

Original articles

Quantitative evaluation of tongue pressure in children with oral breathing

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ABSTRACT

Objective: to quantify tongue pressure in children with oral breathing and to describe their respiratory clinical manifestations, comparing them to the objective evaluation

Methods: the study was performed with 60 children, four to nine years old, treated at the outpatient clinics of the Pernambuco Clinical Hospital, Federal University of Pernambuco, distributed into two groups, with and without oral breathing. The collection consisted of a survey of respiratory clinical manifestations, application of the protocol on respiratory mode and assessment of tongue pressure, using the Iowa Oral Performance Instrument (IOPI).

Results: male predominance and correlation between diagnosis of allergic rhinitis and/or nasal obstruction and the clinical diagnosis of oral breathing were observed. There was a statistically significant difference between the groups for usual position of open lips, open mouth, sagging facial expression muscles, narrow nostrils, shortened upper and everted lower lip. The mean tongue pressure in children with oral and nasal breathing presented a mean of 38.27 Kpa and 53.73 Kpa, respectively.

Conclusion: tongue pressure decreased in children with oral breathing, corroborating that which is reported in the literature. There was agreement between the results of respiratory clinical characteristics and the objective evaluation.

Descriptors: Oral Breathing; Speech therapy; Child; Tongue

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INTRODUCTION

Oral Breathing occurs when the subject replaces the nasal respiratory pattern with an oral replacement pattern. It may be related to allergic, genetic factors, inappropriate oral habits and nasal obstruction, being one of the most frequent symptoms in childhood in much of the literature^{1,2}.

The child who chronically breathes through the mouth may develop speech disorders, inadequate body posture, changes in the respiratory system, facial deformities and poor positioning of the teeth, resulting in structural changes in the face including lips, tongue, palate and mandible, which will adapt to the new respiratory pattern. With this, the vestibular-tongue balance is removed, altering the balance of the facial muscles and generating an important functional deficiency. Due to the lack of nasal airflow, the pressure of the tongue on the palate is reduced, diverting the mandible downwards and backwards relative to the base of the skull¹⁻⁵.

The tongue is characterized by an essentially muscular organ, which occupies the functional space of the oral cavity, being formed by a striated muscle tissue, actively participating in processes such as sucking, chewing, swallowing and phonation, fundamental in maintaining quality of life. In view of the importance of this organ, numerous researchers included in their work the measurement of language strength, as a way of quantitatively evaluating their functions⁶.

Oral breathing alters the position of the tongue in the oral cavity, and when the tongue is lowered and anteriorly positioned, it tends to cause changes in the pattern of stomatognathic functions, in addition to failing to exercise its moderating function of the dental arches, favoring more occlusions². According to a study by Rodrigues et al. (2005)⁷, oral respirators presented enlarged and flaccid tongue.

The strength of the tongue can be assessed qualitatively or quantitatively. Qualitative assessment is the most commonly used by professionals in their clinical practice, being subjective and dependent on the professional's common sense and experience and therefore subject to uncertainties related to the human condition of the evaluator. The quantitative evaluation is performed through instruments that provide the value of the strength exerted by the individual, and the IOPI (Iowa Oral Performance Instrument) is one of the instruments used for this type of quantitative evaluation^{8,9}.

Thus, quantitative assessment increases the probability of appropriate diagnosis of tongue tension

in cases of mild force change, being more sensitive to detect small strength differences observed with progression of therapy or disease⁸.

Therefore, the hypothesis of the study is that tongue pressure is lower in children with oral breathing than in children with nasal breathing. Thus, the objective of this study was to quantify tongue pressure in children with oral breathing and to describe their respiratory clinical manifestations, comparing them to objective assessment.

METHODS

The study was composed of 60 children aged four to nine years, 30 children in each group, oral and nasal breathers. The research was approved by the Committee of ethics and research with human beings of the Federal University of Pernambuco, number 674.637.

It is a comparative, observational, descriptive and cross-sectional study, with a non-probabilistic sampling, for convenience. The research was a reality in children attending Pediatric, Allergology, Endocrinology and Otorhinolaryngology outpatient clinics at the Pernambuco Clinical Hospital (HC), Federal University of Pernambuco (UFPE).

