

Prevalence of dental caries and toothbrushing habits among preschool children in Khartoum State, Sudan

Sitana M. Elidrissi and Sudeshni Naidoo

Department of Community Oral Health, University of the Western Cape, Tygerberg, Cape Town, South Africa.

Background: Dental caries in preschool children remains a major dental public health problem and affects significant numbers of children in developed and developing countries. The incidence is increasing in developing countries, such as Sudan, because of lifestyle changes, absence of oral health-preventive services and inadequate access to oral health care. **Objectives:** This study assessed the prevalence of dental caries and toothbrushing habits among 3- to 5-year-old preschool children in Khartoum State, Sudan, and described the correlation between the mean decayed, missing and filled tooth (dmft) score for primary teeth with toothbrushing and sugar consumption. **Materials and Methods:** The subjects were 553 preschool children with their mothers/guardians, selected by random sampling from the kindergartens of the seven localities of Khartoum State, Sudan. Data were obtained through clinical examination using a modified World Health Organization (WHO) examination data-capture sheet and through structured administered interviews with mothers/guardians. **Results:** The prevalence of dental caries was 52.4%, with a mean dmft score of 2.3. There was an increase in the dmft scores with increasing age. The frequency of children who brushed their teeth regularly at least once a day was high (83.4%), lower dmft scores were associated with starting toothbrushing earlier in life and with increased frequency of brushing per day. Eating sugar-containing food was significantly associated with dmft score. **Conclusions:** The prevalence of dental caries was found to be high among 3- to 5-year-old preschool children, and caries experience increased with age. This was mostly associated with sugar consumption and therefore calls for educational interventions to control sugar intake. The toothbrushing habit is well established in Khartoum State, Sudan, as a large number of children were found to be brushing their teeth regularly. No significant association was found between feeding habits and dmft score.

Key words: Dental caries, preschool children, dmft, toothbrushing

INTRODUCTION

Dental caries in preschool children remains a major oral health problem because it affects significant numbers of preschool children worldwide¹. There has been a decline in the prevalence of dental caries in children and adolescents in developed countries over the last 20 years, whereas in developing countries the prevalence of dental caries is increasing². Globally, the highest prevalence of dental caries in primary teeth is found in children in Africa and South-East Asia³.

In 2003, the prevalence of dental caries in 4- to 5-year-old children in Khartoum State, Sudan, was 5.5%, with a mean decayed, missing and filled tooth (dmft) score for primary teeth of 1.68⁴. Ten years later, in a study among 3- to 5-year-old children, a prevalence of dental caries of 65.5% with a mean

dmft score of 3.53 and increased prevalence with increasing age was reported⁵.

Dietary factors found to be a significant risk for caries are related to the amount, frequency and time of sugar consumption⁶. Studies on 1- to 5-year-old preschool children have found that the daily consumption of sugar-containing drinks (especially at night) and daily sugar intake were independent risk factors for the development of early childhood caries (ECC)^{7,8}. ECC or rampant tooth decay is associated with breastfeeding when this is prolonged and on demand^{9,10}. Mothers should be educated to stop night breastfeeds after their children reach 1 year of age, to encourage their children to use a cup by 10 months of age and to start cleaning their child's mouth and teeth regularly once the first primary tooth has erupted¹¹. In addition, it has been established that bottle feeding,

especially at night, is a risk factor for ECC because most such feeding contains some form of sugar^{12,13}. In developed countries the primary risk factor for ECC is considered to be the use of a 'nap time' bottle that contains fermentable carbohydrates, such as milk, milk with sugar, sweetened milk with formula, fruit juice or other sweetened solutions¹⁴.

Proper oral hygiene and use of fluoridated toothpaste are the most important factors in the prevention of dental caries^{15,16}. Preschool children whose parents began caring for their teeth within the first year of life, and whose parents assisted them with toothbrushing, have been shown to have a better oral health status and lower dmft scores¹⁷. Parents should supervise children 2–7 years of age during toothbrushing and should ensure that only a small, pea-sized amount of fluoridated toothpaste is used and that swallowing of the paste is avoided¹⁸.

