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Asthma and oral changes in children: associated factors in a community of southern Brazil

Asthma and oral changes in children

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AUTHOR CONTRIBUTIONS

G.R. and D.D.F.S. conceived the ideas. G.R. and N.M.L.S. collected the data. D.D.F.S., C.S. and J.B.H. analysed the data. G.R., D.D.F.S., J.B.H. and C.S. led the writing.

CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest.

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SUMMARY

Background: Asthma is a chronic disease that involves several health care services that need attention in relation to its treatment and prevention.

Aim: The objective of this study was to evaluate caries, erosion and enamel defects in children with and without asthma.

Design: Cross-sectional study, with a sample of 228 children ages 6 to 12 years, stratified as asthmatic (n=112) and non-asthmatic (n=116), at two Primary Health Units of the Community Health Service, Brazil. The evaluation consisted of an oral examination and a structured interview with parents/guardians, in addition to data from medical records. Data were analyzed by Poisson regression with a robust error variance, all of them at a level of significance of $p < 0.05$.

Results: Of 112 asthmatic children, 63 (51.2%) had dental caries and 25 (53.2%) enamel defects. In the adjusted analysis, dental caries and use of salbutamol were associated (PR=1.32, 95%CI= 1.01-1.72). In addition, children who performed oral hygiene more than three times a day showed a greater prevalence (PR= 2.36, 95%CI =1.02-4.85) of dental erosion compared with children who performed it only once a day.

Conclusions: There is no evidence for an association between asthma, caries, erosion, and enamel defect in children aged from 6 to 12 years. However, there was an association between dental caries and use of salbutamol.

Keywords: Asthma. Primary health care. Dental caries. Anti-Asthmatic Agents. Tooth erosion. Pediatric Dentistry.

INTRODUCTION

Asthma is defined as a chronic inflammatory disease characterized by lower airway hyperresponsiveness and variable airflow limitation, which is reversible spontaneously or with treatment. This disease is present in different countries and affects approximately 1-18% of the population¹. There are two severity levels, classified as intermittent and persistent (mild, moderate, or severe). The severity is assessed by analyzing symptom frequency and intensity, and lung function, including exercise tolerance, medication required for symptom stabilization, number of medical and emergency visits, annual number of times systemic corticosteroids have been used, number of hospitalizations due to asthma, and need for mechanical ventilation¹.

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There is a consensus in the literature that this disease causes an impact that directly affects the quality of life of an individual, not only due to the respiratory alterations, but also the behavioral, functional and physical losses, as exemplified by children's school absenteeism². In addition, there is a growing body of evidence from clinical or epidemiological studies suggesting a significant increase in oral diseases in asthmatic children, including increased prevalence of caries, enamel defects, malocclusion, erosion, oral candidiasis, and changes in salivary composition and flow, which worsens in children who do not have access to dental care^{3,4}.

Molar incisor hypomineralization (MIH) is recognized as a global problem, and epidemiological reports from all over the world have been continuously published⁵. The etiology of enamel defects remains controversial; however, it has been suggested that systemic problems in pre, peri, and postnatal periods, and the drug used during the first years of life, such as asthma controller medications, are suspected to increase their prevalence^{5,6}.

In view of the features presented by this chronic disease, different levels of health care need to be involved in its treatment and prevention, which requires the implementation of asthma control programs. The Community Health Service of Conceição Hospital Group has a specific asthma control program in Primary Health Care (PHC), whereby health teams are responsible for the prevention, follow-up, and treatment of children diagnosed with asthma and where many children have the first access to health care, from the opportunity of care integrated within oral health within the scope of general health⁷.

The present study intended to investigate whether there is an association between the occurrence of caries, erosion, and enamel defects in asthmatic and non-asthmatic children from 6 to 12 years of age in Primary Health Care. Besides that, to show that there are other possible factors involved in asthma treatment and oral diseases, and its importance in primary health care services settings where the most children have access to improve their health in a long term.

METHODS

Study design and background

A cross-sectional study was carried out between April and September 2012, in two Basic Health Units of the Community Health Service of Conceição Hospital Group (CHS/GHC), located in the city of Porto Alegre, Rio Grande do Sul. CHS is linked to the Brazilian Ministry of Health and recognized across the country as the largest public health service network in the southern region of the country, with 100% of its services provided by the Unified Health System (SUS). It includes four hospitals and twelve Primary Health Care Units of the Community Health Service, devoted to diverse healthcare needs, ensuring universal and free access to care and the population's right to medical attention.

