



## ORIGINAL ARTICLE

# Assessing caries, dental plaque and salivary flow in asthmatic adolescents using inhaled corticosteroids

N.C. Santos<sup>a,b</sup>, S. Jamelli<sup>a</sup>, L. Costa<sup>c</sup>, C. Baracho Filho<sup>a</sup>, D. Medeiros<sup>a</sup>, J.A. Rizzo<sup>a</sup>, E. Sarinho<sup>a,\*</sup>

<sup>a</sup> Federal University of Pernambuco, Recife, Brazil

<sup>b</sup> University of Feira de Santana, Bahia, Brazil

<sup>c</sup> Faculty of Sciences and Technology in Salvador, Bahia, Brazil

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### KEYWORDS

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### Abstract

**Background:** A number of studies have reported that inhaled corticosteroids may cause a greater incidence of caries, reduced salivary flow, changes in saliva composition and an increased frequency of dental plaque, probably through alterations in the oral microbiota. The objective was to compare the frequency of caries, dental plaque and non-stimulated salivary flow rate among asthmatic adolescents using inhaled corticosteroids and non-asthmatic adolescents, as well as the salivary biochemical parameters (pH and leucocytes) in both groups.

**Methods:** This research has a descriptive cross-sectional design to compare dental health of 40 asthmatics on inhaled corticosteroids and 40 non-asthmatic adolescents (median age 13 years).

**Results:** The findings were a higher number of tooth surfaces affected by dental caries (median 4 versus 1.5), and more dental plaques (median 70.5 versus 60.7) among asthmatic adolescents. They also had a significantly higher frequency of salivary leucocytes. The non-stimulated salivary flow was similar in both groups.

**Conclusions:** The results suggest an association between the use of inhaled corticosteroids and an increased risk of dental caries and bacterial plaque, which calls for special attention of these patients by doctors and dental health professionals.

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## Introduction

Inhaled corticosteroids are the main recommended drugs for the treatment of chronic asthma, due to their anti-inflammatory effects.<sup>1–4</sup> These drugs, although extremely

effective, can be associated with local or systemic adverse side effects.<sup>2,5,6</sup> While their systemic effects have been widely studied,<sup>5</sup> few researches have been conducted to assess the adverse local effects on oral-dental health,<sup>3,5</sup> and, while generally viewed as minor side effects, they may still be clinically important, affecting patient's quality of life and interfering with treatment adherence.<sup>5</sup>

The use of large volume spacers reduces the local and systemic adverse effects of inhaled corticosteroids.<sup>7</sup>

\* Corresponding author.

E-mail address: emanuel.sarinho@gmail.com (E. Sarinho).

However, even with the use of these devices it is estimated that a large proportion of the drug is retained in the oral cavity and pharynx<sup>8</sup> and can lead to well-known local adverse effects, such as dysphonia, candidiasis, pharyngitis and cough.<sup>2-5,9,10</sup> Several factors influence the amount of corticosteroid retained in the mouth and oropharynx, such as the type of corticosteroid, the inhaler, the propellant, the use of a spacer and inhaler use technique.<sup>5</sup>

According to a meta-analysis,<sup>6</sup> ciclesonide, for example, produces fewer adverse oral effects when compared to oral budesonide and beclomethasone. The incidences of these adverse effects are also variable due to different diagnostic criteria and methodologies used throughout the studies.<sup>5</sup>

It was found that asthma on its own as well as its pharmacotherapy (inhaled corticosteroids included), may lead to a reduced salivary flow, changes in saliva composition, including pH alteration, and an increased frequency of dental plaque.<sup>11-15</sup>

The aim of this study was to compare the frequency of caries, dental plaque and non-stimulated salivary flow rate among asthmatic adolescents using inhaled corticosteroids, and non-asthmatic adolescent non-users of this drug, as well as the salivary pH and leucocytes.

