Pediatric Dental Care: Open Access

Chakiri et al., Pediatr Dent Care 2016, 1:4
DOI: 10.4172/2573-444X.1000120

Case Control Study OMICS International

The Effects of the Asthma and Its Treatments on Oral Health of Children: A Case Control Study

Hanane Chakiri[1]*, Loubna Bahije[2] and Rachid Fawzi[1]

[1]*Department of Pediatric and Preventive Dentistry, Faculty of Dental Medicine, University Mohammed V - Rabat, Morocco*
[2]*Department of Orthodontics, Laboratory of Biostatistics, Clinical Research and Epidemiology, Faculty of Medicine and Pharmacy, University Mohammed V - Rabat, Morocco*

Abstract

Objective: The aim of this study was to assess the oral hygiene practice and oral health of children with bronchial asthma.

Materials and methods: This study was conducted among 114 asthmatic children and 114 case-controls, who consulted at Rabat Children's Hospital. The two groups had the same distribution regarding age and gender. Survey forms consist of two major components. Firstly, the questionnaire was used to gather general data related to asthma and data related to the oral hygiene. Secondly, the clinical examination was used to identify variables related to oral health status (decayed, missed and filled teeth index DMF, Plaques Index PI, Gingival Index GI, salivary flow). The results were analyzed using the Statistical Package for the Social Science (SPSS Version 13.0) for Windows.

Results: Our study has identified results with a statistically significant difference between the asthmatic group and the control group on most variables: The mean DMF index for this population was 5.08 ± 3.06 vs. 4.28 ± 2.97 for the control group ($p=0.04$), the mean PI was 1.49 ± 0.49 vs. 1.22 ± 0.45 for the control group ($p<0.001$), the average GI was 1.54 ± 0.62 vs. 1.22 ± 0.42 for the control group ($p<0.001$). On the other hand, the number of children with reduced salivary flow was higher in asthmatic children 68 (59.6%) than in the control children 6 (5.3%) ($p<0.01$).

Conclusion: Our study has revealed that asthma, associated or not with its treatment, is a risk factors for dental caries, plaque formation and gingivitis.

Keywords: Asthma; Oral health; Children

Introduction

Bronchial asthma is one of the most common chronic diseases of childhood characterized by chronic airway inflammation and increased airway responsiveness, leading to symptoms such as wheezing, coughing, chest tightness and dyspnea [1].

This is a serious public health problem all over the world, that usually starts in childhood and the patient has to take inhaled therapy lifelong. According to Global Initiative for Asthma (GINA) report (2001), it is estimated nearly 300 million people suffer from asthma [2]. In Morocco, approximately 10 to 15% of children and adolescents are affected [3].

As the prevalence of asthma rises in the pediatric population, it is necessary to examine how this disease affects other areas of health care, most notably oral health. There is inconclusive evidence suggesting a possible association of asthma with increased risk of caries. Some authors have reported an association between childhood asthma and dental caries in preschool children, whereas others have found no such connection. Eloot et al. found that neither the length of the disease period, the medication nor the severity of the asthma disease had a significant effect on the risk of developing caries or gingivitis. Other studies by Reddy et al., Ersin et al. and Mehta et al., however, concluded that asthma, through its disease status and its pharmacotherapy, carries some risk factors for caries development, including decreased salivary flow rate and pH. Furthermore, it has been demonstrated that the duration of illness and medication had significant influences on the risk of caries in asthmatics [4-7].

The aim of this study was to assess the oral hygiene practice and oral health of children with bronchial asthma.

Materials and Methods

A cross-sectional case-control study was performed with 228 children and adolescents aged 3-17 years, consultants to the children's hospital in Rabat, from January to April 2015.

Selected children were divided into two equal groups of asthmatics and controls. The asthma group (n=114) included only patients with bronchial asthma without any other diseases and were under medication as advised by their physician. The subjects forming the control group (n=114), matched for age and gender, were selected from patients consulted children's hospital and were not have any systemic diseases or were not using any medication that could modify the oral conditions.

