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Oral Health Status in Preschool Asthmatic Children in Iran

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ABSTRACT

Asthma is a chronic inflammatory disorder of the airways, which is diagnosed by periodic symptoms of inflammation, bronchial spasm, and increased mucosal secretions. It has higher incidence among the preschool children. There are many contradictory reports based on the effect of asthma on oral health, however it has been hypothesized that asthma could lead to poor oral health. The objective of the present study was to investigate oral health indices in 44 preschool children of three to six years old with mild to moderate asthma and 46 matched healthy children in Tehran Children's Respiratory Center.

Dental plaque, gingival inflammation, mouth breathing, and dental caries were evaluated by one trained examiner according to World Health Organization [WHO] criteria. Culture and colony counting of streptococcus mutans and lactobacillus species were carried out in saliva specimens of the patients. The effects of different factors on the colony counts were statistically analyzed using linear regression analysis.

The level of mother's education and preexisting asthma disease in children had significant effect on the colony counts of streptococcus species whereas no factor was found to influence the number of lactobacillus counts significantly. The results indicated no significant differences between the children with asthma and those without asthma regarding (decayed, missing, filled, teeth) dmft index (mean of 3.34 in asthmatic children and 3.0 in the control group).

Therefore, it can be deduced that the presence of asthma disease did not increase the probability of tooth decay.

Keywords: Asthma; Dental caries; Dmft; Lactobacillus; Streptococcus mutans

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INTRODUCTION

Asthma, a chronic inflammatory disorder of the airways, is one of the serious health problems

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throughout the world. It is diagnosed by periodic symptoms of bronchial inflammation, bronchi spasm, and increased mucosal secretions. It has higher incidence among the preschool children.[1] One Out of 10 children is asthmatic. Before puberty, the prevalence is twice as much in boys, but after puberty it is equal in boys and girls. [2]. This disease can cause periodic coughing, wheeze, dyspnea, and chest tightness.[3]

Overall prevalence of asthma symptoms at a national level was estimated as 13.14% (95% confidence interval [CI], 9.97-16.30%). According to Entezari et al.[4] The prevalence of asthma symptoms in Iran is higher than that evaluated in the international reports. Hence, it is crucially important to prioritize prevention and management of asthma within the range of Iranian public health concerns.

It has been hypothesized that the asthmatic condition could lead to poor oral health. Contradictory results have been reported in this field. In moderate to severe cases of asthma, in addition to general symptoms, oral problems including low saliva flow, increased gingivitis and caries, mucosal changes due to chronic mouth breathing, jaw abnormalities such as dome-shaped palate, posterior cross bite, increased overjet, and long face can be seen.[5]

Asthma medications, especially inhalers, cause mouth dryness, which would make the person vulnerable to more caries. In some cases, corticosteroids are used to manage asthma. This drug causes dryness of the mouth and predisposes the child to fungal infections. In such cases, healing of mouth injuries is delayed. Some other asthma drugs cause nausea and bitterness in the mouth.[6]

Nowadays, clinical studies of caries focus on evaluating all dependent factors including oral hygiene, access to fluoride, and at the same time the rate of caries related microorganisms. Colony count of microorganisms, especially streptococcus mutans and lactobacilli, plays an important role in evaluating caries[6]. The resting pH of the mouth is generally at neutral pH 7. These microorganisms produce organic acids which lead to enamel dissolution. The chemical dissolution of enamel occurs at pH 5.5.[7] The ability to survive in acidic environment is the other characteristic of these microorganisms.

The objective of the present study was to assess the oral health indices in the preschool children with asthma, who have been referred to Asthma and Allergy Research Center in Children's Medical Center of Tehran University of Medical Sciences and other clinics in Tehran from 2010 to 2011.

MATERIALS AND METHODS

In this case-control study, 44 asthmatic and 46 matched healthy preschool children, aged three to six years old, were selected. Comparing means for two independent samples in Minitab software and considering the type I and type II errors at the level of 0.05, the minimum sample size established was 42 patients in each group. All samples were randomly collected from the list of patients who were referred to Immunology, Asthma and Allergy Research Institute in Children's Medical Center of Tehran University of Medical Sciences after being diagnosed by one asthma and allergy subspecialist. All patients had lived in Tehran from their time of birth (with an average amount of 0.35 ppm fluoride in water). Patients were excluded if they had used any chronic medication, had severe asthma disease, and had a history of any systemic disease or mental impairment.

