

Stature Estimation from Forearm Length

Nishat Ahmed Sheikh*, T. Venkata Ramaiah**

Abstract

Stature is one of the most important and useful anthropometric parameter and its estimation hold a special place in the field of Forensic Anthropometry. It has been stated that a variety of factors such as race, gender and nutrition play an important role in determining the height of an individual. There is a relation between the axial growth and the skeletal growth which can be reflected in the growth of the forearm length. The relation appears to be a positive proportion. The present study is made on the students in puberty age with axial growth in at its peak, to estimate the stature of 170 subjects, 88 Girls and 82 Boys from forearm length of individuals having age group of 11-16 Years, in Department of Forensic Medicine, Kamineni Institute of Medical Sciences Narketpally. The subjects were selected irrespective of their caste, religion, dietary habits & socio-economic status. Students having significant growth disorders, deformities, bony anomalies were excluded to rule out any gross anomaly in reconstruction of stature. All individuals were measured for height and forearm length. The data thus obtained has been subjected to statistical computation. It is obviously seen that length of a person can still be made out by the length of the fore arm even in the puberty age group, where there growth is yet not completed.

Keywords: Stature; Age; Height; Fore arm length; Regression formula.

Introduction

Anthropometry is a series of systemized measuring techniques that express quantitatively the dimensions of human body and skeleton. Anthropometry is often viewed as a traditional and perhaps the basic tool of biological anthropology, but it has a long tradition of use in forensic sciences and it is finding increased use in medical sciences especially in the discipline of forensic medicine. Relationships that exist between different parts of body and height have been of great interest to anthropologists, forensic and medical scientists for many years.[4,13] In forensic anthropol-

ogy, living (forensic) stature is among the four major categories of the basic biological profile: sex, age, ancestry and stature.[1,6] one critical role of stature estimation today lies in the forensic identification of crime victims and missing persons.[15]

Identification of a human being is one of the important exercises in Forensic Medicine. Identification is defined as 'Recognition of an Individual' or 'Determination of Individuality of a person'. The earlier one establishes absolute identification; whereas the later defines partial or incomplete identification.[14,16] The Forensic Expert, with his scientific knowledge makes only a partial identification.[16,18] The parameters involved in identifying a person have 'Stature' as one of them.

Height is the measured vertical span between the vertex and heel[18], whereas 'Stature' is the calculated span between the vertex and the toe. There may be a little variation exist between these two measurements, but estimating the stature is an important step in medico-legal work, especially when a medico-legal autopsy is conducted on unknown dead body.

Authors affiliation: *Associate Professor , **Professor & HOD, Department of Forensic Medicine, Kamineni Institute of Medical Sciences, Narketpally, District Nalgonda 508254, State Andhra Pradesh, Country India.

Reprints requests: Dr. Nishat Ahmed Sheikh, MBBS, MD, CTM, DFME, Doctor's quarter: D/4/12, Kamineni Institute of Medical Sciences, Narketpally, District Nalgonda-508254 State Andhra Pradesh Country; India.

E-mail: drnishatsheikh@gmail.com

The process of stature estimation has undergone a complex course of development involving researchers who have developed different means of achieving the desired goal.[17] Thomas Dwight (1884) suggested the following methods for stature reconstruction i.e. anatomical method and mathematical method. The anatomical method invariably requires complete skeleton for stature estimation whereas the mathematical method is one workable even with a single bone.[12] It is not unusual to get mutilated and dismembered dead bodies for autopsies. It becomes difficult to measure the height of those bodies. Stature should be calculated in them, from the available extremities or long bones.[5,7,11] Several studies are made in the aspect on adult persons. The present is made on the children in the age of their skeletal growth.

Aims and Objectives

The present study is conducted on the children in the secondary school, who are aged between 11 and 16 years to:

- Establish the relation between the forearm length and height
- Get regression formula in this relation

Material and Methods

Present study is made on the children who are studying in Sixth standard to Tenth standard in the Local schools at Narketpally. The subjects were selected irrespective of their caste, religion, dietary habits & socio-economic status. Students having significant growth disorders, deformities, bony anomalies were excluded to rule out any gross anomaly in reconstruction of stature. Sufficient permissions and consents are procured before the measurements of the children are taken and clearance from the Institutional Ethical committee is obtained in advance. Height is measured on the 'Steado-meter' in centimetres with decimals up to millimetres.

