

Changes in the prevalence of dental caries in primary school children in Lagos State, Nigeria

OO Sofola, MO Folayan¹, AB Oginni²

Department of Preventive Dentistry, University of Lagos, Lagos, ¹Department of Child Dental Health, Obafemi Awolowo University, Ile-Ife, ²Population Council, Abuja, Nigeria

Abstract

Objectives: To evaluate the changes in the prevalence of dental caries in Lagos State over a 3 years period and the role of age, sex, and playing in the changes observed.

Materials and Methods: Three primary schools in Lagos State, Nigeria were randomly selected for the study. Six hundred and thirty-three children age 2-12 years, were examined for caries in 2000 while 513 children were examined in 2003. The prevalence of tooth decay and the prevalence of untreated tooth decay were calculated for the two years, that is, 2000 and 2003. Also the degree of unmet treatment need among the population with caries experience was measured. Differences in the prevalence and severity of dental caries in the primary and permanent dentition were assessed.

Results: Approximately 18% of children had untreated tooth decay in their primary dentition in 2003: A 26.1% increase from 2000. About 12.0% of the decay, extracted, and filled teeth (deft) index was seen with decayed teeth in 2000 and 16.6% in 2003. Extracted primary teeth decreased from 2.5% in 2000 to 1.5% in 2003. The change in mean deft between 2000 (0.42) and 2003 (0.47) was 11.9%. Over the study period, the overall reduction in the prevalence of dental caries was 34.8% in the permanent dentition. The decline was larger among children aged 5-9 years (62.1%) and among females (75%).

Conclusion: The study showed no overall changes in caries severity but a decrease in caries prevalence in the permanent dentition over the study period. The largest decline in caries prevalence in the permanent dentition was observed in children aged 5-9 years and females. On the contrary, there was an increase in the caries prevalence in the primary dentition.

Key words: Caries, children, Nigeria, prevalence

Date of Acceptance: 06-Mar-2013

Introduction

Dental caries is an ecological disease in which the host, diet, and oral microbial flora interact over a period of time in such a way as to encourage demineralization of the tooth enamel with resultant cavity formation. Dental caries is still one of the most common diseases in the world today. Worldwide, most children and an estimated 90% of adults have experienced caries, with the disease most prevalent in the Middle East, Latin America, and South Asia.^[1] In the United States, dental caries is the most common chronic childhood disease, being at least five times more common than asthma.^[2]

The occurrence of dental caries has decreased in some developed countries^[3-6] and this decline has been attributed to improvement in oral hygiene practices and the use of fluoride in oral dental care.^[7,8] Nonetheless, countries that have experienced an overall decrease in cases of tooth decay continue to have a disparity in the distribution of the disease.^[9] Among children in the United States and Europe, 20% of the population endures 60-80% of cases of dental caries.^[10] A similarly skewed distribution of the disease is found throughout the world including countries

Address for correspondence:

Dr. MO Folayan,
Department of Child Dental Health,
Obafemi Awolowo University, Ile-Ife, Nigeria.
E-mail: toyinukpong@yahoo.co.uk

Access this article online

Quick Response Code:



Website: www.njcponline.com

DOI: 10.4103/1119-3077.127419

PMID: 24553018

like Australia, Nepal, and Sweden where caries prevalence among children is low, while Costa Rica and Slovakia have higher prevalence rates.^[10]

While evidence show that the caries prevalence is low in many African countries^[1,11,12] like Nigeria,^[13] there are however, very few publications on national caries prevalence in Nigeria with no national study on caries incidence. The only national study on the caries in children in Nigeria was conducted in 1995. The survey showed that 30% and 43% of 12 and 15-year-old children had caries.^[14] Other publications on caries prevalence in Nigeria are limited to specific towns and cities and reported prevalence ranging from 13.5-35.5% between 2004 and 2011.^[15-18] A recent publication by Folayan *et al.*,^[19] also showed that the incidence for caries was 9.9% in a population of primary school children with caries incidence higher in primary teeth than in the permanent dentition. Understanding caries pattern, its epidemiology and how the epidemiologic profile changes over time-is important because caries is the primary pathological cause of tooth loss in children in many African countries including Nigeria.^[20,21] Also, an understanding of the caries profile, that is, where new caries emerges, can be useful in proper planning for the utilization of scarce resources. It will also help maximize the potential outcome of resources available for preventive programs, including oral health prevention programs.

This study shall specifically evaluate changes in the prevalence of dental caries in Lagos State over a 3-year period. Lagos State is a densely populated cosmopolitan city and the present economic nerve center of Nigeria. Past studies have shown that the prevalence of caries in children in Lagos State is generally higher than that observable in other locations in the Southwestern region of Nigeria; despite the similarity in culture and diet.^[12,17] A prior study on dental caries in the region showed that socioeconomic status does not play a significant role in the etiology of caries: Significant caries risk factors were sex and age.^[22] This study therefore evaluated for the role of age and sex in the changes in caries prevalence for children resident in Lagos State.

