An anthropometric study of facial height among four endogamous communities in the Sunsari district of Nepal


ABSTRACT

Introduction: Facial anthopometry has well-known implications in health-related fields and has been utilised for forensic purposes in the past. It provides an indication of the variations in facial shape in a population. The facial anthropometric profile of a population can characterise the distinctive features of a likely face in that population. The present study aimed to examine the differences in facial height proportions and facial growth patterns in different communities in the Sunsari district of Nepal.

Methods: The upper facial height (UFH) and lower facial height (LFH) proportions of 857 subjects (429 male and 428 female) aged between three and 18 years old from four communities (Brahmin, Chhetri, Rai and Limbu) in the Sunsari district of Nepal were calculated, and comparisons were made.

Results: Significant differences (p is less than 0.05) in the UFH and LFH percentages were observed between the Brahmin and Rai, Brahmin and Limbu, Chhetri and Rai, and Chhetri and Limbu communities.

Conclusion: The study concluded that there is evidence of statistically significant differences of the upper and lower face height proportions among the different racial groups. A change in the facial height proportions of the various age groups was evident. However, differences in facial height proportions between male and female were found to be insignificant.

Keywords: anthropometry, cephalometry, facial ergonomics, Nepal, upper and lower face height

INTRODUCTION

Facial ergonomics deals with anatomical, physiological and psychological characteristics in a way that enhances human efficiency and wellbeing. It is an area of anthropometry that, in recent years, has become increasingly important in health assessment across many countries. It has ancillary importance in the determination of age, gender and race of an individual as applied in anthropology, archaeology, anatomy as well as in the forensic sciences.

Anthropometric studies play an important role in distinguishing a pure race from the local mingling of races. Facial anthropometric studies involving facial height have far-reaching implications in health-related fields. The science of comparative racial anthropometry has shown that there are consistent differences in the body proportions of various human races. Each race has different gene pools and even genetically different subgroups that exhibit different behaviours, characteristics and peculiarities.

In the past, facial anthropometry has been successfully utilised for forensic purposes by some scientists. However, only a few studies have been conducted on facial height proportions in different communities. The external physical appearance
is very important in the personal identification of any individual or race. Although Nepal is a relatively small country, it is a conglomeration of different religious, linguistic and ethnic groups. Although these groups look different in terms of their physical characteristics, there is no recorded data in the literature that provides evidence of their physical differences. Thus, the present study was designed to document the differences, if any, in facial height proportions and facial growth patterns among the Brahmin, Chhetri, Rai and Limbu communities in the Sunsari district of Nepal.

The objectives of this study were to compare facial height proportions among the four endogamous communities (Brahmin, Chhetri, Rai and Limbu) in the Sunsari district of Nepal in order to study population differences, among the male and female population in order to study gender differences, and among various age groups in order to study facial growth patterns.

**METHODS**

A total of 857 subjects (429 male and 428 female) aged between three and 18 years old belonging to the Brahmin (n = 201), Chhetri (n = 224), Rai (n = 208) and Limbu (n = 224) communities in the Sunsari district of Nepal participated in this study. The subjects were examined after informed verbal consent from their parents was obtained. Sunsari is a Terai (low flat land) district in southeast Nepal. It is densely populated with a wide range of ethnic groups. All four communities are endogamous (genetically homogeneous) in nature. The subjects were grouped based on their community, gender and age. A stratified random sampling method was adopted. Individuals with any cranio-facial abnormalities, growth-related disorders, genetic abnormalities, prolonged diseases such as congenital heart diseases, endocrine, renal and intestinal disorders, facial trauma, and those belonging to intermingling communities (i.e. children whose parents and grandparents had inter-caste marriages) were excluded from the study.

The landmarks in the study were defined as follows:

1. Nasion, the point on the root of the nose where the mid-sagittal plane cuts the nasofrontal suture;
2. Subnasale, the point at which the nasal septum merges with the upper cutaneous lip in the mid-sagittal plane;
3. Ganthion, the lowest point on the lower border of the mandible in the mid-sagittal plane.

The subjects were each made to sit on a wooden chair with a head rest. The anthropometric landmarks, the nasion (n), subnasale (sn) and ganthion (gn), were marked on the subject’s face. With the help of a sliding caliper, the measurements were taken in millimetres (Fig. 1) using standard procedures recommended by Lohman et al. and Hall et al.

The upper facial height (UFH) was the distance between “n” and “sn”, the lower facial height (LFH) was the distance between “sn” and “gn”, and the total facial height (TFH) was the arithmetic addition of UFH and LFH. The percentage of UFH to the TFH was calculated as:

$$\text{UFH proportion (UFH\%)} = \frac{\text{UFH} \times 100}{\text{TFH}}$$

The percentage of LFH to TFH was calculated as:

$$\text{LFH proportion (LFH\%)} = \frac{\text{LFH} \times 100}{\text{TFH}}$$

The data was analysed using the Statistical Package for the Social Sciences version 10.1 (SPSS Inc, Chicago, IL, USA). The significant difference in UFH, LFH and TFH in the study group was tested using the student’s t-test. A p-value < 0.05 was considered to be significant.

**RESULTS**

Table I provides a descriptive analysis of the upper and lower face height proportions among males and females in the different communities. A significant difference (p < 0.05) was found in the percentages of UFH and LFH between the Brahmin and Rai, Brahmin and Limbu, Chhetri and Rai, and Chhetri and Limbu communities. However, there was no significant difference between the Brahmin and Chhetri and between the Rai and Limbu communities.