The aim of the present study was to describe the dental caries status of 3- to 5-year-old preschool children in Khartoum, Sudan, and the relationship between dental caries and their toothbrushing and dietary habits.

MATERIALS AND METHODS

The protocol was approved by the Senate Research Ethics Committee of the University of The Western Cape (Ref no. 12/3/32). The research was conducted in full accordance with the World Medical Association Declaration of Helsinki. Two informed consent forms were signed by the mother/guardian before the interview and before the oral examination. After clinical dental examination of the children, the mothers/guardians were informed about any needed dental treatment and were referred to the dental clinic of their choice.

Inclusion criteria

Preschool children were included in the study if they were between 3 and 5 years of age and registered at a public or private kindergarten in Khartoum-State, and if they provided written consent from their mothers or guardians to participate in the study.

Study design and sample preparation

The present study was a descriptive, cross-sectional study of the prevalence of dental caries and toothbrushing habits among preschool children 3–5 years of age. A systematic random sample of kindergarten schools in the seven localities of Khartoum State, Sudan, was obtained. The seven localities had 3133 kindergarten schools. Basic information regarding the schools was obtained from the Ministry of Education,

and detailed information regarding the number and age of the children was obtained from the localities. The intention was to select 20 children from each of the 28 kindergarten schools ($n = 560$).

Data collection and statistical analysis

Data were collected using two instruments: a data capture sheet modified from the 2007 World Health Organization (WHO) assessment form¹⁹ for clinical dental examination and a structured administered questionnaire for the mothers and guardians. The questionnaire was written in English but translated into Arabic language. The English version of the questionnaire was translated in the University of Khartoum – Faculty of Arts – Translation and Arabicization Unit. The translated Arabic version was then used by different examiners during the pilot study to question 12 mothers and the answers were examined using the kappa statistic ($= 0.961$).

Oral health-related habits were assessed using the questionnaire that was completed by interviewing the mothers/guardians ($n = 553$). The questionnaire was used to obtain information on the mothers/guardians' knowledge about the causes of dental caries, toothbrushing habits of their children (age of starting brushing, frequency, tool of brushing, help from mother during brushing and fluoride content in the toothpaste), breastfeeding and bottle-feeding habits, and dietary habits.

Clinical dental examinations were carried out at the kindergarten schools by a calibrated dentist with the child seated in an upright position. All children were examined using a dental mirror and a probe in the classroom of their school in natural daylight. The criteria for the diagnosis of dental caries were based on WHO 1997 recommendations (sound, decayed, filled with decay, filled no decay, missing tooth, as a result of caries and not recorded teeth). The data-collection process took place from December 2012 to the end of January 2013.

Before the clinical dental examinations, the examiner was calibrated on a group of preselected children (12 children were examined) with the same characteristics to be assessed in the main study, in order to assess intra-examiner agreement. The kappa statistic was 0.925. The response rate was 100% as no mother/guardian refused to participate in the study. The data collected from the dental examination and from the questionnaire were categorised, coded and entered into a computer. The data were captured in Microsoft Excel (for windows, Albuquerque, NM, USA) and basic descriptive analysis was carried out. Data were processed for analysis using a Statistical Package for Social Sciences (SPSS for Windows, version 14.0/PC; SPSS, Chicago, IL, USA), computer soft-

were program to perform more complex statistical analysis. Descriptive statistics was used to describe the demographic factors. The tests of significance used were the independent sample *t*-test, the chi-square test and one-way analysis of variance (ANOVA).

RESULTS

Five-hundred and fifty-three preschool children, between 3 and 5 years of age, participated in the study with their mothers or guardians. Girls ($n = 287$) slightly outnumbered boys ($n = 266$). The calculated statistical sample size was 551 children and this was rounded up to 555 children; the final sample size was 553 because two unusable questionnaires were excluded from the data analysis.

