A Study of relation between stature and ulnar length

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ABSTRACT
BACKGROUND: Identification is fixation of individuality of a person. Stature of a person is one of the vital parts of identification. The aim of this study was to develop a relationship between stature and ulnar length. After the age of 18-21 years, most of the people attain their maximum growth, dimensions of the skeleton remain unchanged and the ratio in size of different parts to one another is also considerably variable in different individuals. In case of fragmented/mutilated body, stature can be estimated on the basis of ratio of the different body parts. In this paper, attempts are made for the estimation of the stature of native of Gujarat state at GMERS medical college hospital, Valsad using “Percutaneous ulnar length” in year 2012-2013. Ulnar length was taken from olecranon process to ulnar head with the elbow flexed, hand semi pronated and in natural position.

Keywords: Stature, Vital parts, Ulnar length, Mutilated body, Olecranon process, Flexion, Pronation.

INTRODUCTION
Growth the vital process is measured by measuring the height of the person, which itself is a sum of length of certain bones and appendages of the body represent certain relationship with form of proportion to the total stature(1). Assessment of height from different parts of the body by anthropometric study of skeleton is an area of interest to anatomist, anthropologist and forensic experts (2). Various long bones have been employed for stature estimation using variety of methodologies (3,4,5,6). Establishment of alternative methodologies for personal height estimation is important for a number of reasons. Firstly, in instances where height estimates needed to be made from fragments of bones in archeological procedures or in forensic examinations after mass disasters or genocide. Secondly, estimates of pharmacokinetic parameters and evaluation of nutritional status rely on accurate measurement of not only body weight but also height.

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No universally applicable formula for stature estimation from the length of long bones is present. As the relationship between them is influenced by the race, sex and age of an individual. The ulna has easily identifiable surface landmarks which make the measurements possible in compromised postures.

MATERIAL AND METHOD
This study was done over the asymptomatic healthy medical students, on total 300 (Male 150+ Female 150) students of GMERS Medical College, Valsad, and Gujarat. Belonging to different socio-economic status. Who were 17 to 20 years of age. The subjects who had any deformity/ailment in either of the upper limbs and those who did not give their consent for participation in the study were not included in study. Informed consents were taken from each individual before including them as subjects in the study. The whole length of the subcutaneous border of the ulna is palpable down to the styloid process (7).

The vertex to the heel height (in centimetre) was measured for each subject with them in the standing erect posture and also bare foot and they were asked to look forward straight to the horizon, so that the Frankfurts’ plane remained horizontal. A ruler was placed on their heads tangentially, so that it could touch the highest point of his/her head. Then, with the help of a pencil, that level was marked
on the wall. With the measuring tape, the height of that point was measured from the floor level. Recorded by the same person to minimize the errors in methodology. The ulnar length was measured from the tip of the olecranon process to the tip of the styloid process, with the elbow flexed and the palm spread over the opposite shoulder with the help of the digital sliding caliper capable of measuring to the nearest 0.01 mm, on the right and the left sides consecutively. The measurements were always taken at a fixed time, between 3 – 5 pm, to eliminate discrepancies of diurnal variation.

After collection of data, they were subjected to statistical analysis for calculation of mean, standard deviation, standard error, correlation coefficient, regression coefficient, value of constant and t test for correlation coefficient applied to test the statistical significance using epiopen. The obtained values were used for the statistical analysis which was done by using the SPSS, version 12.0 software for the required analysis. The prediction of a significant relationship amongst the pair of variables was determined by the “Correlation coefficient” i.e., Pearson’s ‘r’.

The relationship between the changes of a dependent variable (say, y) and an independent variable (say, x) was ascertained by simple linear regression, with the “Regression coefficient (b)”; where the model of the regression equation was \( y = a + bx \) [where \( a = y \) intercept, when \( x = 0 \)]. As in every equation; a 95% confidence interval (which was equivalent to 1.96 standard deviation) was accepted and the standard error of regression (STE) was calculated. The final equation model was \( y = (a + bx) \pm (1.96 \times \text{STE}) \).