Forearm length is measured on a board, which is modified from the 'Osteometric board'. Care is taken in measuring the forearm length. The stretched forearm is kept on the measuring board in supine position, with the tip of the middle finger touching the fixed flank of the board. The mobile flank of the board is approximated to the tip of the Olecranon process after bending the elbow to 90°. The span is measured in centimetres with decimals up to millimetres. 170 subjects are examined and their measurements are made. The values are entered in to excel sheet to get the ratio between the forearm and the height in each individual. The values are analysed, microsoft Office Excel 2003 was used for data Evaluation and chart design.

Inclusion Criteria

All children, both boys and girls studying in sixth to tenth classes from the local government schools are selected, irrespective of their socio-economic standards. The ages of these children are falling between 11 years and 16 years.

Exclusion Criteria

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

Observations

Total 170 children are measured in various age groups starting from 11 years to 16 years who are school going children. Girls are 88 and Boys are 82 among them. Heights of individual are varying irrespective of age and sex.

The ratios between the height and the forearm length are calculated for each individual. An average to the age and sex is calculated among them. (The ratio also can be taken as

Fig 1: Class-wise Strength of Students

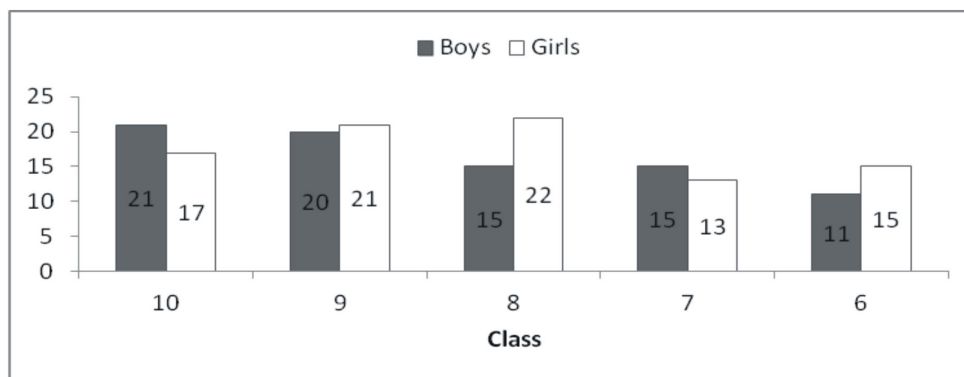
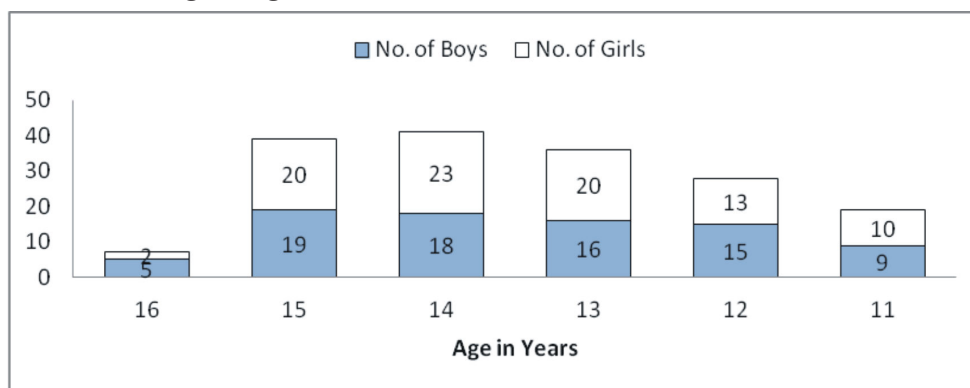


Fig 2: Age and Sex Distribution of the Students



multiplying factor to the forearm length to calculate the height of a person.)

The ratio between the height and the forearm length is falling 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 graph plotted against the age and the average ratios of height to the forearm is declining as the age advances both in Boys and Girls. The 'p' value is coming to 0.0001 which is < 0.05 which is very significant.

