc. [3-4]. Based on the current scenario, we felt there is a strong need to determine the stature estimation from Inter acromial Length, the current study was undertaken to estimate stature from measurement of Inter Acromial length.

Our aim of the study was to derive linear regression formulae from correlation of Inter acromial length and stature and later have a comparison of correlation between stature and Inter acromial length with the studies made by earlier researchers.

Aim and Objective

Current study had been conducted on the consenting volunteers whose ages fall between a range of 22 to 42 years to establish the relation of stature and inter acromial length along with regression formula in relation.

Material and Method

The study is made on the Volunteers total 194 subjects were selected irrespective of their caste, religion, dietary habits & socio-economic status at Gandhi Medical College Musheerabad, Secunderabad, Hyderabad. Sufficient permissions and consents are procured before the measurements of the volunteers are taken and clearance from the Institutional Ethical committee is obtained in advance. Stature; using the stadiometer, the subject was made to stand barefoot in the standard standing position on its baseboard. Both feet are in

close contact with each other and head oriented in Frankfurt's plane. The height was then recorded in centimeter from the standing surface to the vertex in the weight bearing position of foot. The Inter acromial length was measured with the help of spreading caliper and self-retracting measuring tape. Inter-acromial length was measured with the person sitting in the erect position. Inter-acromial length is the distance between two bony landmarks, i.e. acromial process of scapula on each side.

The volunteers were made to sit erect and his arms hanging freely at the sides. Volunteer's posture was looked from behind to make sure that the shoulders are not too far nor back not forward, and it was observed that there need to be a noticeable curvature in lower back. Later the volunteers were asked to hold the breath for few seconds, so as the lateral border of acromial process can be located after following scapula out to the arm until it makes a sharp turn and thus it was marked on each shoulder.

A spreading caliper with blunt end was placed gently in between thumb and forefinger that allowed palpating the bony ridges with other fingers. Spreading calipers arms were later placed on the skin directly next to the lateral border of each acromial process and adjustable pressure was applied so as to compress the soft tissue over on the acromial process, enough precaution were taken not to hurt the volunteers. In entire course of the study for each volunteers measurement was taken twice, that is once with the spreading caliper and second with a self retracting measuring tape. To avoid diurnal variations and to eliminate any discrepancies both measurements were taken in a time slot between 1:00 to 15:30 hours of the day. Value of the constant and regression coefficient was calculated using SPSS Version 19 program.

Inclusion criteria

All volunteers, both Male and Female were selected, irrespective of their socio-economic standards. The ages of these volunteers are falling between 22 years and 42 years.

Exclusion criteria

Volunteers morphologically showing the congenital malformations, Dwarfism / Achondroplasia, features of nutritional deficiencies and injuries to extremities are not included in the present study.

Data Analysis

Data thus collected was analyzed using SPSS version 19. The mean values and the standard deviations were calculated for stature and Inter acromial length. Correlation of the Inter acromial length with the stature was assessed. Regression coefficient and constant was calculated for estimating stature through regression equation from Inter acromian length. The effectiveness of regression equation was tested by significance Z test.

Observation

As per Table 1 Total 194 Subjects were measured in various age groups starting from 22 years to 42 years Females and Males both were 97 each. Heights of individual are varying irrespective of age and sex.

Table 1: Sex-wise and combined Distribution of statures and inter-acromial Lengths (cm)

Characters	Male	Female	Combined (M + F)
Maximum Age	42	40	42
Minimum Age	22	22	22
Maximum Stature	190	180	190
Minimum Stature	137	132	132
Max. Inter-Acromial Length	51.2	47.2	51.2
Min. Inter-Acromial Length	33.4	29.3	29.3

Table 2: Distribution of Stature and Inter-acromial Length in cm for both sex and combined

Variables		Mean	Std. Dev.	Confidence Interval
Age	Male	30.8	6.22	30.8 ± 1.251
	Female	31.14	6.28	31.14 ± 1.2624
Stature	Male	169.83	14.164	169.83 ± 2.85
	Female	156.26	11.776	156.26 ± 2.37
Inter-Acromial Length	Male	46.029	4.094	46.029 ± 0.823
	Female	41.63	4.099	41.63 ± 0.8243

