Anthropometric Measurement and Analysis of the External Nasal Soft Tissue in 119 Young Han Chinese Adults

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Abstract: A random sample of 119 young, healthy Han Chinese adults (56 men and 63 women) between the age of 18 and 25 years (mean, 22.7 y) in PR China was obtained for this study. By the guidance of standard methods, based on Farkas's anthropometric measurements in craniofacial region, 12 nasal soft tissue landmarks and 12 linear and 3 angular measurements were chosen. The linear measurements were taken directly, whereas the angular measurements were taken by photogrammetric method. Eight nasal proportion indices were calculated according to the linear measurements. The application of the independent-samples t-test showed sex dimorphism in most parameters of the nasal region. All the linear measurements were larger in men than in women, whereas all the angular measurements were smaller in men than in women. The significant differences in partial parameters between men and women have been proved. Ten of 12 linear measurements, 1 of 3 angular measurements, and 3 of 8 nasal proportion indices showed significant sexual dimorphism (P < 0.01). Compared with other racial/ethnic groups, the nasal anthropometric measurements and proportion indices of Han Chinese adults were different, to some extent. This study could provide credible and objective reference material for plastic and maxillofacial surgeons for the external nasal soft tissue evaluation and planning of the cosmetic nasal surgery. Besides, these results could be a useful guidance for preoperative and postoperative evaluations of secondary rhinoplasty in nasal deformity associated with cleft lip and palate.

Key Words: Anthropometry, nose, adult, Han Chinese

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Materials and Methods
A random sample of 119 young, healthy Han Chinese adults (56 men and 63 women) between the age of 18 and 25 years (mean, 22.7 y) in PR China was obtained for this study. The sample met the following inclusion criteria: Han Chinese with Han Chinese parents and grandparents, normal growth and development, class I occlusion with minor or no crowding, no history of facial trauma, no previous orthodontic treatment, no maxillofacial or plastic surgery, and no nasal dermatitis. All subjects were students of Central South University in Changsha. Data were collected between 2007 and 2008. The head of each subject was kept on the Frankfurt horizontal plane. The operator located and marked the standard landmarks by careful inspection and palpation on the cutaneous surface. During landmarks marking, the subjects sat relaxed in a position suitable for a correct identification of facial features. By the guidance of standard methods, based on the anthropometric measurements in the craniofacial region of Farkas1 and Farkas et al.,2 each measurement was performed twice by the same operator (Z. J. H.). The linear measurements were taken directly, whereas the angular measurements were taken by photogrammetric method. The standard digital photographic images were taken in right lateral view by using standard anthropometric measurement methods. Images were obtained using a Canon Power Shot S3 IS digital camera (Canon, Inc, Tokyo, Japan) on
a fixed tripod. All the photographs were taken at a distance of 1.60 m from the subjects’ nose. The photographs were digitally stored as JPEG files, and then the angles were measured by using Image-Pro Plus 6.0 (Media Cybernetics, Inc, Silver Spring, MD). From the data accrued, several nasal proportion indices were calculated.

Anthropometric landmarks were defined regarding the previous reports of Farkas\(^1\) and Farkas et al.\(^2\). A total of 12 nasal soft tissue landmarks (5 unpaired midline landmarks and 7 paired landmarks) were selected (Figs. 1 and 2).

Unpaired midline landmarks: nasion (n), the midpoint on the soft tissue contour of the base of the nasal root at the level of the frontonasal suture; pronasale (prn), the most anterior midpoint of the nasal tip; subnasale (sn), the midpoint of the columnella base at the columnella-labial junction; labiale superius (ls), the outermost point on the mucocutaneous border of upper lip in midline; top point of the columnella (c), the midpoint of the columnella crest at the level of the nostril top points.

Paired landmarks (right and left sides noted r and l): endo-canthion (en\(_r\), en\(_l\)), the point located at the inner commissure of each eye fissure; alare (al\(_r\), al\(_l\)), the most lateral point on each alar contour; subalare (sbal\(_r\), sbal\(_l\)), the point where the nasal alar bases disappear into the skin of the upper lip; alar curvature point (ac\(_r\), ac\(_l\)), the most lateral point on the curved base line (alar groove) of each ala; superior point of the nostril (c\(_r\), c\(_l\)), the highest point of each nostril or the superior terminal point of each nostril axis; and subnasale\(_c\) (sn\(_r\), sn\(_l\)), the point at each margin of the midportion of the columnella crest.

Twelve linear and 3 angular standard anthropometric measurements were obtained. The measurement techniques used were described by Farkas\(^1\), Farkas et al.\(^2\) and Fernández-Riveiro et al.\(^4\).

