



## Relationship between Asthma, Malocclusion and Mouth Breathing in Primary Health Care Children

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### Abstract

**Objective:** To assess the relationship between asthma, malocclusion and mouth breathing. **Material and Methods:** This investigation was a cross-sectional study of 228 children between 6 and 12 years of age, of whom 112 were asthmatic and 116 were not, performed in two Primary Health Units of Porto Alegre, Brazil. The assessment consisted of a mouth exam performed by two calibrated dentists, an interview with parents/caregivers and medical chart data. Mouth breathing was determined through oral-facial changes related to Mouth Breathing Syndrome. Occlusion was assessed according to Angle's Classification for permanent or mixed teeth and regarding primary teeth were based on the canine relationships. The data were assessed by the Chi-square test and Poisson regression, with robust variation, at a  $p < 0.05$  significant level. **Results:** Asthma [ $PR = 2.12$  (95% CI: 1.46-3.08),  $p < 0.001$ ] and the use of pacifiers [ $PR = 1.98$  (95% CI: 1.27-3.07),  $p < 0.001$ ] were associated with mouth breathing, in the final multivariate model. Age [ $PR = 1.02$  (95% CI: 1.00-1.03),  $p = 0.039$ ] and thumb sucking [ $PR = 1.08$  (95% CI: 1.03-1.13),  $p = 0.001$ ] were associated with malocclusion in the final multivariate model, while there was no relationship between asthma and malocclusion ( $PR = 1.00$ ; 95% CI: 0.94-1.07). **Conclusion:** This study provides evidence of the relationship between asthma and mouth breathing in children, demonstrating that knowledge regarding the oral health of populations with chronic diseases is fundamental for developing health programmes suitable to their needs and risks.

**Keywords:** Mouth Breathing; Asthma; Oral Health.

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## Introduction

Asthma is a chronic inflammatory disease of the airways, characterised by reversible and incidental symptoms of airways obstruction [1]. The disease has a global prevalence that varies from 1% to 18% in the populations of different countries. Furthermore, the asthma load is still increasing around the world [2], including Brazil, where an estimated 20 million asthmatic people live, if a 10% global prevalence is considered [3]. In Brazil, asthma is the 4th most common reason for hospitalisation among children and young adults and is among the conditions amenable to Primary Health Care.

Asthma is classified into two severity levels: intermittent and persistent (mild, moderate or severe). The treatment drugs can be systemic bronchodilators and/or corticosteroids and may be administered through different routes, with inhalation being the most common [4]. Thus, because of the direct contact with the mouth cavity through the inhalation route or because of the systemic effect, there is an increasing amount of evidence (as stated by clinical or epidemiologic trial [5-10] suggesting a significant increase of oral diseases in asthmatic children - mouth breathing and malocclusions being among these conditions.

In the assessment of asthmatic children's respiratory patterns, cohort studies [7,8] of asthmatic children between 3 and 6 years of age revealed that mouth breathing was more prevalent in asthmatic children. Therefore, asthmatic people have a higher tendency to be mouth breathers [11], and mouth breathing can be a predisposing factor for the evolution of more severe craniofacial changes, such as increased overjet and open bite, abnormal swallowing and speech and a long facial profile [12].

In these terms, considering the role of Primary Health Care as the first contact of the user with the service and the follow-up fully provided to this care in a coordinated manner, the purpose of the present study was to assess the possible relationship between asthma and mouth breathing and malocclusion in the Primary Health Care context.

## Material and Methods

### Study Design

This investigation was a cross-sectional study conducted between April and September 2012, in two Basic Health Units of the Grupo Hospitalar Conceição (GHC), located in the city of Porto Alegre, Rio Grande do Sul, Brazil.

GHC is bound to the Brazilian Ministry of Health and is acknowledged nationwide as the biggest public health service network in the southern region of the country, with 100% public service. It is composed of four hospitals and twelve Primary Care Units of the Community Health Service, which are dedicated to attend to the various needs of healthcare while ensuring access to universal free care and ensuring the population's right to healthcare.

### Data Collection

After training through a conceptual discussion of the assessment criteria/indexes, two dental surgeons were calibrated. The calibration was performed using the in lux method [13]. Kappa's coefficient was employed in both calibrations to assess the concordance between the images assessed by the same examiners and between the examiners themselves. Kappa's intra-examiner 1, intra-examiner 2 and intra-examiner 3 values were, respectively, 1.00/1.00/1.00 (for mouth breathing) and 1.00/1.00/0.85 (for malocclusion).