The children's parents or legal guardians received information about the purpose of this research and informed consent was obtained prior to the clinical examination and saliva collection. Only children

***Corresponding author:** Chakiri H, Consultation Center of Dental Treatment Rabat, Faculty of Dentistry Avenue Allal El Fassi, Mohammed Jazuli Street, Al Irfane City - BP 6212 Rabat Institutes, Morocco,Tel: +2126 66 50 47 39; E-mail: dr.chakirihanane@gmail.com

Received September 30, 2016; **Accepted** October 20, 2016; **Published** October 28, 2016

Citation: Chakiri H, Bahije L, Fawzi R (2016) The Effects of the Asthma and Its Treatments on Oral Health of Children: A Case Control Study. Pediatr Dent Care 1: 120. doi: 10.4172/2573-444X.1000120

whose guardians had signed the informed consent were enrolled in this study.

Questionnaires completed by parents and data from the patients' medical records provided information on socio-demographic, medical history, parents' education, family income, and oral hygiene practices: mouth rinsing after medicine application, tooth brushing, age of beginning tooth brushing, tooth brushing regularity (tooth brushing every day), duration of tooth brushing, frequency of tooth brushing, method of tooth brushing (temporary dentition: correct method when it is horizontal, mixed and permanent dentition: correct method when it is done according to Roll technique) [8].

For asthmatic patient the information regarding the asthma, severity of asthma, type of medication, frequency of administration and duration of the use of asthma medication was obtained from his medical records.

Asthma severity was classified according to Shulman et al. [9] based on parent's information about the hospitalization related to asthma in the last year. If the child was hospitalized twice or suffered 4 acute asthmatic attacks, this was considered severe asthma. If the child was hospitalized once or had 2 acute attacks or 3 wheezing episodes, the diagnosis was moderate asthma. Finally, the patient was diagnosed as mildly asthmatic if no history of hospitalization existed and there had been one acute attack or 2 wheezing episodes. Asthmatic children were categorized according to frequency of medicine application (1, 2, 3 times/day) and according to duration of the use of asthma medication (<4, 4-9, >9 years).

The oral examination was carried by a single examiner and was done using sterile instruments.

Dental caries were assessed using DMFT/dmft index (decayed, missed and filled teeth index) and according to World Health Organization criteria [10]. A tooth was considered 'decayed' if there was frank cavitation on the surface, 'missing' if the extraction was due to caries and 'filled' if it had a restored carious lesion. Exfoliated, un-erupted teeth and those extracted for other reasons apart from caries were not included in the indices.

The biofilm index was measured by using the LOE and SILNESS Plaques Index (PI) obtained as a percentage of dental surfaces with visible plaque from the total number of examined surfaces [11].On this same occasion Gingival Index was also assessed using the LOE and SILNESS Gingival Index (GI) [11].

Dry mouth was assessed by measuring the non-stimulated salivary flow; children 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 five minutes. A resting flow rate of less than 0.1 ml/min is considered abnormal and this rate was adopted as sign of dry mouth [12].

All children received instructions about oral health maintenance and a toothbrush at the end of the clinical examination.

Statistical analyses were analysed using SPSS (13.0) for Windows. In order to describe the general characteristics of the population, quantitative variables were expressed as mean ± standard deviation and categorical variables were expressed as numbers and percentages. An evaluation association in categorical data between groups was using Chi-square, Student and ANOVA tests.

Sample and multiple linear regression analyses were performed to explore the effect of independent variables on DMFT/dmft index as dependent variables. The multivariate model was constituted by the variables that were associated with statistically significant, or with a p<0.20 in the univariate analysis. The level of statistical significance was set at 5%.

Results

The study sample consisted of 228 children, of whom 114 were asthmatic with a mean age of 8, 69 ± 4,05 years and 114 non-asthmatic children with a mean age of 8.24 ± 3.37 years.

The oral health status revealed significant a statistical difference between asthma and control groups.

The mean DMFT/dmft scores was 5.08 ± 3.06 and 4.28 ± 2.97 in asthmatic and non-asthmatic respectively (p=0.04). The mean PI score was 1,49 ± 0,49 in the asthma group and 1,22 ± 0,45 in the non-asthmatic group (p<0,001), the mean GI scores was 1.54 ± 0.62 and 1.22 ± 0.42 in the study and control group, respectively (p<0,001) (Table 1).

