

# CORRELATION OF STATURE IN RELATION TO HEADLENGTH IN CHILDREN

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**Abstract:** Anthropometric measurements vary in different races, sex and age groups. Stature is one of the various parameters of identification. The objective of the present study was to correlate the head length and stature. The present study was conducted on 200 children from BEST residential school in Bellary. Height and head length were measured and Pearson correlation was used to see correlation. Head length and height are positively correlated among boys and girls and it is statistically highly significant. When both boys and girls were combined it also showed positive correlation which is statistically highly significant. This study shows that there is a strong association between height and head length. Simple regression equations generated from head length can be a supplementary approach for stature estimation when extremities are not available and will be useful for anatomists, archaeologists, anthropologists and forensic scientists.

**Keywords:** Stature; Height; Head Length; Anthropometry; Correlation.

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## I. INTRODUCTION

Anthropometry constitutes the means of giving quantitative expression to the variations which different individuals or traits exhibit<sup>1</sup>. It provides the scientific methods and the techniques for estimating various measurements and observations on living as well as skeleton of man.<sup>2</sup> Stature is one of the numerous data for identification. It is a measure of biological development and is determined by a combination of genetic and environmental factors.<sup>3</sup> Estimation of stature of an individual from the skeletal material or from the mutilated or amputated limbs or parts of limbs has obvious significances in the personal identification in the events of murder, accidents or natural disaster mainly concerns with forensic identification analysis.<sup>4</sup> Group specific works can be done when stature cannot be measured directly due to deformity like kyphosis, lordosis, scoliosis, contractures or missing leg.<sup>5</sup>

The height of an individual, when it cannot be estimated directly, as in bedridden, old or frail patients, or in patients who have limb and or vertebral column deformity; an indirect estimation can be achieved by correlating the height with other skeletal parameters.<sup>6</sup> Height estimation by measurement of various long bones and radiographic material has been attempted by several workers with variable degree of success.<sup>7</sup>

Height and other parameters (body segments) like upper extremity, lower extremity, hand length, foot length, forearm length, hand width etc are taken as variables. For regression analysis the variables have to be correlated and statistically significant. Hence height has to be correlated with the parameters. In the present study height is correlated with head length so that it can be used for regression analysis and hence formula can be derived.

Any part of body can be found as evidence and sometimes only head is brought for forensic exam after decapitation. Hence a need to investigate whether there is any possible significant correlation between stature and head measurements in human body. Although a number of long bones are used, cranial dimensions are more reliable and precise mean of predicting the stature in Indians.<sup>8</sup> The estimation of height from various parameters has been done by many workers but not much data is available in literature regarding the estimation of stature from head length in children. In the present study an attempt has been made to find out correlation between head length and stature in children.

## II. MATERIAL AND METHODS

200(100 boys, 100 girls) students from B.E.S.T. residential school Bellary whose age is between 8 and 12 yrs, studying in 3<sup>rd</sup> to 7<sup>th</sup> Standard verified from school records were chosen randomly after a brief history and clinical examination on proforma for sound health. Consent of school head master was taken for the same. The measurements were taken during fixed time of day to avoid diurnal variations.

Head Length, the straight distance from Glabella to opisthocranium was measured using spreading caliper. Height, the vertical distance from vertex to heel was measured using staturimeter in cms. Weight was collected to calculate BMI and assess the nutritional status of the student to include in the study.

Subjects beyond the age group, suffering from chronic diseases, malnutrition, any congenital abnormality affecting head and vertebral column deformity were excluded from the study.

### *Statistical Methods:*<sup>9,10</sup>

This is an analytical study to measure the association between variables Head Length and Height.

- **Pearson Correlation** has been used to find the degree of relationship between total body height and head length.
- **Student t test** (Two tailed, independent) has been used to find the significance of study parameters between male and female.
- **Student t test** (Two tailed) for correlation has been used to find the significance of degree of correlation.
- **Z test** has been used to find the significance of correlations between male and female.

## III. RESULTS

**Study Design:** A Cross-sectional study on 200 school children between 8 to 12 years of 100 boys and girls were taken to evaluate the correlation of body height and head length.

The proportion of children in each age group 8 years, 9 years, 10 years, 11 years, 12 years was equal for all being 20% in each.

