INTRODUCTION

Mouth breathing is a pathology that can cause alterations in the structures and functions of the stomatognathic system, in body posture, craniofacial morphology and dental occlusion, as well as in the patients’ behavior and quality of life.\(^1\)\(^2\)

Taking into account the possible damages to the individual, mouth breathing mode has been addressed in several studies, especially involving the child population. The altered breathing mode, oronasal or mouth breathing, may persist until adulthood if not appropriately treated in childhood.

Nevertheless, it can be observed that only a few studies have sought to assess the impact of mouth breathing in adults, which motivated this research. It is believed that the study of the orofacial morphology in adult mouth breathers may contribute to the clinical practice and the completion of other studies, considering that the impact of mouth breathing in adulthood, after the pubertal growth period, has not been clearly evidenced to date.

The craniofacial morphology can be studied through orofacial anthropometric assessment as a qualitative method complementing the clinical
Facial measurements and breathing mode in adults

having experience in orofacial motricity. A Western®
digital caliper, resolution 0.01mm and precision
± 0.02mm, was the instrument used to obtain the
measures. In order to obtain the measure of facial
width, 8.25cm metal extensions were adapted to the
instrument nozzles for external measurement6.

During the assessment, the subject remained
in front of the examiner, in sitting position, the
feet flat on the ground, natural head position, lips
enclosed and the teeth in centric occlusion without
pressure5,7,8.

Subsequently, to identify the precise local-
ization, the craniofacial spots were palpated and
marked in the skin with dermographic pencil. The
anthropometric measurements were performed
without pressing the caliper ends against the skin
surface, because that could alter the results. All the
measurements were performed twice for greater
reliability. The result on each measurement was
achieved through the average of two collections in
milimeters5,7,8.

The anthropometric measurements were
collected as follows:
• middle third of the face: distance from the glabella
to the subnasal (g-sn);
• lower third of the face: distance from the subnasal
to the gnathion (sn-gn);
• facial height: distance from the glabella to the
gnathion (g-gn);
• facial width: distance between the prominence of
the zygomatic arches (zy-zy);
• right side: distance from the outside corner of the
right eye to the right labial commissure (ex-ch);
• left side: distance from the outside corner of the
left eye to the left labial commissure (ex-ch);
• upper lip height: distance from the subnasal to
the lowest point of the upper lip (sn-sto);
• lower lip height: distance from the highest point
of the lower lip to the gnathion (sto-gn).

For data analysis, the Kolmogov-Smirnov
test was used to verify the normality of the facial
anthropometric measures distribution. Aiming to
compare the anthropometric measures according
to the breathing mode and gender, the Student's
t-test was used. To assess the association of the
variables ‘breathing mode and gender’ with the
facial anthropometric measurements, the Pearson’s
Correlation test was used. The statistical analyses
were performed by the SPSS (Statistical Package
for Social Science, version 20) software, consid-
ering the significance level of 5%.
RESULTS

Through the results analysis, it was verified that all the averages of the vertical anthropometric measures (middle third, lower third, facial height, upper lip and lower lip) were significantly higher in mouth-breathing subjects than in nasal breathers (Table 1). It was also possible to observe a moderate positive correlation between the breathing mode and the measures of the lower third, facial height and lower lip, as well as a weak positive correlation between the breathing mode and the measures of the middle third and upper lip (Table 3).

On the other hand, no correlation or differences were found in the averages of cross-sectional (sides of the face) or horizontal (facial width) measures between the nasal and mouth breathers (Tables 1 and 3).

In gender comparison, it became evident that all averages of facial anthropometric measures were significantly higher in males (Table 2). Additionally, all facial anthropometric measures displayed positive correlation with the variable ‘gender’, with a weak correlation with facial width and a moderate correlation with other measures (Table 3).

### Table 1 – Comparison of facial anthropometric measures in breathing mode

<table>
<thead>
<tr>
<th>Facial anthropometric measures</th>
<th>Breathing mode</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NB n=46</td>
<td>MB n=36</td>
</tr>
<tr>
<td></td>
<td>average±SD</td>
<td>average±SD</td>
</tr>
<tr>
<td>Middle third</td>
<td>61.16±4.95</td>
<td>63.89±5.16</td>
</tr>
<tr>
<td>Lower third</td>
<td>57.65±4.49</td>
<td>61.86±7.47</td>
</tr>
<tr>
<td>Facial height</td>
<td>118.19±7.79</td>
<td>126.42±10.36</td>
</tr>
<tr>
<td>Facial width</td>
<td>127.89±5.35</td>
<td>129.68±8.45</td>
</tr>
<tr>
<td>Right side</td>
<td>70.02±3.78</td>
<td>71.54±3.94</td>
</tr>
<tr>
<td>Left side</td>
<td>70.02±4.51</td>
<td>70.61±3.86</td>
</tr>
<tr>
<td>Upper lip</td>
<td>20.05±2.33</td>
<td>21.17±2.59</td>
</tr>
<tr>
<td>Lower lip</td>
<td>37.83±3.86</td>
<td>41.86±5.46</td>
</tr>
</tbody>
</table>

Legend: NB=nasal breathing; MB=mouth breathing; SD=standard deviation; (*)=significance in Student’s t-test (p<0.05).