Linear measurements were as follows: nasal height (n – sn), nasal bridge length (n – prn), nasal tip protrusion (sn – prn), intercanthal width (en\(_r\) – en\(_l\)), nasal width (al\(_r\) – al\(_l\)), nasal base width (ac\(_r\) – ac\(_l\)), ala length (ac\(_r\) – prn, ac\(_l\) – prn), ala thickness (a\(_{r}\) – a\(_{l}\), a\(_{l}\) – a\(_{l}\)), columnella length (c – sn), columnella width (sn\(_r\) – sn\(_l\)), superior width of the columnella (c\(_r\) – c\(_l\)), and nostril floor width (sbal\(_r\) – sn, sbal\(_l\) – sn).

Angular measurements were as follows (Fig. 3): nasofrontal angle, which is measured between the proximal nasal bridge contour and the anterior surface of the forehead below the glabella; nasal tip angle, which is formed by the lines following the general direction of the columnella and the nasal bridge; and nasolabial angle, which is...
Comparison of Proportion Indices in Men and Women

TABLE 1. Comparison of Linear Measurements in Men and Women

<table>
<thead>
<tr>
<th>Measurements</th>
<th>Men (N = 56)</th>
<th>Women (N = 63)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nasal height, mm</td>
<td>60.33 ± 4.25</td>
<td>58.23 ± 3.73</td>
<td>**</td>
</tr>
<tr>
<td>Nasal bridge length, mm</td>
<td>51.80 ± 3.94</td>
<td>50.54 ± 3.87</td>
<td>NS</td>
</tr>
<tr>
<td>Nasal tip protrusion, mm</td>
<td>18.24 ± 2.33</td>
<td>16.54 ± 1.75</td>
<td>**</td>
</tr>
<tr>
<td>Intercanthal width, mm</td>
<td>37.45 ± 2.98</td>
<td>35.99 ± 2.34</td>
<td>**</td>
</tr>
<tr>
<td>Nasal width, mm</td>
<td>39.30 ± 2.23</td>
<td>34.75 ± 2.22</td>
<td>**</td>
</tr>
<tr>
<td>Nasal base width, mm</td>
<td>39.23 ± 2.39</td>
<td>35.14 ± 2.57</td>
<td>**</td>
</tr>
<tr>
<td>Ala length (l), mm</td>
<td>32.32 ± 1.48</td>
<td>28.81 ± 2.17</td>
<td>**</td>
</tr>
<tr>
<td>Ala length (r), mm</td>
<td>32.37 ± 1.48</td>
<td>28.90 ± 2.28</td>
<td>**</td>
</tr>
<tr>
<td>Ala thickness (l), mm</td>
<td>4.12 ± 0.57</td>
<td>3.65 ± 0.45</td>
<td>**</td>
</tr>
<tr>
<td>Ala thickness (r), mm</td>
<td>4.34 ± 0.60</td>
<td>3.85 ± 0.47</td>
<td>**</td>
</tr>
<tr>
<td>Columella width, mm</td>
<td>8.39 ± 1.47</td>
<td>7.99 ± 1.13</td>
<td>NS</td>
</tr>
<tr>
<td>Columella length, mm</td>
<td>6.32 ± 0.73</td>
<td>5.96 ± 0.72</td>
<td>**</td>
</tr>
<tr>
<td>Superior width of the columella, mm</td>
<td>8.90 ± 1.28</td>
<td>8.07 ± 1.00</td>
<td>**</td>
</tr>
<tr>
<td>Nostril floor width (l), mm</td>
<td>15.00 ± 1.26</td>
<td>13.35 ± 1.05</td>
<td>**</td>
</tr>
<tr>
<td>Nostril floor width (r), mm</td>
<td>14.62 ± 1.24</td>
<td>13.05 ± 1.02</td>
<td>**</td>
</tr>
</tbody>
</table>

*P < 0.05.
**P < 0.01.
NS indicates not significant.

Eight nasal proportion indices defining the relationships between the nasal measurements in this study have been described by Farkas' and Farkas et al.2 They included the following proportion indices: nasal index (al₃ / al₁ x 100 / n - sn), nasal–intercanthal width index (al₃ / al₁ x 100 / en₁ – en₀), nasal tip protrusion–width index (sn₁ – p₁ x 100 / al₁ – al₀), nasal bridge index (n – p₁ x 100 / n – sn), ala–length–nasal height index (ac₁ – p₁ x 100 / n – sn, ac₁ – p₁ x 100 / n – sn), columella width–nasion index (sn₁ – sn₁ x 100 / al₁ – al₀), columella length–nasion tip protrusion index (c – sn₁ x 100 / sn₁ – p₁), nostril floor–nasion index (sn₁ – sn₁ x 100 / sn₁ – p₁), nostril floor–nasion–nasal height index (sn₁ – sn₁ x 100 / sn₁ – p₁).