According to the classification of Shulman et al. (2001) of the severity of asthma, a significant association was found between asthma severity and DMFT/dmft, PI or GI scores (p=0.02, p=0,01 and p=0,01, respectively)

Asthmatic patients were divided according to the duration of the use of asthma medication into patients who had been on medication for less than 4 years (n=43; 37.8%), 4 to 9 years (n=64; 56; 1%) and longer than 9 years, termed long duration (n=7; 6,1%). According to our study results, there was a significant association between duration of taking anti-asthmatic medication and DMFT/dmft, PI and GI scores (p=0.05, p=0,04 and p=0,02, respectively). All asthmatic patients examined using daily inhaled corticosteroids, and they used bronchodilators combined with corticosteroids via oral route if necessary

Asthmatic patients were classified according to medication frequency into three groups, patients taking their medication once a day (n=49; 43%), twice a day (n=61; 53,5%) and three times and more (n=4; 3,5%). A significant association was observed between medication frequency and DMFT/dmft (p=0,05) (Table 2).

Our results showed a significant difference in the salivary flow between cases and controls (p<0.01), the number of children with reduced salivary flow was higher in asthmatic children 68 (59.6%) than in the control children 6 (5.3%) (Table1).

32 (28.3%) of asthmatic patients reported regularly rinse the mouth after medicine application and 22 (19.5%) had never rinsed their mouth after inhalation of medication. A significant association was found between the mouth rinsing after medicine application and the DMFT/dmft (p=0, 04) (Table 2).

In regards to oral hygiene, the control group presented better

Variable	Asthmatics N=114	Non asthmatics N=114	P
DMFT/dmft index (M ± SD)	5.08 ± 3.06	4.28 ± 2.97	**0.04**
Plaque index (M±SD)	1.49 ± 0.49	1.22 ± 0.45	**<0.001**
Gingival index (M ± SD)	1.54 ± 0.62	1.22 ± 0.42	**<0.001**
Salivary flow (%)			
Low	68 (59.6)	6 (5.3)	**<0.001**
Normal	41 (36)	104 (91.2)	
high	5 (4.4)	4 (3.5)	

Table 1: Oral health of children with and without asthma.

Variables	DMFT/dmft Index		Plaque index		Gingival index	
	M ± SD	p	M ± SD	p	M ± SD	p
Asthma severity						
Severe	5.27 ± 3.24	**0.02**	1.59 ± 0.48	**0.01**	1.71 ± 0.57	**0.01**
Moderate	5.30 ± 3.08		1.51 ± 0.49		1.55 ± 0.59	
Mild	4.60 ± 2.96		1.38 ± 0.48		1.41 ± 0.69	
Duration of the use of asthma medication						
<4 years	4.60 ± 3.02	**0.05**	1.37 ± 0.50	**0.04**	1.45 ± 0.62	**0.02**
4-9 years	5.13 ± 2.88		1.53 ± 0.47		1.55 ± 0.63	
>9 years	7.57 ± 4.12		1.82 ± 0.40		1.98 ± 0.47	
Medication frequency		**0.03**		0.07		0.23
Once/day	5.04 ± 3.25		1.39 ± 0.53		1.46 ± 0.65	
Twice/day	4.89 ± 2.54		1.54 ± 0.45		1.56 ± 0.61	
Trice/day	8.50 ± 6.24		1.90 ± 0.29		1.98 ± 0.47	
Rinse the mouth after medicine application						
Always	5.53 ± 2.71	**0.04**	1.49 ± 0.50	0.93	1.57 ± 0.68	0.91
Sometimes	4.46 ± 2.90		1.50 ± 0.53		1.52 ± 0.63	
Never	6.23 ± 3.64		1.45 ± 0.39		1.51 ± 0.55	

Table 2: Relationship between asthma characteristics and DMFT/dmft index, plaque index, gingival index.

conditions of oral hygiene; we observed a statistical significant difference between asthmatics and non-asthmatics for the tooth brushing, age of beginning tooth brushing, tooth brushing time, tooth brushing regularity and method of tooth brushing (Table 3).

Sample linear regression analyses showed that age (p=0, 11), asthma (p=0, 04), severity of asthma (p=0,02), frequency of administration (p=0,04) and duration of the use of asthma medication (p<0,001) were significantly associated with DMFT/dmft score. Sex (p=0, 55), tooth-brushing (p=0,44), age of beginning tooth brushing (p=0,35), duration of tooth-brushing, tooth (p=0,73), tooth-brushing regularity (p=0,58), frequency of tooth-brushing (p=0,59) and method of tooth-brushing (p=0,75) were not associated with dental caries (DMFT/dmft scores).