These participants were selected from the inclusion and exclusion criteria. The following were included: Children of both sexes, with and without oral breathing classification, from the application of the respiratory function functional classification protocol elaborated for this research and association with the nosological diagnosis. The following were excluded: Children with neurological impairment, carriers of serious heart diseases, with craniofacial abnormalities present and that were in speech therapy.

Initially, the medical records were reviewed in outpatient clinics to obtain data on nosological diagnosis, treatment and interventions. The control and comparison groups were defined from the medical diagnosis in the medical record. After screening the participants to participate in the study through the exclusion and inclusion criteria, those responsible were informed about the procedure and invited to participate in the study by reading the Free and Informed Consent Term.

Next, the research counted on the application of the protocol developed for research, being composed of data for identification and clinical evaluation of the respiratory mode to assist in the diagnosis of oral breathing. In this protocol, the functional signs and symptoms of respiration and nosological diagnosis are evaluated.

For the nosologic diagnosis, the presence of allergic rhinitis and mechanical obstruction (adenoid hypertrophy), both in the chart and the registry of the evaluation of the palatine tonsil sizes by the researcher, were considered, and the mouth was opened with tongue placement out of the tongue out of the oral cavity together with a sound emission /a/.

The sizes of the tonsils were marked on the evaluation card the graduation of the tonsils according to Brodsky's classification. According to this scale, the size of the tonsils was classified as: grade 1 - tonsils inside the tonsillar store, with difficult visualization, being located posterior to the anterior tonsillar pillar; grade 2 - easily visible tonsils behind the posterior tonsillar pillar; grade 3 - tonsils occupying three quarters of the distance to the midline (uvula); grade 4 - completely obstructing tonsils and touching¹⁰.

The assessment of tongue pressure was performed using the Iowa oral performance instrument (MODEL 2.3), which consists of an instrument used to measure and quantify tongue pressure. This instrument is formed from a portable manometer connected to a pressure lamp or tongue-filled air-filled sensor of 2.7 milliliters that is positioned between the tongue and hard palate. The pressures are obtained and displayed digitally by a series of LED lights (expressed in kPa) on an LCD panel on the instrument¹¹, as shown in Figure 1.

The lingual sensor was positioned against the palatine vault, located in the upper wall of the mouth.

Where the lingual sensor was connected and positioned between the dorsum of the tongue and the hard palate of the individuals evaluated (Figure 2) and asked to perform a maximum tongue pressure against the bulb pressed towards the palate for about two seconds. During the procedure, verbal reinforcement was offered to obtain a higher level of pressure.



Source: Own (2014).

Figure 1. IOPI (Model 2.3)



Source: Own (2014).

Figure 2. Steps for placing the bulb in the oral cavity

Once the participant pressed the sensor the maximum and the effort ceased, the value displayed on the LCD screen of the IOPI device was noted. The patient was advised to rest for 40 seconds, so that the continuation consisted of the repetition of the steps already described three times.

The maximum tongue pressure was the highest recorded pressure on the LCD screen and the mean pressure consisted of the arithmetic mean during the three phases. These results were recorded by the researcher.

The statistical tests for this analysis were chi-square and Fisher's exact test. Statistical analysis was performed using the statistical program SPSS v.17. For all tests the level of significance was 5%.

RESULTS

Table 1 shows data on the distribution of respiratory clinical manifestations over respiratory mode. It is possible to observe that more than 73.3% of the children in the oral breathing group had a significant difference in the manifestations of daytime and nighttime oral breathing, frequent colds, snoring, nocturnal sialorrhea and dry throat sensation upon awakening.

There was no statistically significant difference between the groups with oral and nasal breathing in relation to asthma, bronchitis, nocturnal apnea, being fatter than the other children and difficulty chewing.

Regarding sex and respiratory mode, there was a higher prevalence of males in the group of mouth breathers (n = 18) and females in the nasal respirators group (n = 15).