Data were analyzed using SPSS 16.0 (SPSS, Inc, Chicago, IL). Mean and SD for each nasal measurement and index were calculated within sex, respectively. Sexual dimorphism was evaluated by the independent-samples t-test. A level of significance of 1% (P < 0.01) was used for all analyses.

RESULTS

Descriptive statistical data including means and SDs together with the independent-samples t-test results for men and women are given in Tables 1 and 2. Table 1 shows the results from the analysis of the linear measurements for men and women, respectively. Angular measurements are listed by sex in Table 2. The nasal proportion indices are presented in Table 3. The paired measurements (3 linear measurements and 2 proportion indices) are listed on both sides, respectively.

The measurements were compared between men and women. A sexual dimorphism, men larger than women, was found for the values of the all 12 linear measurements. A statistically significant difference existed between men and women in the linear measurements except nasal bridge length and columella length (P < 0.01). The means of all the 3 angular measurements in women were greater than those in men. However, only the nasofrontal angle in men was significantly more acute than in women (P < 0.01).

A nasal proportion index analysis was performed using the nasal measurements collected, and these proportion indices were also compared between men and women. A statistically significant difference existed between sexual groups in 3 of 8 calculated nasal proportion indices including nasal index, nasal–intercanthal width index, and length–nasion–nasal height index (P < 0.01).

DISCUSSION

Measurement of the human face was first performed by the Ancient Greeks and has always been an interesting subject for anatomists, artists and surgeons. The neoclassic, created as guides
by scholars and artists of the Renaissance era based on classic Greek canons, was used to define the relationships among various facial structures.\textsuperscript{1,5-8,22} Despite the extensive use of the neoclassic canons, clinicians found it was a mistake to use a single set of values and canons to try to achieve a prescribed result with neglect of facial variations, racial/ethnic background, and the patient’s personal preferences. Aesthetic results from clinical treatments depended on the anatomic structures present. Data from several studies have shown great variety in the facial and nasal size, shape, and proportions among different racial/ethnic groups. Hence, surgeons should take into account population-specific factors when planning maxillofacial surgery.\textsuperscript{3-14,20-26}

As well as the face and body, rapid growth of the nose occurred at a young age. With knowledge of the developmental levels of the measurements at an early age, their changes with age and their maturation times are of great importance in timing early or final corrective surgical procedures. Posner\textsuperscript{26} concluded that after the age of 14 years, the nose tip did not grow forward to the extent as did the nasal bones. Meng et al\textsuperscript{16} found that increments in nose height, depth, and inclination were essentially complete in girls by 16 years, whereas they continue to increase in males up to and beyond 18 years. Farkas et al\textsuperscript{1} have found that the nose width and nose height were fully developed in females by age 12 and in males by age 14 or 15. Ferrario et al\textsuperscript{21} reported that the nose had almost completed its growth relative to the adult group by the age of 13 in females, whereas in males, a large increase was still to occur. After maturation, the changes in measurements are minimal. In this study, adults of both sexes 18 to 25 years of age were included as subjects because most of the aesthetic surgeries, especially secondary rhinoplasty in nasal deformity associated with cleft lip and palate, were performed for this age group.

On analyzing the nose, it was observed that the mean values of the 12 linear measurements for men were greater than those measured for women. With exception of 2 measurements (nasal bridge length and columella length), all the linear parameters in both sexes showed significant differences. Great dimorphism in the facial and nasal regions was exhibited by 2 sexual traits.

The racial/ethnic morphometric differences in the nasal complex in the world populations have been the focus of investigations. Several comparative investigations have been carried out between the racial/ethnic groups. The values in this study were compared with those reported by Farkas\textsuperscript{1} and Farkas et al\textsuperscript{2} for white, Choe et al\textsuperscript{10,11} for Korean American females, Uzun et al\textsuperscript{12} for Turkish males, and Aung et al\textsuperscript{1} for Chinese adults. Differences exist, to some extent, in these racial/ethnic populations.

The nasal height in this study was greater than the values of the 3 other racial/ethnic groups. The nasal length was smaller than that for the Turkish men, but greater than that for the white women and Korean American women. Despite the same ethnic origin, the values of the 2 measurements were significantly different between the current study and that of Aung et al. It may be caused by the inaccurate cutaneous location of the landmark nasion (n), which was actually an osseous intersection. We also found that partial measurements (intercanthal width, nasal width, nasal base width, and nostril floor width) in this study were greater compared with those reported by Farkas et al for a white population, whereas nasal tip protrusion, ala length, ala thickness, columella length, and columella width demonstrated smaller values. However, the values of the 9 measurements were similar to those of Choe et al and Aung et al. These results substantiated the similarity in nasal region between the Han Chinese and Korean American.