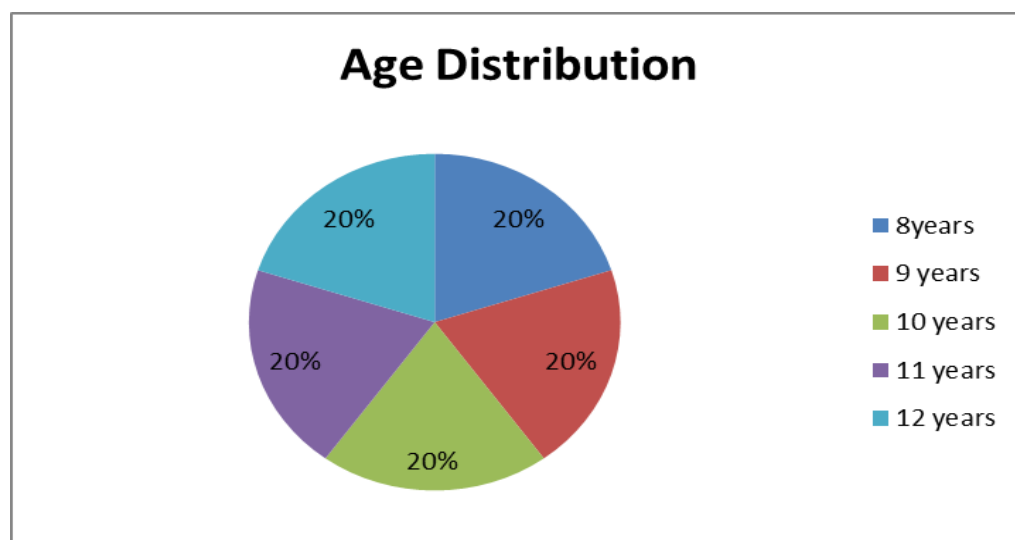


Figure 1

Among them boys are 50.0% and girls 50.0%

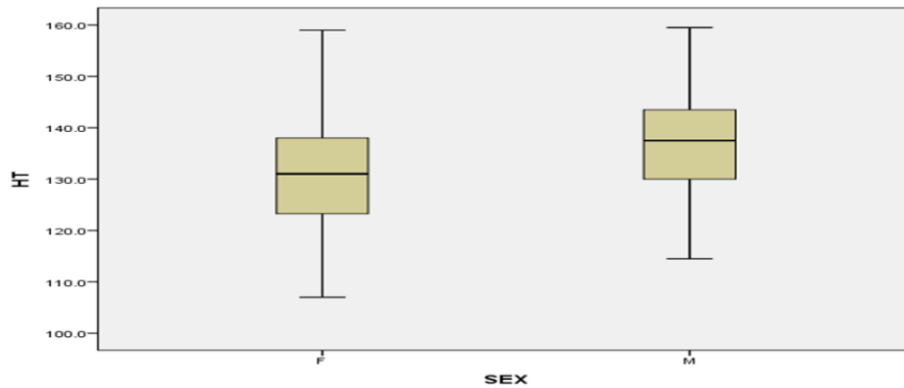
**Table 1 Comparison of Study Parameters between Boys and Girls**

Results are presented in Mean ± SD(Standard Deviation) (Min-Max)

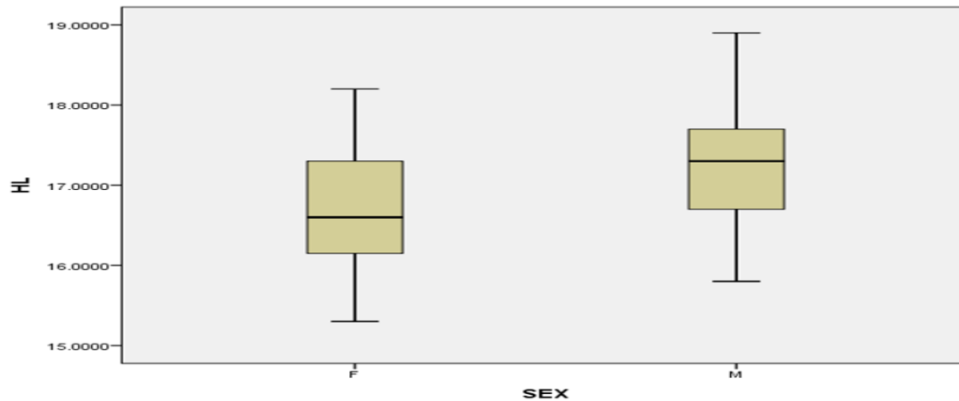
Study parameters	Boys	Girls	P value
Height (cm)	137.060± 9.235 (114.5-159.5)	131.450 ± 10.407 (107.0-159.0)	0.001
Head length (cm)	17.254± 0.746 (15.80-18.90)	16.70900 ± 0.723 (15.30-18.20)	0.001