In multiple linear regression analyses adjusted for age asthma, severity of asthma, frequency of administration and duration of the use of asthma medication only asthma (p=0, 02), frequency of administration (p<0,001) and duration of the use of asthma medication (p=0,02) were significantly associated with DMFT/dmft score (Table 4).

Variable	Asthmatics N=114	Non-asthmatics N=114	p
Toothbrushing (%)	91 (80)	103 (90.4)	**<0.001**
Age of beginning tooth brushing (M ± SD)	5.87 ± 1.17	5.04 ± 1.07	**<0.001**
Duration of tooth-brushing (%)			**0.01**
1 mn	50 (54.9)	35 (34)	
2 mn	41 (45.1)	66 (64.1)	
3 mn	0	2 (1.9)	
Tooth-brushing regularity (%)			**<0.001**
Régular	23 (23)	41 (45)	
Frequency of tooth-brushing (%)			0.38
Once/day	26 (28,6)	34 (33,6)	
Twice/day	55 (60,4)	53 (51)	
Trice/day	10 (11)	16 (15,4)	
Method of tooth-brushing (%)			**0,01**
Correct	26 (25)	38 (41,8)	

Table 3: Oral hygiene practices of children with and without asthma.

Discussion

The current study revealed that asthmatic patients suffer more from the two main oral diseases, caries and gingival disease, than non-asthmatic subjects and supported the hypothesis that asthma and its treatment may increase the risk of oral diseases. The relationship between asthma and dental caries appears to be complex, with some papers showing an increased caries rate in asthmatic children while others show no difference between those with asthma and those without asthma.

In Our study the difference was statistically significant in the caries indices (DMFT/dmft scores) between asthmatic and non-asthmatic children, but we did not observe a clinical difference as regards the mean DMFT/dmft scores. This finding can be explained by the fact that dental caries in general is highly prevalent in Moroccan children regardless of their medical history or medication intake [13]. Our results are in agreement with a various studies which have investigated oral health in individuals with asthma [14-17]. In a recent study by Khalifa et al., it was revealed a higher DMFT/dmft scores in people with asthma compared to controls [18], they also found that the asthma group had higher levels of *Streptococcus mutans* and salivary pH below which would explain the presence of favorable conditions for development of carious lesions in asthmatics.

According to the results of our study, there was a significant difference in the plaque index and the gingival index values between the asthmatic children and the control group. Our results are in agreement with many studies examined the association between periodontal disease and asthma. Shulman et al. in 2009, Laurikanen and Kuusisto in 1998, McDerra et al. in 1998 and Hyyppä et al. in 1984 demonstrated that asthma patients suffered more from gingivitis than the control groups [9,19-21], while Bjerkeborn et al. in 1987 [22] encountered no differences in the gingival index. McDerra et al. and Hyyppä et al. did not detect any differences in the index of plaque [20,21].

Hence, there is a need to educate this group of patients about their increased risk and the importance of proper plaque control.

Various explanations have been put forward for why children and adolescents with asthma have significantly more severe gingivitis than controls. Firstly, it could be the result of an altered immune response. In fact, the concentration of immunoglobulin E in gingival tissue was

Variables	Univarate analysis			Multivarate analysis		
	β	IC 95%	P	β	IC 95%	P
Age	0,14	[-0,03–0,28]	**0,11**	0,11	[-0,04–0,90]	0,2
Sex	-0,05	[-0,48–0,79]	0,55			
Tooth-brushing	-0,08	[-0,69–0,30]	0,44			
Age of beginning tooth-brushing	1,08	[-0,69–0,91]	0,35			
Tooth-brushing regularity	0,05	[-0,53–0,95]	0,58			
Method of tooth-brushing	-0,03	[-1,37–0,99]	0,75			
Fréquence of tooth-brushing	-0,05	[-1,22–0,70]	0,59			
Duration of tooth-brushing	0,03	[-0,96–0,37]	0,73			
Asthma	0,13	[0,01–1,58]	**0,04**	0,46	[-0,08–0,78]	**0,02**
Severity of asthma	0,08	[-0,02–0,98]	**0,02**	-0,35	[-1,11–0,40]	0,35
Duration of the use of asthma medication	0,18	[0,01–0,94]	**0,04**	0,67	[-0,04–0,90]	**0,02**
Medication frequency	0,35	[1,29–3,82]	**<0,001**	3,11	[1,63–4,35]	**<0,001**
Rinse the mouth after medicine application	0,04	[-0,62–1,04]	**0,12**	-0,45	[-0,04–0,90]	0,29

