

# Association between asthma and dental caries in the primary dentition of Mexican children

Eliza M Vázquez, Francisco Vázquez, María C Barrientos, José A Córdova, Dolores Lin, Francisco J Beltrán, Carlos F Vázquez

Tamaulipas, Mexico

**Background:** Asthma has been associated with a great number of negative health outcomes. This study was undertaken to detect the association between asthma and dental caries in the primary dentition.

**Methods:** Data were obtained from a cohort of 1160 Mexican children aged 4-5 years. We used the questionnaire of the International Study of Asthma and Allergies Diseases in Childhood. Asthma was classified according to parents' reports. Caries indexes were measured as the number of decayed (d), missing (m), and filled (f), teeth (t) (dmft) or surfaces (dmfs). Decayed teeth included initial caries in this study. Adjusted odds ratios (adjusted ORs) were determined for asthma using logistic regression model. Gender, sugary products consumption, and oral hygiene habits were utilized as covariates.

**Results:** The prevalence of dental caries was 17.9% in the 1160 children. Approximately 226 (19.5%) children were identified with asthma. Among them, 166 (73.5%) presented with symptoms during the day and 60 (26.5%) during the day and night. The prevalence of caries in children with asthma was 19.9%; it was higher in children with nocturnal asthma symptoms than in those with asthma symptoms only during the day. Logistic regression model showed that asthma (adjusted OR=1.24; 95% confidence interval [95% CI]=0.84–1.81) was not associated with caries. A significant association was found between nocturnal asthma symptoms (adjusted OR=1.85; 95% CI=1.00–3.44) and dental caries.

**Conclusions:** Asthma is not associated with dental caries. Nocturnal asthma symptoms appear to be associated with dental caries in the primary dentition.

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**Key words:** asthma;  
dental caries;  
tooth deciduous

## Introduction

Dental caries and asthma constitute important problems worldwide. According to previous reports, the prevalence of dental caries in children aged 4-5 years is over 40%.<sup>[1,2]</sup> The negative effects induced by dental caries include pain, dysfunction, poor appearance and speech development problems.<sup>[3]</sup> Similarly, asthma is a chronic disease characterized by recurrent attacks of breathlessness and wheezing, which vary in severity and frequency from person to person. Symptoms may occur several times in a day or week in affected individuals, and for some people they become worse during physical activities or at night. The main symptoms of asthma are episodes of breathlessness, wheezing (an audible whistling sound from the chest on breathing), and cough, varying from mild and almost undetectable to severe and unremitting.<sup>[4]</sup> According to the World Health Organization (WHO), asthma is the most important chronic respiratory disease in childhood.<sup>[5]</sup> Its prevalence in preschool children is higher than 12%.<sup>[6-8]</sup> Each year childhood asthma generates a great number of hospitalizations and missed school days.<sup>[9,10]</sup>

The increasing prevalence of asthma as well as that of caries in preschool children has prompted investigators to speculate that asthma in childhood might be a causal factor in the development of caries. The results obtained to date are debatable; some researchers have found positive associations between asthma and caries,<sup>[11,12]</sup> while others not yet.<sup>[13-15]</sup> According to reports, the consequences of the symptoms of asthma with regard to dental caries are due to the reduced flow of saliva caused

**Author Affiliations:** Autonomous University of Tamaulipas (UAT), University Center Tampico-Madero, Tamaulipas, México (Vázquez EM, Barrientos MC, Córdova JA, Lin D, Beltrán FJ); Mexican Institute of Social Security (IMSS), Madero city, Tamaulipas, México (Vázquez F); Public Health Institute, Veracruzana University, México (Vázquez CF)

**Corresponding Author:** Eliza M. Vázquez, MD, Faculty of Medicine of Tampico. Autonomous University of Tamaulipas (UAT), 89339 University Center Tampico-Madero, Tamaulipas, Mexico (Tel: (52) (833) 216-5247; Email: dra.eliza.vazquez@gmail.com)

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by medication and possible mouth breathing during asthma episodes.<sup>[12,16]</sup>

The present study was to detect the association of dental caries with asthma in the primary dentition of Mexican children.