### Table 2 – Comparison of facial anthropometric measures according to gender

<table>
<thead>
<tr>
<th>Facial anthropometric measures</th>
<th>Gender</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Female n=59 (72%)</td>
<td>Male n=23 (28%)</td>
</tr>
<tr>
<td></td>
<td>average±SD</td>
<td>average±SD</td>
</tr>
<tr>
<td>Middle third</td>
<td>60.85±4.33</td>
<td>66.24±5.29</td>
</tr>
<tr>
<td>Lower third</td>
<td>57.61±4.20</td>
<td>64.33±8.11</td>
</tr>
<tr>
<td>Facial height</td>
<td>118.65±7.93</td>
<td>129.88±9.80</td>
</tr>
<tr>
<td>Facial width</td>
<td>127.51±6.21</td>
<td>131.47±8.22</td>
</tr>
<tr>
<td>Right side</td>
<td>69.05±2.57</td>
<td>74.89±3.61</td>
</tr>
<tr>
<td>Left side</td>
<td>68.56±2.99</td>
<td>74.69±3.72</td>
</tr>
<tr>
<td>Upper lip</td>
<td>19.89±2.04</td>
<td>22.20±2.81</td>
</tr>
<tr>
<td>Lower lip</td>
<td>38.42±4.44</td>
<td>42.63±5.25</td>
</tr>
</tbody>
</table>

Legend: SD=standard deviation; (*)=significance in Student’s t-test (p<0.05).
Facial measurements and breathing mode in adults

In the averages of the middle third in none of the age groups studied. On the other hand, it became evident that the measures of the sides of the face and facial height correlate only with gender (Table 3), the averages being higher in males (Table 2), with no association with the breathing mode verified.

Regarding the averages obtained, it can be observed that the middle third and lower third of the face are close to the values suggested by the literature on adult patients (55 to 65 mm). An aspect that draws attention are the higher values of the middle thirds than those in the lower thirds, which is in accordance with only one study selected, that have found the middle third significantly higher in adult nipo-brazilian women when compared with black and white women, whose lower third was higher. These results differ from other studies that verified that the middle third was lower than the lower third.

Another interesting finding refers to the average value of the upper lip measure, which was significantly higher in mouth-breathing subjects than in nasal breathers. Although some studies mention the shortened upper lip as one of the clinical characteristics of the mouth breather, as well as in other research carried out with children, this characteristic was not found in the anthropometric assessment. This probably occurs due to the solicitation of labial closure during the assessment, which may generate a muscular effort that is able to compensate the aspect of the shortened upper lip.

### Table 3 – Correlation of breathing mode and gender with orofacial anthropometric measures

<table>
<thead>
<tr>
<th>Facial anthropometric measures</th>
<th>Breathing mode Correlation</th>
<th>p</th>
<th>Gender Correlation</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Middle third</td>
<td>0.26</td>
<td>0.017*</td>
<td>0.47</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Lower third</td>
<td>0.33</td>
<td>0.002*</td>
<td>0.48</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Facial height</td>
<td>0.42</td>
<td>&lt;0.001*</td>
<td>0.52</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Facial width</td>
<td>0.13</td>
<td>0.298</td>
<td>0.26</td>
<td>0.028*</td>
</tr>
<tr>
<td>Right side</td>
<td>0.19</td>
<td>0.081</td>
<td>0.68</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Left side</td>
<td>0.07</td>
<td>0.536</td>
<td>0.65</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Upper lip</td>
<td>0.22</td>
<td>0.043*</td>
<td>0.42</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Lower lip</td>
<td>0.40</td>
<td>&lt;0.001*</td>
<td>0.38</td>
<td>&lt;0.001*</td>
</tr>
</tbody>
</table>

Legend: (*)=significance in Pearson’s Correlation Coefficient (p<0.05).

### DISCUSSION

The present study aimed to assess the impact of breathing mode on craniofacial morphology in adult subjects, based on the comparison of anthropometric measurements in nasal and mouth breathers. No studies were found regarding anthropometric assessment in adult mouth breathers, which justifies the comparison of some findings with studies carried out with children. Facial anthropometric measurements were also compared between genders, since several studies have demonstrated differences in facial anthropometric measures between males and females.

Through the comparison of facial measures between breathing modes, it was verified that all vertical measures (middle third, lower third, facial height, upper lip and lower lip) were significantly higher in mouth breathers, with a positive, weak to moderate correlation between these variables.

The literature reports that mouth-breathing patients frequently exhibit the habitual tongue position on the floor of the mouth, open or half-open lips, which favors the posteroinferior rotation of the mandible, an increase in the mandibular plane and the antigonic incisura, characterizing a predominantly vertical craniofacial growth, dolichofacial type. This can explain the findings of the present study, confirming the influence of breathing mode on the increase of all measurements performed in the vertical plane.