### Table I. Facial parameters among male and female subjects in the communities studied.

<table>
<thead>
<tr>
<th>Community</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>UFH%</td>
<td>LFH%</td>
<td>UFH%</td>
</tr>
<tr>
<td>Brahmin</td>
<td>44.4 ± 1.6</td>
<td>55.6 ± 1.1</td>
<td>44.2 ± 1.4</td>
</tr>
<tr>
<td>Chhetri</td>
<td>44.6 ± 1.2</td>
<td>55.4 ± 1.2</td>
<td>44.4 ± 1.1</td>
</tr>
<tr>
<td>Rai</td>
<td>43.2 ± 1.4</td>
<td>56.8 ± 1.5</td>
<td>43.1 ± 1.6</td>
</tr>
<tr>
<td>Limbu</td>
<td>43.3 ± 1.7</td>
<td>56.7 ± 1.8</td>
<td>43.2 ± 1.8</td>
</tr>
<tr>
<td>Total</td>
<td>43.6 ± 1.6</td>
<td>56.4 ± 1.7</td>
<td>43.8 ± 1.7</td>
</tr>
</tbody>
</table>

SD: standard deviation; UFH: upper facial height; LFH: lower facial height proportion
communities (p > 0.05). No significant difference was found in the facial height proportions between the male and female subjects in the different population groups (p > 0.05).

Table II presents the mean and standard deviation of the upper and lower face height proportions for the different age groups. It was found that there was significant difference in the UFH and LFH proportions (p < 0.05) between subjects aged 3–5 years old and 5–9 years old, as well as between those aged 9–15 years old and 15–18 years old. However, there was no significant difference between subjects aged 5–9 years old and 9–15 years old, as well as between those aged 3–5 years old and 15–18 years old. The data analysis shows that the UFH proportion increased and the LFH proportion decreased initially from 3–15 years of age, after which the UFH proportion decreased and the LFH proportion increased from 15–18 years of age; the adult proportions were found to be similar to those observed in the 3–5 year age group (Fig. 2).

### DISCUSSION

The measurement of the upper, lower and total facial height is a routine aspect of clinical examination in orthodontic practice. Such measurements are also employed in facial anthropometric studies. The measurements are often used to carry out a comparative study of facial ergonomics among various communities. Prior to the advent of cephalometric radiography, dentists and orthodontists often used anthropometric measurements (i.e. measurements made directly during a clinical examination) to assist in establishing facial proportions.

Clinical anthropometry has recently undergone a revival because of current data provided by Farkas in his studies of Canadians of Northern European origin, where he found that LFH constitutes 59.5% of the TFH.\(^{(20)}\) In the present study, LFH was found to be comparatively lower (56.3% of TFH). The ideal proportions of UFH and LFH have been found to be 45% and 55% of the TFH, respectively.\(^{(20)}\) In another study, Farkas et al found a lower face/face height ratio of 59.2% ± 2.7% in male and 58.6% ± 2.9% in female subjects.\(^{(24)}\) LFH constituted 56.3% ± 1.7% of the TFH in male and 56.1% ± 1.6% in female subjects in the present study. Thus, although the percentage of LFH was found to be higher in males, the mean male-female differences in our study were not significant and lower when compared to the findings of Farkas et al.’s study.\(^{(24)}\) These differences may be attributed to differences in the study populations.

Significant differences in facial height proportions were found between the Brahmin and Rai, Brahmin and Limbu, Chhetri and Rai, and Chhetri and Limbu communities. On the other hand, insignificant differences between the Brahmin and Chhetri, and Rai and Limbu communities were observed. These differences may be attributed to the differences in the racial groups to which these communities belong. The Brahmins and Chhetri belong to the Aryan race, while the Rai and Limbu belong to the Mongoloid racial group. Thus, this is suggestive of the inter-racial differences found in their respective facial height proportions.

Among the Hausa-Fulani children in northern Nigeria, UFH has been found to constitute 44.1% of the TFH and LFH to constitute 55.8%.\(^{(25)}\) These findings are comparable with our results. Fok et al have suggested that the face grows in a constant fashion.\(^{(26)}\) However, this study found that the upper face grows from 3–15 years of age, while the lower face grows from 15–18 years of age. Changes in the upper and lower face height proportions may be attributed to the fact that mandibular growth, which is responsible for LFH, recedes maxillary growth in 5–9 year olds more than in 3–5 year olds. There is an equal proportional growth in 5–9 year olds and 9–15 year olds. However, mandibular growth supersedes maxillary growth in 15–18 year olds as compared to 9–15 year olds. Thus, it is clear that there is a change in facial height proportion in the various age groups. However, the upper and lower facial heights attain the
same proportion in adulthood, as was the case during childhood.

Facial anthropometric studies have vast implications in health-related fields and are useful for orthodontists, plastic surgeons, maxillofacial surgeons for their treatment plans, as well as for physical anthropologists and forensic facial reconstruction experts. This study concluded that race differences are evident for upper and lower face height proportions, that differences in facial height proportions between male and female are not significant and that there is a change in facial height proportion in various age groups, although the upper and lower facial heights attain the same proportion in adulthood, as was the case during childhood.

REFERENCES