**Original Article**

***Artigo Original***

# Facial type and head posture of nasal and mouth-breathing children

## *Tipo facial e postura de cabeça de crianças respiradoras nasais e orais*

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**Keywords**

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## ABSTRACT

**Purpose:** To verify the facial type and the head posture of nasal and mouth-breathing children from habitual and obstructive etiologies, as well as to correlate the morphological facial index to the head angulation position in the sagittal plane. **Methods:** Participants were 59 children with ages between 8 years and 11 years and 10 months. All subjects were undergone to speech-language pathology screening, otorhynolaryngologic evaluation, and nasopharyngoscopy, allowing the constitution of three groups: nasal breathers – 15 children; mouth breathers from obstructive etiology – 22 children; and habitual mouth breathers – 22 children. In order to determine facial type and morphological facial index, the height and the width of the face were measured using a digital caliper. The head posture was assessed through physical examination and computerized photogrammetry. **Results:** It was verified the predominance of short face in nasal breathers, and long face in mouth breathers. There was an association among facial type and breathing mode/mouth breathing etiology: the brachyfacial type was more frequent among nasal breathers, and less frequent in subjects with obstructive nasal breathing. Head posture was similar in all three groups. No correlation was found between morphological facial index and head posture. **Conclusion:** The brachyfacial type favors the nasal-breathing mode and the head posture is not influenced by breathing mode and by the etiology of mouth breathing, as well as it is not related to facial type.

**Descritores**

Respiração bucal/etiologia
Face/anatomia & histologia
Postura
Fotogrametria
Criança

## RESUMO

**Objetivo:** Verificar o tipo facial e a postura de cabeça de crianças respiradoras nasais, e respiradoras orais de etiologia obstrutiva e viciosa, e correlacionar o índice morfológico da face à angulação da postura da cabeça no plano sagital. **Métodos:** Participaram 59 crianças com idades entre 8 anos e 11 anos e 10 meses. Todas passaram por triagem fonoaudiológica, avaliação otorrinolaringológica, e exame de nasofibrofaringoscopia, o que possibilitou a constituição de três grupos: com respiração nasal – 15 crianças; com respiração oral obstrutiva – 22 crianças; e com respiração oral viciosa – 22 crianças. Foram mensuradas a altura e a largura da face com paquímetro digital, para determinação do índice e do tipo facial. A postura da cabeça foi avaliada por meio de exame físico e fotogrametria computadorizada. **Resultados:** Verificou-se predomínio de face curta nos respiradores nasais e de face longa nos respiradores orais. Houve associação entre tipo facial e modo respiratório/etiologia da respiração oral, o tipo braquifacial foi mais frequente nos respiradores nasais e menos frequente nos respiradores orais de etiologia obstrutiva. As crianças dos três grupos apresentaram postura de cabeça semelhante. Não foi verificada correlação entre índice morfológico da face e a postura da cabeça. **Conclusão:** O tipo braquifacial favorece o modo respiratório nasal e que a postura da cabeça não é influenciada pelo modo respiratório e etiologia da respiração oral, assim como não está relacionada ao tipo facial.

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## INTRODUCTION

Mouth breathing is a common disease in childhood and has a multifactorial etiology. Broadly, mouth breathing has been classified as obstructive, when there is physical barrier to the airflow through the upper airways, or unobstructive or habitual, as a result of prolonged mouth habits, muscle alterations, transitory swelling of the nasal mucosa, and repaired airways obstruction, among other factors[1,2]. The literature refers several changes caused by mouth breathing[1-3]. However, there is a lack of studies considering the different etiologies and their respective effects.

Modifications in the standard vertical facial growth are often related to mouth breathing, both obstructive and habitual. Some studies have reported that mouth-breathing mode predisposes the vertical facial growth due to the posteroinferior rotation of mandible[3,4]. However, there are increasing questions regarding the cause and effect relation between the breathing mode and facial type, once mouth breathing may occur due to structural characteristics of the dolichofacial type[4,5].

The head posture is the result of a complex and delicate balance between the muscles involved in the cervical-mandibular-cranial system designed to maintain the pharyngeal airway[6]. Hence, the forward head posture, commonly related to mouth breathing, is described as an adaptation to expand and facilitate the air flow through the oropharynx[2,7]. Nevertheless, the change in head position requires that the column adapts itself to compensate the deviation, resulting in whole body posture changes[8,9].