The caries experience was 52.4%, with a mean dmft score of 2.3 (11.1% decayed, 0.3% missing because of caries and 0.03% filled). The decayed component was the largest part of the mean dmft score (88.6%). The most commonly decayed tooth was the lower-right second molar (9.6%). There was an

increase in the dmft scores with increasing age, with the mean dmft scores being 1.4, 2.2 and 2.8 in 3-, 4- and 5-year-old children, respectively. There was no significant difference in the mean dmft scores between boys and girls (Table 1).

Toothbrushing

The total number of children who brushed their teeth regularly either once or twice a day was 535 (98.5%); 1.8% did not brush their teeth at all. Only 6.8% of mothers reported that they started brushing their child's teeth soon after the first tooth erupted compared with 24.3% who started brushing after their children reached 3 years of age. More than 83% of children were brushing their teeth once a day and 15.1% were brushing twice a day (Table 2). Table 2 also depicts information regarding toothbrushing frequency, mother assistance during brushing and use of fluoridated toothpaste.

Children whose mothers started to brush their teeth at an earlier age had lower dmft scores than those whose mothers started to brush their teeth after they reached 2 years of age ($P = 0.139$). Lower dmft scores were found among children who brushed their teeth three times a day ($P = 0.646$). No statistically significant difference was found between the mother helping during brushing and the mean dmft of their children ($P = 0.996$) and between the mean dmft scores of children whose mothers were sure that they were using a toothpaste containing fluoride and children whose mothers did not ($P = 0.703$).

Breast and bottle feedings

The vast majority of mothers (97.3%) reported breastfeeding their children, and about 25% of

Table 1 Mean decayed, missing and filled tooth (dmft) score for primary teeth, according to age and gender

Variable	<i>n</i> (%)	dmft (mean \pm SD)	Prevalence (%)
Age			
3 years	103 (18.6)	1.4 \pm 2.4	45.6
4 years	254 (45.9)	2.2 \pm 3.2	52.4
5 years	196 (35.4)	2.8 \pm 4.0	56.1
Gender			
Boys	266 (48.1)	2.2 \pm 3.3	53.0
Girls	287 (51.9)	2.2 \pm 3.5	51.9
Total	553	2.2 \pm 3.4	52.4

SD, standard deviation.

Table 2 Association between toothbrushing and decayed, missing and filled tooth (dmft) score for primary teeth

Variable	<i>n</i> (%)	dmft (mean \pm SD)	Prevalence (%)	<i>P</i> -value
Age starting brushing				
After the first tooth erupted	37 (6.8)	1.9 \pm 2.5	59.5	0.139 (not significant)
After reached 1 year old	101 (18.6)	1.8 \pm 2.9	46.5	
After reached 2 years old	233 (42.9)	2.2 \pm 3.1	51.5	
After reached 3 years old	132 (24.3)	2.9 \pm 4.5	57.6	
Others	40 (7.4)	2.2 \pm 2.9	57.5	
Brushing frequency				
Once a day	453 (83.4)	2.3 \pm 3.4	54.3	0.646 (not significant)
Twice a day	82 (15.1)	2.2 \pm 3.4	47.6	
Three times a day	8 (1.5)	1.2 \pm 2.1	37.5	
Mother help				
Yes helping children	385 (70.9)	2.3 \pm 3.4	53.2	0.996 (not significant)
Not helping	158 (29.1)	2.3 \pm 3.6	52.5	
Fluoridated toothpaste				
Using	226 (41.6)	2.2 \pm 3.1	55.3	0.703 (not significant)
Not using	8 (1.5)	1.3 \pm 2.0	50	
Don't know	309 (56.9)	2.3 \pm 3.7	51.5	

SD, standard deviation.

children were bottle-fed. The percentage of children who were both breast-fed and bottle-fed was 22.9%: The mean dmft score was slightly lower in children who were breast-fed compared with those who were not breast-fed (2.3 *vs.* 3.4; $P = 0.200$). No significant difference was found in dmft scores between children who were bottle-fed and children who were not ($P = 0.376$; *Table 3*).