## Patients and methods

The present research has a descriptive cross-sectional design. This study was carried out at the postgraduate department of Child and Adolescent Health at the Federal University of Pernambuco, Recife, Brazil and was fully approved by the Ethics Committee of the Federal University of Pernambuco, Brazil. Forty asthmatic and 40 non-asthmatic adolescents of both sexes, with an age range from 10 to 18 years (median – 14 years) were recruited. Asthma was diagnosed by an allergy specialist, according to the GINA criteria, and all patients had mild or moderate persistent asthma.<sup>16</sup>

The inclusion criteria for the asthmatics were the use of inhaled corticosteroids for at least three months and relief inhaled beta-2 agonists for less than once a week. Asthmatics using any inhaled drug other than corticosteroids and with diagnosed oral candidiasis, systemic diseases, including concomitant persistent allergic rhinitis were excluded. All asthmatic children used steroid by dry powder inhaler. Age- and sex-matched healthy non-asthmatics were recruited as the comparative group from the same socioeconomic stratum and they denied any inhaled medication use, confirmed by their parents.

For the sample size calculation we considered the work of McDerra et al.<sup>17</sup> who found the occurrence of caries risk ratio of 2.78 between exposed and non-exposed children to inhaled corticosteroids. To detect a difference of this magnitude, with alpha and beta errors respectively of 5% and 20%, it was estimated that 39 subjects were needed per group. The study was conducted with 40 adolescents in the case group and 40 in the comparison group.

The sample was also characterised with regard to age, gender, *per capita* income and mother's schooling. Patients were recruited from the Allergy Pediatric Clinic of the Hospital das Clínicas of the Federal University of Pernambuco, Recife, Brazil, from September to December

2006. Non-asthmatics were recruited from the neighbouring community. Oral examinations and data recording were performed by the same researcher (Santos, NCN a dentist). The presence of dental caries was assessed by the number of decayed, missing and filled surfaces (DMFS) and decayed, missing and filled teeth (DMFT) according to WHO.<sup>18</sup> On this same occasion, visible plaques were also assessed through the Visible Plaque Index (VPI) obtained as a percentage of dental surfaces with visible plaque from the total number of examined surfaces.<sup>19</sup> Visual inspection was complemented by the use of a probe to measure pocket depth.

In order to measure the non-stimulated salivary flow, adolescents were seated in an upright posture, with the head tilted forward, as motionless as possible, allowing the saliva to drain passively into a disposable plastic cup for fifteen minutes. A resting flow rate of less than 0.1 ml/min is considered abnormal and this rate was adopted as the cut-off point.<sup>20</sup>

The assessment of pH and leucocytes in saliva was performed using reagent paper strips with methyl-red and bromothymol-blue for pH and an esterase detection strip for leucocyte.

Descriptive statistics was used to show frequencies of occurrence, measures of central tendency and dispersion. Comparative analyses were performed by the non-parametric Mann-Whitney Test and Chi-square Test and were considered significant for a *p* value <0.05.

## Results

The study included 40 asthmatic adolescents using inhaled corticosteroids (case group) and 40 non-asthmatic adolescents, non-users of any type of drug (comparison group). The age ranged from 10 to 18 years (median: 13 years), 38 (55%) were male, 36 (40%) mothers had only primary education and 33 (42.5%) adolescents came from families with income less than US\$ 100.00 per capita/month. No differences were found between groups regarding these baseline data. In relation to the frequency of oral hygiene, the majority (90%) of those studied reported that they usually brushed their teeth three or more times per day although only 36 patients (40%) had received any kind of instructions regarding oral hygiene directly from a dentist.

The saliva data of 13 of the 80 adolescents were not assessed as some refused to perform the examination, while others could not provide enough saliva for the sample collection.

In the assessment for dental caries (Table 1), the median number of DMFT in asthmatic adolescents using inhaled steroids was 3.0 (interquartile 25–75%, range: 1.5–5.0) and 1.5 (interquartile 25–75%, range: 0.0–3.5) in non-asthmatics. It was also observed that the asthmatic adolescents presented more tooth surfaces affected by cavity disease (MDFS) in relation to the control group (*p*=0.007).

Table 2 illustrates the parameters of oral hygiene by assessing the presence of visible bacterial plaque. The median of the Visible Plaque Index in the asthmatic group was 70.5% and when compared to the non-asthmatic comparison group, this difference was statistically significant (*p*=0.03).