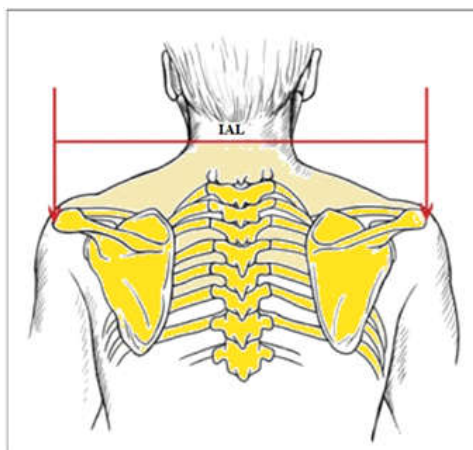


Fig. 1: Inter-acromial Length



Fig. 2: Stadio-meter and Spreading Caliper

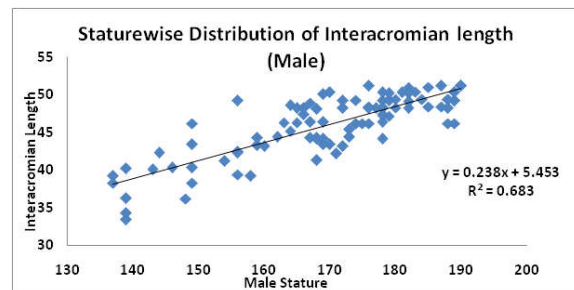


Fig. 3: Stature wise distribution of Inter-acromian Length in Males

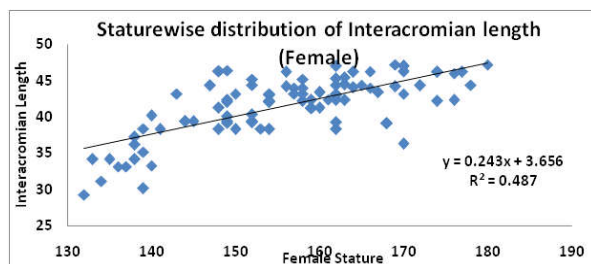


Fig. 4: Stature wise distribution of Inter-acromian Length in Females

Stature of Male is highly correlated to Inter Acromial length (i.e. Correlation coefficient = 0.827) with P-value is 0.000000. Therefore, Regression equation of Male Inter-Acromial length on stature is,

$$\text{Inter-Acromial Length} = 0.239 \times \text{Stature} + 5.4532.$$

Similarly for Female Stature is highly correlated to Inter-Acromial length (i.e. Correlation coefficient = 0.70) with p-value is 0.0000. Therefore, Regression equation of Female Inter- Acromial length on stature is,

$$\text{Inter-Acromial Length} = 0.243 \times \text{Stature} + 3.657$$

Combined Stature and Inter-Acromial length is highly correlated (i.e. Correlation Coefficient = 0.8163) with P-value is 0.00000. Therefore, the Regression equation of combined Inter- Acromial length on stature is,

$$\text{Inter-Acromial Length} = 0.2584 \times \text{Stature} + 1.69481$$

Table 3: Relation between Stature (X) and Inter-Acromial Length (Y)

Characters	Regression Formulae	Correlation Coefficient (r)	P- Value
Male	$Y = 0.239 \times X + 5.4532$	0.827	0.00000
Female	$Y = 0.243 \times X + 3.657$	0.70	0.00000
Combined (M + F)	$Y = 0.2584 \times X + 1.695$	0.8163	0.00000

Discussion

The study was conducted on volunteers at Musheerabad Hyderabad GMC, belonging to various religious and regions were studied. Our attempt was to devise the linear regression equations as well as multiplication factors for estimation of stature from Inter acromial length in both the genders. In this study Inter acromial length is found to be good parameter for predicting stature in both the genders. The linear regression equation derived from Inter acromial length for estimation of stature showed a statistically significant relationship in both the genders. As such Estimation of stature, as part of identification process, has a long history in physical anthropological studies. Stature plays a very important role in the description of a human population, for physical, anthropological, and biomechanical research.

In comparison a relatively less amount of work had been done as well use of statistical methods to calculate the stature from Inter acromial Length. In our current study the observation shows that there is high degree of positive correlation in case of males and females as well combined. Regression equation of Male Inter- Acromial length on stature is, Inter-Acromial Length = $0.239 \times \text{Stature} + 5.4532$. Similarly for Female Stature is highly correlated to Inter-Acromial length (i.e. Correlation coefficient = 0.70) with p-value is 0.0000. Therefore, Regression equation of Female Inter-Acromial length on stature is, Inter-Acromial Length = $0.243 \times \text{Stature} + 3.657$. The males had longer inter-acromial lengths. In comparison to females, Males tend to develop

broader shoulder from puberty, and this may be a reason for the higher inter-acromial length, our findings are in accordance with conducted by Koulapur VV et al. [5].

Ozaslan A. et al, conducted a study to estimate stature from bi-acromial and biiliocrystal measurements on Turkish Population and he opined in his study that In males the best possible correlation was observed for Bi-Acromial Breadth ($r=0.42$) and In females ($r=0.26$), but for Bi-Ilio Cristal Breadth observation was relatively very weak correlation in both males ($r=0.21$) and females ($r=0.19$) [6]. There were multiple studies wherein other parameters were used to determine the stature like in Jasuja et al. [7] derived multiplication factors for Punjabi Jat males for estimation of stature; 6.88 and 6.44 for right and left foot length respectively.

Similarly Giles et al. [8] did suggest that foot length displays a biological correlation with height and can be estimated from foot length. As well Nishat Ahmed Sheikh et al. [9] estimated stature from forearm length, the ratio fall between 3.49 and 3.88 for boys with a mean of 3.67 and SD+0.090; and between 3.45 and 3.88 for girls with a mean of 3.68 and SD 0.093. The stature had been found to have significant positive correlation with the Inter acromial length. Whether the regression equation was effective in estimating stature from the Inter acromial length, the estimated values were compared with the measured values. No significant difference was found between the measured and estimated stature. From this result inference could be drawn that the stature of an individual can be estimated from Inter acromial length.

This method of stature estimation can be used by law enforcement agencies and forensic scientists. The only precaution which must be taken into consideration is that these formulae are applicable to the population from which the data have been collected due to inherent population variations in these dimensions, which may be attributed to genetic and environmental factors like climate, nutrition etc. The results obtained in our study correlates with the previous studies.

Conclusion

The present study has established definite correlation between stature and Inter acromial length and also regression equations have been established. Tremendous help can be seek in medico legal cases in establishing stature and identity of an individual when only some remains of the body

are found. There is a need to conduct more studies among people of different regions & ethnicity so that stature estimation becomes more reliable & identity of an individual is easily established. We conclude that the obtained formulas are specific to that study populations therefore application of these by the other populations might cause incorrect results. Thus necessity in creation of specific equations peculiar to populations should be taken into account by researchers.

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