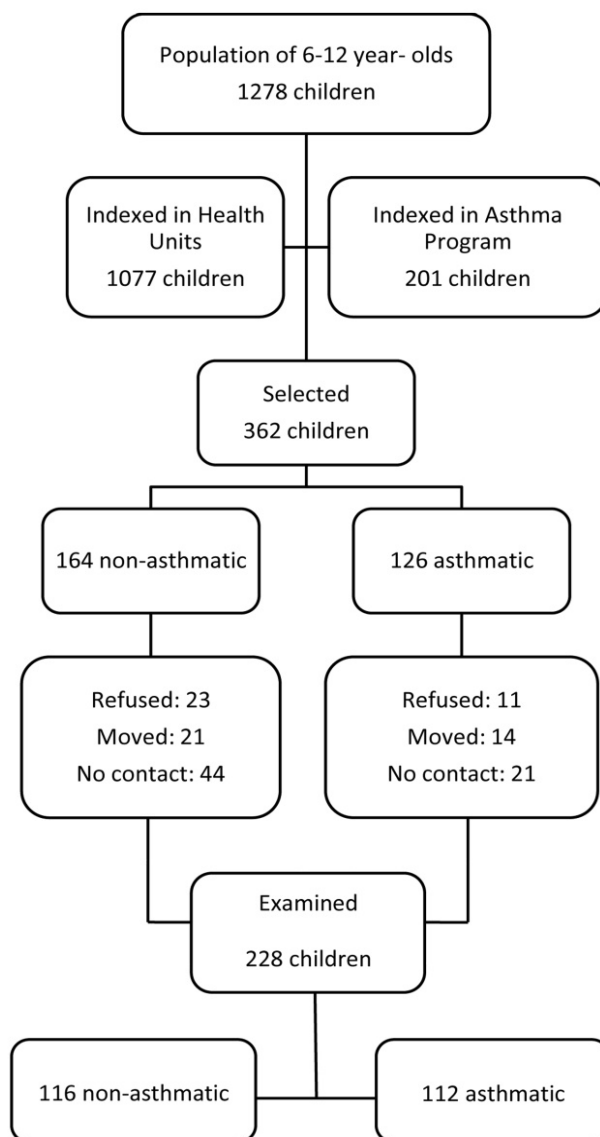
An interview with the parents or caregivers was conducted at the Health Units or during house visits, to gather information regarding family income, caregiver education, asthma and the children's mouth habits. Subsequently, the examinations were conducted by two examiners. The children were seated in chairs, and the examination was conducted with the aid of a dental mirror and with artificial lighting.

Non-asthmatic children between 6 and 12 years of age registered in the Health Units and asthmatic children registered in the Asthma Programme of the Health Units in 2012 were included in the study; the individuals for whom a mouth examination was not possible were excluded from the study. The presence or absence of asthma was determined by the family physician working in one of the primary care units, and asthmatic patients were regarded as having Intermittent or persistent asthma, as a measure of severity of disease.

To estimate the sample size, a calculation was performed considering the number of 1278 children. For select a bidirectional alpha of 0.05 and beta of 0.20 it was estimated a total sample of 214 individuals considering the estimated prevalence of mouth breathing [14] and malocclusion [15]. In order to avoid losses, 362 children were randomly selected, and 228 were examined, as described in Figure 1. Among the latter number, 112 children were asthmatic, and 116 children were non-asthmatic; in addition, they were sorted out of a table of random numbers, which were obtained from the list of users registered in both Health Units. A random stratified sample, proportional per age group (Group 1: 6 and 7 years of age; Group 2: 8 and 9 years of age; Group 3: 10 to 12 years of age), was performed.

The presence or absence of mouth breathing was determined through oral-facial changes related to Mouth Breathing Syndrome, such as a forward head posture, dark circles under the eyes, a narrow and long face, a flat nose with narrow nostrils, open or half-open hypotonic and dried lips, a hypotonic and lowered tongue, an atresic maxilla, an ogival palate and hypotonic oral-facial muscles, among other typical characteristics that enable an easy diagnosis [16]. Many of this characteristics, as dark circles, are both related to allergies process and asthma. Moreover, the parent/caregiver reports regarding the presence of snoring, open-mouth postures, nasal obstruction and excessive salivation were also considered.

Occlusion was assessed according to Angle's Classification for permanent or mixed teeth, through the mesio-distal relationship of the first permanent molar. Regarding primary teeth, the criteria used for the occlusion were the same, although these criteria were based on the canine relationships [17].



**Figure 1. Flowchart – Recruitment and selections of participants.**

### Statistical Analysis

Data were analysed by the Chi-square test and Poisson regression, with robust variation. All variables related to the malocclusion and mouth breathing outcomes (with  $p < 0.020$ ) were considered potential confounding factors and were included in the multivariate model. Variables with  $p$  values lower than 0.05 were considered statistically significant. The SPSS software, version 16.0 (SPSS Inc., Chicago, IL), was used.

