Characterization of Facial Anthropometrics and Correlation with Sexual Dimorphism in 18-25 Years South Indian Adult Population.

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Abstract: Background: The Facial anthropometrics have wide implications in determining the age, sex for identification in forensics and cosmetic pre-surgical assessments. The studies on comparisons of face indices with north and south Indian population were cited routinely but not within the south Indian population. Thus, the current study had attempted to characterise facial anthropometrics and correlate with sexual dimorphism. Aims/Objectives: To characterise the facial anthropometrics and correlate with sexual dimorphism in south Indian population. Methodology: An observational study was conducted on 200 subjects, recruited by convenient sampling after meeting the inclusion and exclusion criteria. The “Facial index” (FI) was calculated after measurement of face height (FH), Upper face height (UFH), Lower face height (LFH), Face width (FW) using digital vernier calliper. The facial anthropometrics and face types were evaluated for differences in male and females. The state of origin from south India was also evaluated for similar significant implications. The t-test and ANOVA or chi-square tests were used for statistical analysis as needed. Results: The study population of 200 subjects, 45% (n= 90) were males and 55% (n=110) were females. The FH (p<0.0001), FI (p<0.0001) and LFH (p<0.0001) were significantly different in males and females. The majority of the participants i.e 51.3% (n=102) were hyperleptoprosopic followed by 19% (n=38) of leptoprosopic and mesoprosopic variants. There is a statistically significant difference (p<0.0001) between both genders, upper facial height (p<0.0001) and lower facial height (p<0.0004) considering the face type. Conclusion: The facial anthropometrics and face form had significantly correlated with sexual dimorphism in the study. The FH, FI and LFH along with facial form can be used as reference for future studies in south Indian adult population in age range of 18-25 years.

Key Words: Facial indices, Anthropometry, Population, Facial height

Introduction: Human face is the anterior portion of the head extending from the forehead region to the chin area and between the ears. The shape of the face is basically determined by the underlying bones and by the distribution of fat under facial muscles.[1] The anatomical variations of the face serve as unique factors rendering differences between each individual face or a unique identity to a person’s face. The variations in craniofacial form between humans is largely due to differing patterns of biological inheritance.[1] The anthropometrics are assessments of face and skull for understanding the age, gender and ethnicity of origin for particular individual. These measurements were first done by Greeks as and other historians in renaissance period.[2-4] The Polycletus reported that the height of the face to 1/10 of the body and the whole head is 1/8th of it, which is one of the earliest attempts to understand anthropometrics. The ancient skull measurements can be found in modern clinical anthropology.[2] Modern anthropometry has wider applications today from medical identification in forensics/criminology, planning facial reconstruction/cosmetic or maxillofacial surgeries, and estimation of a person’s stature.[3] The science of comparative racial anthropometry has shown that there are consistent differences in the body proportions of various human races.[5] There is substantial evidence that each race has different gene pools and even genetically different subgroups that exhibit different behaviours, characteristics and peculiarities.[6,7] Anthropometric studies play an important role in distinguishing a pure race from the local mingling of races.[8] India has a heterogeneous population, which can be grouped basically into north and south based on geographical identity (Tropic of cancer).[9] The northern Indians have similarities in facial and physical dimensions which differ from.[3,9] South India is a conglomeration of different religious, linguistic and ethnic groups. The language, culture and traditions widely differ in Tamil (Tamil Nadu), Telugu (Telangana/Andhra), Malayalam (Kerala) and Kannada (Karnataka) states.[9] There is theory on Aryan influence (Telangana, northern Andhra and Karnataka) compared to true indigenous Dravidians (Tamil Nadu, Kerala) which may also count for some differences in facial anthropometrics which are never evaluated in studies. Also, each state in south represents specific groups which look different in terms of their physical characteristics and there seems to favour studies on that provide evidence of their facial metric values form each state.
Thus, the present study was aimed to characterise on the facial metrics and associate the same with sexual dimorphism in south Indian population.