The control group of children was primarily selected from the case groups' siblings. If the case did not have any sibling, healthy children of the same age, sex, and socioeconomic status (low to moderate) were selected. Demographic data and socioeconomic status were recorded by asking each parent using a questionnaire. Demographic data included age, sex, and body mass index. The following were considered as socioeconomic variables: level of education and monthly household income. The national minimum wage at the time of the research corresponded to US$100.

Asthma severity (mild, moderate, or severe) was classified according to self-classification of asthma, years of diagnosis of asthma, oral corticosteroid use in prior year, history of intensive care unit (ICU) or hospitalization during the past year due to asthma, availability of an asthma specialist, current exacerbation, indoor allergen exposure, and use of a controller medication. The children with mild to moderate asthma disease were included in the study.

At the dental appointment, the children's parents received necessary information about the aim of this survey and a written informed consent was obtained from them prior to the examinations. Observation and tactile tests were used to examine number of decayed,

missed and filled teeth [dmft], dental plaque, gingival inflammation, and mouth breathing by one final-year dental student examiner who had been previously trained according to World Health Organization [WHO] criteria.[8] Based on WHO criteria, no radiation was used throughout the study.

All cases were examined seated using a flashlight. The control group was examined in the same conditions at the hospital or at day care centers. Teeth were examined using visual and tactile tests right after they were dried with gauze. Dental caries diagnosis was performed according to WHO criteria where enamel was exposed in smooth teeth surfaces or pits and fissures, or its bottom or surrounding tissue was softened. dmft criteria are as follows:

Decayed: A decayed or filled tooth with decay under or around it.

Missing: A tooth that is missing because of decay.

Filled: A tooth that is filled but is not decayed.

Total number of decayed, missing, and filled primary teeth was recorded as children's dmft. In addition, gingival inflammation (GI) was recorded in both case and control groups for primary teeth (present, not present). Plaque index (PI) was also measured after cleaning the teeth (visible plaque, no plaque) according to Silness-Löe Index as presented in Table 1.

Clinical diagnosis of mouth breathing was defined as a combination of snoring, sleeping with mouth open, drooling on the pillow, frequent and intermittent nasal obstruction, and ENT (Ear, Nose, and Throat) diagnosis of mixed or predominantly mouth breathing.[9, 10]

Furthermore, saliva samples were collected between 8 and 11 A.M. to reduce variations caused by changes in circadian rhythm using paraffin stimulation.[11] Those responsible for each child were instructed not to allow him/her eat or drink for two hours before saliva collection. Stimulation of whole saliva was performed by chewing paraffin wax. The collected saliva during the first 10 seconds was discarded into ice-chilled test tubes. Samples were mixed for 30 seconds and diluted using phosphate buffer solution 0.05 mol/l pH 7.3. After that, samples were cultured for colony counting of streptococcus mutans on plates containing Mitis Salivarius-Bacitracin (MSB), and also for colony counting of lactobacillus species on plates containing Rogosa SL agar (Lactobacillus selective agar). These plates were aerobically incubated at 37° C for 3 days. Likewise, MSB agar plates were incubated in jars at 37° C for 2 days.

Data Analysis

Data were analyzed using SPSS statistical software, version 16.0 for windows (SPSS Inc, Chicago, Illinois), and comparisons were made using multivariate linear regression. Multiple linear regression analysis with backward selection was conducted to identify the effects of different variables associated with presence of asthma disease, oral health status, socioeconomic and demographic conditions, presence of mouth breathing, and education of the parents on the colony counts of streptococcus mutans and lactobacillus. The association between the colony counts of streptococcus mutans and lactobacillus and d, m, f, and dmft indices was measured by the use of Pearson correlation coefficient.

Ethical Approval

Approval was obtained from the Iranian Research Ethics Committee. Written informed consent was obtained from the legal guardian of each child studied.

Table 1. The plaque index system (Silness-Löe Index).

Scores	Criteria
0	No plaque
1	A film of plaque adhering to the free gingival margin and adjacent area of the tooth. The plaque may be seen in situ only after application of disclosing solution or by using the probe on the tooth surface.
2	Moderate accumulation of soft deposits within the gingival pocket, or the tooth and gingival margin which can be seen with the naked eye.
3	Abundance of soft matter within the gingival pocket and/or on the tooth and gingival margin.