The literature states that the long facial type has higher nasal resistance[4] and such increase is associated to the forward head position[10]. Thus, it is possible to question the existence of a positive correlation between facial type and head forward, i.e., the longer the face, the greater would be the nasal airflow resistance and the head forward posture.

Considering that different etiologies of mouth breathing may be associated to craniofacial morphological differences and that facial type can be related to head posture, the present study had the aim to verify the facial type and the head posture of nasal and mouth-breathing children from obstructive and habitual etiologies, as well as to correlate the morphological facial index to the head angulation position in the sagittal plane.

## METHODS

The research project was approved by the Research Ethics Committee of Universidade Federal de Santa Maria – CEP/UFSM, protocol number 220.0.243.000-8. All parents/guardians' children signed a written consent form and all children agreed to take part in the study.

The present study consists on a quantitative and transversal exploratory research, carried out from November 2008 to July 2009. Participants were 59 children (25 boys and 34 girls) aged from 8 to 11 years and 10 months, selected from a school screening and a waiting list of the orofacial motricity sector at the Speech-Language Pathology School-Clinic.

The inclusion criteria to participate in the study were: age from 8 years to 11 years and 11 months old, once the body posture changes resulting from the altered breathing mode establish only after 8 years old[8]; to be Caucasian, in order to avoid racial interferences; to have the four first permanent molars, considering these teeth eruption determine oral cavity modifications[11] by the maxilla and mandible lateral growth and the occlusion and vertical dimension stabilization[12]. The exclusion criteria were: evident signs of neurological impairment and/or craniofacial malformation; to have undergone or to be under orthodontic treatment, speech therapy and/or physical therapy; and to have performed facial surgery or suffered a facial trauma[13]. Prolonged mouth habits and malocclusion were not considered exclusion criteria.

In order to verify the study criteria' fulfillment, the participants underwent a speech-language pathology screening consisted of anamnesis and assessment of the stomatognathic system. The parents' anamnesis was related to personal data, development aspects, speech-language pathology complaints, habitual breathing mode and current and previous treatments performed by the child. The evaluation of the stomatognathic system observed morphological features, the habitual breathing mode and the adequation to the remaining criteria of the study.

To classify the children in the three study groups: nasal breathers (NB), mouth breathers of obstructive etiology (OMB) and habitual mouth breathers (HMB), an otorhinolaryngologic evaluation was carried out to confirm the child's breathing mode and the etiology of mouth breathing. This evaluation consisted of parents' anamnesis related to the stomatognathic system, and clinical tests including oroscopy, rhynoscopy and otoscopy, besides nasopharyngoscopy with a flexible nasofibroscope Machida® of 3.2 mm and microcamera Asap. The images were recorded on a DVD.

The palatine tonsils and adenoid hypertrophy was classified into one to four grades based on the oroscopy and nasopharyngoscopy, respectively[14,15]. Other obstructive airway diseases were not observed.

The nasal-breathing group was composed by children, who predominantly breathe through the nasal cavity and presented some sealing point in the mouth during the stomatognathic system assessment. Besides, they did not present signs and symptoms of daytime and nocturnal mouth breathing at the otorhinolaryngologic exam, regardless the palatine tonsils and adenoid hypertophy grade. Fifteen children, 13 girls and two boys, aged from 8 years and 5 months to 11 years and 4 months, with mean age of 9 years and 7 months, took part in this group.

The obstructive mouth-breathing group was composed by children who mostly breathe through the mouth due to adenoid and/or palatine tonsils hypertrophy of grade three or four, with or without rhinitis. This group had 22 children, 12 girls and ten boys, aged from 8 years to 1 month and 11 years and 10 months, with mean age of 9 years and 3 months.

The habitual mouth-breathing group was constituted by children who predominantly breathe through the mouth in the absence of upper airway obstruction and/or with nasal mucosa transitory swelling (intermittent rhinitis). This group had 22 children, nine girls and 13 boys, aged from 8 years and 8

months to 11 years and 10 months, with mean age of 9 years and 11 months.

The facial type and head postures assessments were carried out in order to satisfy the research purposes.

### Facial type evaluation

The evaluation of the facial type was performed by a trained speech-language pathologist using measurements taken directly in the children's face. It was used a digital caliper (Digimess Pró-fono®) with 8.25 cm metal extensions on the external stem for the external measurements[1]. During the examination, the child was comfortably seated with feet supported on the ground or on equivalent support, facing the examiner. The head was kept in natural position, with sealed lips and teeth in centric occlusion[16].