## Methods

### Study design

We conducted a cross-sectional study in a cohort of 1160 children, aged 4-5 years (mean,  $4.5 \pm 0.5$  years), who had been followed up longitudinally from the age of 4 months. Originally the sample was made up of 1200 children, of whom 40 children were excluded: 30 for parents refusing consent for their children to participate in the study and 10 for withdrawal from day care centers because their mothers had been dismissed from their jobs. The study took place in the area of Tampico-Madero-Altamira, Mexico, located 542 km northwest of Mexico City.

### Patients

The children who participated in this study were part of a population included in another major multidisciplinary research project conducted by a series of specialists including a pediatrician, an allergy specialist, a family physician, dentists, general physicians and dental assistants. Data analysis of the children included in this study was carried out in 2005. The children attended day care centers as required by the Scheme of Ordinary Participation and Unique Communitarian Neighborhood Program organized by the Mexican Government to care for the children of working mothers through the Mexican Institute of Social Security (IMSS), and the preschool education school (kindergarten) of the area. The IMSS is the largest public health care institution in Mexico that provides care, pensions and social security. Physical examinations are performed each month by family physicians, nursing personnel, nutritionists, etc., as part of the healthcare activities of the program of the day care center, which include weight and height measurements, vaccinations and the recording of contagious and non-contagious diseases detected. The personnel working at the IMSS day care centers are trained on an ongoing basis by experts by means of courses, talks and workshops on the correct care of children. The day care centers possess sufficient information to identify and locate previously registered children, even after their departure at 4 years of age.

### Data from questionnaire

A questionnaire was utilized to register information

on gender, dental caries, asthma, sugar consumption antecedent, and tooth-brushing habits. The questionnaire included closed multiple-choice and binomial questions, and was validated by two pilot studies. In each of these studies, 20 individuals were interviewed during a 15-day period; agreement was 75%.<sup>[17]</sup> The questionnaire was answered by children's parents or guardians at the study site and was administered by an allergist, three dentists and another duly trained individual. Training of the people who applied the questionnaire was carried out through talks and workshops on correct information gathering.

Diagnosis of dental caries was established according to the WHO guidelines by three calibrated dentists,<sup>[18]</sup> who were trained by means of exercises during 2 consecutive days. Within the 2 days, the dentists performed routine dental examinations on 20 children who had been diagnosed by an expert teacher previously trained in the diagnostic technique. Scores were compared with those obtained by the expert (Kappa = 0.93). Oral examination was carried out at the day care center and kindergarten by personnel using disposable gloves, a dental mirror, tongue depressor and a clinical battery-powered flashlight. Cotton swabs and gauze were used for moisture control and removal of plaque on tooth surfaces when necessary. No X-ray films were taken. Oral examinations were carried out annually from the second year of life; this study was evaluated when the children at the age of 4-5 years. The dependent variable was dental caries which was recorded when a lesion in pit or fissure or on a smooth tooth surface had a detectably softened floor, undermined enamel or softened wall. A tooth with a temporary filling was also included in this category. The index of dental caries was measured by calculating the number of decayed (d), missing (m), and filled (f) teeth (t) (dmft) or surfaces (dmfs). dmfs scores included all carious lesions on occlusal, interproximal, and buccal and lingual smooth surfaces. Molars and premolars were considered to have five surfaces, and anterior teeth have four surfaces.

Decayed teeth included initial caries in this study. The criterion for initial caries was a chalky white spot on the enamel surface. Oral data were recorded on examination forms in accordance with the WHO criteria. For analysis dental caries were coded as 1 = caries present, and 0 = caries absent.

Questions on asthma were taken from the International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire. The ISAAC program was developed to afford greater validity to epidemiological studies on asthma, allergic rhinoconjunctivitis and atopic eczema.<sup>[19,20]</sup>

A child was classified with asthma when the parents

gave an affirmative response to the two following questions: 1) Has your child ever had wheezing or whistling in the chest during the past 12 months? 2) In the last 12 months, has your child had a dry cough at night, apart from cough associated with a cold or a chest infection? Or if the parents answer YES to the question; 3) Has your child ever had a diagnosis of asthma by a physician? This independent variable was dichotomized as 1: asthma present, and 0: asthma absent.