### Ethical Aspects

This study was conducted in compliance with the Resolutions 196/96 and 466/12 of the National Health Council that governed researches involving human beings in Brazil. It was submitted and approved by the GHC Research Ethics Committee.

## Results

Most of the participants were girls (55.3%), had a family income lower than R\$1,500 (which is the same as 2.2 minimum wages in Brazil [37.7%]) and had parents with incomplete and complete high-school educations (57.2%). Regarding the mouth habits, 145 (63.6%) children previously used a pacifier, while 203 (89%) had never practiced thumb sucking.

The most common type of asthma was intermittent, in 62 children (55.4%), followed by mild persistent, in 38 children (33.9%). The most used drug was salbutamol (a short-acting bronchodilator) in 95 children (84.8%), followed by 35 children (31.3%) who used budesonide (an inhaled corticosteroid), 33 children (29.4%) who used systemic corticosteroids and 28 children (25%) who used beclomethasone (inhaled corticosteroid). Seventy children (62.5%) had never been hospitalised due to asthma.

As for the mouth diseases analysed in this study, their frequencies, according to the assessed variables, are presented in Table 1.

**Table 1. Characteristics of the participants.**

Variables	Malocclusion		p-value	Mouth Breathing		p-value	
	Presence N (%)	Absence N (%)		Presence N (%)	Absence N (%)		
Gender	Male	92 (43.0)	10 (71.4)	0.038	34 (42.5)	68 (45.9)	0.617
	Female	122 (57.0)	4 (28.6)		46 (57.5)	80 (54.1)	
Age	6-7 years	68 (31.7)	7 (50.0)	0.083	26 (32.6)	49 (33.1)	0.871
	8-9 years	69 (32.3)	6 (42.8)		28 (35.1)	47 (31.8)	
	10-12 years	77 (36.0)	1 (7.1)		26 (32.5)	52 (35.1)	
Education	Elementary School	55 (26.1)	4 (28.6)	0.669	19 (23.8)	40 (27.6)	0.02
	High School	122 (57.8)	9 (64.3)		55 (68.8)	76 (52.4)	
	Undergraduate and Graduate Studies	34 (16.1)	1 (7.1)		6 (7.5)	29 (20.0)	
Asthma	No	108 (50.5)	8 (57.1)	0.628	27 (33.8)	89 (60.1)	0.000
	Yes	106 (49.5)	6 (42.9)		53 (66.3)	59 (39.9)	
Type of Asthma	Intermittent	58 (54.7)	4 (66.7)	0.567	26 (49.1)	36 (61.0)	0.204
	Persistent	48 (45.3)	2 (33.3)		27 (50.9)	23 (39.0)	
	None	7 (6.6)	-		5 (9.4)	2 (3.4)	
Number of Asthma Medications	1 medication	35 (33.0)	2 (33.0)	0.932	12 (22.6)	25 (42.4)	0.092
	2 medications	47 (44.3%)	3 (50.0)		25 (47.2)	25 (42.4)	
	3 medications	17 (16%)	1 (16.7)		11 (20.8)	7 (11.9)	
Hospitalisations	No	149 (69.6)	9 (64.3)	0.675	51 (63.8)	107 (72.3)	0.182
	Yes	65 (30.4)	5 (35.7)		29 (36.3)	41 (27.7)	
Finger Sucking	No	189 (88.3)	14 (100.0)	0.175	70 (87.5)	133 (89.9)	0.585
	Yes	25 (11.7)	-		10 (12.5)	15 (10.1)	
Previous use of Pacifier	No	76 (35.5)	7 (50.0)	0.275	18 (22.5)	65 (43.9)	0.001
	Yes	138 (64.5)	7 (50.0)		62 (77.5)	83 (56.1)	

Asthma [PR = 2.12 (95% CI: 1.46-3.08), p<0.001] and the use of pacifiers [PR = 1.98 (95% CI: 1.27-3.07), p<0.001] were associated with mouth breathing, in the final multivariate model (Table 2). Age [PR = 1.02 (95% CI: 1.00-1.03), p=0.039] and thumb sucking [PR = 1.08 (95% CI: 1.03-1.13), p=0.001] were associated with malocclusion in the final multivariate model (Table 3).

