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Research Article

Comparison of Caries Experience of Asthmatic and Non-Asthmatic Children in Enugu, Nigeria

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ABSTRACT

Background: Asthma and dental caries are two most common chronic diseases among children. The aim of the present study was to determine and compare the dental caries experience between asthmatic and non-asthmatic children in Enugu.

Methods: 120 asthmatic children who had been diagnosed of asthma for at least 1 year were selected and matched for age 2-17 years with 120 non-asthmatic controls. Prevalence of caries was assessed using the decayed, missing, and filled surfaces (dfs for deciduous teeth and DMFS for permanent teeth) index through clinical examination by two calibrated dentists according to WHO guidelines. Information on various confounding factors were collected through questionnaires and patients' medical records.

Results: Asthmatic children had significantly higher (P<0.000) caries experience on primary teeth (dfs was 2.02±0.18 for 2-6 years-old and dfs was 2.46±0.68 for 7-12 years-old) and permanent teeth (DMFS was 1.86±1.12 for 7-12 years-old and DMFS is 1.84±1.22 for 13-17 years-old). Asthmatic children did not differ significantly from their non-asthmatic counterparts with respect to gender, dietary habits, oral hygiene, time since last dental visit and parents' education.

Conclusion: Children with asthma have higher caries experience than their non-asthmatic counterparts in this study. Reasons for this difference are multifactorial necessitating the need for special multidisciplinary oral health preventive program for these high-caries-risk children.

Introduction

Dental caries is a dietary carbohydrate-modified bacterial infectious disease with saliva as a critical regulator. It is the most common chronic infectious disease of childhood. It forms through a complex interaction between acid-producing bacteria and fermentable carbohydrates over a period of time. It is also affected by many host factors including saliva and the inherent nature of the teeth. Saliva is shown to play an important role in the maintenance of the oral health. Any factor which reduces the quality and quantity of saliva can increase the risk of dental caries [1].

Asthma is a common chronic inflammatory condition that causes respiratory symptoms in children and adults. It causes the airways to constrict and produce excess mucus, leading to wheezing, breathlessness, chest tightness, and coughing. It is characterized by the obstruction of airflow which varies over a short period of time and is reversible, either spontaneously or with treatment. Asthma treatment has two main objectives: to control the airway inflammation, and to reopen the airways. Drugs that achieve the first objective are called anti-inflammatory agents and those that achieve the second are called bronchodilators [2]. The need for asthma medication is determined according to asthma severity. Administration of some of these drugs may lead to reduction of salivary flow and oral pH to less than 7, thereby compromising the protective role of saliva, and predisposing the teeth to caries formation. Prevalence of asthma ranges from 5.1-14.3% in Nigerian children [3]. Asthma itself is a public health concern, being a

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major cause of infirmity, depletes scarce health resources and reduces quality of life of affected individuals. With its predisposition to dental caries formation in the affected individuals, the burden becomes more profound especially in developing countries like Nigeria, where health costs are largely borne by the individual patient [4, 5].

A number of studies have considered asthma as a risk factor in the occurrence of dental caries [6-9]. The results of a number of recent studies also indicate a clear relationship between asthma and dental caries [6, 10]. With increasing prevalence rate of asthma in Africa, it became necessary to find out the relationship between asthma and dental caries in our societies. Currently, there is dearth of literature on dental health of asthmatic children in Nigeria. Therefore, the aim of this study was to determine and compare the experience of dental caries between asthmatic and non-asthmatic children. Our null hypothesis is that there is no difference in caries experience between asthmatic and non-asthmatic children.

Methodology

I Study Design

This cross-sectional and comparative study was carried out on children diagnosed of asthma and non-asthmatic children attending the children outpatient clinics of University of Nigeria Teaching Hospital, Ituku Ozalla Enugu and Enugu State University Teaching Hospital Enugu, both of which are tertiary health institutions in Enugu, South Eastern Nigeria from January 2018 to December 2019.