Table 2. The number and percentage of asthmatic children and asthma-free group in relation to presence of gingival inflammation, dental plaque, and mouth breathing.

Group	Gingival inflammation		Dental plaque		Mouth breathing	
	Negative	Positive	Negative	Positive	Negative	Positive
Control group	21.7%	78.3%	21.7%	78.3%	95.7%	90.9%
(n = 46)	(n = 10)	(n = 36)	(n = 10)	(n = 36)	(n = 44)	(n = 40)
Asthmatic group	20.5%	79.5%	20.5%	79.5%	4.3%	9.1%
(n = 44)	(n = 9)	(n = 35)	(n = 9)	(n = 35)	(n = 2)	(n = 4)

The results of gingival inflammation, dental plaques, and mouth breathing are shown in Table 2. No meaningful difference was observed in these variables between the two groups.

Mean d, m, f, and dmft indices and mean colony counts of streptococcus mutans and lactobacillus in the control group and in the case group are shown in Table 3.

The medicines for asthma and its symptoms taken by children and reported by mothers were classified as follows: 1. oral β-agonists [salbutamol (AZMET, Medicon Laboratories Ltd.) (24 children, 54.5%)], 2. inhaled corticosteroids [fluticasone (AROTIDE, Eskayef Bangladesh Ltd.) (21 children, 47.7%) and beclomethasone (BECLOMIN, Square Pharmaceuticals Ltd.) (8 children, 18.2%)], 3. systemic corticosteroids [prednisolone (G-PREDNISOLONE, Gonoshasthya Pharmaceuticals Ltd.) (5 children, 11.4%)], 4. Antihistamines [cetirizine dehydrochloride (ASITROL, Asiatic Laboratories Ltd.) (30 children, 68.2%), hydroxizine hydrochloride (ATARAX, Pfizer) (2 children, 4.5%), ketotifen (ZADIFEN**,** Unimed & Unihealth Manufacturers Ltd.) (17 children, 38.6%), loratadine (ALEZE, Unimed & Unihealth Manufacturers Ltd.) (3 children, 6.8%)], and 5. theophylline daily pills **(**AROFIL 300, Incepta Pharmaceuticals Ltd.) (1 child, 2.3%). The most common medicine used in syrup formulation was salbutamol, whose consumption was reported by 24 children, of which 16 (66.6%) used it intermittently.

Table 3. Indices of central distribution of variables related with dental caries in preschool children in the case and control groups.

Topics	Control Group (n=46)		Asthmatic Group (n=44)	
	Mean	SD	Mean	SD
d index	2.28	1.53	1.77	1.55
m index	0.26	0.49	0.39	0.49
f index	0.46	0.69	1.18	1.02
dmft index	3.0	1.8	3.34	1.71
Streptococcus mutans	125847.83	309981.072	138477.27	314300.44
Lactobacillus	182195.65	434599.515	196840.91	425239.46

Table 4. The results of backward linear regression analysis in evaluation of effects of different variables on streptococcus mutans colonies in preschool asthmatic and control groups.

Topics	Non-standard coefficients		Standard coefficients	T	*P* value
	B	Standard error	β		
Constant number	618387.7	215656.7		2.867	0.005
Sex	81051.908	67537.088	0.127	1.2	0.234
Age	-10402.7	31625.863	-0.036	-0.329	0.743
Presence of asthma	-162239	79648.233	-0.263	-2.037	0.045
Mouth breathing	-159379	126441.3	-0.129	-1.260	0.211
Father's education	-28066.7	38350.149	-0.109	-0.732	0.466
Mother's education	-119239	50195.245	-0.385	-2.375	0.02

Inhaled corticosteroids were used by 31 children, of which 12 (38.7%) used them on a daily basis correctly. Systemic corticosteroids were consumed by 5 children, of which 4 (80%) reported occasional use. In addition, most patients (52.5%) have used the medication for more than two years.

The results of backward linear regression analysis showed that the presence of asthma (p=0.045) and mother's educational level (bachelor's degree or higher) (p=0.02) had a significant effect in predicting the colony counts of streptococcus mutans species in the studied population (Table 4), while no factors significantly influenced the number of lactobacillus counts (Table 5). Other variables including sex (p=0.234), age (p=0.743), mouth breathing (p=0.211), and father's educational level (bachelor's degree or higher) (p=0.466) had no significant effect in predicting the colony count of streptococcus mutans (Table 4). Furthermore, sex (p=0.38), age (p=0.904), preexisting asthma disease (p=0.096), mouth breathing (p=0.247), paternal level of education (p=0.371), and maternal level of education (p=0.082) had no significant effect on lactobacillus colony count (Table 5).