The anthropometric measurements collected (Figure 1) were the facial height (from nasion to gnathion) and facial width, also called bi-zygomatic diameter (distance between two zygomatic points). Each assessment was performed twice to increase the results reliability, as recommended by the literature[16]. For the final result, it was considered the arithmetic mean, in millimeters, of the two measurements.

The facial type was determined from the morphological facial index or facial index, a centesimal relation between the height and width facial. The higher the index, the longer and narrower is the face[17].

The facial types were classified in[17]: up to 78.9 – hypereuriprosopic (hyperbrachyfacial); from 79.0 to 83.9 – euryprosopic (brachyfacial); from 84.0 to 87.9 – mesoprosopic (mesofacial); from 88.0 to 92.9 – leptoprosopic (dolichofacial); and above 93.0 – hyperleptoprosopic (hyperdolichofacial).

### Head posture evaluation

The head posture evaluation was performed qualitatively by a physical therapist, through visual examination and, quantitatively, using computerized photogrammetry. Both assessments were conducted with children in orthostatic posture in swimming suit and barefoot.

The physical examination of head posture was performed according to the classical protocol. The evaluation consisted of visual examination of possible deviations from this body segment and it was recorded in a specific protocol[18].

The photogrammetric evaluation was performed in right profile. The anatomical points in the ear tragus and seventh cervical vertebrae were marked with small polystyrene balls. A plumb line was hung on the right side of the child as a vertical reference. For better visualization of the anatomical points marked, a dark and opaque background was used. The photos were taken with a digital camera, positioned on a 0.85 meter height tripod, three meters away from the child. The children were instructed to keep their usual body posture with opened eyes glancing to the horizon line[19].

The photogrammetric analysis was performed with the Postural Analysis Software (SAPo v0.68®)[20]. The head posture were assessed, in the right lateral view, through the angle formed by the tragus, seventh cervical vertebra and the horizontal line (Figure 2)[21].

### Data analysis

The results were analyzed descriptively. The Lilliefors test verified the normality of the variables studied. For the comparison of the head posture between groups, the Kruskal-Wallis test was used. To test the association between the facial type and the breathing mode/etiology of mouth breathing, the Chi-square test was used. The Chi-square residual analysis was used to verify the significant deviations. The correlation analysis between morphological facial index and head posture was performed using the Spearman Correlation test. It was considered the significance level of 5% ($p < 0.05$) in all analysis.

## RESULTS

In each group, it was carried out the distribution of facial types (Table 1).

Additionally, the results obtained from association among the facial type and breathing mode/mouth breathing etiology are shown (Table 2). For statistical analysis purposes the

**Figure 1.** Anthropometric assessment to determine the facial type: height and width facial measurement

**Figure 2.** Forward head angle calculated in the photogrammetric assessment in the lateral right view

hyperbrachyfacial and brachyfacial facial types as well as the hyperdolichofacial and dolichofacial types were grouped. It was verified an association among these variables and, by the Chi-square residual analysis, it was identify that the brachyfacial type was more frequent in the NB and less frequent in the OMB than the expected, assuming the independence among the variables.

The physical examination evidenced that all children presented forward head postures, without difference among NB, OMB and HMB (Table 3). The photogrammetric analysis did not show difference in the head posture among the groups as well.

There was no association between the morphological facial index and the head posture angle (Table 4).

**Table 1.** Facial types distribution

| Facial type | Group | | | | | |
|---|---|---|---|---|---|---|
| | NB | | OMB | | HMB | |
| | n | (%) | n | (%) | n | (%) |
| Hyperbrachyfacial | 2 | (13.3) | 0 | (0.0) | 0 | (0.0) |
| Brachyfacial | 5 | (33.3) | 1 | (4.5) | 8 | (36.4) |
| Mesofacial | 4 | (26.7) | 10 | (45.5) | 5 | (22.7) |
| Dolichofacial | 3 | (20) | 8 | (36.4) | 8 | (36.4) |
| Hyperdolichofacial | 1 | (6.7) | 3 | (13.6) | 1 | (4.5) |
| Total | 15 | 100 | 22 | 100 | 22 | 100 |

**Note:** NB = nasal breathers; OMB = obstructive mouth-breathing group; HMB = habitual mouth-breathing group

## DISCUSSION

The facial type establishment based the morphological facial index[17] and not by means of images exams is justified for being an easy, quick and no invasive tecnique utilized in the speech-language therapy clinics[22], with low cost, which corresponds to the Ricketts cephalometric analysis results[13]. However, this exclusive assessment procedure may consist in a limitation of the present study.

