

# **Original Research Article**

# AN ANTHROPOMETRIC STUDY ON DERIVING STATURE FROM HEAD CIRCUMFERENCE

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#### ABSTRACT

**Background:** Establishment of stature confines the process of identification in the investigation of a crime if any human body is found unidentified. Forensic experts often need to help the police in their investigation to establish the identification of victims. Estimation of stature by the measurements of head circumference has significant role in establishment of identification of the individual.

**Materials and Methods:** A cross sectional study was conducted in the department of forensic Medicine, SV Medical college, tirupati, analysing 120 individuals aged between 18 years and 25 years. Head circumference and stature of each individual was measured and correlation coefficient and linear regression equation was derived separately for both genders.

**Results:** Among 120 individuals studied, 60 were females and 60 were males, with an equal male to female ratio. The overall correlation coefficient was found to 0.546 showing a moderately positive correlation between head circumference and stature. The correlation coefficient was 0.302 for females with a weak positive correlation and for males was 0.55 with a moderate positive correlation. Linear regression equation calculated for overall study population was y=35.61+2.49x. in females was y=104.876+0.958x and males was y=56.118+2.077x; where y is the stature of the individual and x is the head circumference.

**Conclusion:** The study found that correlation coefficient has a moderately positive significance in overall participants.

Keywords: Head circumference, stature, correlation coefficient.

# **INTRODUCTION**

The term 'stature' originated from Latin statura, meaning height or size of the body, and from the Latin verb stare, meaning to stand: stature relates to natural standing height of a living individual. In the context of Forensic Anthropology, it forms part of the biological profile of an individual in the identification process.<sup>[1]</sup>

Anthropometry is a biological science deals with systematic measurements and proportions in human body. Stature is an important anthropometric factor in the field of identification in forensic speciality.

Establishment of stature confines the process of identification in the investigation of a crime if any human body is found unidentified. Forensic experts often need to help the police in their investigation to establish the identification of victims. Estimation of stature by the measurements of head circumference has significant role in establishment of identification of the individual.

There are been several studies regarding the estimation of stature from various parameters including measurement of circumference of head. And in all those studies, each researcher has derived at his own formula for estimation of stature particularly height of the individual by measurement of circumference of head.

The physiological relationship between body height and every component of the body of a person including head face trunk and some feet is clear and proportionate.<sup>[2]</sup>

## **Objectives**

- To determine correlation between stature and head circumference in individuals aged between 18 and 25 years.
- To determine correlation between stature and head circumference in males and females separately.
- To derive a linear regression equation for estimation of stature from head circumference in both genders separately.

# **MATERIALS AND METHODS**

Study design: A Cross-sectional study.

Study population: The study will be conducted in Department of Forensic Medicine, Sri Venkateswara medical college, Tirupati among individuals aged between18-25 years.

#### **Inclusion criteria**

Individuals aged 18-25 years who have consented for the study.

#### **Exclusion criteria:**

Below 18 and more than 25 years.

- Individuals with craniofacial abnormalities
- Individuals with skeletal deformities.

# Sample size: 120 individuals

Method of Data Collection: Data for this study will be collected from willing participants after obtaining written informed consent. Stature will be measured in erect standing posture using a stadiometer. Head circumference will be measured from glabella to glabella, passing through the occipital protruberance and supra-orbital ridges, using a measuring tape

Data analysis methods: A master chart prepared, incorporating above readings. Correlation coefficient was calculated for both genders and a linear regression equation derived using Microsoft excel for both genders separately as well as for overall population.

# **RESULTS**

A total of 120 subjects were examined, of which, 60 were males and 60 were females, which are represented in [Table 1], [Figure 1 and Figure 2].

Table 1: Sex wise distribution of cases.				
S no.	Sex	Number of cases		
1.	Males	60		
2.	Females	60		
3.	Total	120		









Table 2: Mean and SD of variables measured.							
S no.	Variable	Male		Female		Total	
		Mean	SD	Mean	SD	Mean	SD
1.	Head circumference	56.05	1.73	54.2	1.99	55.13	2.06
2.	Stature	172.53	6.55	156.63	5.72	164.58	10.02
3.	Age	20.88	1.46	20.02	1.07	20.45	1.34

The mean and standard deviation of the measurements of head circumference, stature and age were calculated and presented in the [Table 2]. Pearson's correlation test to determine the strength of relationship between stature and head circumference

is presented in [Table 3]. The results indicated a moderately positive correlation in males and a weak positive correlation in females.