**RESULTS**

The observation were analysed separately for both right and left ulna in each sex on all subjects and results are tabulated. The mean ages of the study subjects (male 17.212 ± 2.25 and female 17.302 ± 2.21) were not significantly different between genders. Gender differences in mean height and length of ulna were found to be highly significant (\( P < 0.05 \)). Mean ulna lengths of the male were significantly larger than that of the females of all ages. Statistical analysis indicated that bilateral variation was insignificant for the measurements of ulna length in both sexes.

**Table: 1 Male Students**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Mean</th>
<th>SD</th>
<th>Range (in cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height</td>
<td>169.82</td>
<td>4.78</td>
<td>162-175</td>
</tr>
<tr>
<td>Ulnar length (R)</td>
<td>27.81</td>
<td>2.02</td>
<td>25.5-30.5</td>
</tr>
<tr>
<td>Ulnar length (L)</td>
<td>27.79</td>
<td>2.03</td>
<td>25.5-30.5</td>
</tr>
</tbody>
</table>

**Table: 2 Female Students**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Mean</th>
<th>SD</th>
<th>Range (in cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height</td>
<td>164.78</td>
<td>4.18</td>
<td>156-169</td>
</tr>
<tr>
<td>Ulnar length (R)</td>
<td>24.80</td>
<td>1.92</td>
<td>22.5-26.5</td>
</tr>
<tr>
<td>Ulnar length (L)</td>
<td>24.70</td>
<td>1.80</td>
<td>22.5-26.5</td>
</tr>
</tbody>
</table>

**Table: 3 Pearson’s correlation coefficient**

<table>
<thead>
<tr>
<th>Subject</th>
<th>Correlation Coefficient(r)</th>
<th>Coefficient of determination (%)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>0.61</td>
<td>41</td>
<td>( p &lt; 0.01 )</td>
</tr>
<tr>
<td>Female</td>
<td>0.64</td>
<td>45</td>
<td></td>
</tr>
</tbody>
</table>

**Table: 4 Linear Regression Equation**

<table>
<thead>
<tr>
<th>Subject</th>
<th>Correlation Coefficient(r)</th>
<th>Regression Equation</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>0.61</td>
<td>( Y = 92.51 + 1.63 \times X )</td>
<td>( p &lt; 0.01 )</td>
</tr>
<tr>
<td>Female</td>
<td>0.64</td>
<td>( Y = 99.45 + 3.16 \times X )</td>
<td></td>
</tr>
</tbody>
</table>

Gender differences in mean height and ulna length were found to be highly significant (\( P < 0.0001 \)). Mean ulna lengths of the male were significantly larger than that of the females for all ages (\( P < 0.0001 \)).

**DISCUSSION AND CONCLUSION**

Anthropometric characteristics have direct relationship with sex, shape and form of an individual and these factors are intimately linked with each other and manifestation of internal structure and tissue components which in turn are influenced by environmental and genetic factors (8). A number of common disabilities and disease processes make it difficult to accurately measure standing height in many patients (9). Results obtained from a study that attempted to reconstruct stature from ulna length in Hindu population in Gujarat state demonstrated a regression coefficient between height and ulna length to be +3.506 for males (5). The ulna length was proven to be superior to arm span measurement (10) and hand length (11) in predicting height. Ilayperuma et al derived...
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regression equations for stature estimation from length of ulna in both males and females in Srilankan population (11).

From the present study, it has been concluded that
1. Mean height and length of ulna is more in males than in females.
2. Gender differences in mean height and length of ulna were found to be highly significant (P <0.05)
3. There is positive correlation between stature and length of ulna.
4. Simple linear regression equation so far derived can be used for estimation of height in Gujarat.
5. If either of the measurement (length of ulna or total height ) is known, the other can be calculated.
6. This fact will be of practical use in Medico legal investigations and in anthropometry. Study would be useful for Anthropologist and Forensic Medicine experts.

REFERENCES