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THE IMPACT OF ASTHMA AND ITS MEDICATIONS ON DENTAL CARIES STATUS AND STREPTOCOCCUS MUTANS COUNT IN CHILDREN: A CROSS-SECTIONAL STUDY

Dental Science

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ABSTRACT

Background: Asthma and its medications have been linked to oral diseases in asthmatic children.
Aim: Assessment of the dental caries status, salivary Streptococcus mutans count and S. mutans colony score in children receiving inhaled anti asthmatic medications and their comparison in healthy children
Material And Method: A cross-sectional study was performed on 40 asthmatic children and 40 healthy children in the age group of 6-14 years. DMFT/deft indices were calculated and saliva samples were collected. Diluted saliva was inoculated on MSB agar plates. S. mutans count and colony score were analysed after 24-48 hours of inoculation.
Results: Statistically significant difference was observed in the mean DMFT/deft index, salivary S. mutans load and S. mutans colony score in children of the asthmatic group and control group.
Conclusion: Prevalence of dental caries and cariogenic bacteria is higher in asthmatic children.

KEYWORDS

dental caries, asthma, inhaled anti asthmatic medications, Streptococcus mutans, oral health

INTRODUCTION

In the recent years, asthma has emerged as a major public health problem affecting more than 339 million people globally.[1] It is one of the most common chronic diseases of childhood with the incidence rate showing exponential increase in the last decade in India.[2] Any systemic disease affecting children especially during the early ages has widespread ramifications and asthma is not an exception.[3] Asthma is known to have a detrimental effect on the oral health. Most of the reports published in the last 20 years have uncovered an association between asthma and dental caries and asthma and gingivitis both in children and adults.[4,5,6] However, out of the two, gingivitis and dental caries, the latter is an irreversible disease with far reaching consequences if not detected and treated early. Dental caries remains the most common cause of tooth loss among young and adults thereby worsening the functional and esthetic debilitation.[7]

Asthma patients are subjected to quick relief medication such as short-acting bronchodilators, systemic corticosteroids and anticholinergic drugs and long-term control medication which includes anti-inflammatory agents, long-acting bronchodilators and leukotriene modifiers. These drugs are predominantly delivered through inhaled route using various forms of inhalers or nebulizers. These medicaments may sometimes be used up to two or five times a day over a long period. Therefore, it is necessary to scrutinize the effects of asthma and its medications on oral health. With the prevalence of asthma escalating in the pediatric population, it becomes important to comprehend how the disease and its treatment affect other areas of health care, particularly oral health.[8]

Numerous studies have been performed to investigate the relationship between the two. However, the results have been inconsistent.[9, 10, 11,12] This study has attempted to compare the difference in dental caries occurrence in asthmatics compared to non-asthmatics. Since salivary S. mutans count is the most reliable indicator of caries activity, the comparison of S. mutans count will establish beyond doubt, the link between the two. The present study was carried out to determine the dental caries status and the salivary S. mutans count in children receiving inhaled anti-asthmatic medications and compare the same parameters in non-asthmatics.

MATERIAL AND METHODS

A cross-sectional study was conducted on asthmatic and healthy children in the age group of 6-14 years to determine and compare the dental caries status, salivary Streptococcus mutans count in both groups. The study population comprised of patients reporting to Pediatric and Chest clinic of Institutional Medical College & Hospital, Out Patient Department. 40 asthmatic children complying with the inclusion and exclusion criteria were selected. Asthmatic children receiving anti-asthmatic medications for one year or more were selected while those receiving systemic anti-asthmatic medications or medications for any other systemic disease were excluded. Similarly children undergoing orthodontic treatment or having dental anomalies were eliminated. 40 apparently healthy, age and sex matched children complying with the inclusion and exclusion criteria were selected to participate in control group. An informed consent was obtained from the parents/guardians of the participants.

1ml unstimulated saliva sample was collected from the children participating in the study. All the children were informed briefly about the procedure prior to saliva collection. Children were asked to avoid intake of food or drink 90 minutes before the procedure and maintain their normal oral prophylaxis. The collected saliva sample was diluted and inoculated on MSB agar plates under sterile conditions. This was incubated at 37^0 C for 48 hours (Fig.1).