Methodology:
Study settings:
The Observational study was conducted from 06/2017 to 07/2018 (a period of 12 months) at the Department of Anatomy of tertiary care hospital. A sample of 200 subjects, who recruited by convenient sampling were considered for the study after meeting the inclusion and exclusion criteria. The approval of the Institutional Ethics Committee was taken before initiating the study. The patients reporting to OPD of Vinayaka Missions Medical college hospital between the age group of 18-25 years were included for the study. The subjects who had any congenital deformity of face, trauma or disfigurement, those who have undergone any facial surgery were excluded from the study.

The data for the sample of 200 selected subjects were recorded in a private space after explaining the procedure of the study. The measurements were taken with the participants in a relaxed state with natural head position, using digital vernier calliper [UNIQUE VATIKA®, India] by single examiner.

Facial anthropometrics:
1. Morphological face height (FH) - Distance between nasion (The point on the root of the nose where the mid-sagittal plane meets the nasofrontal suture) and Gnathion (The lowest point on the lower border of mandible in mid-sagittal plane);
2. Upper face height (UFH) - Distance between Nasion and Subnasale (Point at which the nasal septum merges with the upper cutaneous lip in mid-sagittal plane);
3. Lower face height (LFH) – Distance between Subnasale and Gnathion;
4. Face width (FW) – Zygoma to Zygoma (Bi-zygomatic width)

All the measurements were taken in millimetres (mm) and tabulated.

The “Facial index” was calculated using the formula: Morphological face height divided by face width and multiplied by 100.

Face types:
The face types were classified as Hyperleptoprosopic, Leptoprosopic, Mesoprosopic, Europrosopic and Hypereuroprosopic as per Bannister’s classification.[10] The facial anthropometrics and face types were evaluated for significance of mean differences in male and females. The state of origin form south Indian was also evaluated for similar significant implications by statistical analysis.

Statistical analysis
Data was analyzed using R software (version 3.6.1). The categorical variables are depicted as range/ frequencies, while the continuous variables as mean ± standard deviations. The t-test and ANOVA were used as needed for intergroup comparisons; the chi-square test for evaluating the associations between the variables.

Results
The study population consisted on 200 subjects of which 45% (n=90) were males and 55% (n=110) were females. The various parameters measured in the current study were Face Height (FH), Face Width (FW), Face Index (FI), Upper face height (UFH) and Lower face height (LFH). The mean and standard deviation along with range of these measurements for the sample (n=200) of the study is shown in Table 1.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Range (in mm)</th>
<th>Mean ± SD (in mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face Height (FH)</td>
<td>49.9 – 133.1</td>
<td>107.4 ± 8.5</td>
</tr>
<tr>
<td>Face Width (FW)</td>
<td>85.0 – 140.6</td>
<td>112.1 ± 10.5</td>
</tr>
<tr>
<td>Face Index (FI)</td>
<td>57.16 – 125.36</td>
<td>96.71 ± 10.53</td>
</tr>
<tr>
<td>Upper face height (UFH)</td>
<td>19.2 – 80.3</td>
<td>48.1 ± 5.8</td>
</tr>
<tr>
<td>Lower face height (LFH)</td>
<td>30.0 – 81.4</td>
<td>59.3 ± 7.3</td>
</tr>
</tbody>
</table>

The parameters namely Face Height (p<0.0001), Face Index (p<0.0001) and LFH (p<0.0001) were significantly different in males and females (Table 2).

Table 2: Comparisons of various facial parameters with Gender (independent sample t test)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Male</th>
<th>Female</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>N (%)</td>
<td>Mean ± SD</td>
<td>N (%)</td>
<td>Mean ± SD</td>
</tr>
<tr>
<td>Face Height</td>
<td>90 (45%)</td>
<td>111.3 ± 9.4</td>
<td>110 (55%)</td>
</tr>
<tr>
<td>Face Width</td>
<td>90 (45%)</td>
<td>110.4 ± 10.6</td>
<td>110 (55%)</td>
</tr>
<tr>
<td>Face Index</td>
<td>90 (45%)</td>
<td>101.43 ± 11.05</td>
<td>110 (55%)</td>
</tr>
<tr>
<td>UFH</td>
<td>90 (45%)</td>
<td>48.4 ± 6.9</td>
<td>110 (55%)</td>
</tr>
<tr>
<td>LFH</td>
<td>90 (45%)</td>
<td>62.9 ± 7.8</td>
<td>110 (55%)</td>
</tr>
</tbody>
</table>

Considering the face type, the majority of the participants i.e 51.3% (n=102) were hyperleptoprosopic followed by 19% (n=38) of leptoprosopic and mesoprosopic variants. There is a statistically significant difference (p<0.0001) between both genders considering the face type (Table 3).