II Study Population

The study population consisted of a total of 240 children made up of 120 asthmatic and 120 non-asthmatic children aged 2-17 years. They were selected from the children outpatient clinics during the period of data collection by the authors following satisfaction of the inclusion criteria. Accordingly, all children diagnosed of asthma by the pediatricians were assigned to the study group and non-asthmatic children selected based on their medical records were assigned to the control group.

III Inclusion and Exclusion Criteria

Children between the ages of 2 and 17 years, diagnosed of asthma and are undergoing treatment for asthma for at least one year constitute the study group, while non-asthmatic children according to medical records and confirmation of the absence of respiratory and other allergic diseases were assigned to the control group. Absence of other systemic diseases and willingness to give written and informed consent were part of the criteria for inclusion in this study for both groups. Children who refused to give their consent or whose parents/guardian failed to give written consent were excluded from the study.

IV Questionnaire Administration and Clinical Examination

Structured, interviewer administered-questionnaire responded to by patients or their parents or guardians were used to collect demographic information on the participants, including age, gender, dietary history, oral hygiene habits, dental visit history, parents' education, and history of asthma. Assessment of dental caries was done using the decayed, missing, and filled surfaces of permanent teeth (DMFS) and decayed and filled surfaces of deciduous teeth (dfs) indices according to World Health Organization guidelines [11]. Dental examinations were carried out in the dental clinic on a dental chair under artificial light by two calibrated dentists using a standard dental mirror and the Community Periodontal Index of Treatment Needs (CPITN) probe (rounded tip probe). The dental examiners were blinded to children with and without asthma. To ensure accurate assessment for dental caries, the two examiners were calibrated for the study by a benchmark examiner, who is a cariologist, experienced in caries diagnosis. The first ten participants that were recruited into the study were used for the calibration exercise and were later removed from full participation in the study. The agreement between the two examiners (inter-examiner agreement) and between the examiners' individual evaluations (intra-examiner reliability) were assessed using the unweighted kappa (κ) statistic. Kappa values for intra-examiner reproducibility were 0.82 and 0.89 respectively, and for inter-examiner reproducibility was 0.78. These values met the 0.70 pre-established value for qualification. Agreement of clinical assessments was therefore established to be good which validated the examination procedure.

V Statistical Analysis

Results were collated and analysed using standard descriptive statistics. Data from the questionnaire and clinical examinations were analysed using the Statistical Package of Social Science (SPSS) version 16. Chi-square test of association was used to compare proportions and ratios with the significant level set at $P < 0.05$ and 95% confidence level.

Results

A total of 240 children participated in this study (120 asthmatic and 120 non-asthmatics). They were divided into 3 age groups; 2-6 years which consisted of 17 children, 7-12 years (93 children) and 13-17 years (10 children) for each group. The average age of the participants was 9.5 ± 2.5 years for asthmatic and 9.7 ± 2.1 years for non-asthmatic children. There were 62 (51.7%) males and 58 (48.3%) females in the asthmatic group, while the non-asthmatic group was made up of 66 (55.0%) females and 54 (45.0%) males.

There was no statistically significant difference in the gender, dietary history, oral hygiene habits, visit to dentist and parent's educational level between the asthmatic children and their non-asthmatic counterparts (Table 1). From the table more asthmatic children consumed sweet drinks in between meals than the non-asthmatic children, though this difference was not significant (p=0.299).

In this study, the prevalence of caries in asthmatic children was 21.7% while their non-asthmatic counterparts had 16.2% prevalence. The deciduous teeth were significantly more decayed and more restored (filled) among the asthmatic children than their non-asthmatic counterparts (P=0.000), except for the 2-6yrs age group where the difference in the restored component was not statistically significant (P=0.505) as shown in (Table 2). The difference in the mean DMFS was statistically significantly (P=0.000) higher in asthmatic children compared to their non-asthmatic counterparts in the 7-12years age group

(Table 3). It was also observed that about 60-65% of the participants (both asthmatic and non-asthmatic children) have never visited the dental clinic

Table 1: The confounding factors in asthmatic children and their non-asthmatic counterparts with regard to gender, fluoride exposure history, dietary history, oral hygiene, time since last dental visit, and parents' education.