The S. mutans colony forming units (CFU/ml) in the saliva samples collected from study and control group were computed. The oral cavity was examined clinically. As proposed by Mandal S et al, for permanent dentition, DMFT score was calculated. For mixed dentition, DMFT (decayed, missing and filled permanent teeth)and deft (decayed, extracted or filled deciduous teeth) were calculated and added together to obtain a final score.[13] Any other relevant oral findings were also recorded.

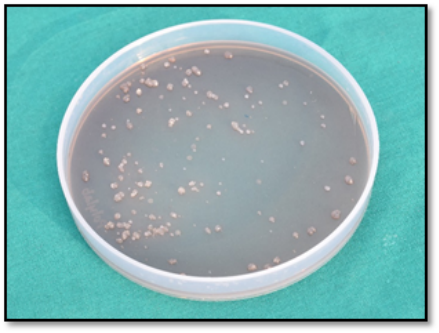


Fig 1. MSB Agar With Salivary S. Mutans Colonies

RESULTS AND STATISTICAL ANALYSIS:

After approval of Institutional Ethical Committee and Maharashtra University of Health Sciences, the study was performed on 80 children in the age group of 6-14 years. The study population included 40 asthmatic children receiving inhaled anti asthmatic medications for more than a year. The control group comprised of age and sex matched healthy children. DMFT/deft indices were determined clinically and paralleled in the two groups. The salivary S. mutans count was estimated in both the groups. The estimation of the salivary load of S. mutans was done by counting the colony forming units (CFU/ml) and calculating the colony scores of these bacteria on MSB agar culture plates. It was then compared among the groups. Additionally, the dental caries index and S. mutans colony count together with S. mutans colony score were compared age wise (in the age groups of 6-10 years and 11-14 years) and sex wise to record if it varied accordingly.

The differences were statistically analysed using the GraphPad Prism software (Version 7). Unpaired t test was applied to analyse the difference between the three parameters in the two groups. A p value of <0.05 was considered significant for the differences in the mean of dental caries index, S. mutans in CFU/ml and S. mutans count scores in the study and control groups

The Following Conclusions Were Drawn From The Study:

a) The mean DMFT/deft index for children of the asthmatic group and control group was 2.25 ± 1.10 and 1.7 ± 1.04 respectively. A statistically significant difference was found between the two groups ($p<0.05$) (graph 1).

b) The mean salivary S. mutans load in the study group was 5.96 ± 5.72 in contrast with the mean value of 3.36 ± 3.38 estimated in the healthy children. The difference was statistically significant with $p<0.05$ (graph 1).

c) The difference in the mean S. mutans colony score with values of 1.15 ± 0.93 and 0.48 ± 0.47 in study and control group respectively was statistically significant ($p<0.05$,unpaired t test) (graph 1).

d) On further analysing the mean DMFT/deft index, S. mutans colony count and S. mutans colony score age wise (i.e. by comparing the same in the age groups of 6-10 and 11-14 years) it was found that the difference was statistically insignificant ($p>0.05$; unpaired t test) (table 2,3,4).

e) Similarly, on analysing the mean values of the three parameters sex wise, it was found that the difference was statistically insignificant ($p>0.05$;unpaired t-test) (table 2,3,4).

f) Some oral findings such as mouth breathing, gingivitis and enamel defects were more prevalent in asthmatics.

The results of the study showed clearly that higher DMFT/deft index, salivary S. mutans count and S. mutans colony score is seen in asthmatics compared to normal children.

Table 1. Age And Sex Wise Distribution Of DMFT/deft Indices In The Study And Control Group

				N	Mean	Std. dev	Difference in mean	p-value
DMFT/deft	Age wise	Study	6-10 yrs	28	2.18	1.09	0.24	0.54
			11-14 yrs	12	2.42	1.16		
		Control	6-10 yrs	23	1.78	1.04	0.19	0.57
			11-14 yrs	17	1.59	1.06		
	Sex wise	Study	Male	17	2.41	1.12	0.28	0.43
			Female	23	2.13	1.1		
		Control	Male	18	1.54	1.1	0.34	0.31
			Female	22	1.89	0.96		

Unpaired t test (p>0.05)
p value not significant

Table 2. Age And Sex Wise Distribution Of S. Mutans Colony Count In Study And Control Group