According to Pearson test, d (p<0.0001, r=0.419), m (p<0.0001, r=0.365), and dmft indices (p<0.0001, r=0.525) had significant effects on streptococcus mutans colony count. Similarly, d (p<0.0001, r=0.409), m (p<0.001, r=0.359), and dmft indices (p<0.0001, r=0.526) significantly affected lactobacillus colony counts. Furthermore, the results showed direct association between lactobacillus colony count and the colony count of streptococcus mutans species (p<0.0001, r=0.866) (Table 6).

DISCUSSION

The results indicated no significant differences between the case and the control group regarding dmft index (mean of 3.34 in the case group and 3.0 in the control group). Mean index of dmft was estimated a little bit higher in the case group compared to the control group. In other words, preschool children with asthma did not show higher rate of dental caries compared to the healthy individuals. Mean colony counts of streptococcus mutans and lactobacillus derived from saliva samples of both groups were almost the same.

Moreover, 79.5% of asthmatic children and 78.3% of nonasthmatic individuals had gingival inflammation. The difference in gingivitis rate and visible dental plaques between the two groups was not significant.

Controversial results have been presented regarding the association between asthma and dental caries. Some studies found no relationship between asthma and probability of tooth decay.[11-19]

According to Salem et al,[12] there was no significant difference between asthmatic children and healthy ones with regard to dental caries. Mean dmfs index was 3.98 in the case group and 4.30 in the control group. In 2004, Eloot et al[13] studied oral health of children with asthma and reported that the length and severity of the disease, and medication did not have a significant effect on dental caries or on gingivitis in asthmatic children. Similar results of the relationship

Table 5. The results of backward linear regression analysis in evaluation of effects of different variables on lactobacillus colonies in preschool asthmatic and control groups.

Topics	Non-standard coefficients		Standard coefficients	t	P value
	B	Standard error	β		
Constant number	736694.3	304602.6		2.419	0.018
Sex	84221.348	95392.23	0.096	0.883	0.380
Age	-5427.19	44669.702	-0.014	-0.121	0.904
Presence of asthma	-189211	112498.5	-0.222	-1.682	0.096
Mouth breathing	-208377	178591.1	-0.122	-1.167	0.247
Father's education	-48688.0	54167.366	-0.138	-0.899	0.371
Mother's education	-124974	70897.879	-0.293	-1.763	0.082

Table 6. The results of Pearson test in evaluation of correlations between different variables in preschool children with and without asthma.

Variables	dt index	mt index	ft index	dmft index	Streptococcus mutans colony count	Lactobacillus colony count
dt index	_	_	_	_	_	_
mt index	r = 0.074 *P* =0.489	_	_	_	_	_
ft index	r = 0.259 *P* =0.014	r = 0.207 *P* =0.051	_	_	_	_
dmft index	r = 0.768 *P* =0.0001	r = 0.456 *P* =0.0001	r = 0.362 *P* =0.0001	_	_	_
Streptococcus mutans colony count	r = 0.419 *P* =0.0001	r = 0.365 *P* =0.0001	r = 0.097 *P* =0.365	r = 0.525 *P* =0.0001	_	_
Lactobacillus colony count	r = 0.409 *P* =0.0001	r = 0.359 *P* =0.0001	r = 0.119 *P* =0.263	r = 0.526 *P* =0.0001	r = 0.866 *P* =0.0001	_

between dental caries and asthma were reported by other researchers [8, 14, 15] even though in most of the studies radiography was not used.[14, 16, 17] This practice increases the probability of undiagnosed dental caries in proximal areas.

In 2005, Ghasempour et al.[18] studied tooth caries of asthmatic children and found a significant difference in DMFT indices (in permanent teeth) between the case and the control group (2.27 in asthmatic children and 0.8 in the control group). However, no meaningful difference was observed in dmft indices (in primary teeth) of asthmatic children (mean 3.53) and the control group (mean 3.22). This finding is in agreement with our results. According to a critical review of literature conducted by Maupomé et al.[19] to ascertain the strength of the scientific and professional evidence supporting an association between dental caries and the experience and severity of asthma, asthma was not a risk factor for caries.