**Table 1** Median levels of decayed, missing or filled teeth (DMFT) and decayed, missing or filled surfaces (DMFS) of adolescents examined in the city of Recife.

Variable	Adolescents using corticosteroids		Adolescents not using corticosteroids		p value
	(n = 40)		(n = 40)		
	N	%	N	%	
<i>DMFT</i>					
Median		3.0		1.5	0.00
(Q25–75%)		1.5–5.0		0.0–3.5	
≤3	23	57.5	30	75.0	
>3	17	42.5	10	25.0	0.15
<i>DMFS</i>					
Median		4.0		1.5	0.007
(Q25–75%)		1.5–7.5		0.0–5.0	

Mann–Whitney Test.

**Table 2** Assessment of the presence of dental plaque in 80 adolescents.

Variable	Adolescents using corticosteroids		Adolescents not using corticosteroids		p value
	(n = 40)		(n = 40)		
<i>Visible plaque index percentual<sup>a</sup></i>					
Median (%)		70.5		60.7	0.03
(Q25–75%)		47.7–87.5		39.2–71.4	
Up to 30% – localised	4	10.5	3	8.6	
>30% – generalised	34	89.5	32	91.4	0.77

<sup>a</sup> Mann–Whitney Test.<sup>b</sup> Chi-square Test.

Thirty asthmatic patients and 37 subjects in the comparison group agreed to collect saliva for flow assessment (Table 3), the distribution presented a median rate of 0.15 ml/min (0.06–0.27) for the asthmatic adolescents and 0.11 (0.07–0.33) for the comparison group. With regard to salivary pH, of the 30 patients examined using inhaled cor-

ticosteroids, 63.3% presented a pH level <7.0 compared to 64.9% in the 37 subjects from the comparison group. Thus, no significant difference was observed.

Leucocytes in the saliva were detected in 51.8% of asthmatic patients and in 48.1% of non-asthmatic adolescents ( $p = 0.05$ ) as in Table 3.

**Table 3** Non-stimulated salivary flow and biochemical assessment of saliva of 80 adolescents.

Variable	Adolescents using corticosteroids		Adolescents not using corticosteroids		p value
	(n = 30)		(n = 37)		
	N	%	N	%	
<i>Salivary flow<sup>a</sup></i>					
Median		0.15		0.11	0.73
(Q25–75%)		(0.06–0.27)		(0.07–0.33)	
Positive	28	94.4	26	70.2	
Negative	2	6.6	11	27.8	0.05
<i>pH<sup>b</sup></i>					
<7.0	19	63.3	24	64.9	0.89
≥7.0	11	36.7	13	35.1	

<sup>a</sup> Mann–Whitney Test.<sup>b</sup> Chi-square Test.

## Discussion

Although the published research has studied ethnic and socioeconomically different populations with differences also in terms of disease severity and medication type and dosage making it difficult to compare results, physicians who manage asthmatics using inhaled corticosteroids should be concerned about providing their patients with the appropriate information and guidance on oral hygiene. A recent study found that although asthma can cause a reduction in salivary flow rate, the illness did not seem to increase dental caries in children with access to proper dental care.<sup>14</sup> However, another study showed that young adults with long-term controlled asthma had more caries, more gingival inflammation and a lower stimulated salivary secretion rate than individuals without asthma.<sup>15</sup>

Some evidence from the literature suggests that poor oral health could be linked to asthma, especially the increased progression of carious lesions and a reduced salivary flow, as well as an increase in the frequency and extent of gingival inflammation.<sup>11,12,17,21</sup>

Hyyppä et al. assessed asthmatic oral health and the possible influence of drugs used in their treatment. The pH and salivary composition showed no differences between the 30 asthmatics (10–12 years of age) and the 30 control subjects.<sup>22</sup>

Six studies examined the association between periodontal disease and asthma. Shulman et al.,<sup>23</sup> Laurikainen and Kuusisto,<sup>11</sup> McDerra et al.<sup>17</sup> and Hyyppä et al.<sup>24,27</sup> demonstrated that asthma patients suffered more from gingivitis than the control groups, while Bjerkeborn et al.<sup>25</sup> encountered no differences in the prevalence of gingivitis. McDerra et al.<sup>17</sup> and Hyyppä et al.<sup>22</sup> did not detect any differences in the incidences of plaque. McDerra et al.<sup>17</sup> also confirmed that asthma patients are more affected by dental calculus, while Hyyppä et al.<sup>22,24</sup> encountered no differences in the quantity of calculus.