	Asthmatic children	**Non-asthmatic children**	**χ2**	***P-value**	**Mannwhit p-value**
Gender, n (%)					
Male	62 (51.7)	66(55.0)	0.268	0.605	0.607
Female	58(48.3)	54(45.0)	0.268	0.605	
Dietary history, n (%)					
Consuming food and drinks 5 times/day	75(62.5)	73(60.8)	0.071	0.791	0.956
Drinking sweet drinks between meals	70(58.3)	62(51.7)	1.077	0.299	
Use of sweets	77(64.2)	72(60.0)	0.443	0.506	
Daily use of milk	39(32.5)	42(35.0)	0.168	0.682	
Oral hygiene, n (%)					
Tooth brushing 1 time/day	81(67.5)	78(65.0)	0.168	0.682	0.684
Tooth brushing 2 times/day or more	39(32.5)	42(35.0)	0.168	0.682	
Last dental visit, n (%)					
In the last 6 months	12(10.0)	15(12.5)	0.376	0.540	0.403
More than 6 months	30(25.0)	33(27.5)	0.194	0.660	
Never Attended	78(65.0)	72(60.0)	0.640	0.424	
Parents' education, n (%)					
Elementary school	36(30.0)	40(33.3)	0.308	0.579	0.902
Secondary school	58(48.3)	51(42.5)	0.824	0.364	
Post-secondary school	26(21.7)	29(24.2)	0.212	0.645	

There are no statistically significant differences between the asthmatic children and their non-asthmatic counterparts (P>0.05).

Table 2: Mean ± SD dfs among asthmatic children and their non-asthmatic counterparts in primary teeth.

Index	**Age Group (# of subjects)**	**Conditions**	**Mean**	**Standard deviation**	***t***	**T-test/P-value**
Decayed surfaces	2-6yrs (17)	Asthmatic	1.49	0.28	16.49	0.000*
		Non-asthmatic	0.09	0.21		
	7-12yrs (93)	Asthmatic	1.83	1.38	4.34	0.000*
		Non-asthmatic	1.01	1.19		
Filled surfaces	2-6yrs (17)	Asthmatic	0.68	0.09	0.67	0.505
		Non-asthmatic	0.65	0.16		
	7-12yrs (93)	Asthmatic	0.63	0.14	4.49	0.000*
		Non-asthmatic	0.52	0.19		
dfs	2-6yrs (17)	Asthmatic	2.02	0.18	7.61	0.000*
		Non-asthmatic	1.61	0.13		
	7-12yrs (93)	Asthmatic	2.46	0.68	8.54	0.000*
		Non-asthmatic	1.53	0.80		

*Statistically significant (P<0.05).

Table 3: Mean ± SD DMFS among asthmatic children and controls in permanent teeth.

Index	**Age Group (# of subjects)**	**Conditions**	**Mean**	**Standard deviation**	***t***	**T-test/P-value**
Decayed surfaces	7-12yrs (93)	Asthmatic	1.34	0.83	6.39	0.000*
		Non-asthmatic	0.62	0.70		
	13-17yrs (10)	Asthmatic	1.32	0.68	1.75	0.097
		Non-asthmatic	0.94	0.09		
Missing surfaces	7-12yrs (93)	Asthmatic	0.10	0.28	3.28	0.001*
		Non-asthmatic	0.00	0.09		
	13-17yrs (10)	Asthmatic	0.21	0.31	0.07	0.941
		Non-asthmatic	0.20	0.29		
Filled surfaces	7-12yrs (93)	Asthmatic	0.42	0.52	4.15	0.000*
		Non-asthmatic	0.14	0.39		

	13-17yrs (10)	Asthmatic	0.31	0.16	2.83	0.011*
		Non-asthmatic	0.12	0.14		
DMFS	7-12yrs (93)	Asthmatic	1.86	1.12	7.61	0.000*
		Non-asthmatic	0.76	0.83		
	13-17yrs (10)	Asthmatic	1.84	1.22	1.16	0.262
		Non-asthmatic	1.26	1.01		

*Statistically significant (P<0.05).