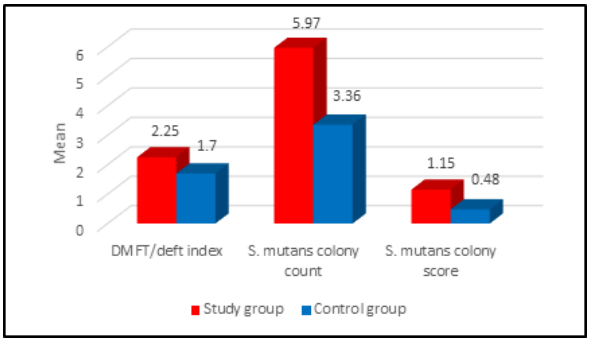
				N	Mean	Std. dev	Difference in mean	p-value
S. mutans Colony count in CFU $x10^4$	Age wise	Study	6-10 yrs	28	5.15	5.72	2.71	0.17
			11-14yrs	12	7.86	1.44		
		Control	6-10 yrs	23	4.08	4.19	1.68	0.12
			11-14yrs	17	2.39	1.44		
	Sex wise	Study	Male	17	6.11	6.67	0.25	0.89
			Female	23	5.86	5.06		
		Control	Male	18	3.96	4.36	1.34	0.22
			Female	22	2.62	1.36		

Unpaired t test (p>0.05)
p value not significant

Table 3. Age And Sex Wise Distribution Of S. Mutans Colony Score In Study And Control Group

				N	Mean	Std. dev	Difference in mean	p-value
Colony score	Age wise	Study	6-10yrs	28	1.03	0.43	0.38	0.02
			11-14yrs	12	1.42	0.51		
		Control	6-10yrs	23	1.00	0.52	0.17	0.25
			11-14yrs	17	0.82	0.39		
	Sex wise	Study	Male	17	1.12	0.60	0.06	0.72
			Female	23	1.17	0.39		
		Control	Male	18	0.95	0.57	0.06	0.67
			Female	22	0.89	0.32		

Unpaired t test (p>0.05)
p value not significant



Graph 1. Comparison of mean DMFT/deft score, S. mutans colony count and Colony score in study and control group

DISCUSSION

Pediatric asthma is a serious global health concern. Most cases of asthma begin in childhood with a peak prevalence in the age from 6 to 11 years.14 Asthma care represents a significant economic and social burden, accounting for numerous hospitalizations and missed days of school.9 Findings indicate that there is an increased risk of oral diseases in asthmatic patients mainly obtained from studies in children and adolescents involving different age groups. Many authors agree that young asthmatic patients are more likely to suffer from caries and/or periodontal diseases than non-asthmatic subjects while others believe that asthma may not be responsible for increasing oral diseases prevalence.4,5,6,9,10,11,14 However, whether it is the disease or its treatment that affect the oral health, remains unidentified.

Caries is a disease with a multifactorial etiology involving the interaction of four primary factors: Host's susceptibility, microorganism, diet and time. There is a heightened caries risk among asthmatics from their disease, their anti-asthma medication or their attempts to alleviate the physiological sequelae of the condition.15 Jayakumar et al (2011) while studying the prevalence of asthma found that majority of asthmatic children were 4-10 years (55.8%) followed by 11-16 years (44.1%).16 Prevalence of wheezing was 11.9% and 13.8% in 6–9 years and 10–14 years based on the study of Kumari and Jagzape (2019).17 Hence to determine the influence of asthma and its medications, children belonging to the age group of 6-14 years were chosen which is in accordance with the study of Kargul et al.18 Pal et al (2009) conducted a study to assess the prevalence of bronchial asthma in Indian children and recognized that childhood asthma, among children 13 – 14 years of age, was lower than that in younger children (6 – 7 years of age). He held the view of "children growing out of allergic diseases".19 To see whether this higher asthma prevalence reflects in the caries prevalence also, in the present study, the children were segregated into age groups of 6-10 years and 11-14 years. On age wise segregation, no statistically significant difference was found in the three parameters between the two age groups. Bhalla et al. demonstrated that asthma prevalence was higher in males and hence a higher caries prevalence was expected in males compared to females.2 Therefore, for further analysis, the groups were divided into male and female. The results showed that although there was an obvious difference in the mean values, it was not statistically significant. However, when the DMFT/deft index, S. mutans colony count and S. mutans colony score were compared in the study and the control group, statistically significant difference was found. These findings illustrate the impact of asthma and its medications on oral health. Asthmatics are known to have decreased availability of biologically active components like total protein, amylase, calcium ions, hexosamine, salivary peroxidase, lysozyme and secretory IgA favoring both favors both bacterial colonization and plaque growth.20 Moreover, Anshuja et al. 2018 proved that definite microbial changes occurring in asthmatics further get modified by antiasthma medications. A significant increase in microbial counts of cariogenic bacteria, especially S. mutans was found in asthma patients after initiation of medication.21 Asthma medications have been known to affect the severity of dental caries. Wu and Liu observed children with asthma using quick-relief agents and bronchodilators had a higher rate of severe dental caries than children without asthma.22 Alaki et al. also showed that persistent use of anti-asthmatic drugs, severity of asthma and combination therapy significantly affect the characteristics of saliva in asthmatic children.23 The results of the present study are in accordance with Khalilzadeh where a higher mean salivary S. mutans count and DMFT index was found in asthmatic children versus non-asthmatics.12