Children with asthma were classified into two groups: one group of asthmatic children presenting with asthma symptoms during the day and night and the remaining group presenting with asthma symptoms during the day but not the night. For analysis, in the group of children who suffered asthma symptoms during the day, this variable was coded as: 1: diurnal asthma symptoms present; 0: diurnal asthma symptoms absent. In the group of children who had asthma symptoms during the day and night, this variable was coded as: 1: nocturnal asthma symptoms present; 0: nocturnal asthma symptoms absent.

Additionally, parents were questioned concerning any prescription medication being administered to the children during the day and night. We sought medication administered for asthma and classified them as inhaled and oral steroids, bronchodilators; syrups (usually salbutamol) or other medication.

Gender, sugar consumption antecedent and oral hygiene practices (tooth brushing frequency) were utilized as covariates for the analysis. We chose these confounders because they demonstrated a strong association with dental caries in previous studies.<sup>[21-23]</sup>

Sugar consumption antecedent was determined by questions on the questionnaire to which children's parents responded, on the type, quality and quantity of foods and beverages consumed by the children while they watched television, as well as the frequency with which children consumed snacks (defined as any food consumed between the main meals including breakfast, lunch and dinner). Questions documenting children's food-consumption habits and lifestyles were taken from the questionnaire applied at the Mexican National Health and Nutrition Survey 2006.<sup>[24]</sup> Sugar consumption antecedent was considered present if the children consumed snacks (cookies, candies, chocolate), fruit juice, non-diet or other sugar-containing drinks more than one time per week during 6 months prior to the study. Oral hygiene practices were dichotomized into tooth brushing frequency <1 and tooth brushing frequency  $\geq 2$ .

All children in the study consumed potable water, and used fluoride gel and fluoride toothpaste for their oral hygiene. Children diagnosed with dental caries, asthma or any other pathology were referred for care of

their disease(s) to the corresponding Medical Service Unit.

### Statistical analysis

Data were analyzed by means of SPSS 10.0 statistical package software. Logistic regression models were performed to study the association of dental caries with asthma, diurnal asthma symptoms, nocturnal asthma symptoms and nocturnal medication. Adjusted odds ratios and their 95% confidence intervals were calculated. A  $2 \times 2$  contingency table (Chi-square, crude OR, and a 95%CI) was employed to determine the association of dental caries with asthma, diurnal asthma symptoms, nocturnal asthma symptoms and nocturnal medication. We utilized dichotomous variables for indicating the presence or absence of a certain characteristic. A *P* value <0.05 was considered statistically significant.

## Results

### Sample characteristics

The prevalence of dental caries was 17.9% in the 1160 children investigated. Of the children, 226 (19.5%) were identified with asthma. In the children with asthma, 166 (73.5%) demonstrated asthmatic symptoms only during the day and 60 (26.5%) during the day and night. Of the children with nocturnal asthmatic symptoms, 59 (98.3%) had nocturnal medication. A group of 934 children were identified with no history of asthma at any time in their lives. They served as controls for detecting differences in children with asthmatic and non-asthmatic symptoms. Age of the children at initiation of asthma was  $14.53 \pm 12.23$  months. The mean dmft value of the children was  $1.08 \pm 2.34$ , while the corresponding dmfs value was  $1.43 \pm 3.29$ . The dmft value was significantly higher in the boys than in the girls ( $1.17 \pm 2.40$  vs  $0.99 \pm 2.20$ ,  $P < 0.031$ ). No significance was found on dmfs value between the boys and girls ( $1.60 \pm 3.60$  vs  $1.26 \pm 3.0$ ,  $P = 0.270$ ).

