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# Estimation Of Stature From Head Length and Head Breadth-A Cross Sectional Study

Research Article

Palak Shah[1], Lakshmi Thangavelu[1*]

[1] Department of Pharmacology, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, India.

## Abstract

Stature is an important biological parameter in medico-legal examination. This includes the determination of species of origin, age, sex and stature from the bones. It occurs when highly decomposed or mutilated fragments are brought to the medico-legal examination. Sometimes only the skull of the human is brought to the examination and helps in the estimation of stature. Among the common questioner of medico legal examination e.g. age, sex, race, etc, estimation of stature becomes equally important in such cases. The aim of this study was to estimate the stature of human from the head length and the head breadth. This prospective study was done in department of Anatomy, Saveetha Dental College, Chennai located in Southern India. It was carried out in September 2015. A total of 100 young and healthy individuals comprising of 73 girls and 27 boys were selected for the present study. Anthropometric methodology: The stature and then head measurements of each subject were taken by using standard anthropometric instruments, in centimetres, to the nearest millimetre according to the technique described by Vallois. Descriptive statistics for height, head length, head breadth. (Male = 27; Female = 73). Head length: The regression equation generated showing the correlation between the height and the head length: Height = 2.306 (Head length) + 119.324 (R2 - 0.042) Head breadth: Theregression equation generated showing the correlation between the height and the head breadth: Height = 1.701Head breadth + 136.385 (R2 - 0.010). From this study, it can be concluded that the stature can be estimated from head length and the head breadth of the South Indian population.

**Keywords:** Estimation; Stature; Head Length; Head Breadth; South India.

## Introduction

Stature or standing height is defined as the distance the head vertex and the standing surface. Because it provides one piece of information that may be an aid in individual identification, stature prediction occupies a central position in anthropological research and forensic identification analysis in the events of accidents, murders, genocide or natural disasters. It occurs many a times when highly decomposed or mutilated bodies or fragmentary remains of skull are brought for medico-legal examination. Sometime only skull is brought for examination and this is most common in our region whereVictims are attacked by wild animals in deep forests. In such situation it becomes difficult to identify deceased.

Since all these parts of the body and bones are not always available for forensic examination, it becomes necessary to make use of other parts of the body like head and face region. But only a few studies have been conducted on cephalo - facial region with respect to estimation of stature. In identification of human remains, forensic anthropologists help to interpret evidence pertaining to manner or cause of death. Marks on bones provide very important information's to how death occurred. With all evidence of skeleton trauma, it is imperatives recognized and distinguish among the ante mortem, perimortem (around the time of death) postmortem (after death). There are a few studies for stature estimation from skull alone. It is proved that each race requires its own formula for stature estimation. Racial and ethnic variations also exist in population of different geographical areas. Marks on the bone provide a very important information to know how the death occurred. Therefore, this study was undertaken from maxillo-facial anthropometry using head length and the head breadth and formulate regression models for this purpose.

***Corresponding Author**:
Lakshmi Thangavelu,
Department of Pharmacology, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, India.
Email Id: Lakshmi@saveetha.com

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Among the common questionnaire of medico legal examination e.g. age, sex, race, etc, estimation of stature becomes equally important in such cases. There is definitive biological correlation of stature with all the body parts such as extremities, head, trunk, vertebral column etc. There are variations in the length of limb bones relative to stature and according to race, sex, age, side of the body, climate, heredity and nutrition [1]. Whenever the body is recovered in mutilated or fragmented state, the problem of identification of the person is difficult even by the most experienced forensic experts. The mutilation of dead body is done by a criminal who wants to destroy all the traces of identity and to facilitate the disposal of dead body. Height is fundamental to assess growth, nutrition, calculating body surface area and predicting pulmonary function in childhood.

There are a few studies for stature estimation from skull alone. It is proved beyond doubt that each race requires its own formula for stature estimation. The climate and dietary habits of the people of different regions of India are variable. Racial and ethnic variations also exist in population of different geographical regions. Hence opinions based on the result of studies done in one population cannot be entirely applicable to other population [2]. Many studies have been conducted on stature from percutaneous measurements of various body part including arm, leg, feet, etc [3-6]. Considering this scenario there is a need of systematic study for stature estimation from fragmented and dismembered skull remains.

Since there are few studies in the existing literature which assesses the stature of the individuals using head length and head breadth in a particular ethnicity, it warrants studies in the research focus. This can be utilized in the field of forensic odontology and it can aid in identification of individuals who have succummbed to catastrpohic incidents or genocide or natural disasters. Therefore the present study was undertaken to determine stature from maxillo-facial anthropometry using head length and head breadth in the South Indian population.