Table 4: Linear regression analyses of DMFT/dmft index.

found to be elevated in asthmatic patients, which caused gingival destruction. Additionally, an enzyme group involved in inflammation (the arginine aminopeptidases) was found to be slightly elevated in the gingival fluid of asthmatic children, indicating that gingival inflammation was increased in asthma. Moreover, the tendency to breathe through the mouth could cause the dehydration of alveolar mucosa, resulting in a worsening of the oral condition. Finally, the use of inhaled steroids has been linked to increased levels of gingivitis [23-25].

The possible cause of an increase in oral diseases among asthmatic patients could be due to the disease itself including the severity and/or duration of the disease or due to their medications including the type, dose and duration of medications or the technique of inhaler use. 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. Although the studies by Hyyppä et al. in 1984, Bjekeborn et al. in 1987, Laurikainen et al. in 1998 and Lenander-Lumikari et al. in 1998 assessed the frequency of caries, periodontal disease and saliva, only the first two authors dealt with this issue specifically in children and adolescents [19-22,26].

In the present study, the data showed that there was no significant association was found between asthma severity and DMFT/dmft, PI or GI scores, which is in agreement with the observations by Paganini et al. in 2011, Marzi et al. in 2012 and Sumer et al. in 2013 [27-29]. Over hand Tomi et al. in 2012 reported associations between increasing prevalence of caries and lower salivary flow rate with increasing severity of asthma were observed, most likely due to the increased dosage and frequency of medication required to treat more severe asthma [30].

A link between oral diseases and the commonly used anti-asthma inhalant medications has biological credibility. The duration of the use of asthma medication is an important factor with regards to altering the oral flora [31]. In the present study, there was a significant association between duration of taking anti-asthmatic medication and DMFT/dmft, PI and GI scores. This is in agreement with many studies showing an association between the duration of taking asthma medication and the likelihood of developing caries or gingivitis [6,32-34]. However, our results disagree with those of Eloot et al. in 2004, who stated that neither the severity of asthma nor the duration of the use asthma medication can affect the risk of developing caries or gingivitis [4].

The importance of saliva in maintaining oral health cannot be underestimated. Decreased salivary flow rate in asthmatic children and also changes in saliva composition and its pH are linked to the use of anti-asthmatic medications. This association was observed for inhaled b2-agonists and in combination with glucocorticoids. In our study, the assessment of salivary secretion of asthmatic children revealed the presence of a dry mouth in 68 (59.6%) asthmatic against 6 (5.3%) controls with a statistically significant difference ($p<0.001$). Many researchers focused on the study of the likely effects that can result from chronic asthma treatment on salivary secretion, especially the frequent use of bronchodilators [35]. Laurikainen et al. in 1998 showed a decrease in salivary flow and salivary pH [19], while Ryberg et al. in 1987 showed a decrease in total protein concentration, amylase, hexosamine, salivary peroxidase, lysozyme and sIgA in stimulated saliva asthmatic patients [36]. Sag et al. in 2007 in their study reported a significant reduction in salivary flow and reduced production of saliva proteins in young adults using either beta-2 agonists alone or in combination with corticosteroids [37]. Later Hegde et al. in 2012 found that levels of salivary antioxidants reduced in asthmatic children [38].

The oral hygiene is a preventive measure that includes a set of practices for the conservation of dental and periodontal health. The results of our study showed a statistically significant difference in oral hygiene practices between the asthmatic population and the non-asthmatic population. Our data are in agreement with the study by McDerra et al. in 1998 [20], on the other hand, some authors did not observe differences in oral hygiene patterns between the asthma group and the respective controls [35,39].

In this study, a significant association was found between the mouth rinsing after medicine application and the DMFT/dmft. Samec et al. in 2013 reported the use of spacer and rinsing the mouth with water after medicine application demonstrated to be protective factors in caries development [32]. Spacer is believed to reduce the amount of the lactose reaching the tooth surface, whereas rinsing after medication intake can facilitate cleansing away of residual sugar from the tooth surfaces.