Table 1. Distribution of respiratory clinical manifestations according to respiratory mode

Variables	Oral (N=30)		Nasal (N=30)		Value of p*
	N	%	N	%	
Breathing through the mouth	30	100.0%	0	0.0%	<0.001
Breathing through the mouth during the day	22	73.3%	0	0.0%	<0.001
Breathing through the mouth at night	29	96.6%	0	0.0%	<0.001
Frequent colds	22	73.3%	5	16.6%	<0.001
Asthma	5	16.6%	0	0.0%	0.052**
Bronchitis	6	20.0%	0	0.0%	0.024**
Respiratory Allergies	19	63.3%	5	16.6%	<0.001
Rhinitis	19	63.3%	3	10.0%	0.001
Restless sleep	15	50.0%	5	16.6%	0.006
Apnea	5	16.6%	0	0.0%	0.052**
Snoring	20	66.6%	1	3.3%	<0.001
Drools	22	73.3%	1	3.3%	<0.001
Wakes up with dry mouth	21	70.0%	1	3.3%	<0.001
Fatter than the other kids	2	6.6%	7	23.3%	0.145**
Slimmer than the other kids	15	50.0%	6	20.0%	0.015
Has difficulty chewing	6	20.0%	0	0.0%	0.024**

NASAL = nasal breathing patient group; ORAL = group of oral breathers. Legend: * p <0.05 (Chi-square test); %: percentage.

Table 2 presents data on respiratory signs and symptoms in children with oral and nasal breathing. There was a statistically significant difference with greater relevance in children with oral breathing, in the data on habitual position of the parted lips, open

mouth, flaccidity of facial expression muscles, narrow nostrils, shortened upper lip and everted lower. There was no significant difference between the two groups regarding halitosis, whitish tongue, daytime sleepiness, difficulty maintaining alertness and reduced appetite.

Table 2. Distribution of respiratory clinical manifestations, according to signs and symptoms related to respiratory mode

Variables	Oral (N=30)		Nasal (N=30)		Value of p*
	N	%	N	%	
Have dark circles	19	63.3%	1	3.3%	<0.001
Keep their lips parted	25	83.3%	0	0.0%	<0.001
Keep their mouth open	25	83.3%	0	0.0%	<0.001
Feature flaccidness of the face muscles	23	76.6%	0	0.0%	<0.001
Narrow nostrils	22	73.3%	2	6.6%	<0.001
Shortened upper lip	21	70.0%	0	0.0%	<0.001
Everted lower lip	22	73.3%	0	0.0%	<0.001
Halitosis	19	63.3%	11	36.6%	0.070**
Whitish tongue	7	23.3%	0	0.0%	0.011**
Drowsiness during the day	16	53.3%	15	50.0%	1.000**
Difficulty maintaining attention	16	53.3%	9	30.0%	0.115**
Reduced appetite	13	43.3%	9	30.0%	0.422**

NASAL = grupo de pacientes respiradores nasais; ORAL = grupo de pacientes respiradores orais. Legenda: * $p < 0,05$ (teste do Qui-quadrado); %: percentual.

Table 3 shows the data referring to the nosological diagnosis and the respiratory pattern. A statistically significant relationship was found with mild allergic

rhinitis and oral breathing, as well as for moderate nasal obstruction and grade III palatine tonsil.

Table 3. Relationship between nosological diagnosis and respiratory pattern

Variables	Categories	Oral n(%)	Nasal n(%)	Value of p*
Rhinitis	Light	19(63.3%)	5(16.6%)	0.001
	Moderate	7(23.3%)	2(6.6%)	0.005
	Severe	2(6.6%)	0(0.0%)	0.005
Diagnosis of nasal obstruction (adenoid hypertrophy)	Light	10(33.3%)	0(0.0%)	0.001
	Moderate	12(40.0%)	0(0.0%)	<0.001
	Severe	1(3.3%)	0(0.0%)	1.000
Palatine Tonsil's classification	Degree I	2(6.6%)	9(30.0%)	0.042**
	Degree II	14(46.6%)	14(46.6%)	1.000**
	Degree III	11(36.6%)	4(13.3%)	0.037
	Degree IV	0(0.0%)	0(0.0%)	-

NASAL = nasal breathing patient group; ORAL = group of oral breathers. Legend: * $p < 0.05$ (Chi-square test); %: percentage.