Sugar consumption

More than 99% of the children were eating sugar-containing food every day and only a very low percentage of children (0.4%) reported that they were not eating such food. Nearly 30% ate sugar-containing food more than three times per day, 28.5% twice a day, 24.9% three times a day and 17.1% once a day. No statistical significance was found between eating sugary food and the mean dmft score ($P = 0.466$; *Table 3*). A highly significant difference was found between the mean dmft score and the frequency of eating food containing sugar per day. The dmft scores increased with the increasing number of times that sugar was eaten per day, ranging from 1.4 once per day to 2.8 for three and more times per day ($P = 0.001$; *Table 3*).

DISCUSSION

Dental caries in preschool children is a public health problem, although it is a preventable disease and one in which prevention should begin early in life. The present study investigated the prevalence of dental caries and toothbrushing habits in a random sample of preschool children in Khartoum State, Sudan.

The prevalence of dental caries varies widely throughout the world and it is not easy to compare the prevalence of ECC between different studies

because they are conducted for a variety of reasons, each with different aims and objectives and using differing measurement criteria. The external validity of the findings is therefore restricted (i.e. the extent to which inferences can be made is limited to specific populations and may not necessarily reflect local, regional or national trends). This is important as there may be considerable variations in the prevalence and manifestation of ECC within subpopulations in an area as diverse as sub-Saharan Africa.

The prevalence of dental caries among the preschool children in the present study was high (52.4%) and the mean dmft score was 2.3. A study in Khartoum State, Sudan, only a decade ago reported a much lower dmft score of 1.68⁴ and a more recent 2013 study in the same age group found that it had more than doubled (3.53)⁵. Whilst this may be caused by lifestyle and dietary changes, it could also be a result of different sampling criteria. Internationally, the mean dmft score in studies carried out in different countries in Asia was found to range from low scores of 1.5 in Hong Kong and 1.85 in Pakistan to a high score of 5.5 in Thailand²⁰⁻²². In the present study, the mean dmft scores were 1.4, 2.2 and 2.8 among 3-, 4- and 5-year-old children, respectively, whereas the results of a study in Uganda showed higher dmft scores of 1.7, 2.4 and 3.1 among the same age groups²³. A study in Riyadh, Saudi Arabia, showed that the mean dmft score among 4- to 6-year-old preschool children was 6.9, which is very high compared with the present study²⁴. The mean dmft score increased dramatically with age, and this finding concurs with other reported studies^{5,20,21,23,25}. The present study also concurred with other studies that reported no gender difference in the caries prevalence in preschool children^{5,15,23,26}.

Toothbrushing with fluoridated toothpaste is important for the prevention of dental caries in children. To

Table 3 Association between feeding habits, eating sugar-containing food and decayed, missing and filled tooth (dmft) score for primary teeth

Variable	<i>n</i> (%)	dmft (mean ± SD)	Prevalence (%)	<i>P</i> -value
Breastfeeding				
Breast-fed	538 (97.3)	2.2 ± 3.4	51.9	0.200 (not significant)
Not breast-fed	15 (2.7)	3.4 ± 3.0	73.3	
Bottle feeding				
Bottle-fed	140 (25.6)	2.5 ± 3.4	56.2	0.376 (not significant)
Not bottle-fed	407 (74.4)	2.2 ± 3.4	51.1	
Eating sugary food				
Yes	551 (99.6)	2.3 ± 3.5	53.8	0.466 (not significant)
No	2 (0.4)	0.5 ± 0.7	50	
Frequency of eating sugary food				
Once a day	94 (17.1)	1.4 ± 2.4	39.4	0.001 (significant)
Twice a day	157 (28.5)	1.8 ± 3.0	46.5	
Three times a day	137 (24.9)	2.8 ± 4.0	57.7	
More than three times	163 (29.5)	2.8 ± 3.7	61.3	