In sample and multiple linear regression analyses, our findings suggest that there is a relationship between the asthma, duration of the use of asthma medication, medication frequency and a higher frequency or severity of dental caries in asthmatic patients. It has also been shown by others that asthma, associated or not with its treatment, is risk factors 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.

Conclusion

The results of our study showed clearly that asthma, and its treatment, are risk factors for the pathology of the oral cavity. There was a significant deterioration in most oral health indicators studied in patients with asthma and statistically significant differences between asthma patients and the control group were noted regarding the index CAO/cao, plaque index, gingival index, and salivary flow.

Considering these factors, special attention should be paid to their oral hygiene and to their prophylaxis, as well. The types of drugs and the modalities of their administration might be modified by the pneumologist/pediatrist, in favor of the drugs with reduced adverse effects. Utilization of a spacer for the administration of inhalation medication should be extended to each child, as well as a subsequent abundant mouth rinsing.

However, additional studies should be developed on such topic, including more numerous subjects and several variables, for a complete elucidation of the relation between bronchial asthma, its medication and the oral pathology.

Acknowledgement

There is not funding to report for this study. The authors declare no potential conflicts of interest with respect to the authorship and/or publication of this article.

References

1. Thomas M, Parolia A, Kundabala M, Vikram M (2010) Asthma and oral health: A review. Aust Dent J 55: 128-133.
2. Derek M, Michael G (2001) The dental patient with asthma: An update and oral health considerations. J Am Dent Assoc 9: 1229-1239.
3. Isaac Souhail F (2008) L'asthme de l'enfant. Revue française des maladies respiratoires 16: 26-34.
4. Eloot A, Vanobbergen J, De Baets F, Martens L (2004) Oral health and habits in children with asthma related to severity and duration of condition. Eur J Paediatr Dent 5: 210-215.
5. Reddy DK, Hegde AM, Munshi AK. (2003) Dental caries status of children with bronchial asthma. J Clin Pediatr Dent 3: 293-295.
6. Ersin N, Gülen F, Eronat N, Cogulu D (2006) Oral and dental manifestations of young asthmatics related to medication, severity and duration of condition Pediatrics International 48: 549-554.
7. Mehta A, Sequira P, Sahoo R, Kaur G (2009) Is bronchial asthma a risk factor for gingival diseases? A control study. The New York State Dental Journal 1: 44-46.
8. Muller-Bolla M, Courson F, Manière-Ezvan A, Viargues P (2011) Toothbrushing: Which methods to use? Rev Odont Stomat 40: 239-260.
9. Shulman J, Taylor S, Nunn M (2001) The association between asthma and dental caries in children and adolescents: A population based case-control study. Caries Res 35: 240-246.
10. Petersen PE (2003) The approach of the who global oral health programme. The World Oral Health Report 03: 12-16.
11. Löe H (1967) The gingival index, the plaque index and the retention index systems. J Periodontol 38: 610.
12. Helenius L (2005) Oral and salivary parameters in patients with rheumatic diseases. Acta Odontol Scand 63: 284-293.
13. El Jirari C, Dartigues A, Cherkaoui P (2000) La situation de la maladie carieuse dans la population infantile marocaine (6 A 15 Ans). Oodonto-Stomatologie Tropicale 89: 11-13.
14. Maupomé G, Shulman JD, Medina-Solis CE (2010) Is there a relationship between asthma and dental caries? A critical review of the literature. J Am Dent Assoc 9: 1061-1074.
15. Stensson M, Wendt L, Koch G (2008) Oral health in preschool children with asthma. International Journal of Paediatric Dentistry 4: 243-250.
16. Botelho M, Marciel Sm, Dezan C, Fernandez K, Ardrade F (2011) Cariogenic microorganisms and oral conditions in asthmatic children caries research 45: 386-392.