Discussion

Considering that a number of recent studies have indicated a clear relationship between asthma and dental caries, and as such asthma considered a risk factor for caries, the present study investigated and compared the dental caries prevalence between asthmatic and non-asthmatic children [6-10]. The result of this present study, which demonstrated a significantly higher caries prevalence in asthmatic children when compared with their non-asthmatic counterparts rejected the null hypothesis of this study. This result is in agreement with two previous studies conducted among the Slovenian and Mexican children with and without asthma, which reported a significantly higher prevalence of dental caries among the asthmatic children [6, 12]. In contrary, some other researchers have reported no correlation between asthma and the prevalence of dental caries in children [13-15]. The prevalence level observed in both asthmatic and non-asthmatic children in the present study is in agreement with the prevalence level reported among similar age groups in the previous studies in Enugu [16, 17]. The mean DMFS and dfs observed in the present study appears higher than the previously reported means for the age groups investigated. This could be explained by the use of DMFS and dfs indices in the present study, which are known to be more sensitive than DMFT and dft indices that were commonly used in most previous studies conducted in Enugu [18].

From the analysis of the study population, there was no significant difference in fluoride exposure history, dietary history, oral hygiene practices between the asthmatic children and their non-asthmatic counterparts. Since these are the known predictors and risk factors of dental caries in our environment, and are not associated with differences between the groups, they are therefore not likely to be the reason for the difference in occurrence of caries [16]. The higher rate of caries observed in children with asthma may be attributed to the decrease in salivary flow rate experienced as a side effect of beta-2 agonist inhaler used by the asthmatic children. It is well and long established that reduction in the quality and quantity of saliva increases the risk of dental caries [1]. This higher rate of caries observed in asthmatic children can also be ascribed to the presence of fermentable carbohydrate in anti-asthma medications. Some dry powder inhalers contain sugar to improve tolerance of the taste of the drug. Frequent oral inhalation of these sugar-containing drugs combined with the decrease in salivary flow rate may contribute to the increase in the risk of caries [6, 18].

Frequent consumption of sugary drinks, in an attempt to counter the desiccating effect of mouth breathing and the reduction in the salivary flow caused by beta-2 agonist medications as well as to wash away the taste of the inhaled medication, can also be a reason for the increase in the caries rate in asthmatics [19]. Moreover, the oral hygiene procedures may be neglected due to the increase in the attention given to their general asthmatic condition at the expense of the routine oral hygiene procedure [8]. Although in this study there was no significant difference in the oral hygiene practices, the oral hygiene of the participants were not clinically assessed. Furthermore, it was also observed that about 60-65% of the participants (both asthmatic and non-asthmatic children) have never visited the dental clinic. This has been established as a risk factor for caries in this region as reported in previous studies [16, 20].

In conclusion, in the present study, asthmatic children have higher prevalence of dental caries than the non-asthmatic children, probably due to intake of sugar-containing inhaler, low saliva flow rate caused by intake of beta-2 agonist-containing medications, and frequent intake of sugary drinks to relief the medication-induced dry mouth and to wash away the taste of the inhaled medication.

Recommendation

The reasons for the difference in caries prevalence observed in the present study may be multifactorial, thus necessitating the need for special attention to preventive dental programs including increasing the awareness of parents and provision of organized dental care for asthmatic children who are at greater risk of dental caries.

Children with asthma should be made conscious of the possible risk of dental caries and should be encouraged to have regular dental check-ups. They should also be instructed to rinse their mouths after using an inhaler, if possible with fluoride mouth rinse. In order to compensate for the xerostomia, they may be advised to use saliva substitutes and sip plain water. Children with asthma, should be encouraged to use sugar-free chewing gum to stimulate salivary flow and buffer the oral acids [19].

Further research with higher number of participants on the effects of different anti-asthmatic medications on the oral health of children, multicenter approach and assessment of the influence in our environment is hereby recommended.

Ethical Approval and Informed Consent

The study was approved (Approval #: UNTH/CSA/329/VOL.5/09/17) by Health Research Ethics Committee of the University of Nigeria Teaching Hospital, Ituku Ozalla, Enugu. Written informed consent were obtained from the parents/guardians of the children, while assent was obtained from the children themselves.

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