## Materials and Methods

This prospective study was done in the Department of Anatomy, Saveetha Dental College and Hospital, Chennai located in Southern India. This study was approved by the Institutional Review Board of the University. It was carried out from September 2015 to December 2015. A total of 100 young and healthy individuals comprising of 73 girls and 27 boys were selected for the present study.

### Anthropometric Methodology

The stature and then head measurements of each subject were taken by using standard anthropometric instruments, in centimetres, to the nearest millimetre according to the technique described by Vallois.

**Stature:** The stature was measured in standing position to the vertex in Frankfurt plane by using anthropometric rod.

**Head Length (HL):** The distance between the glabella and farthest projecting point in the mid-sagittal plane, on back of the head (Occiput). The later is termed as the Opisthocranion. Glabella is the most forward projecting point in the midline of the forehead at the level of supraorbital ridges and above the nasofrontal suture.

**Head Breath (HB):** The greatest transverse diameter on the head is from euryon to euryon. Euryon is bilaterally paired point that forms the terminus of the line of greatest breadth of the skull. Not a fixed point but determined with calliper.

The height of the individual was measureed using a standard height measuring frame.

## Results

The statistical analysis was performed using the SPSS software (Macros version). The descriptive statistics for height, head length and head breadth. (Male = 27; Female = 73) has been depicted in [Table 1]. The mean measurement for height is 161.99. The maximum height of the population was found to be 185cm while the minimum height for the population was 142cm. The mean head length was seen to be 18.501, and the maximum and minimum head length was 20.9cm and 16.3cm respectively. Had length means was found to be 15.05. The maximum head breadth was 16.5cm and the minimum head breadth was 14.1cm.

### Head Length

The regression equationgenerated showing thecorrelation between the height and the head length was found to be:

Height = 2.306 Head length + 119.324 ($R^2$ - 0.042)

### Head Breadth

The regression equation generated showing the correlation between the height and the head breadth:

Height = 1.701 Head breadth + 136.385 ($R^2$ - 0.010)

## Discussion

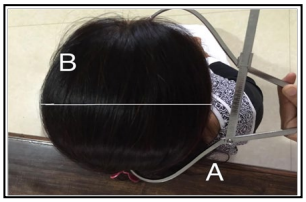
An accurate estimation of stature for the purpose of identification has a significant forensic importance. The findings of our study. Several studies reported various statures for other ethnic groups and nations across the world. Mean stature of Ijaw males is 175.1 cm and that of Ijaw female is 166.3 cm, while the mean stature of Ikwerre male is 164.5 cm and that of Ikwerre female is 156.4 cm [7]. Adult Urhobo male has an average height of 172.5 cm and an adult Urhobo female has an average height of 161.7 cm [8]; while the mean stature of adult Ibo male is 167.6 cm and that of Ibo female is 163.2 cm [9].The mean stature of Turkish adults is 174.4 cm (males) and 160.9 cm (females); that of Sri Lankans is 170.1 cm (males) and 157.6 cm (females) [10]; male Montenegrins are 183.2 cm tall while female Montenegrins are 168.4 cm tall making Montenegro the second tallest nation in the world after Netherlands (male 183.8, female 170.3) [11].

Mean stature for populations of adults, therefore, varies from minimum values for the Efe Pygmies of Africa at 144.9 cm for men and 136.1 cm for women to the maximum values for the Dutch of Europe at 184.0 cm for men and 170.6 cm for women

**Table 1. Descriptive statistics for height, head length and head breadth.**

| Measurement | Mean (cm) | Maximum (cm) | Minimum (cm) |
|---|---|---|---|
| Height | 161.99 | 185 | 142 |
| Head length | 18.501 | 20.9 | 16.3 |
| Head breadth | 15.05 | 16.5 | 14.1 |

**Figure 1. Measurements using a spreading calliper.**




A : Head Length
B: Head Breadth

[7]. Though works concerning estimation of stature from long bones as well as from certain body dimensions have been put forward for some of the Indian population, works concerning estimation of stature from cranial dimensions are scanty. Hence present study is an attempt to estimate stature from head length and head breadth. And also tried to final out any correlation between stature and head length & head breadth. This is study is very unful when only skulls is bought for examination. The findings in the present study indicate that Head length and Head breadth are positively and significantly correlated with stature similar observations on stature have been reported in other races [12].

Stature Head length and head breadth were significantly greater in males when compared with females which is in occurrence with Bardale and Dixit [12] found correlation coefficient of head breadth with height as 0.26 which was not coincide with our study (0.053) and standard error of estimate for regression formula on head breadth was 6.40 which is similar to our study (6.80). For female the correlation coefficient of head breadth with height was 0.23 and standard error of estimate was 5.81. The values of SEE and r for females are very much similar to our results. Study onmale Gujjars of India by Kewal Krishnan [13] showed that correlation coefficientfor head breadth in females was found to be 0.682 and SEE was 4.792. The regression equation given by themforstature estimation inmalesis 98.056 + 5.320 x Maximum head breadth. For highly correlated variates, regression equation can become practically useful for prediction and they are widely used in reconstruction formulae for stature, from the measurements of certain long bones [14].