The findings in this study partially support results of other authors, who compared the facial anthropometric measures among children with no speech-language complaints, and mouth-breathing children aged seven to 11. The authors verified a statistically significant difference in the measures of the upper lip, lower lip, lower third and the right and left side of the face, and no significant differences were evident in the averages of the middle third in none of the age groups studied.

On the other hand, it became evident that the measures of the sides of the face and facial height correlate only with gender (Table 3), the averages being higher in males (Table 2), with no association with the breathing mode verified.

Regarding the averages obtained, it can be observed that the middle third and lower third of the face are close to the values suggested by the literature on adult patients (55 to 65 mm). An aspect that draws attention are the higher values of the middle thirds than those in the lower thirds, which is in accordance with only one study selected, that have found the middle third significantly higher in adult nipo-brazilian women when compared with black and white women, whose lower third was higher. These results differ from other studies that verified that the middle third was lower than the lower third. Despite the fact that only leukoderma subjects have been included, the ample racial miscegenation in Brazil, found especially in the state of Rio Grande do Sul, have probably influenced this outcome, since most of the studies with other samples of Brazilians showed that the middle third is lower than the lower third.

Another interesting finding refers to the average value of the upper lip measure, which was significantly higher in mouth-breathing subjects than in nasal breathers. Although some studies mention the shortened upper lip as one of the clinical characteristics of the mouth breather, as well as in other research carried out with children, this characteristic was not found in the anthropometric assessment. This probably occurs due to the solicitation of labial closure during the assessment, which may generate a muscular effort that is able to compensate the aspect of the shortened upper lip. In other study, a statistically significant difference
was verified in the measure of the upper lip by analyzing the variable ‘habitual resting position’ with and without labial closure, which was higher in the first situation\cite{25}.

In the analysis of facial measurements according to the variable ‘gender’, it was verified that all the anthropometric measures performed were significantly higher in males than in females (Table 2), which is in accordance with the literature\cite{10,11,13}. This study confirmed the hypothesis that there is a sexual dysmorphism in facial measurements in adults, since all the anthropometric measurements showed an association with the variable ‘gender’ in Pearson’s Correlation test (Table 3). This finding confirms the need to take into account this variable when designing studies involving facial anthropometric measurements.

On the basis of the aforementioned, it was possible to verify that the variable ‘breathing mode’ is associated with the anthropometric measurements performed in the vertical plane in adult subjects; on the other hand, the variable ‘gender’ is associated with all the anthropometric measures obtained. However, other independent variables that have not been studied, such as race/ethnicity\cite{9,11,26-28} and facial typology\cite{10,29}, may also impact the facial anthropometric measures, as demonstrated in previous studies. Accordingly, it is recommended further research that applies a similar analysis model, taking into account other variables that may impact the facial anthropometric measures.

In this study, it was possible to detect that mouth-breathing subjects showed a predominantly vertical pattern of growth, confirming therefore the influence of the breathing mode alteration on craniofacial morphology. For this reason, it must be stressed the need of multidisciplinary follow-up and treatment of mouth breathing mode during childhood, to minimize the negative effects before the period of craniofacial growth spurt.

**CONCLUSION**

The facial anthropometric measures of the vertical plane were higher in mouth breathers, suggesting a more elongated facial pattern of growth in these subjects.

Sexual dimorphism was observed in all the measures obtained (vertical, horizontal and cross-sectional plane), with all the measures being higher in males.

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**RESUMO**

Objetivo: comparar as medidas antropométricas faciais de adultos segundo o modo respiratório e o sexo. Métodos: a amostra do estudo foi constituída por 82 sujeitos adultos, na faixa etária entre 18 e 35 anos, 59 do sexo feminino e 23 do sexo masculino. A partir das avaliações fonoaudiológica e otorrinolaringológica, foram diagnosticados 46 respiradores nasais e 36 respiradores orais. As medidas faciais foram obtidas com paquímetro e comparadas segundo diagnóstico do modo respiratório e sexo dos sujeitos, utilizando-se o teste t de Student e da Correlação de Pearson, com nível de significância de 5%. Resultados: as medidas antropométricas verticais (terço médio, terço inferior, altura facial, lábio superior e lábio inferior) foram significativamente maiores nos respiradores orais e apresentaram correlação positiva com o modo respiratório. Todas as medidas faciais realizadas foram maiores no sexo masculino e mostraram correlação positiva com a variável sexo. Conclusões: as medidas antropométricas faciais do plano vertical foram maiores nos respiradores orais, sugerindo padrão de crescimento facial mais alongado nesses sujeitos. Todas as medidas antropométricas faciais obtidas nos planos vertical, horizontal e transversal foram maiores nos sujeitos do sexo masculino.

**DESCRITORES:** Face; Medidas; Antropometria; Respiração Bucal; Adulto
REFERENCES