In the distribution of facial types in each group, there was a predominance of short face, hyperbrachyfacial and brachyfacial, in nasal breathers and, predominance of long face, hyperdolichofacial and dolichofacial, in mouth breathers. These findings agree with results from other studies[1,13].

Regarding the etiology of mouth breathing, there were similarities between OMB and HMB groups in the distribution of facial types, except the brachyfacial type, which occurred more frequently in the HMB group. There is a scarceness of research considering the relation of the obstructive and habitual etiologies of mouth breathing and the craniofacial morphology, what limits the discussion of these results.

It was verified an association among the facial type and breathing mode/mouth breathing etiology. Assuming independence among these variables, the brachyfacial type was more frequent than expected in the NB group, and less frequent in the OMB group. An anthropometric study[23], conducted with adolescents, did not show an association between facial type and breathing mode, disagreeing of the results of this study.

The results of the NB group in relation to facial type suggest the short face by structural aspects, i.e., shorter vertical intra-oral space, greater muscular power and wider air column, can favor nasal breathing[4,23]. However, the higher frequency of short face in this group can also be explained by the own adequacy to the breathing mode, once the nasal breathing helps to maintain the structural balance of the face[3]. A research conducted using cephalometry with nasal and oral breathers, from 7 to 13 years old, showed correlation between the brachyfacial type and nasal breathing, agreeing with the results of the present study[22].

In the OMB group, the low frequency of brachyfacial type confirms the previous statement regarding the structural aspects, which may favor the nasal breathing in this facial type[4,23]. The upper airway obstruction occurred more frequently in dolichofacial and mesofacial types, respectively, although these facial types have not shown significant association with NB, OMB and

**Table 2.** Association among facial type and breathing mode/etiology of mouth breathing

| Facial type | Group | | | | | | p-value |
|---|---|---|---|---|---|---|---|
| | NB | | OMB | | HMB | | |
| | n | % | n | % | n | % | |
| Brachyfacial | 7 | 46.6** | 1 | 4.5** | 8 | 36.4 | |
| Mesofacial | 4 | 26.7 | 10 | 45.5 | 5 | 22.7 | 0.04* |
| Dolichofacial | 4 | 26.7 | 11 | 50 | 9 | 40.9 | |
| Total | 15 | 100 | 22 | 100 | 22 | 100 | |

* Significant values (p<0.05) – Chi-square test

** Chi-square residual analysis

**Note:** NB = nasal breathers; OMB = obstructive mouth-breathing group; HMB = habitual mouth-breathing group

**Table 3.** Head posture angles in the sagittal plane

| Group | n | Mean | SD | CV | p-value |
|---|---|---|---|---|---|
| NB | 15 | 46.15 | 4.27 | 0.09 | |
| OMB | 22 | 45.71 | 4.34 | 0.09 | 0.45 |
| HMB | 22 | 45.09 | 5.42 | 0.12 | |

Kruskal Wallis test (p<0.05)

**Note:** NB = nasal breathers; OMB = obstructive mouth-breathing group; HMB = habitual mouth-breathing group; SD = standard deviation; CV = variation coefficient

**Table 4.** Correlation between head posture and the morphological facial index

| | Head posture in relation to the horizontal plane | | | | | |
|---|---|---|---|---|---|---|
| | NB | | OMB | | HMB | |
| | r | P | r | p | r | p |
| Facial index | 0.132 | 0.64 | -0.262 | 0.24 | -0.385 | 0.07 |

Spearman Correlation test (p<0.05)

**Note:** NB = nasal breathers; OMB = obstructive mouth-breathing group; HMB = habitual mouth-breathing group; r = Spearman rank correlation coefficient

HMB groups. The results obtained in OMB group also suggest that the obstructive factor and the breathing mode adaptation may have produced the face lengthening and, therefore, the brachyfacial type was less frequent in this group[3].