A comparison between an international anthropometric study of facial morphology in various racial/ethnic groups and our study reflected the generally accepted notion that one of the dominant characteristics of the Asian (Chinese, Japanese, Korean, etc) face was a broader and rounder nose with the flared alae because of the wider intercanthal width, nasal width, and nasal base width. In addition, the nonprominent nose of the Asian population was observed on the lateral view owing to their shorter nasal tip protrusion and columella length. This finding is concordant with the results reported by Aung et al\textsuperscript{1,7,9,12-14,22,26} which included facial landmarks, compared with direct measurements, and showed that sharp facial profile contours could eliminate the differences between the direct and the indirect measurements of the nose. In addition, determination of angular measurements was independent of the head tilt and magnification but depended on head rotation.

Distinct sex differences in the angular measurements were found. All the angles were larger in women. This finding was similar to the studies of Malko et al,\textsuperscript{25} Milosevic et al,\textsuperscript{24} and Fernández-Riveiro et al.\textsuperscript{4} Interestingly, the angular values in these racial/ethnic groups were close to the values found in the current study. Among the 3 angles, the nasofrontal angle rather than the nasal tip angle and the nasolabial angle demonstrated significant sex difference. These results differed from those of the other investigators to a certain extent.

In this study, in a lateral view, men had a heavier brow with the forehead appearing more prominent than those of women because of the more acute nasofrontal angle seen in men. Powell and Humphreys\textsuperscript{27} suggested that the ideal nasofrontal angle should be from 115 to 130 degrees. This range was narrower than the results of our study. The nose appeared more upturned as indicated by the more obtuse nasal tip angle in the women. The nasolabial angle appeared to be more acute in men because of the greater forward angulation of the upper lip.\textsuperscript{9,13}

The beauty of the face is the result of the relationship between each facial region and symmetry of its components. The importance of facial proportions indices, which would bear some relation to the clinical appearance of the nose, has been declared by several surgeons.\textsuperscript{1,2,10,36} Tessier et al\textsuperscript{50} recognized that the appropriate proportion indices contributed to facial harmony and balance. Edler et al\textsuperscript{57} believed that the proportion indices could be useful in the objective quantification of facial attractiveness.

For the better analysis of the face and nose, the linear measurements were used to calculate the nasal proportion indices. We compared the values in our study with those of Farkas\textsuperscript{1} and Farkas et al\textsuperscript{2} for white. The findings showed that interpretation of the index values supported the specific features of the Han Chinese nose. The nasal proportion index values of Han Chinese and white subjects were quite different. In our study, nasal tip protrusion–width index was smaller, whereas nostril floor width–nasal tip protrusion index had a greater value. Despite the smaller values of columella length and width, columella width–nasal width index and columella length–nasal tip protrusion index showed greater values. The broader Han Chinese nose is compatible with the wider intercanthal width. The features of the Han Chinese nose from a mental or basal view are usually of the mesorhine-type with bulbous nasal tip and very prominent alar lobules rounding off with broad alar bases on both sides. Those particular nasal aesthetics are in harmony with the other facial characteristics that are typical of the Han Chinese face.

Today, the anthropometric methods and surgical practice intersect at a point to treat congenital or posttraumatic facial and nasal disfigurements in various racial/ethnic groups successfully. Rhinoplasty surgeons require access to facial and nasal databases based on accurate anthropometric measurements to perform optimum correction in both sexes. Any surgeon who performs rhinoplasty should be keenly aware of the sex and racial/ethnic differences in nasal anatomy because feminization of a man’s nose will create a disharmonious face, and a disproportionate face and nose

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could make Han Chinese divested of their features of the Han nationality.

In our study, direct anthropometric and photogrammetric methods were used to perform the linear and angular measurements, respectively. The data in this study could be seen as reference material for plastic and maxillofacial surgeons for the external nasal soft tissue evaluation and planning of facial aesthetic and reconstructive surgery. Besides, these measurements could be a useful guidance for preoperative and postoperative evaluations of cleft lip surgeries in the Han Chinese patients.

All subjects in this study comprised college students who met the inclusion criteria; therefore, these results are not regarded as normative values of a random Han Chinese population. Rather, these results are seen as a useful reference material until an improved reference range is provided by further studies involving a random sample of the healthy Han Chinese population.

REFERENCES