Table 3: Association between genders with face type (chi-square test)

<table>
<thead>
<tr>
<th>Face Type</th>
<th>Male (%)</th>
<th>Female (%)</th>
<th>Total (%)</th>
<th>Chi Square test</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hyperleptoprosopic</td>
<td>11 (5.5%)</td>
<td>27 (13.6%)</td>
<td>38 (19.1%)</td>
<td>36.628</td>
<td>0.0001</td>
</tr>
<tr>
<td>Leptoprosopic</td>
<td>9 (4.5%)</td>
<td>29 (14.5%)</td>
<td>38 (19.0%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mesoprosopic</td>
<td>2 (1.0%)</td>
<td>17 (8.5%)</td>
<td>19 (9.5%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Europrosopic</td>
<td>66 (33.2%)</td>
<td>36 (18.1%)</td>
<td>102 (51.3%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hypereuroprosopic</td>
<td>2 (1.0%)</td>
<td>3 (1.5%)</td>
<td>3 (1.5%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The majority of subjects were represented form Tamil Nadu i.e. 132 (66.0%), followed by Kerala 21.0% (n=42), Karnataka 10.5% (n=21) and 2.5% (n=5) from Andhra Pradesh. However, the place of origin from the south Indian state was not significant with face type in our study (Table 4).
The facial proportions and in identifying the race, age, gender and personal identity of a person. The Southern India, given the nature of variations in religious/linguistic or ethnic groups still has been considered as a union and to have distinct difference in facial forms and identities from northern India. [3] The language, culture and traditions widely differ in Tamil, Telugu, Malayalam and Kannada states. [9]

In a study conducted by Datta S et al involving people of Maharashtra, the mean facial height was 103.4±9.2 mm and mean facial width was 120.6±5 mm in males and 111.9±8.7 mm and 129±7.4 mm the findings are in line with the current study [11] Also, their study showed that facial height was more in male compared to female whereas facial width was more in females which coincides with present study. The present study showed the mean facial index higher than the previous studies done by Kumar et al [12] but lower than that of Prasanna et al.[13] The upper facial height and lower facial height measured in the present study coincides with the values given by LG Farkas for Indian males and females. [14]

The present study showed the common type of face was hyperleptoprospic in both males and females followed by leptoprospic which contradicts the Indian study done by Shetti et al on Indian students in which the dominant face type was found to be mesoprosopic in both male and female students and the least common type was hypereuriprosopic. [15] Likewise, Kalha et al in their study concluded that men of South Indian ethnic population have longer faces which coincides with the present study. [16] A study by Lakshmi Kumari et al found that males and females of Andhra Pradesh have leptoprospic and mesoprosopic type of face respectively as a dominant form. They also reported that hyperleptoprospic facial form was the least common face type which is highly contradicted in the present study with hyperleptoprospic being the most dominant type. [17] The state of origin has not been a significant factor in our study, however low representation form Andhra Pradesh state is to be noted here. The present study coincides with the findings of Mane et al who stated hyperleptoprospic was the dominant face type followed by leptoprospic, mesoprospic, europrospic and hypereuriprosopic. [18]

Considering gender variations, the current study showed significant differences between both genders in terms of facial parameters and type of faces. This is consistent other Indian studies. [13, 19] that had concluded that craniofacial parameters could be used as an important tool to assess sexual dimorphism apart from the ethnicity and gender of an individual. The values obtained for facial anthropometrics and facial forms can be used for future reference in south Indians. The facial Indias have wider applications apart from quoted forensic or orthognathic surgery planning. The midface height in children were linked to occurrence of congenital cardiac disorders and microdeletion on the long arm of chromosome 22 in south African study, which undermines the importance. [20]

The strength of the study lies in sample size and methodology while the lower sample representation forms some south Indian states was the drawback. The future directions include co-relation of the facial anthropometrics with possible larger samples from each southern state relating to occurrence of chronic disorders or outcomes of cosmetic surgery.

