



## ESTIMATION OF STATURE BY CEPHALIC ANTHROPOMETRIC MEASUREMENTS IN CHHATTISGARH REGION

### Anatomy

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### ABSTRACT

**Introduction:** Stature is an important parameter when determining the identity of a deceased individual while conducting a forensic investigation. Estimating stature from different body parts becomes imperative in cases where whole body is not available in various scenarios such as mass disasters. **Material and Methods:** The present investigation was conducted to study correlation between anthropometric measurements of maximum head length, maximum head breadth and horizontal head circumference with the stature. Data for the study was obtained from 248 students from Pt. J.N.M. Medical college Raipur. The mean age of the male participant was  $20.28 \pm 1.40$  while in females it was  $20.51 \pm 1.33$ . Height of the participants, maximum head length, maximum head breadth and horizontal head circumference were measured following standard protocols using stadiometer, spreading caliper and measuring tape. **Result:** all anthropometric parameters measured were equally highly significant in male and female participants ( $P < 0.003$ ). Significant relationships were established between stature, maximum head length, maximum head breadth and horizontal head circumference in both genders. Multiple linear regression analysis of maximum head length, maximum head breadth and horizontal head circumference generated predictive equations with statistically significant ( $P < 0.001$ ) ability for height prediction. **Conclusion:** these results showed a significant correlation between stature and cephalic anthropometric parameters in both genders. Stature can be accurately predicted from a combination of these cephalic anthropometric measurements. This information can be valuable in forensic investigations and medicolegal cases involving the identification of body parts.

### KEYWORDS

stature, head length, head breadth, head circumference, anthropometry

### INTRODUCTION

Anthropometry in forensic involves the application of anthropometry in the identification of human remains and aims to establish distinguishing features at the time of death based on physical and skeletal measurements<sup>1</sup>. The "Big Four" of forensic anthropometry i.e., Ancestry, sex, age and stature of unknown human are the major challenges for any forensic investigator to estimate and to develop a biological profile.<sup>2</sup>

Stature estimation of intact bodies does not pose any problem. Whereas it becomes a great challenge when we must work with incomplete skeletal remains, dismembered human body parts and decomposing bodies. A proportional biological relationship of stature exists with every part of human body including head, face, trunk, extremities, etc., which plays a vital role in forensic examination to calculate the stature from dismembered and mutilated body parts<sup>3</sup>. Cephalometry is an important branch of anthropometry which involves measurements of the head and face. Cephalometry is helpful in forensic medicine, plastic and reconstructive surgery, orthodontics and clinical diagnosis. Also, craniofacial measurements are important for determining various head and face shapes<sup>4</sup>.

The aim of this study is to investigate cephalic anthropometric measurements, correlate it with stature and generate predictive equations with statistically significant ( $P < 0.001$ ) ability for height prediction.

### MATERIAL AND METHODS

#### Study Design:

Cohort This study was carried out on a cross sectional sample of 248 students (110 males and 138 females) without any physical deformities or previous history of trauma to the head with mean age of male participants being  $20.28 \pm 1.40$  and while of females being  $20.51 \pm 1.33$  years of the Pt.J.N.M. Medical college Raipur. Samples were drawn randomly across the student population, after giving informed consent to participate in the study.

The study collected data on the stature(S) of the participants as well as their cephalic anthropometric measurements namely, maximum head length(MHL), maximum head breadth(MHB) and horizontal head circumference (HHC) following the description of Reddy and Reddy.<sup>1</sup>

**Table 1 Anthropometric Measurements**

| Measured feature                    | Armamentarium used | Methodology                                                                                                                                                                                                                                                                      |
|-------------------------------------|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Stature(S)                          | anthropometer      | Participant made to stand on a horizontal platform with Heels together and to the ground Stretching upward to full extent Back as straight as possible Head adjusted to Frankfurt's horizontal plane Horizontal arm of anthropometer made in contact with the participant's head |
| Maximum head length(MHL)            | Spreading caliper  | Straight distance between glabella and opisthocranium                                                                                                                                                                                                                            |
| Maximum head breadth(MHB)           | Spreading caliper  | Maximum biparietal diameter Distance between the most lateral points of the parietal bones                                                                                                                                                                                       |
| Horizontal head circumference (HHC) | Measuring tape     | Maximum circumference of the head Measured from just above the glabella area to opisthocranium                                                                                                                                                                                   |





**Figure 1: Stature And Cephalic Measurements (a) S, (b) MHL, (c) MHB, (d) HHC**

The Cephalic dimensions were analyzed using SPSS Statistics v.19.0 (IBM, Armonk, NY, USA). The mean, standard deviation, and range were calculated for the Cephalic measurements, and comparisons were made between genders. Pearson's correlation coefficient was also used to analyze the data.