There was no significant difference in the percentage of dental caries in boys and girls (19.6% vs 16.3%). The mean value of dmft in the boys was  $1.17 \pm 2.42$  and the mean value of dmfs was  $1.60 \pm 3.57$ . In the girls, the mean dmft and dmfs values were  $0.99 \pm 2.24$  and  $1.26 \pm 2.97$ , respectively. A higher prevalence of asthma was found in the boys (21.5%) than in the girls (17.5%), but with no significance. Moreover, the prevalence of nocturnal asthma symptoms was similar in the boys and in girls (6.5% vs. 5.5%). And the difference in the percentage of nocturnal medication was not significant in the boys and girls (8.6% vs. 7.3%) (Table 1).

**Table 1.** Gender distribution of dental caries, asthma, diurnal asthma symptoms, nocturnal asthma symptoms, nocturnal medication, sugar consumption antecedent and tooth brushing frequency of preschool children

Variables	Boys (n=582)		Girls (n=578)		P value
	Yes/No	Yes (%)	Yes/No	Yes (%)	
Dental caries	114/468	19.6	94/484	16.3	0.627
Asthma present	125/457	21.5	101/477	17.5	0.534
Diurnal asthma symptoms	93/457	16.9	73/477	13.3	0.634
Nocturnal asthma symptoms	32/457	6.5	28/477	5.5	1.000
Nocturnal medication	50/532	8.6	42/536	7.3	1.000
Sugar consumption antecedent	302/280	51.9	229/349	39.6	0.002
Tooth brushing frequency					
<1 per day	42	7.2	54	9.3	0.261
≥2 per day	540	92.8	524	90.5	0.646

dmft: decayed, missing, and filled teeth; dmfs: decayed, missing, and filled surfaces; SD: standard deviation. P value was determined by binomial test.

**Table 2.** Association between dental caries and gender, asthma, diurnal asthma symptoms, nocturnal asthma symptoms and nocturnal medication in 1160 children younger than 5 years, using logistic regression models

Variables	Dental caries		Unadjusted OR (95% CI) P value	Adjusted OR (95% CI)* P value
	Yes/No	Yes (%)		
Gender				
Boys	114/468	19.6	1.25 (0.92–1.69) (0.081)	0.84 (0.61–1.15) (0.291)
Girls†	94/484	16.3		
Asthma present	45/181	19.9	1.17 (0.81–1.69) (0.220)	1.24 (0.84–1.81) (0.264)
Asthma absent	163/771	17.5		
Diurnal asthma symptoms present†	28/138	16.9	0.96 (0.61–1.49) (0.478)	1.04 (0.66–1.64) (0.850)
Diurnal asthma symptoms absent	163/771	17.5		
Nocturnal asthma symptoms present†	17/43	28.3	1.87 (1.04–3.36) (0.030)	1.85 (1.00–3.44) (0.048)
Nocturnal asthma symptoms absent	163/771	17.5		
Nocturnal medication present†	30/62	32.6	2.41 (1.52–3.85) (0.000)	2.30 (1.41–3.73) (0.001)
Nocturnal medication absent	178/890	16.7		

\*: adjusted for sex, sugary products consumption antecedents and tooth brushing frequency; †: reference category.

## Associations

Table 2 displays the association between dental caries with gender, asthma, diurnal asthma symptoms, nocturnal asthma symptoms and nocturnal medication. There was a higher prevalence of dental caries in children with nocturnal asthma symptoms (28.3%) and those with nocturnal medication (32.6%) than in the other groups. The prevalence of dental caries was similar between children with asthma (19.9%) and those without asthma (17.5%). The results revealed that nocturnal asthma symptoms (crude OR = 1.87; 95% CI = 1.04–3.36;  $P=0.030$ ) and nocturnal medication (crude OR = 2.41; 95% CI = 1.52–3.85;  $P=0.000$ ) were associated with dental caries, and that asthma (crude OR = 1.17; 95% CI = 0.81–1.69;  $P=0.220$ ) was not associated with dental caries.