In the HMB group, the distribution of facial types had similar frequencies. The literature states that the dolichofacial type predisposes to the habitual mouth breathing due to vertical growth of the third lower face. As a consequence of the increase in the intraoral vertical space, the proper tongue position in the oral cavity and the labial sealing are impaired[4,5]. In the present study, however, the association between dolichofacial type and habitual mouth breathing could not be proven. It is believed that the variability of facial types presented in this group could be explained by the composition of the group, once it was composed by children with nasal mucosa transitory swelling, who kept the habitual mouth breathing even after the obstruction had been controlled. The habitual mouth breathing secondary to this factor could occur with the same frequency in the different facial types, once the predisposition to the nasal mucosa transitory swelling, usually from allergic causes, seems to be independent of facial type.

Regarding the dolichofacial type, the structural conditions that predispose mouth breathing, as described in literature, have been investigated in order to clarify possible causes and effects of craniofacial morphology and respiratory mode. There is a presumption that the dolichofacial type may be related to obstructive mouth breathing for having narrower airspace, favoring the obstruction in case of unbalanced growth of the pharyngeal lymphoid tissues[4,24]. However, this assumption was not confirmed in a study comparing, through cephalometry, the size of oropharyngeal and nasopharyngeal spaces in subjects without obstruction divided into three groups according to facial type. The results indicated that the facial type did not influence the size of nasopharyngeal and oropharyngeal airspaces[25].

For the muscle characteristics, several authors claim that the dolichofacial type shows masticatory muscles weakness, which added to the jaw vertical growth would difficult the lip seal and predispose mouth breathing[4,5].

The association between facial type and breathing mode is controversial concerning what first happens. It is known that the facial growth pattern is genetically determined and may suffer interference from external factors. Based on this, the results of the present study indicate the brachyfacial type favors nasal breathing and the mouth breathing may accentuate the vertical facial growth in subjects predisposed to this facial type by hereditary factors[22].

The comparison among NB, OMB and HMB groups did not show difference in the head posture. There is no reference value for the measured angle, therefore it is not known if the value obtained means a forward head posture. However, by physical examination, all children show the forward head. This indicates that the values obtained for the angle are below of the corresponding values to the alignment of the head at the age group (from 8 years to 11 years and 11 months old), considering the smaller the angle, the greater is the forward head.

These results corroborate the results from another study that aimed to compare the posture of nasal and obstructive mouth-breathing children, through stereophotogrammetry, also considering the angle formed by C7, tragus and the horizontal line. The authors found no difference in the angle measured between groups. Nevertheless, they found forward head in most children, both nasal and mouth breathers[21]. In that study, the mean angle obtained in right profile was 48.10° degrees for the nasal and 48.50° for the mouth breathers. In the present study, the angles obtained where 46.1° for the NB group, 45.71° for the OMB group and 45.09º for the HMB group, suggesting that children in this study exhibited a higher degree of forward head than the study cited[21].

The changes in stomatognathic system, especially the breathing mode, can directly influence the head and cervical spine postures[26]. However, the body posture may be influenced by many other intrinsic and extrinsic factors such as heredity, physical conditions that the child is exposed, level of physical activity, physiological adaptations due to growth and body development, among others[21,27,28]. It is believed that all these factors involved in postural control would justify the findings of this study, once the change in the horizontal alignment of the head occurred independently of the breathing mode and the mouth breathing etiology, contradicting the findings of several authors who observed more evident changes in head posture in mouth breathers[2,8,9,19,26,29].

On the other hand, the findings of the present study are consistent with those obtained in a research of school-age children from 7 to 10 years. The study showed, by qualitative analysis of photographs, a higher incidence of postural changes in children in this age, including head and cervical spine, which may be related to muscular, skeletal and flexibility individual differences[27].

Authors who have studied the body posture of children selected according to the breathing mode affirm that postural changes are common in childhood, but the persistent mouth breathing seems to contribute to these changes maintenance and increase, which may be more evident in later stages of development[8].

It was not verified the relation between the morphological

facial index and the head postures in each one of the groups. Conversely, a previous study, with adult subjects, using cephalometry, found association between the forward head and long facial type[30]. In the present study, this finding can be explained by the fact that the body posture is influenced by several other aspects already mentioned besides the breathing mode. Additionally, the occlusal conditions, frequently altered in mouth-breathing subjects, may influence the head posture as well.

## CONCLUSION

The results suggest that the brachyfacial type favors the nasal breathing mode, and head posture seems not be influenced by breathing mode and by the mouth breathing etiology, as well as it is not related to the facial type.

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