The research project was approved by the GHC Research Ethics Committee under the CAAE number 00978312.7.0000.5530, and the authors abide by the universal declarations and regulations of the country (CNS Resolution 466/12).

Participants

Parents/guardians and their children aged between 6 and 12 years, both non-asthmatic (registered with the Health Units) and asthmatic (registered with the Asthma Program at the Health Units) were included in the study.

Sample

To estimate the sample size, a calculation was performed considering a total of 1278 (1077 children without asthma and 201 children indexed in Asthma Program) children registered in the territory covered by the Primary Health Units of the Community Health Service of Conceição Hospital Group (CHS/GHC). These children have a longitudinal follow up of care that involves a multiprofessional health team. To select a bidirectional alpha of 0.05 and beta of 0.20, a total sample of 214 individuals was estimated considering the estimated prevalence of dental caries, dental erosion and enamel defects^{8,9}. To avoid losses, 362 children were selected at random (204 non-asthmatic and 158 asthmatic), and 228 were examined, as described in Figure 1. Of the 228 children, 112 were asthmatic and 116 non-asthmatic; in addition, they were drawn from a table with random numbers, which were obtained from the list of registered users in both health facilities. Proportionate stratified random sampling was performed for asthmatic and non-asthmatic children and by age groups (group 1: 6 and 7 years, group 2: 8 and 9 years, group 3: 10 to 12 years).

Variables and measurement

Questionnaire:

An interview with the parents/guardians of the children was conducted at the Health Units or during home visits to collect information about the parents/guardians in relation to education (Elementary School, High School, or Undergraduate and Graduate Studies), and about their children in relation to sex, age (categorized as 6/7 years, 8/9 years, and 10/12 years), presence or absence of asthma, type of asthma, medicines taken, and number of times oral hygiene is performed per day.

Data from the children's medical records:

The presence or absence of asthma was determined by the family doctor providing follow-up for the children at the health facility, and asthmatic patients were considered to have intermittent or persistent asthma as a measure of disease severity. This variable was collected from the medical records of children attending the CHS-GHC Health Units.

Clinical examination:

Oral examinations were performed in the Health Units by two examiners who were dentists. The examination was performed with the children sitting in a dental chair, using a dentist's mirror under artificial lighting. The oral conditions caries, erosions, and enamel defects were examined according to diagnostic criteria.

Caries was characterized as the presence of a cavity, with its color ranging from yellow to light brown and a soft, crispy consistency¹⁰. The criteria used to diagnose carious lesions in the teeth and surfaces were those recommended by the

World Health Organization through the dmft and DMFT indices,¹⁰ and only cavitated lesions were taken into account.

Erosive lesions were characterized as a smooth surface, with a U-shape or the shape of a saucer, showing a broad and shallow lesion, with a polished surface and absence of dental biofilm,¹¹ assessed in accordance with the index from the 1993 Children's Dental Health Survey in the UK^{12,13}. All teeth were assessed, and occurrences were registered considering the condition found as a whole, rather than the involvement of only one tooth or surface.

The developmental defects of the dental enamel were characterized as anomalies of the structure, resulting in a defective enamel, with the presence of pits or grooves in the dental surface and color changes¹⁴. The criteria used for their diagnosis were those recommended by the WHO in accordance with the modified DDE index¹⁰.

Calibration:

After being trained by means of a conceptual discussion on the assessment criteria/indices to be used, two dentists were calibrated. The calibration was performed using the *in lux* method¹⁵. For caries, a methodology using a set of exfoliated and/or extracted teeth under the most varied conditions was followed, and the processes were repeated after seven days^{16,17}. The Kappa coefficient was used in both calibrations to evaluate the agreement between the images evaluated by the same examiners and between the examiners themselves. Kappa's intra-examiner 1, intra-examiner 2 and inter-examiner 1 and 2 values were, respectively, 0.91 / 0.90 / 0.82 (DMFT), 0.92 / 0.78 / 0.69 (DMFS), 1.00 / 0.85 / 0.70 (Enamel Defects), and 1.00 / 0.84 / 0.69 (Dental Erosion).