Stensson et al[20] studied oral health status of preschool children of three to six years old with asthma. They found a significant difference between the dmfs indices of 3-year-old asthmatic patients (mean 1.4) and the control group (mean 0.5). In the same study, mean index for 6-year-olds with and without asthma was 2.5 and 1.8, respectively. In 2010, Stensson et al [21] showed that asthmatic children of 3-6 years old were more prone to tooth decay compared to their healthy peers. Furthermore, in 2011 Stensson et al [22] found that the mean dfs index (including visible and primary caries) in chronic but controlled cases of asthma in young adults was 8.6. Meanwhile, dfs index in their healthy peers was 4.0. They concluded that children with long-term, controlled asthma had higher gingivitis rate and a lower stimulated saliva flow. Bimstein et al.[23] reported that asthmatic children had longer history of toothache, dental plaques, calculus and caries compared to healthy ones.

Asthma and tooth decay, are both chronic diseases with several effective factors. One reason for our different results from other studies might be the exact diagnosis of asthma from other respiratory problems. Symptoms of asthma include edema of smooth muscle, increased bronchial reaction to stimuli, and increased serum level of immunoglobulines. Therefore, this disease is pathophysiologically different from other respiratory inflammations, and it is probable to be misdiagnosed[17]. In addition, the severity of the disease can affect tooth decay.[14] The present study evaluated children with mild to moderate asthma.

Studies that reported a meaningful relationship between tooth decay and asthma often emphasized the high prevalence of variables such as mouth breathing and consumption of sugary drinks among asthmatic children. Therefore, such a strong relationship could occur because of higher consumption of sweet drinks, higher prevalence of mouth breathing, and inappropriate oral health habits. Nascimento et al[24] showed that mouth breathing was a risk factor for tooth decay.

On the other hand, finding the relationship between asthma and tooth decay in preschool children is difficult, and several confounding variables can affect the results. There are few researchers who were able to

control these variables. The severity of asthma, type and form of the medication change through the course of the disease can affect accurate diagnosis of asthma in young kids.

The lack of significant relationship between tooth decay and asthma in children in the present study could be due to matching of the 2 groups for sex, age, socioeconomic status and mouth breathing.

It is evident that one of the major factors in increasing tooth decay in asthmatic children is low saliva flow and the increased number of lactobacilli and streptococcus mutans species.[9] In the present study, the colony counts of streptococcus mutans and lactobacillus were measured. Due to the association between colonized microorganisms on tooth surfaces and in saliva, a simple accurate method of saliva sampling was used in the study. The results showed that mean colony counts of streptococcus mutans and lactobacillus species in the control group were 125847.83 and 182195.65 CFU, respectively, and for asthmatic children were 138411.27 and 196840.91 CFU, respectively, which was a little bit higher.

Previous studies stated that providing patients with adequate knowledge about their asthma disease could increase the patients' compliance.[25] In the present study, the presence of asthma and mother's education level had a significant effect on predicting colony count of streptococcus mutans species, whereas other variables including sex, age, mouth breathing and father's education level had no significant effect. These effects could be the results of doctors' trainings of applying sprays in a way that no medication remains in mouth and pharynx. Most of the patients used spray form of medication (90.9%). In addition, none of the studied variables had a significant effect on colony count of lactobacillus. Since these bacteria are responsible for rampant caries especially in the area between enamel and dentin, and need more acidic environment than streptococcus mutans, the difference in colony count could be attributed to low severity and low acidity of the plaque.[6] Salem et al.[12] found that the difference between the two groups with regard to streptococcus mutans was significant, where the colony counts of streptococcus mutans were higher in the control group. Ersin et al.[14] found no association between the two groups. Mazzoleni et al.[16] reported higher colony counts of both streptococcus mutans and lactobacillus in asthmatic children while primary tooth decay was similar in both groups and permanent tooth decay was more in asthmatic group.

The current study had some limitations. A small-sized sample was studied because of the time limits. In addition, in the present study, the effect of different types of medications on the results was not evaluated. According to Paganini et al,[11] no association was observed between drug use frequency and drug type. However, further researches should be done with larger sample size to confirm the obtained results.

The results of the present study showed that there was no significant relationship between oral health indices and asthma. Therefore, asthma did not increase the probability of tooth decay.

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