Mean and S.D. of height in Boys = 137.06 ± 9.23, Mean and S.D. of height in Girls = 131.45 ± 10.40

Mean and S.D. of head length in Boys = 17.25 ± 0.74, Mean and S.D. of head length in Girls = 16.70 ± 0.72



**Figure 2** Box and Whiskers Plot Of the Distribution of Height of Boys and Girls

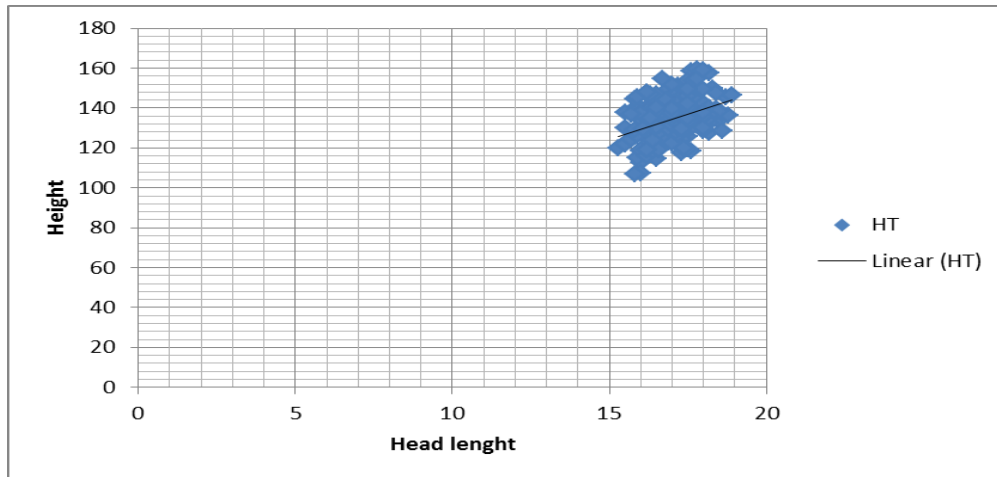


**Figure 3** Box and Whiskers Plot Of the Distribution of Head Length of Boys and Girls

**Table 2** Correlation of Head Length and Height

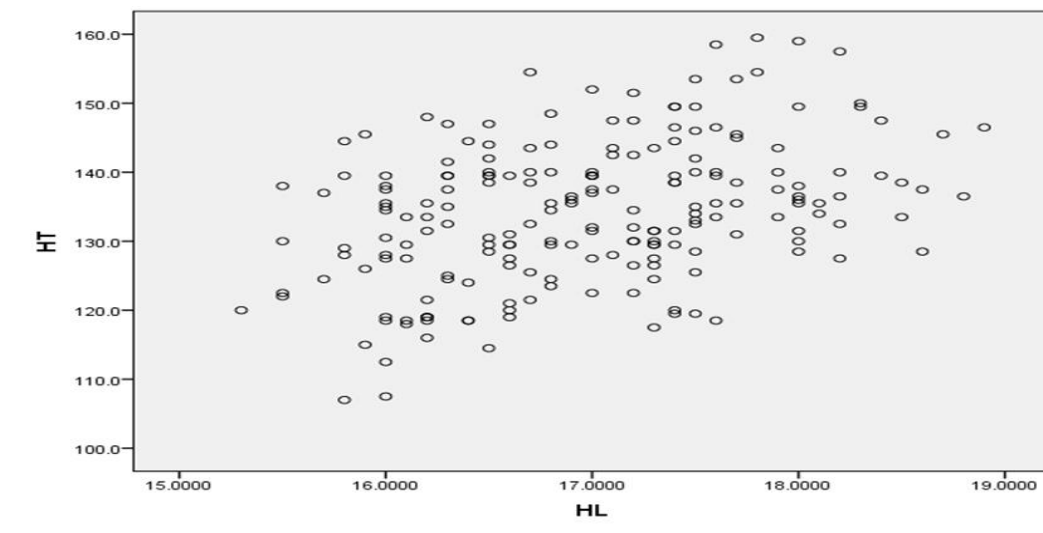
Variable	Pearson Correlation of Head length and Height	P value
Boys	0.204	0.021
Girls	0.416	0.001
Combined	0.390	0.001

1. There is a positive correlation of 0.204 between Head length and height among boys and is statistically significant.
2. There is a positive correlation of 0.416 between Head length and height among girls and is statistically highly significant.  $P < 0.01$ .
3. There is a positive correlation of 0.390 between Head length and height when combined and is statistically highly significant.  $P < 0.01$ .