SD, standard deviation.

prevent ECC in preschool children by home-based care approaches, brushing with a small amount of fluoridated toothpaste is effective when it starts soon after teeth eruption²⁷. In the present study, a high percentage of children were brushing their teeth on a daily basis and more than 20% of the mothers reported that they started toothbrushing for their children after the child reached 3 years of age. Children whose mothers started to brush their teeth at an earlier age had slightly lower dmft scores than those whose mothers started to brush their teeth after they reached 2 years of age; however, the difference was not statistically significant. Similar findings have been reported in other studies^{15,17,20,28}. Furthermore, children who brushed their teeth more than once per day experienced lower caries levels. These results are supported by other studies^{22,28}. Interestingly in the present study, a mother's support during toothbrushing was not associated with lower dmft scores and this finding does not concur with the findings of a systematic review¹⁷ and with the other studies^{17,29}.

It has been reported that there is an increase in the prevalence of dental caries in children who are bottle fed compared with those who are breast-fed³⁰. Nearly all the mothers reported that they breast-fed their children, and about one-quarter of children were bottle-fed. Nearly 23% of children were both breast- and bottle-fed. There is still much controversy regarding the association between breastfeeding and dental caries because the latter is associated with other factors, such as sugar intake and microorganisms³¹. Some researchers have reported that prolonged breastfeeding of more than 1 year and high frequency of feeding were risk factors for ECC^{32,33}. On the other hand, the results of the present study found that there was no significant difference between breastfeeding and caries experience. This differed from another study that reported a noticeable decrease in the prevalence of ECC in children breast-fed up to 2 years of age³⁴. ECC was only associated with breastfeeding when it was 'prolonged' and when feeding was 'on demand'^{9,10}.

A primary risk factor for ECC is bottle feeding that contains fermentable carbohydrates^{7,14,15,35,36}. The present study found no association in dmft scores between children who were bottle-fed and those who were not. Furthermore, studies have reported that bottle feeding during day and night, frequency, duration of feeding and sweetened contents were also significant risk factors for ECC^{7,35,36}. Nocturnal bottle feeding has been found to be a significant risk factor in the development of dental caries in primary teeth^{15,20,37} and despite the fact that the present study found higher dmft scores among children who sleep with a bottle, this finding was not statistically significant.

Most dietary factors found to be significant are related to the consumption of sugar, particularly, the amount, frequency and time of consumption⁶. Studies on preschool children concluded that daily consumption of sugar-containing drinks, especially at night, and daily sugar intake were independent risk factors for the development of ECC^{7,8}. The present study found that nearly all the children were eating sugar every day, and one-third ate sugar-containing food more than three times per day. The dmft scores increased according to how often sugar was eaten each day, ranging from 1.4 for one time per day to 2.8 for three and more times per day. This finding is supported by other studies which found that the frequency of consumption of sweets was significantly associated with the development of ECC^{6,26,38}.

CONCLUSIONS

The present study found that the prevalence of dental caries among preschool children was high and the mean dmft was directly proportional to the child's age. This was mostly associated with sugar consumption and therefore calls for educational interventions to control sugar intake. Toothbrushing is an important preventive practice for children and a high number of children were found to be brushing their teeth regularly. No association was found between dental caries experience of the study children and their toothbrushing and bottle-feeding habits.

There is urgent need for a comprehensive oral-preventive programme for preschool children. This programme should be designed to include counselling of mothers/guardians and kindergarten school teachers for promoting healthy behaviours of children through dietary counselling and oral hygiene instructions, including supervised toothbrushing at least twice daily.

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Conflict of interest

None declared.

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Correspondence to:
 Prof. Sudeshni Naidoo
 Faculty of Dentistry,
 University of the Western Cape,
 Private Bag X1,
 Tygerberg 7505, South Africa.
 Email: suenaidoo@uwc.ac.za