## Multivariate logistic regression analysis of results

Multivariate logistic regression analysis showed that nocturnal asthma symptoms (adjusted OR = 1.85; 95% CI = 1.00–3.44;  $P=0.048$ ) and nocturnal medication

(adjusted OR = 2.30; 95% CI = 1.41–3.73;  $P=0.001$ ) were significantly associated with dental caries, and that asthma (adjusted OR = 1.24; 95% CI = 0.84–1.81;  $P=0.264$ ) was not associated with dental caries (Table 2).

## Discussion

Our study proved that asthma is not associated with dental caries in the primary dentition. Nocturnal asthmatic symptoms appear to be associated with dental caries.<sup>[14,15]</sup> Nonetheless, it was reported that asthma constituted an important risk factor for the development of caries in the primary dentition.<sup>[12]</sup>

Understanding the relation between asthma and dental caries in the primary dentition may be an important step in clarifying the etiology of the caries. Some mechanisms have been proposed by means of which asthma favors dental caries. In patients with asthma, for instance, there is a dysfunction of  $\beta$  adrenergic receptors, specifically those classified as  $\beta_2$  or inhibitory, which are localized in bronchial,



gastrointestinal, vascular and genitourinary smooth muscle. Administration of  $\beta_2$ -adrenoreceptor agonist drugs not only produces bronchodilation in people with asthma but also alters the composition and flow of the saliva.<sup>[13,25,26]</sup> On the other hand, individuals with asthma might consume erosive drinks.<sup>[27]</sup> In addition, 85% of cases of asthma in preschool children are considered to possess an allergic component; thus it is necessary to administer antihistamine drugs for control of the allergic factor.<sup>[6]</sup> One of the most important secondary effects produced by antihistamines is oral cavity dryness which reduces the antibacterial protection provided by the saliva.<sup>[28]</sup>

The results of logistic regression model analyses showed that nocturnal asthmatic symptoms are associated with dental caries in the primary dentition. However, it is difficult to understand why nocturnal asthmatic symptoms can be associated with dental caries. We suggest the indirect effect between these variables. It is possible that the presentation of this clinical condition at night generates the need for parents or guardians to administer drugs to the children, usually in the form of syrups containing colorants, sugar and diverse flavorings.<sup>[29,30]</sup> Because the drugs are administered late at night, the children lack adequate oral cleaning to eliminate drug residues within the oral cavity. Thus the remnants of the administered drugs can favor localized destruction of susceptible dental hard tissues by acidic byproducts from bacterial carbohydrate fermentation.<sup>[31]</sup> This theory is supported by the higher percentage of children with nocturnal asthma symptoms had nocturnal medication in the present study. According to the analyses in this study, nocturnal medication is associated with dental caries in the primary dentition. To the previous findings we must add that the saliva buffering capacity is also reduced at night.

The current study possesses the following methodologic limitations: 1) Information concerning asthma collected from children's parents or guardians. The information in questionnaire should be evaluated for fear of inaccurate or biased data (memory bias) which could lead to sub- or over-diagnosis.<sup>[32]</sup> Nonetheless, for many years, the application of questionnaire has demonstrated to successfully capture highly reliable information on respiratory disease.<sup>[22]</sup> 2) The diagnosis of dental caries was made visually without use of X-rays. 3) The prevalence of nocturnal asthmatic symptoms was lower than the overall prevalence. 4) In this study, parents of children only provided information on the history of medicine in syrup form but not inhaled medications for asthma. 5) These results cannot be generalized to open population because the children participating in the study were attending day care centers that have

preventive odontology programs.

In conclusion, asthma is not associated with dental caries. Nocturnal asthmatic symptoms and nocturnal medication are associated with caries in preschool children. The association indicates that there is a need for establishing community health programs to identify and limit these factors for the development of dental caries and asthma in children. Likewise, strategies for maintaining adequate oral hygiene should be reinforced among preschool and school populations.

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**Ethical approval:** The study was approved by the Ethics Committee of the No. 6 Regional General Hospital of the (IMSS) and the Faculty of Medicine of the UAT, Mexico. Parental written and oral informed consent was obtained.

**Competing interest:** None.

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