Statistical analysis

Data analysis was carried out using a conceptual framework comprised of variables that are distributed into three categories: sex, age and education of parents/guardians (category 1); asthmatic or no asthmatic, type of asthma and types of asthma medications (category 2); frequency of daily oral hygiene (category 3) and outcomes (dental caries, dental erosion and enamel defects) considering the Oral Health in the context of Primary Health Care. The characteristics of the sample and the outcomes (caries, erosion, and enamel defect) were analyzed by comparisons by chi-square test. Variables with p value <0.20 in the chi-square test was analyzed with prevalence ratios using a crude and adjusted analysis of Poisson regression with a robust variance. The magnitudes of the associations between the dependent variable and the independent variables, were estimated using prevalence ratios, with a significance level of 5% and respective confidence intervals (CI) of 95%. SPSS software, version 16.0 (SPSS Inc., Chicago, IL) was used.

RESULTS

Two hundred and twenty-eight children between ages 6 and 12 were evaluated, of which 126 (55.3%) were males. Of 112 asthmatic children, 63 (51.2%) had caries (dmft/DMFT >0), 36 (45.0%) erosion, and 25 (53.2%) enamel defect (Table 1). The data for the sample characteristics related to the presence and absence of caries, erosion, and enamel defects are shown in Table 1. The analysis of the sample characteristics did show statistical differences in relation to children that had three or more times per day oral hygiene and dental erosion, in comparison to children that had once or twice per

day oral hygiene (Table 1). For the enamel defect endpoint, no association was found with the variables under study.

In the adjusted analysis of caries in relation to the types of medications used, there was a statistically significant difference (PR = 1.32, 95% CI = 1.01-1.72) between the group that did not use any medications compared with the group that used salbutamol only, which was associated with presence of dental caries (Table 2). This means that asthmatic children that use salbutamol as medication, have an increase in 32% of dental caries.

In relation to the education of parents/guardians, there was a statistically significant difference in the crude analysis (PR = 1.79, 95% CI = 1.02-3.17) between parents with undergraduate and graduate studies and presence of dental erosion, in comparison parents with parents with elementary school, but this association did not remain in the adjusted model (Table 3). As for the number of times a day that children performed oral hygiene, those who did so more than three times a day showed a higher prevalence (PR = 2.36, 95% CI = 1.02-4.85) of erosion in the adjusted analysis compared with children who performed oral hygiene only once a day. This means that children that had three or more times per day oral hygiene increased in 1.36 prevalence of dental erosion.

DISCUSSION

According to the World Health Organization, asthma is a major chronic respiratory disease in children¹⁰. The increase in its prevalence has led several investigators to study possible associations with the development of caries, enamel defects, and erosion; however, the existing studies in the literature are divergent. In this

study, asthmatic children that using salbutamol as a medication showed association with presence of dental caries.

The development of caries in asthmatic children is probably due to a reduction in salivary flow caused by medications used to control the disease (interfering with the protective effect of saliva) and to oral breathing, often associated with the disease¹. So, it is possible the asthma medication is thought to be a mediator between asthma and dental caries, and we suggestion for future studies the use of structural equation model for investigate this mediation¹⁸. It should be noted that the present study was conducted in a Primary Health Care setting, where most of the children evaluated had mild levels of asthma (intermittent and mild persistent), and since they were placed under health surveillance in primary health care, better follow-up and attention were provided for their care and treatment, accompanied by a multiprofessional health team including a dentist.

A systematic review and meta-analysis concluded, based on a study of 25 articles from 1950 to 2010, that asthma significantly increases the risk of caries in the deciduous and permanent dentition. One of the predisposing factors is possibly the medication taken, which acts on saliva secretion and the content of immunoglobulin A¹⁹. On the other hand, another literature review based on the study of 27 articles found that, although recent studies show little evidence of a relationship between asthma and dental caries, most show that the severity of the disease and its pharmacotherapy (types of drugs) are factors for an increased risk of caries³. Moreover, we highlighted that most of the published studies was developed in hospital context, and the present study provide evidence to primary health care setting. Therefore, the increase in caries in asthmatics seems to be more associated with the treatment, especially the use of

salbutamol, than with the disease itself, which is according findings in this study, in a Primary Health Care setting.