$r = 0.390$   $P = < 0.001$   $N = 200$

**Figure 4** Correlations between Head Length and Height



**Figure 5** Scatter Diagram Representing Head Length And Height

#### IV. DISCUSSION

The stature of an individual mainly being genetically predetermined is an inherent characteristic, the estimation of which is an important assessment in identification. Height has been estimated from measuring various parameters of body, refining formulae. For regression analysis the variables have to be correlated and statistically significant. Here the variables are height and head length which was measured in 200 children. It can be observed from the tables and statistics that the head length is strongly related to height and a strong linear association between them. Boys and girls were considered both separately and as a whole. Correlation is significant in males and strongly significant in females and as a whole.

Apparently normal, healthy children with no physical abnormality were chosen randomly for the study. If any sampling error are likely, its due to physiological variations that occur invariably in humans caused by different ages, sexes, regions, environmental, genetic, familial and racial factors besides unidentified ones.

In 1981 Saxena et al studied head length and height for males aged 25-30 yrs in Uttar Pradesh where the correlation coefficient being + 0.2048.<sup>11</sup> Similarly in 2004 Jadav et al showed positive correlation between head length and height with correlation coefficient + 0.53.<sup>12</sup> In both the studies discussed above the correlation coefficient was not derived separately for males and females where as in the present study it has been done so. IsuraniIlayperuma (2010) found that height versus cranial dimensions is a positive correlation and is highly statistically significant.<sup>13</sup> In 2012 Sonali

Khanapurkar, Ashish Radke used multiple parameters foot length, hand length and head length to estimate stature of 1000 students aged 19-22 years. All the parameters correlate significantly with stature but foot length when combined with hand length in both the sexes depicts higher correlation co-efficients with stature than head length individually.<sup>14</sup>

Here coefficient between height and head length in boys, girls and all of them is shown in Table 2. The relationship between height and head length in all the cases (boys and girls) as well as independently of boys and girls are positively correlating. Figure 4 shows linear line in graph which justifies that height and head length are positively correlating. Figure 5 shows a scatter diagram for the same.

**Table 3** Comparison of Similar Previous Studies with Present Study

Workers	Age group	Correlation coefficient	Statistical significance
Saxena(1981)	25-30yrs	+0.2048	Significant
Jadhav H R (2004)	17-22yrs	+0.53	Significant
Harsh M P(2007)	8-12yrs	+0.45	Significant
Pawarsudhir(2010)	17-22yrs	+0.62	Significant
Seema(2011)	18-23yrs	+0.52	Significant
Syed HissamuddinUzair	21-48yrs	+0.66	Significant
Parth M. Pandya(2012)	8-18yrs	+0.3	Significant
Present study	8-12yrs	+0.39	Significant

## V. CONCLUSION

Body proportions and dimensions are widely variable with respect to age, sex and racial groups. The present study has shown the usefulness of head measurement in stature estimation of children aged between 8 to 12yrs belonging to Bellary and its surrounding.

Head length and height are positively correlated among boys with correlation coefficient of 0.20 which is statistically significant. Among girls also it is positively correlated with correlation coefficient of 0.41 which is statistically highly significant. When both boys and girls were combined it also showed positive correlation with correlation coefficient being 0.39 which is statistically highly significant.

As the study shows positive correlation which is statistically highly significant regression analysis can be done and equation can be derived. If either of the measurement (head length or total height) is known, the other can be calculated and this can be used practically in medico legal investigations and in anthropometry.

It is a non invasive, non time consuming and non expensive method, which does not need any specialized training hence, can be used by anyone. Out of the various parameters available for stature estimation, this appears to be equally accurate, less tedious and less cumbersome.

The availability of the head or part of the head or even a dry skull is enough to assess the stature of the individual from the formulae derived in this study. The method outlined above is simple, practical and gives reliable results and therefore it must be utilized and encouraged in day to day work.

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