## RESULTS

The descriptive statistics for all the Cephalic measurements recorded in the sample are shown in the following tables. All the Cephalic measurements showed significant correlation with stature ( $P < 0.005$ )

**Table 2 :Descriptive Statistics Of Stature And Maximum Head Length Gender Wise**

| Parameters         | Stature                   | Maximum Head Length       | Stature                   | Maximum Head Length       |
|--------------------|---------------------------|---------------------------|---------------------------|---------------------------|
|                    | Male                      | Male                      | Female                    | female                    |
| Max                | 190.5                     | 21                        | 173.7                     | 19.5                      |
| Min                | 155.4                     | 5                         | 124.9                     | 16                        |
| Mean               | 171.46±7.28               | 18.83±0.86                | 156.70±7.05               | 17.85±0.59                |
| Standard Deviation | 7.2833                    | 0.86                      | 7.0516                    | 0.59                      |
| P value            | 0.000 (significant <0.05) | 0.000 (significant <0.05) | 0.000 (significant <0.05) | 0.000 (significant <0.05) |

**Table 3: Descriptive Statistics Of Stature And Maximum Head Length Gender Wise**

| parameters         | stature                  | Maximum Head Breadth     |                          | Maximum Head Breadth     |
|--------------------|--------------------------|--------------------------|--------------------------|--------------------------|
|                    | male                     | male                     | female                   | Female                   |
| max                | 190.5                    | 17                       | 173.7                    | 15.5                     |
| min                | 155.4                    | 13                       | 124.9                    | 12                       |
| mean               | 171.46±7.28              | 15.82±5.64               | 156.70±7.05              | 14.27±0.63               |
| Standard Deviation | 7.2833                   | 5.64                     | 7.0516                   | 0.63                     |
| P value            | 0.000(significant <0.05) | 0.002(significant <0.05) | 0.000(significant <0.05) | 0.002(significant <0.05) |

**Table 4 Descriptive Statistics Of Stature And Horizontal Head Circumference Gender Wise**

| Parameter          | Stature                   | Horizontal Head Circumference | Stature                   | Horizontal Head Circumference |
|--------------------|---------------------------|-------------------------------|---------------------------|-------------------------------|
|                    | Male                      | Male                          | Female                    | Female                        |
| Max                | 190.5                     | 60                            | 173.7                     | 57                            |
| Min                | 155.4                     | 51                            | 124.9                     | 50                            |
| Mean               | 171.46±7.28               | 55.22±6.29                    | 156.70±7.05               | 52.92±1.41                    |
| Standard Deviation | 7.2833                    | 6.29                          | 7.0516                    | 1.41                          |
| P value            | 0.000 (significant <0.05) | 0.000 (significant <0.05)     | 0.000 (significant <0.05) | 0.000 (significant <0.05)     |

The following relationship derived from above data

1.  $S = 8.92 \text{ MHL}$
2.  $S = 10.9 \text{ MHB}$
3.  $S = 3.02 \text{ HHC}$

Where (S= Stature of the person, MHL= Maximum Head Length, MHB= Maximum Head Breadth, HHC= Horizontal Head circumference)

## DISCUSSION

Most of the time, forensic experts must deal with unidentified deceased or mutilated remains. In such instances, identification of the deceased or remains is one of the primary and most crucial elements of the investigation. Many factors need to be studied and considered to make

a positive identification. Determination of sex and stature plays a pivotal role in establishing identity. Half the identity is established when the sex and the stature is acquired.

Clear and comparable biological correspondence is present to the stature with every part of the body. Anthropologists and forensic scientists estimate stature from the measurement of long bone lengths or other parts of the body. For more than a century, anthropometric approaches to measure bone length or a part of the body in living and dead have been employed to estimate stature.

In the present study, correlation between Cephalic measurements and stature has been done. There are a few studies for correlating stature from cephalometry or craniometry. In 1981, Saxena et al<sup>5</sup> correlated between head length and stature for males aged 25-30 yrs in Uttar Pradesh. The correlation coefficient between stature and head length being + 0.204.

Similarly in 2004 Jadav et al<sup>6</sup> showed positive correlation between head length and height with correlation coefficient + 0.532. This study included both sexes aged between 17-22 years. In both the studies discussed above the correlation coefficient was not derived separately for males and females whereas in the present study it has been done so. In the present study, head length was measured in both the sexes between 17-25 yrs and correlation coefficient was measured to be 0.474. Isurani Ilayperuma et al<sup>7</sup> (2010) estimated stature from the cranial dimensions like head length, head height, head breadth and found that stature versus cranial dimensions is a positive correlation and is highly statistically significant which is in accordance with present study.

## CONCLUSION

The present study was done to correlate the stature of an individual using data derived with cephalic anthropometric measurements using correlation coefficients.

The following deductions were drawn:

- Males exhibit greater dimensions for the cephalic anthropometric measurements and the stature.
- The parameters are significantly and positively correlated to the stature.
- The present study observed that there exists sexual dimorphism regarding stature and the parameters.
- From the current study, the best parameter to estimate stature in cephalic measurements is Mean Head Length.
- There exists a population-based difference in stature and body dimension proportions and thus necessity of estimation of equations for different regions should be noted.

Thus, it is concluded that correlation between cephalic anthropometric measurements were found to be statistically significant and these anthropometric measurements showed inter-regional and gender variations. All the variables showed positive correlation with the stature.

It is also concluded that all the parameters can be used to measure stature. These indices will be beneficial in facial reconstruction surgeries, maxillofacial surgeries, and in forensic medicine, for estimating the stature and sex of an individual.

**Conflict Of Interest** – The authors declare that they have no conflict of interest.

**Ethical Approval:** The study was approved by the Institutional Ethics Committee

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