As for erosion, there was no association between the presence or absence of this dental alteration and the types of medications used for the control of asthma. The literature has indicated that, among the extrinsic factors leading to erosion, the habit of constantly drinking acidic beverages is better associated with this prevalence^{20,21}. In the case of asthmatics, there is a hypothesis that medications used in the form of oral inhalants, which come into direct contact with the palatal or lingual surfaces, resulting in higher degrees of erosion²² due to the low pH of medications, especially if they remain for prolonged periods in contact with the tooth surface²³. However, despite clinical studies showing this relationship, it was not seen in the present study, which can be explained by the fact that the SSC asthma protocol recommends the use of spacers, which reduce the permanence of drugs deposited in the mouth, and rinsing the mouth with water after the use of medications, followed by tooth brushing⁷.

As for the analysis of erosion and the level of schooling of parents/guardians, children with a higher frequency of oral hygiene and whose parents/guardians had a higher educational level showed a higher prevalence of erosion. Studies have reported a greater prevalence of erosion in children with a higher socioeconomic level, as these have different eating patterns, with greater access to the consumption of industrialized beverages, and oral hygiene habits with a higher brushing frequency^{21,24}. There are other studies that have not found this association²⁶. As a result, there is no consensus in the literature about the relationship between erosion and level of education of parents/guardians and the frequency of oral hygiene of the children evaluated.

In this study, the prevalence of enamel defects found was 53.2% in asthmatics and 48.1% in the non-asthmatic group, without statistical differences between groups, and the same occurred for the type of asthma and types of medications used. A recent systematic review including 25 studies on the etiology of MIH found, in several studies, an association of early childhood illnesses, such as asthma, as an etiological factor for MIH, but the results were conflicting regarding the use of medications²⁷.

A study with Danish children from 6 to 8 years of life assessed the presence of marked opacities in the permanent first molars in asthmatic children, both those taking and not taking medication. Children who used inhaled medications (β 2-agonists and corticoids) before age 3 had marked opacities and hypoplasia, and those who did not use oral or inhaled medications for asthma control also presented alterations to the dental enamel. In brief, the authors concluded that the use of asthma medications before age three did not present an increased risk for the development of marked opacities in the first molar, if compared with children that did not take medications, but had a greater chance of developing hypoplasia²⁸. In agreement with the present study, it is possible to observe that enamel defects were not related to the medications used for asthma control in patients aged 6 to 12 years who presented with intermittent and mild persistent asthma in a PHC setting.

As limitations of this study, it can highlight the cross-sectional analysis and the fact that the patients evaluated were cared for by physicians and dentists in their health units, and their oral and overall health was properly controlled. There is no consensus in the literature over the relationship between asthma and the occurrence of caries, enamel defects, and erosion; therefore, longitudinal studies need to be carried out to establish a possible cause-effect relationship between asthma and oral alterations in children.

CONCLUSION

According to the results found in this study, there is no evidence for an association between asthma, caries, erosion, and enamel defects in children aged from 6 to 12 years in a Primary Health Care setting. Nevertheless, there was a relationship between caries prevalence and use of salbutamol, regardless of asthma type and severity, and erosion with high frequency of oral hygiene.

WHY THIS PAPER IS IMPORTANT TO PAEDIATRIC DENTISTS

- The pediatric dentists should be attentive to cases of asthmatic patients, with special attention to the medications that this patient consumes and possible relationships with their oral health condition.
- It is the role of the pediatric dentist of Primary Health Care to promote the integral care and maintenance of the oral health of children with asthma.

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Table 1 – Characteristics of the participants, according to the parents/guardians of the children attending the SSC-GHC^a Primary Health Units, in Porto Alegre/Brazil, 2012. (N=228)