The tongue pressure in the group of oral breathers was lower than the nasal respirators group, being 38.27kPa and 53.73kPa, respectively. There was a significant difference in pressures between the groups, with nasal respirators being responsible for higher levels of tongue pressure.

With regard to gender, tongue pressure was lower in males (45.70 kPa \pm 12.01) compared to females (46.37kPa \pm 8.11), thus raising the possibility that the relation of tongue pressure was lower in males and its prevalence in the group of oral breathers.

DISCUSSION

Oral breathing is a pathology related to numerous clinical signs and symptoms. There are several causes related to oral breathing, thus, it is understood that there is a relation with several very different diseases, causing its diagnosis and classification not to be very defined¹². The investigation of oral breathing is fundamental, as it is a condition with potential for the development of complications. In this research, a detailed and specific questionnaire was applied for the characterization of the

respiratory mode and nosological diagnosis present in the oral respirator.

In the study, two sample groups were considered, that is, the group of oral breathers and the nasal respirators one. The groups were classified according to medical diagnosis and the clinical characteristics found in each sample group were described.

Motonaga, Berte and Lima¹³ (2000) and Imbaud et al. (2006)¹⁴ agreed with the information found in the research on the characteristics of the child with oral breathing. The authors emphasized that the majority of the children presented complaints of predominantly oral breathing during the day and night, snoring and nocturnal sialorrhea. These symptoms may lead to irreversible changes in the craniofacial growth pattern when established for a long period, mainly in the developmental stage of children, and impair the quality of the child's sleep, presenting xerostomia and restless sleep^{15,16}.

According to Cintra, Castro and Cintra (2000)⁴ the occurrence of frequent colds is common in this population, with characteristics of persistent hyaline nasal secretion and sneezing. This information corroborates the findings of the study, where 73.3% of oral breathers presented this clinical manifestation within the respiratory alterations. Another important finding of the study was the prevalence of children considered to be leaner for their age within the oral breathers group. Some scholars explain that by the altered lip position, the tongue stops pressing the palate and rests on the floor of the mouth and, therefore, the palate becomes ogival and the dental occlusion is compromised⁴. Malposition of the tongue causes chewing and phonation problems. Thus, the child has to chew and breathe at the same time, and eating becomes difficult, eating less and needing liquid to swallow^{16,17}.

There were alterations such as dark circles (63.3%), narrow nostrils (73.3%), open lips (83.3%) and morphological changes in the upper and lower lips (70.0% and 73.3%, respectively) in children with oral breathing, these data were also cited by other authors as being facial features commonly found in subjects with oral breathing^{12,13,18,19}.

Correlating the etiology with the clinical findings, we verified the main causes of oral breathing to allergic rhinitis, Hypertrophy of palatine and pharyngeal tonsils, habit and also associated obstructive pathologies^{11-13,20,21}. This study agrees with the findings of these studies, which indicate the incidence of allergic rhinitis (93.3%) and tonsillar hypertrophy (76.6%) as

concomitant factors of infection and obstruction of the upper airways, favoring nasal obstruction and reduction of nasal airflow.

Among allergic rhinitis, allergic rhinitis deserves to be highlighted, since it affects about 10 to 30% of the general population, reaching approximately 25.7% among schoolchildren, from six to 13 years old and because it is evidenced as the main etiological factor of respiration oral^{4,22-24}.

A study of 142 oral ventilators of both genders, aged two to 16 years, in the Otorhinolaryngology Outpatient Clinic of the Clinical Hospital of the University of São Paulo, found that 66 (46.5%) of the patients had palatine tonsils degrees III and IV, Brodsky's rank¹¹. In agreement with the study, there was a significant presence of palatine tonsil in grade III in the control group (36.6%).

Among the instruments for measuring tongue pressure, the Iowa Oral Performance Instrument (IOPI) is the most used in scientific research²⁵⁻²⁹, being this instrument used in this research. Comparison of the pressure values found in this research with others in the literature is difficult, since the vast majority use this objective method to evaluate speech functions²⁷ and swallowing^{25,29-33}, Isometric^{8,26,30,34} and isometric with visual feedback²⁶.