### Conclusion

The facial anthropometrics and face form had significantly correlated with sexual dimorphism in the study. The face height, Face index and Lower facial height along with facial forms can be used as reference for future studies in south Indian adult population of 18-25 years.

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**Table 4: Birth place with Face type distribution**

<table>
<thead>
<tr>
<th>Birth Place</th>
<th>Face Type</th>
<th>Lepto (%)</th>
<th>Meso (%)</th>
<th>Euro (%)</th>
<th>(Hyper-lepto) (%)</th>
<th>(Hyper-Euro) (%)</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tamil nadu</td>
<td>24 (12.0%)</td>
<td>22 (11.0%)</td>
<td>16 (8.0%)</td>
<td>69 (34.5%)</td>
<td>1 (0.5%)</td>
<td>132 (66.0%)</td>
<td></td>
</tr>
<tr>
<td>Kerala</td>
<td>7 (3.5%)</td>
<td>10 (5.0%)</td>
<td>2 (1.0%)</td>
<td>22 (11.0%)</td>
<td>1 (0.5%)</td>
<td>42 (21.0%)</td>
<td></td>
</tr>
<tr>
<td>Andhra Pradesh</td>
<td>1 (0.5%)</td>
<td>2 (1.0%)</td>
<td>0 (0.0%)</td>
<td>2 (1.0%)</td>
<td>0 (0.0%)</td>
<td>5 (2.5%)</td>
<td></td>
</tr>
<tr>
<td>Karnatak a</td>
<td>6 (3.0%)</td>
<td>4 (2.0%)</td>
<td>1 (0.5%)</td>
<td>9 (4.5%)</td>
<td>1 (0.5%)</td>
<td>21 (10.5%)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>38 (19.0%)</td>
<td>38 (19.0%)</td>
<td>19 (9.5%)</td>
<td>102 (51.0%)</td>
<td>3 (1.5%)</td>
<td>200 (100%)</td>
<td></td>
</tr>
</tbody>
</table>

Chi Square test $\chi^2$ = 8.867, p value = 0.714

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**Table 5: Association of UFH and LFH with face types**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>N (%)</th>
<th>LFH Mean ± SD</th>
<th>F</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lepto</td>
<td>38 (19.0%)</td>
<td>5.71 ± 0.61</td>
<td>10.112</td>
<td>0.0001</td>
</tr>
<tr>
<td>Meso</td>
<td>38 (19.0%)</td>
<td>5.62 ± 0.48</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Euro</td>
<td>19 (9.5%)</td>
<td>5.64 ± 0.41</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hyper Lepto</td>
<td>102 (51.0%)</td>
<td>6.21 ± 0.75</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hyper Euro</td>
<td>3 (1.5%)</td>
<td>4.95 ± 1.64</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total LFH</td>
<td>200 (100%)</td>
<td>5.93 ± 0.73</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>UFH</th>
<th>N (%)</th>
<th>LFH Mean ± SD</th>
<th>F</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lepto</td>
<td>38 (19.0%)</td>
<td>4.79 ± 0.42</td>
<td>3.989</td>
<td>0.004</td>
</tr>
<tr>
<td>Meso</td>
<td>38 (19.0%)</td>
<td>4.90 ± 0.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Euro</td>
<td>19 (9.5%)</td>
<td>4.61 ± 0.31</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hyper Lepto</td>
<td>102 (51.0%)</td>
<td>4.86 ± 0.64</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hyper Euro</td>
<td>3 (1.5%)</td>
<td>4.95 ± 1.64</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total UFH</td>
<td>200 (100%)</td>
<td>4.81 ± 0.58</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Discussion

The anatomical variations of the face serve as unique factor for the identification of a person. The variations are driven by biological inheritance and environmental factors. [1] The anthropometrics are assessments of face and skull having implications in medical identification, forensics, criminology and planning cosmetic maxillofacial surgeries. [3] India has people of diverse origin due to its cultural traits and diversity of genes. The anthropologists group the population based on origin, region to which they belong and mainly on the external appearance and features. The facial index helps in describing the facial height, Face index and Lower facial height along with facial forms can be used as reference for future studies in south Indian adult population of 18-25 years.
References