17. Meldrum A, Thomson W, Drummond B, Sears M (2001) Is asthma a risk factor for dental caries? Findings from a cohort study. Caries Res 35: 235-239.
18. Khalifa M, Aboulkheir H, Khodair S, Mohamed G (2014) Salivary composition and dental caries among children controlled asthmatics. Egyptian Journal of Chest Diseases and Tuberculosis 63: 777-788.
19. Laurikainen K, Kuusisto P (1998) Comparison of the oral health status and salivary flow rate of asthmatic patients with those of non-asthmatic adults - Results of a pilot study. Allergy 53: 316-319.
20. McDerra E, Pollard M, Curzon M (1998) The dental status of asthmatic British school children. Pediatr Dent 20: 281-287.
21. Hyyppä T (1984) Studies on immunologic and inflammatory factors in the saliva and gingiva in patients with asthma. Proc Finn Dent Soc 80: 1-64.
22. Bjerkeborn K, Dahllo G, Hedlin G, Lindell M, Mode T (1987) Effect of disease severity and pharmacotherapy of asthma on oral health in asthmatic children. Scand J Dent Res 95: 159-164.
23. Ferrazano Gf, Sangianantoni G, Cantile T, Amato I, Ingenito A (2012) Dental health in asthmatic children: A south Italy study. Journal of Dentistry for Children 3: 170-175.
24. Mehta A, Sequeira PS, Sahoo RC (2009) Bronchial asthma and dental caries risk: Results from a case control study. J Contemp Dent Pract 10: 59-66.
25. Turkistani J, Farsi N, Almushayt A, Alaki S (2010) Caries experience in asthmatic children: A review of literature. J Clin Pediatr Dent 35: 1-8.
26. Lenander-Lumikari M, Laurikainen K, Kuusisto P, Vilja P (1998) Stimulated salivary flow rate and composition in asthmatic and non-asthmatic adults. Arch Oral Biol 43: 151-156.
27. Paganini M, Dezan C, Bichaco T (2011) Dental caries status and salivary properties of asthmatic children and adolescents. International Journal of Paediatric Dentistry 21: 185-191.
28. Marzie B, Hossein N, Mohammad H (2012) Effect of inhaled medication and inhalation technique on dental caries in asthmatic patients Iranian. Red Crescent Medical Journal Iran 12: 816-821.
29. Sumer MA, Eman A, Niveen Samir B, Khlood K, Sarah M (2013) The effects of asthma and asthma medication on dental caries and salivary characteristics in children oral health. Prev Dent 11: 113-120.
30. Samec T, Amaechi BT, Battelino T, Krivec U, Jan J (2013) Influence of anti-asthmatic medications on dental caries in children in Slovenia. International Journal of Paediatric Dentistry 23: 188-196.
31. Milano M, Lee J, Donovan K. (2006) A cross-sectional study of medication-related factors and caries experience in asthmatic children. Pediatric Dentistry 28: 415-419.
32. Shashikiran ND (2015) Effect of anti-asthmatic medication on dental disease: Dental caries and periodontal disease. Journal of Indian Society of Pedodontics and Preventive Dentistry 2: 65-68.
33. Wong MC, Lo E, Schwarz E, Zhang HG (2001) Oral health status and oral health behaviors in Chinese children. J Dent Res 80: 1459-1465.
34. Lipworth BJ (1996) Airway and systemic effects of inhaled corticosteroids in asthma: Dose response relationship. Pulmonary Pharmacology 9: 19-27.
35. Stensson M, Wendt LK, Koch G, Nilsson M, Oldaeus G (2010) Oral health in pre-school children with asthma - followed from 3 to 6 years. Int J Paediatr Dent 20: 165-172.
36. Ryberg M, Möller C, Ericson T (1987) Effect of 2 - adrenoceptor agonists on saliva proteins and dental caries in asthmatic children. J Dent Res 66: 1404-1406.
37. Hegde Am, Raj K, Shetty S (2012) Relation of caries status on the salivary total antioxidant levels in asthmatic children. Contemporary Clinical Dentistery 3: 402-405.
38. Guergolette Rp, Dezan Cc, Frossard W, Ferreira F, Cerci Neto A (2009) Prévalence des défauts de développement de l'émail chez les enfants et les adolescents asthmatiques. Jornal Brasileiro de Pneumologia 4: 295-300.
39. Alzaher Khalifa MH, Abouelkheir HM, Khodiar S (2014) Salivary composition and dental caries among children controlled asthmatics. Egyptian Journal of Chest Diseases and Tuberculosis 63: 777-788.