LENGTH OF EXTERNAL EAR: A TOOL FOR PREDICTION OF HEIGHT- STUDY IN WESTERN MAHARASHTRA POPULATION
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ABSTRACT

BACKGROUND
In medicolegal and forensic examination, estimation of stature is considered an important anthropometric parameter that defines physical identity of an individual. Therefore, present study was carried out to investigate the utility of estimating stature from length of external ear in western Maharashtra population and predict the accuracy of regression equation.

MATERIALS AND METHODS
The length of right and left external ear was measured by using vernier calliper and measurement of height of person done by using standard height frame. This study was carried on 102 males and 102 females with the age of 18 to 30 years.

RESULTS
Data were analysed by SPSS version 20. Mean and standard deviation of stature, ear length and correlation coefficient between ear length and stature was observed. A linear equation model for prediction of stature was generated from given measurement of external ear.

CONCLUSION
Present study showed significant positive correlation between ear length and stature from western Maharashtra population. Finally, it is concluded that length of ear can be used as an additional tool in estimation of nearly accurate stature. This study is useful in forensic anthropology and for medicolegal purpose to estimate the approximate height of the individual.

KEYWORDS
Age, regression equation, vernier caliper.

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BACKGROUND
Anthropology is the study of humans. Individuality of person means personal identification. Most useful anthropometric parameter is stature or body height that determines physical personal identity of an individual. Stature measurement is also essential for identification of skeletal remains and for comparison of different population. In anthropological research, stature prediction occupies central position for medical jurisprudence or for medicolegal experts.¹

Ears in humans are the defining feature of the face and its structure shows the signs of age and sex. Human ear consists of external, middle and internal parts. Pinna forms part of external ear. The lateral surface of pinna is irregularly concave and shows various prominences and depressions.²

Many studies have been carried out to estimate stature by measuring the length of long and short bones of upper and lower limbs and feet. A number of regression equations derived to determine stature from long bones.³⁻⁷

The present study was carried out to investigate the utility of estimating stature from length of external ear in western Maharashtra population and predict the accuracy of regression equation.

MATERIALS AND METHODS
Study subjects are 102 males and 102 females of Western Maharashtra origin, within age group 18-30 years irrespective of their caste, religion, dietary habits and socioeconomic status. The present study is aimed at predicting the stature from the length of both ears.

Vernier calliper, Anthropometer, data sheet, consent form. Subject with normal pleasing face with no any craniofacial abnormality, with no history of plastic or reconstructive surgery and any accidental injury to ears. Each subject was explained with the procedure and consent was taken.

Measurement of Height (stature)
Height is the vertical distance from vertex of the subject to the floor. During measurement subject was asked to stand erect, barefoot on a level floor and the feet parallel to each other. The anthropometer rod which was kept in the median sagittal plane of the subject. The reading was taken when the cross bar was touching the subject vertex.
Measurement of Ear Length

Measurement of ear length was taken according to standard landmark points defined by De Carlo et al (1998) and methodology was adopted from McKinny et al (1993) and Brucker et al (2003). Ear length was measured as the distance from the most inferior projection of the ear lobule to the most superior projection of the helix. All measurements were taken by a single investigator using vernier calliper in order to minimize bias. For each subject the measurements were carried out thrice to ascertain accuracy.

These measurements were compiled on master chart and in excel format and analysed using a statistical package for social sciences Version (SPSS 12). The mean and standard deviation of standing height and length of right and left ears and their average were derived from which their correlation coefficient with standing height was calculated. Regression equation for stature were derived from right and left ears and their average were derived from which their standard deviation and correlation coefficient with stature 0.920. (Table 3)

Ear Length

The length of right side ear found varied from 5.25 cm to 6.1 cm of males with mean value of 5.63 cm, standard deviation 0.258 and correlation coefficient with stature 0.950. The length left side ear found varied from 5.23 cm to 6.08 cm with mean value 5.62 cm, standard deviation 0.264 and correlation coefficient with stature 0.949. The average of length of right and left ears varied from 5.24 cm to 6.09 cm with mean value of 5.62 cm, standard deviation 0.261 and correlation coefficient with stature 0.949. (Table 2)

Similarly, the length of right side ear found varied from 5.23 cm to 5.84 cm of females with mean value of 5.55 cm, standard deviation 0.194 and correlation coefficient with stature 0.908. The length left side ear found varied from 5.19 cm to 5.99 cm with mean value 5.53 cm, standard deviation 0.217 and correlation coefficient with stature 0.933. The average of length of right and left ears varied from 5.21 cm to 5.91 cm with mean value of 5.54 cm, standard deviation 0.205 and correlation coefficient with stature 0.920. (Table 3)

The linear regression equation for estimation of stature were derived from the lengths of the right side, left side and average of both sides separately in male and female.

These were calculated as:

1. For male
   a. Right side: \( y = 44.61 + 21.15 \times x \)
   b. Left side: \( y = 45.72 + 19.4 \times x \)
   c. Average: \( y = 49.11 + 20.38 \times x \)

Where \( x \) is the length of ear. Stature were calculated by putting value of \( x \) in different situations and compared with actual standing height and were found close (+/- 6) in most of the cases. As in a male of 162 cm the length of right ear was 5.25 cm and the stature calculated by regression equation 67.98 + 18 X x was 162.48 cm which was 0.48 cm more than the actual standing height. Similarly, as in female of 152 cm the length of right ear was 5.23 cm and the stature calculated by regression equation 5.23 cm and the stature calculated by regression equation 67.98 + 18 X x was 162.48 cm which was 0.48 cm more than the actual standing height.
stature calculated by regression equation 44.61 + 21.15 X x was 155.22 cm which was 3.22 cm more than the actual standing height. (Table 4)

<table>
<thead>
<tr>
<th>Subject</th>
<th>Side</th>
<th>Regression equation</th>
<th>Ear Length cm</th>
<th>Standing Height cm</th>
<th>Calculated Stature cm</th>
<th>Variation in cm</th>
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</thead>
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<tr>
<td>Male</td>
<td>Right</td>
<td>67.98 + 18 X</td>
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<td></td>
<td>Max. 6.10</td>
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<td>162.20</td>
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<td></td>
<td>Max. 6.08</td>
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<td>178.36</td>
<td>-0.64</td>
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<td></td>
<td>Average of both</td>
<td>69.2 + 17.8 X</td>
<td>Min. 5.24</td>
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<td>162.47</td>
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<td>177.60</td>
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<td>Female</td>
<td>Right</td>
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<td>155.22</td>
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<td>Left</td>
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<td></td>
<td>Max. 5.91</td>
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<td>169.55</td>
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</tbody>
</table>

Table 4. Regression Equation and Variations in Calculated Stature

DISCUSSION
Many workers have studied on various parameters of long bones for measurement of stature. However, a practical difference arises in a situation where only dismembered body parts were available for medical examination like in mass disaster. So, it has been great interest to anthropologist to study the relationship that exists between different parts of the body and height.

Ear length is important in evaluation of congenital anomalies, facial reconstruction and in forensic purposes. Purkait R, Bozkir et al and Asai Y et al, where length of ear measurements (e.g. nose, mouth and ear measurements) act as a useful tool in absence of the other facial measurements (e.g. nose, mouth and ear examination as standards available are scanty.

Also, it has been a practical approach for estimation of stature when other parts of the body not available. The regression equation derived from right, left and average length of ears can be a supplementary approach for estimation of stature when other parts of the body not available. Also, regression equation derived in this study will be of potential use in clinical, medicolegal and anthropological studies.

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REFERENCES