		Presence of Dental Caries N (%)	Absence of Dental Caries N (%)	p- value	Presence of Dental Erosion N (%)	Absence of Dental Erosion N (%)	p- value	Presence of Enamel Defects N (%)	Absence of Enamel Defects N (%)	p- value
Sex	Male	68 (55.3%)	58 (55.2%)	0.994	45 (56.3%).	81 (54.7%).	0.826	27 (57.4%).	82 (45.3%).	0.735
	Female	55 (44.7%)	47 (44.8%)		35 (43.8%).	67 (45.3%).		20 (42.6%)	99 (54.7%)	
Age	6-7 years	38 (30.9%)	37 (35.2%)	0.176	26 (32.5%)	49 (33.1%)	0.690	16 (34.0%)	59 (32.6%)	0.979
	8-9 years	47 (38.2%)	28 (26.7%)		29 (36.3%)	46 (31.1%)		15 (31.9%)	60 (33.1%)	
	10-12 years	38 (30.9%)	40 (38.1%)		25 (31.3%)	53 (35.8%)		16 (34.0%)	62 (34.3%)	
Education of parents/ guardians	Elementary School	36 (29.5%)	23 (22.3%)	0.433	15 (19.0%)	44 (30.1%)	0.117	13 (28.3%)	46 (25.7%)	0.849
	High School	69 (56.6%)	62 (60.2%)		48 (60.8%)	83 (56.8%)		27 (58.7%)	104 (58.1%)	
	Undergraduate and Graduate Studies	17 (13.9%)	18 (17.5%)		16 (20.3%)	19 (13.0%)		6 (13.0%)	29 (16.2%)	
Asthma	No	60 (48.8%)	56 (53.3%)	0.493	44 (55.0%)	72 (48.6%)	0.360	22 (46.8%)	94 (51.9%)	0.531
	Yes	63 (51.2%)	49 (46.7%)		36 (45.0%)	76 (51.4%)		25 (53.2%)	87 (48.1%)	
Type of Asthma	Intermittent	38 (60.3%)	24 (49.0%)	0.231	22 (61.1%)	40 (52.6%)	0.399	48 (57.1%)	14 (50.0%)	0.510
	Persistent	25 (39.7%)	25 (51.0%)		14 (38.9%)	36 (47.4%)		36 (42.9%)	14 (50.0%)	
Types of Asthma Medications	None	66 (53.7%)	57 (54.3%)	0.053	46 (57.5%)	77 (52.0%)	0.731	23 (48.9%)	100 (55.2%)	0.722
	Salbutamol	26 (21.1%)	11 (10.5%)		12 (15.0%)	25 (16.9%)		8 (17.0%)	29 (16.0%)	
	Salbutamol+Beclomethasone or Budesonide+Systemic corticosteroids	31 (25.2%)	37 (35.2%)		22 (27.5%)	46 (31.1%)		16 (34.0%)	52 (28.7%)	
Number of Daily Oral Hygiene	Once a day	19 (15.4%)	12 (11.4%)	0.677	5 (6.3%)	26 (17.6%)	0.038	–	-	
	Twice a day	46 (37.4%)	41 (39.0%)		30 (37.5%)	57 (38.5%)		–	-	
	Three or more times per day	58 (47.2%)	52 (49.5%)		45 (56.3%)	65 (43.9%)		-	-	

^a Community Health Service of Grupo Hospitalar Conceição.

Table 2 – Poisson regression with a robust variance for presence of dental caries. Porto Alegre/Brazil, 2012. (N=228)

Age	Crude PR	95%CI	p-value	Adjusted PR ^a	95%CI	p-value
6-7 years	1			1		
8-9 years	1.237	0.699-1.323	0.142	1.214	0.919-1.606	0.173
10-12 years	0.962	0.931-1.642	0.810	0.933	0.682-1.277	0.666
Types of Asthma Medications	Crude PR	95%CI	p-value	Adjusted PR ^a	95%CI	p-value
None	1			1		
Salbutamol	1.310	1.003-1.709	0.047	1.320	1.012-1.720	0.040
Salbutamol+Beclomethasone or Budesonide+Systemic corticosteroids	0.850	0.625-1.155	0.298	0.854	0.629-1.158	0.308

^aAssociations adjusted for the associated variables in chi-square test (Age and Types of Asthma Medications) with p value <0.20.

Table 3 - Poisson regression analysis for the presence of dental erosion. Porto Alegre/Brazil, 2012. (N=228)

Education of parents/guardians	Crude PR	95%CI	p-value	Adjusted PR^a	95%CI	p-value
Elementary School	1			1		
High School	1.441	0.881-2.356	0.145	1.340	0.821-2.187	0.242
Undergraduate and Graduate Studies	1.798	1.020-3.170	0.042	1.666	0.950-2.925	0.075
Number of Daily Oral Hygiene	Crude PR	95%CI	p-value	Adjusted PR^a	95%CI	p-value
Once a day	1			1		
Twice a day	2.138	0.911-5.019	0.081	2.065	0.879-4.851	0.096
Three or more times per day	2.536	1.102-5.837	0.029	2.369	1.029-4.851	0.043

^aAssociations adjusted for the associated variables in chi-square test (Education of parents/guardians and Number of Daily Oral Hygiene) with p value <0.20.

Figure 1. Flowchart of the study population.