In the present study, some oral findings such as mouth breathing, gingivitis and enamel defects were more prevalent in asthmatics. Al-Awadi et al (2013) concluded that mouth breathing was prevalent among asthmatics and was associated with an increased salivary S. mutans count. Mouth breathing may be associated with initiation of periodontal disease and/or its progression. Probable causes are gingival surface dehydration, decreased epithelial resistance to bacterial plaques, and lack of salivary auto-cleaning. As mouth breathing causes water loss it is a potential factor which could contribute to oral dryness and further increase caries risk.[24] Dental erosion was seen in only two asthmatic patients which is in favor of the study undertaken by Dugmore CR, Rock WP (2003).[25] The main causes of dental erosion as enlisted by Sivasithamparam K et al are higher consumption of acid soft drinks by asthmatics to neutralize taste of drugs, the acidity of medications being less than pH 5.5 and intrinsic acid from gastrooesophageal reflux (GOR).[26] However, as the study population belonged to a lower socioeconomic status, only few children could afford acidic beverages on regular basis. Moreover, the pH of MDI (Metered Dose Inhaler) which was being prescribed had higher pH than the dry powder forms. In the present study, 17.5 % children presented with dental enamel defects, the risk being greater in pediatric patients presenting symptoms before 3 years of age. Mathu-Muju K and Wright JT (2006) reported that the risk of dental enamel defects is higher in children with poor health during the first three years of life (the critical period for crown formation of permanent first molars, incisors and canines)[27]. In addition, Kellerhoff NM, Lussi A (2004) suggested that any health problem prior to 5 years of age can modulate ameloblast activity and therefore impair amelogenesis.[28]

One strength of the present study is that all the participants had physician-diagnosed asthma and almost all the asthmatics were being medicated with both β2 -agonists and corticosteroids. In addition, the entire study population was selected from the same geographical area and had similar socioeconomic status and dietary habits. The groups were therefore homogeneous. Limitations of the present study are cross-sectional study design and smaller sample size. The patients reporting to the asthma clinic were advised β2 agonists only during acute attacks and corticosteroids for a longer duration. Hence, an even action of the former could not be evaluated as it varied depending on the frequency of the attacks. Moreover, there were also patients who had been treated previously with medications other than the aforementioned ones in other hospitals.

This study proved the association of increased prevalence of dental caries in asthmatics with S. mutans playing a deterministic role. Future studies focusing on the exact pathophysiologic mechanism responsible for deterioration of oral health in asthmatic children are warranted to pave way for medication development with less harmful effects overall.

CONCLUSION

Higher DMFT/deft index, S. mutans colony count and S. mutans colony score were more prevalent in asthma patients compared to age and sex matched healthy children. Thus, asthma, and its treatment, can be considered as risk factors in children for various pathologies in the oral cavity irrespective of age or sex. This in turn implies that oral prophylactic strategies should be employed to address the increased caries risk in asthmatics. Asthmatics should be encouraged to have regular dental check-ups, fluoride interventions and adherence to caries-prevention measures. Dental practitioners must be vigilant to recognize the correlation between asthma and its associated oral health problems.

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