According to Cintra et al., asthma patients may present higher levels of caries due to their intake of liquid medicines or inhalers and also because of their need to breathe through the mouth.<sup>26</sup>

Few studies have assessed the relationship between the presence of oral diseases and asthma. There are even fewer studies which, in addition to assessing asthma, consider the severity of this condition as well as aspects related to the medications used in its treatment, such as type of medication, dosage and duration of treatment.<sup>21</sup> Although the studies by Hyyppä et al.,<sup>22,27</sup> Bjerkeborn et al.,<sup>25</sup> Laurikainen and Kuusisto,<sup>11</sup> and Lenander-Lumikari et al.<sup>12</sup> assessed the frequency of caries, periodontal disease and saliva, only the first two authors<sup>22,25</sup> dealt with this issue specifically in children and adolescents.

The results of the present study allow us to hypothesize that asthmatic adolescents using inhaled corticosteroids have a higher risk for dental caries compared to non-asthmatics although a cause and effect relationship is not possible to state nor is the influence of the asthma *per se*. Some studies suggest that the higher number of caries is associated with the prolonged use of drugs that leads to a reduced salivary flow and pH,<sup>17,21</sup> thereby reducing the protective effects of the saliva and to an increase in the number of lactobacilli and *Streptococcus mutans*.<sup>21</sup>

Our sample comes from a low educational and low income population and although 40% of the adolescents reported having received information on oral health care, none reported having received instructions from a physician but only from a dentist. This situation reinforces the need to include oral health practices within the context of asthma treatment, as well as in adolescent care centres.

In this study, it was found that the median DMFT was higher than that targeted for the year 2010 (DMFT <1.0).<sup>15</sup> Adolescents with asthma had two times higher DMFS than the non-asthmatics, which similar to what was found in the study by McDerra et al.<sup>17</sup>

A recent study showed a significant increase in plaque and gingival scores among asthmatics as compared to the control group. Hence, there is a need to educate this group of patients about their increased risk and the importance of proper plaque control.<sup>28</sup> In the present study, it was found that asthmatic adolescents using inhaled corticosteroids also presented higher levels of visible plaque. A possible explanation for this result may be the increased number of pathogenic oral bacteria. It was also hypothesized that there is also the possibility that parents of adolescents using inhaled corticosteroids tend to be more lenient, because of their own difficulties in dealing with asthma and the social limitations it imposes on their children. They therefore fail to carry out the appropriate monitoring procedures of oral hygiene, which tend to be overridden by the persistent, worrying condition of asthma.

During the analysis of the database, the median value of the non-stimulated salivary flow for the case group was 0.15 (0.06–0.27) ml/min. This result was considered low when compared to the expected parameter (normal value = 0.25–0.35 ml/min and risk value <0.10 ml/min).<sup>20</sup> However, no difference was recorded between the asthmatic and control group.

The group using inhaled corticosteroids presented a higher frequency of leucocytes in the saliva by reagent strip, and, although this may reflect a response to bacterial overgrowth and plaque formation, further studies need to be undertaken in order to broaden the clinical value of this type of salivary investigation.

In conclusion, our findings suggest that there is a relationship between the use of inhaled corticosteroids and a higher frequency or severity of dental caries in low-income asthmatic patients. It has also been shown by others that asthma, associated or not with its treatment, is a risk factor for dental caries and plaque formation and a regular follow-up of oral health status is important in this population, especially in children and adolescents.<sup>29,30</sup>

## Conflict of interest

The authors have no conflict of interest to declare.

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