Table 3: Correlation coefficient for variables measured					
Variable	Pearson's correlation coeffcient				
	Males	Females	Total		
Head circumference Vs Stature	0.55	0.302	0.546		

Stature was estimated from individual head circumference measurements using the linear regression equation; y=a+bx. Where, 'y' is the dependent variable being stature of the individual, 'a'

is the intercept and 'b' is the regression coefficient of the independent variable; 'x' is the head

circumference measurement. The data is represented in [Table 4].

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Table 4. Regression equation for overan study population and both genders					
<b>Regression equation</b>	Males	Females	Total		
y=a+bx	y=56.118+2.077x	y=104.876+0.958x	y=35.61+2.49x		

### DISCUSSION

Study conducted by R.A.Patil et al. shows highly significant correlation between height and head circumference. The equation relating stature to the head circumference was derived as stature, y=97.19+1.11HC for females and y=88.77+1.45HC for males while the present study determines the strength of relationship to be moderately significant; more so in males than females.<sup>[3]</sup>

Fozia bibi et al. conducted a study in female population of upper Punjab states that head length is a trust worthy predictor in estimating height,<sup>[4]</sup> however our study presented only a weak positive correlation between head circumference and stature in the female particiapants compared to males suggesting that possibility of other factors influencing the stature.

Divya Bharti et.al. conducted a study in Haryanvi population and observed that there was a strong positive correlation between height and head circumference while our study derived a moderate positive correlation between the variables, confirming the physiological relationship between head circumference and stature.<sup>[5]</sup>

Another study conducted by R.Prenetha.et.al. concluded that head circumference is a moderately reliable parameter for stature estimation in both genders,<sup>[6]</sup> which is congruent with our study with similar results.

A study by Bethi Manasa and Anagani Jayashree conducted on healthy adolescent college students aged between 18 to 25 years in Telangana state concluded a positive correlation coefficient of 0.34 between stature and head circumference,<sup>[7]</sup> while the present study concluded a moderately strong correlation of 0.546.

Study by Rajendra SM et.al. for estimation of stature from head circumference in central india brought out a significant correlation of 0.542 between stature and head circumference which is proximate with our study's correlation coefficient of 0.546. Their study also determined a low standard error of estimate, thus indicating a higher reliability and accuracy of head circumference for stature estimation.<sup>[8]</sup>

In a study on use of head circumference as a predictor of height of individual, conducted among Nepalese population by Mansur DI et.al.; a correlation coefficient of 0.443 for males and 0.302 for females was derived. The regression equation derived for males was y=71.69+1.648x and for females was 106.8+0.916x.<sup>[9]</sup> The observations of this study are similar to the values derived in the present study especially for females. In a study by Ilayperuma et.al. conducted in Sri Lankan cadavers aged between 55-89 years, on occipito-frontal circumference as a personal stature predictor concluded that it is a simple, cost effective, non invasive and objective method for personal stature prediction.<sup>[10]</sup> The correlation coefficient for males in their study was calculated to be 0.62 which is closer to the correlation coefficient of 0.55 in males of our study. However their study calculated a higher positive correlation coefficient of 0.86 in females while our study only provided a weak correlation coefficient of 0.302.

Ahmet RO et.al. conducted a study on adults in Isparta in Turkey on adult head circumference and centiles and concluded that pediatric centile charts were also appropriate for use in adults of either sex.<sup>[11]</sup> In their study, head circumference correlated with height in women with r = 0.12 and in men with r = 0.33 which was lower compared with our present study.

A study on teenagers aged between 13-19 years conducted in Nigeria on estimation of stature from cephalofacial parameters by P.U.Lukpata et.al. detected a significant positive correlation of 0.3857 between stature and head circumference in males; while other parameters like nasal height, nasal width and nasal index didnot reveal positive correlation with stature.<sup>[12]</sup> Hence the correlation coefficient of our study is in concurrence with their study.

# CONCLUSION

The present study concluded that there is moderately strong positive correlation between head circumference and stature. The slope for males (2.077) is steeper than for females (0.958), reflecting a stronger relationship between head circumference and stature in males. The moderate correlations (r2  $\approx$ 0.298 overall, 0.091 for females, 0.302 for males) indicate that head circumference explains only part of the variation in stature, with other factors likely influencing the stature. The findings of this study may be used for identification in cases of dismembered bodies, traumatic decapitation etc. As the physiological relationship between body height and every component of the body of a person is proportionate, when one of the parameters is known, the remaining variables can be estimated using regression formulae.

**Limitations of study:** The accuracy of these formulae is limited to specific population and hence a universal formula cannot be derived. As inferred by William PL et.al., the measurement of stature is also

affected by factors such as race, sex, age of the subjects etc.<sup>[13]</sup>

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