**Table 2. Poisson regression analysis for mouth breathing.**

Variables		Crude PR (95% CI) p-value	Adjusted PR (95% CI) p-value
Asthma		2.03 (1.38 - 2.98) p<0.001	2.12 (1.46 - 3.08) p<0.001
Gender	Male	1.09 (0.76 - 1.57) p= 0.62	-
Age (Years)		0.98 (0.90 - 1.07) p= 0.69	-
Income		1.00 (1.00 - 1.00) p= 0.32	-
Education	High School	1.30 (0.85 - 1.99) p= 0.22	1.29 (0.85 - 1.94) p= 0.237
	Undergraduate and Graduate Studies	0.53 (0.23 - 1.20) p= 0.13	0.58 (0.27 - 1.26) p= 0.17
Finger Sucking		1.16 (0.69 - 1.94) p= 0.57	-
Previous use of Pacifier		1.97 (1.26 - 3.09) p<0.001	1.98 (1.27 - 3.07) p<0.001

**Table 3. Poisson regression analysis for malocclusion.**

Variables		Crude PR (95% CI) p-value	Adjusted PR (95% CI) p-value
Asthma		1.02 (0.95 - 1.09) p= 0.628	1.00 (0.94 - 1.07) p= 0.891
Gender	Male	1.07 (1.00 - 1.15) p= 0.051	1.07 (1.00 - 1.15) p= 0.058
Age (Years)		1.02 (1.00 - 1.03) p= 0.046	1.02 (1.00 - 1.03) p= 0.039
Income		1.00 (1.00 - 1.00) p= 0.865	-
Education	High School	1.00 (0.92 - 1.09) p= 0.982	-
	Undergraduate and Graduate studies	1.04 (0.95 - 1.14) p= 0.365	-
Finger Sucking		1.07 (1.03 - 1.11) p= 0.000	1.08 (1.03 - 1.13) p= 0.001
Previous use of Pacifier		1.04 (0.96 - 1.12) p= 0.312	-

## Discussion

This study showed the association between asthma and mouth breathing in 6- to 12-year-old children attending Primary Care Units. The present investigation is novel in the Brazilian context, since it was carried out in the context of Primary Health Care, which has governing principles that include first contact, longitudinality, comprehensiveness and coordination of care. Thus, Primary Care, if effective, may alleviate certain health problems in the community, representing a different setting from other previous studies, which were conducted in schools, universities or hospitals, with specific populations or severe asthmatic people. In the present study, 66.3% of the children breathed

through their mouths and were asthmatic, corroborating other investigations [7-9], in which a high prevalence of mouth breathing in asthmatic people was also found. Certain studies also report that allergies, rhinitis and/or childhood asthma lead to the development of mouth breathing, thereby modifying growth and the normal development of the face [10,12].

There was an association between the previous use of pacifiers and mouth breathing, as 77.5% of the children who had already used pacifiers were mouth breathers. Some authors reported that breathing disorders can result from detrimental mouth habits [18]. Moreover, the occurrence of mouth habits is a harmful factor for the proper development of occlusion and stomatognathic system functions, even contributing to the development of mouth breathing [19].

A direct relationship between malocclusion and asthma could not be established, corroborating with study findings with 176 children and adolescents between 3 and 15 years of age [20] but disagreeing with other investigations [5,21] that found more cases of crossed bites in asthmatic children and a relationship between asthma and anterior open bite in children [6]. Such findings, obtained from cross-sectional studies, reveal that there is no agreement in the dental literature regarding the relationship between the presence of malocclusion and asthma, its time of manifestation and the severity degree in the paediatric population [20].

The association between malocclusion and thumb sucking was confirmed, corroborating that mouth habits greatly increase the chance of malocclusion development [22,23]. A classical study observed that the trifecta of the duration, intensity and frequency of thumb sucking can influence a child's cranial-facial development, promoting neuromuscular changes and leading to crossed bite, open bite, changed overjet and abnormal swallowing, which is in line with the present study, in which 11.7% of the children had already performed thumb sucking and had malocclusion [24].

Measurement bias was among the limitations of the present study. First, the in lux method was employed to calibrate the examiners, i.e., through pictures. Second, Angle's classification was used to diagnose the presence or absence of malocclusion, and it is questionable whether the latter is valid and reliable once it is only restricted to the sagittal dental dimensions, not including the vertical and transversal dimensions or considering the face. Yet, this classification remains as the base for many malocclusion assessment methods, previously proposed, given that the results obtained in these studies yielded a lower diagnostic precision [25]. Third, the mouth-breather assessment criteria were similar among several authors, although there was no unanimous consent regarding the most precise method to identify this condition. Hence, only one author was chosen, and the parent/caregiver reports regarding the presence of snoring, open-mouth postures, nose obstruction and salivation in the children were heavily considered.

## Conclusion

Mouth breathing was more common in children asthmatic. As this is a sensible condition to the Primary Health Care, there is a need to qualify and increase the comprehensive care of asthmatic children and adolescents because this approach to asthmatic people's oral health (as also stated by



other health professionals) is the way to effectively practice interdisciplinary and complete care. Moreover, this approach can decrease the financial burden of the healthcare services (because of the high cost of the treatment), compared with the preventive method.

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