Table 1: Average ratios of Height to Forearm lengths (Age and Sex wise)

Age (in Years)	Boys	Girls
11	3.7531	3.7378
12	3.6631	3.6857
13	3.7108	3.6598
14	3.6379	3.6627
15	3.6346	3.6896
16	3.6624	3.6539

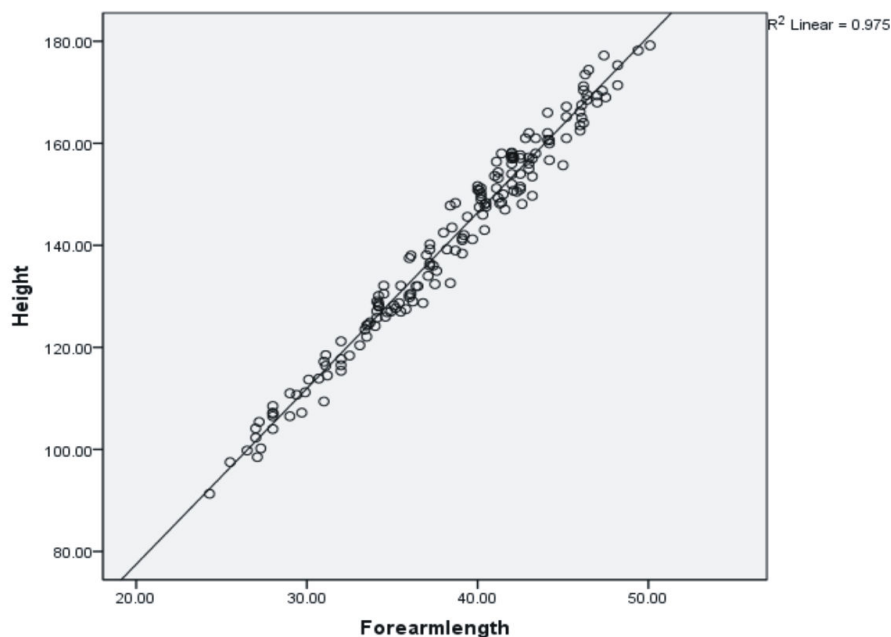
Discussion

The forensic anthropologists and medical experts generally encounter a complication while dealing with dismembered bodies or those recovered in extremely decomposed or skeletonised form. Thus estimation of stature is an important parameter in medico-legal examination and anthropological studies.[10] Morphology of forearm length helps in estimation of stature therefore the study was carried out to investigate the relationship between stature and forearm length.

The average height of males within a population is significantly higher than that of females 2, 3, 8. The results obtained in this study also show the same result. Variety of factors such as, age, race, gender and nutritional status affect human development and growth and therefore, different nomo-grams are required for different populations.[9,19]

It is observed in the present study that, the axial growth is proportion to the growth of

Fig 3: Scatter Plot and Regression Line Demonstrating the Relationship between Measured Height and Measured Forearm Length



the upper limbs, especially to the forearm. The values are not following any particular pattern but, there is a range of 3.6 to 3.7; which is coming as multiplying factor to the measured fore-arm length to estimate the stature of a person in the puberty age group. In our study, the correlation coefficient was found to be statistically significant indicating a strong relationship between hand length and stature for Males and females respectively. It is recommended that similar studies on different age groups should be carried out to complement the results of the present study.

Conclusion

Estimation of stature is of paramount importance to forensic experts and anthropologists. There is a strong relationship between stature and forearm length. In this study there is a definite relation existing between the height and the forearm length. Axial and skeletal growths go hand in hand, provided there are no significant factors coming in the way of physical development. Some words of caution should be given when estimating stature. Human's of the same population vary in body

proportions, even individuals are known to have same stature. This means that for every given stature, there are individuals with long trunks and short extremities or short trunks and long extremities, although the proportions are centered on mean population values. In general, higher the correlation between the measurements and the stature, the more accurate an estimate of the stature may be. There are lot of variations in estimating stature from fore-arm length measurement of people of different regions and races. So, there is a need to conduct more studies among people of different regions and ethnicity so that stature estimation becomes more reliable and identity of an individual is easily established.

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