Various workers have shown significant correlation between height and different parts of the body. Singh and Sohal, Jit and Singh have shown a significant correlation between height and length of clavicle. Charnalia, showed the significant correlation between height and foot-length, where correlation coefficient was 0.46. Athawale, derived a regression equation between total height and forearm bones. Shroff and Vare, have also derived the height from the length of superior extremity and its segments. It is stated that the racial characters are best defined in the skull. As a result cranial dimensions constitute one of the most important characters for determining the racial difference.

Variety of non-metric and metric parameters has been utilized in the assessment of ethnic and gender differences in craniofacial morphology. The non-metric parameters are subjective as no quantitative techniques are devised. On the other hand, features that can be expressed as actual measurements, like cranial dimensions, provide more objective racial and gender diversity assessment of the crania. Correlation coefficients between the total height and head length among population of Rajasthan were found to be statistically significant and positive indicating a strong relationship between the two parameters. Previous studies have shown correlation coefficients of 0.627, 0.53, & 0.52 between head length and height, where as in the present study it was 0.94 for males and 0.85 for females which is suggestive of strong positive correlation between these two parameters. Regression equations for their respective population were also derived by previous workers. Regression equations for stature prediction were formulated using head length and estimated statures in present study for study population and were compared with the actual statures to check the accuracy. The results further confirmed that head length provides an accurate and reliable means in stature prediction. In forensic examinations and anthropological studies, prediction of stature from incomplete and decomposing cranial remains is vital in establishing the identity of an unknown individual. Therefore, formulae based on the head length provide an alternative stature predictor under such circumstances. The cranium has easily identifiable surface landmarks making the measurements possible even in compromised conditions.

Stature is one of the most commonly used criteria in studies on body structure [15]. Measurement of body height is important in many settings: it is an important measure of body size and gives an assessment of nutritional status as well as an important measure of determination of basic energy requirements, standardization of measures of physical capacity and adjusting drug dosage, and evaluation of children's growth, prediction and standardization of physiological variables such as lung volumes, muscle strength, glomerular filtration and metabolic rate [16]. It is also common knowledge that exact body height cannot always be determined through direct measurements because of various deformities of the extremities or in patients who have undergone amputations or similar injuries. Measuring stature can also be difficult in physically and mentally frail nursing home patients, e.g. patients that are wheelchair-bound or bedridden and those with osteoporosis, sequelae after hip fractures, or stroke. In such circumstances, an

estimate of body height has to be derived from other reliable anthropometric indicators important and useful anthropometric parameters which is seen.

There is no data in literature to compare the correlation coefficients between age-height, age head length, age-head breadth and age-head height. The differences in relation to cranial dimensions observed in males and females may be used in determining sex and may be due to populations of different geographical areas.

Sexual dimorphism is an important component of the morphological variation in biological populations. The sex divergence in cranial morphometry observed in present study supports the previous observations. As rate of skeletal maturity in males and females vary during the course of growth and development, there is need for alternative formulae for genders.

In forensic examinations and anthropological studies, prediction of stature from incomplete and decomposed cranial remains is vital in establishing the identity of an unknown individual. Therefore formulae based on the cranial dimensions provide an alternative stature predictor under such circumstances. Data can be used in conjunction with other anthropological techniques to sex and race determination of unknown individuals. Variety of factors such as age, race, sex and nutritional status affect development and growth and therefore different normograms are required for different populations. The present study has documented such norms for cranial dimensions and presented gender specific linear regression lines for stature and age prediction in adult Indian population. Thus population, sex and age specific regression lines will be of immense use in medico-legal, anthropological and archaeological studies.

Frutos conducted a study based on 118 complete humeri from Guatemalan forensic sample. He studied six anthropometric dimensions and concluded that the classification accuracies for the univariate functions range from 76.8% to 95.5% and for stepwise function procedure was 98.2%. Kemkes-Grottenthaler 60 evaluated the reliability of patella anthropometry in sex determination in a material from different archaeological samples [17]. He achieved almost 84% accuracy in sex determination. Patil and Mody conducted a lateral cephalometric study on central Indian population to devise a model for determination of sex. They took ten measurements on the radiographic cephalograms of 150 normal healthy individuals and determined sex by discriminant function analysis.

## Conclusion

We conclude that the stature can be estimated from head length and the head breadth. Of the South Indian population. Besides this, age of the individual can also be estimated through regression lines using data on cranial dimensions. Thus data provided in the present study will of paramount importance to anthropologists to find racial differences when only parts of deceased or Indian any where in the world are available and may be key to sex determinatione can be estimated from the head length and the head breadth.

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