In the case of the study conducted by Lambrechts et al. (2010)³⁵ the sample included subjects between seven and 44 years of age, where the maximum pressure was measured with a Myometer 160. This type of myometer was manufactured specifically for the measurement of pressure or tension of the intra and perioral muscles in the field of orthodontics. It was observed in this study that the mean tongue pressure was 1.66 N, since it included children from seven years and more than 80% of the sample was composed of individuals under 18 years of age. This study showed that the strength of the child's tongue is lower than that of the adult, for being, childhood, the stage of body development and maturation of the nervous system.

The study conducted by Perilo (2007)³⁶ evaluated the axial force of the tongue in children through subjective and objective means by using an equipment developed at the Federal University of Minas Gerais, comparing them. Fifteen children, of both genders, aged between eight and 12 years old, were distributed between oral pre-surgical respirators, speech therapy and nasal respirators. The lingual force was evaluated by urging children to push their tongue against a spatula and then against the evaluator's gloved finger.

In this study, Perilo (2007)³⁶ classified the lingual force as: adequate, slightly hypotensive, hypotensive or hypertensive. The data from the study revealed the subjective strength of the tongue as hypotensive and slightly hypotensive in the group of pre-surgical oral breathers, followed by oral breathers in Speech-Language Pathology. All nasal breathers had adequate tongue strengths. These findings were in agreement with the objective language strength assessment of the research.

In the study by Hermann et al. (2013)³⁷, 104 children aged six to ten years and diagnosis of OR were evaluated by a multiprofessional team. Specifically, Speech Therapy subjectively evaluated the tonicity and mobility of tongue, lips and cheeks. In this study, 79 children (75.9%) had altered tongue tonus.

In the analysis of the present study, the mean values of tongue pressures in 30 oral and 30 nasal breathers were 38.27 and 53.73 kPa, respectively. Thus, we observed a comparison of pressures between the groups, it was considered that the pressures presented by the group of oral breathers present a significant difference of reduced lingual tension, unlike the group with nasal breathing.

Thus, the results found agree with the findings in the literature regarding the diminution of tongue tonus that these subjects present due to the altered respiratory pattern.

Several methods found in the literature refer to instruments used to assess tongue strength⁷. This term is correctly used for instruments that assess tongue pressure over the area. That is, to recognize force it is essential to calculate the area where the pressure detector is positioned or the oral cavity.

In the study, the surface area was not measured and for this reason it is a research to quantify the values of lingual pressure. During the search the expression "force" was found to be more prevalent among instruments with the same objectives. Therefore, there is a lack of studies that assess language pressure in the child population.

According to several authors^{11,12,19,37-40} in relation to sex, it was verified that there is a greater prevalence of males in the groups of oral breathers studied. These findings corroborate with the data found in this study, where 33 (55%) of the evaluated ones were boys.

Thus, the importance of new research to verify language pressures is emphasized, especially in the population of children with oral breathing, since the

altered breathing promotes quite different repercussions for these cases.

The data collected in this study point to the importance of the evaluation of signs and symptoms and clinical objective methods in subjects with oral breathing, mainly during childhood, to complement the clinical findings and more reliable therapeutic follow-up.

Analyzing the values of tongue pressure in children with oral breathing and nasal breathing. With the results, it was possible to enrich the literature with quantitative data on language pressure evaluation, contributing to functional evaluation and complementation of the diagnosis data in Orofacial Motricity, allowing the speech-language pathologist to perform a more reliable orofacial myofunctional assessment, to draw specific therapy plans and follow the evolution, observing the pressure gain that the patient obtained, even if this value is imperceptible to the qualitative evaluation. This will make the therapy more stimulating for the patient, increasing their adherence to treatment.

CONCLUSION

In this study, it was observed that the mean of maximum tongue pressures was lower in the group of individuals with oral breathing. The prevalence was higher in males, and the sample revealed that there is a direct association of the altered respiratory mode with the nosological diagnosis of allergic rhinitis and adenoid nasal obstruction.

There was also agreement between the results of respiratory clinical characteristics and objective evaluation, and the instrument used in this study was shown to be effective in complementing and confirming clinical speech-language findings. However, further studies are necessary, mainly Brazilian ones, involving the IOPI and a greater number of children with and / or without oral breathing, in order to draw the profiles of the expected pressures for each age, gender and respiratory mode.

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