Materials and Methods

Study design and sampling technique

Three primary schools in Lagos State, Nigeria were randomly selected for this study. Public and private schools listed on the Lagos State Ministry of Education school registration list for year 2000 were all considered eligible for inclusion in the study. The schools were stratified into public and private schools. One school was randomly selected from the private school strata and two schools from the public school strata. The ratio of 1:2 for public: Private school selection was based on the ratio of school representation in the school registration list. All the students in the selected schools were enlisted to be included in the study sample.

Ethics

Prior to data collection, ethical clearance was obtained from the ethics board in Lagos University Teaching Hospital and permission obtained from the Lagos State School Management Board. Detailed information about the study was sent to the parents of children. Only children whose parents refused their child to participate in the study were excluded from the study. No such refusal was obtained. Also, children were informed about the objective of the study, the scope of the study, and the freedom not to participate in the study prior to data collection.

Data collection

Only children who were present on the proposed date of school visit were included in the study sample for years 2000 and 2003. Over the study period, oral health information was collected through face-to-face interviews by a trained interviewer in participants' school after examination. Data collected included sex and age as at last birthday. The age for each child was calculated in years.

Dental examination was conducted by a trained dentist in the school premise under natural light. Caries status was assessed using the decayed, missing, and filled permanent teeth deft/DMFT index. The interviewer specifically tried to verify cause of missing teeth for any child with a missing tooth. Specific questions asked included history of toothache, visit to the dentist, extraction of teeth at the dentist, and recall of tooth exfoliation. Where a history points to the cause of a missing tooth being due to extraction as a sequelae to caries, the tooth is then charted as extracted (e) for the deciduous dentition or missing (M) for the permanent dentition.

After the conclusion of each child's oral examination, referrals for oral health care were written for all pupils who required dental treatment. At the end of the exercise, oral health education was provided for the students in each class. The education included brief discussions on the cause of dental caries, appropriate methodology for oral hygiene, and importance of dental visits for preventive oral health care.

Reliability of examinations

A single dental examiner was involved in the study. The intrarater reliability were measured by comparing examination findings during repeated examinations. Both percent agreement and Cohen's Kappa^[23,24] were calculated from paired observations for the years 2000 and 2003. Kappa value was 0.94 for year 2000 and 0.97 for year 2003.

Diagnostic criteria

The WHO criteria was used for the diagnosis of dental caries and its sequelae (missing teeth (due to disease) and filled teeth). The intraoral examination was conducted under natural light. Radiographs were not used in the study.

Gross debris was cleared with gauze where necessary, before examination of each tooth. Tooth surfaces were examined using a non-magnifying mirror and a No. 23 dental explorer to assess for presence of carious and restored (filled) lesions.

Tooth-specific data points were used to calculate measures of caries prevalence and severity. Lowercase letters represent scores for primary teeth and uppercase letters represent permanent teeth.

Two measures of prevalence were calculated: The prevalence of tooth decay (caries experience; which includes untreated, extracted, and restored lesions) and the prevalence of untreated tooth decay. Indices used for severity of disease were the number of decayed, extracted, and filled primary teeth (deft) and the number of DMFT.^[25-27] The missing (m) component was not included in the calculation of indices for primary teeth. These criteria have been used in previous surveys of dental caries to avoid misclassifying missing primary teeth that are normally exfoliated and permanent teeth that were extracted for reasons other than dental caries. However, efforts were made to replace this with the extracted (e) component where the child could explain that the missing tooth was due to extraction.

In addition; the ratio of deft to the total number of deft among those who had experienced dental caries was calculated. This measure can be used to estimate the degree of unmet treatment need among the subset of the population with caries experience.

Data management and analysis methods

The data analysis for this study was done in line with the methods used by Beltrán-Aguilar *et al.*,^[28] The age categories used correspond generally to the age categorization used by the 2006 Lagos State Census Population Report (0-4 years, 5-9 years, 10-14 years). The target population for the oral examination fell within 2-12 years.

To minimize the impact of differences in age and sex distribution between the two surveys, all estimates were adjusted for age and sex. Adjustments were made based on the Lagos State population estimates derived from the 2006 National Census figures. Sex data were adjusted by age.

Statistical analyses were conducted using StataIC 10 (StataCorp, USA). All analyses used sample weights to account for the unequal probability of selection and nonresponse to produce national estimates and standard errors. In this report, differences between the 2000 and 2003 estimates were considered significant if the confidence intervals of the estimates did not overlap.

The study presented data for dental caries in the primary teeth (defined as having one or more decayed, filled, or

missing teeth among those with at least one primary tooth) and dental caries in the permanent teeth among children aged 5-12 years (defined as having one or more decayed, filled, or missing teeth among those with at least one permanent tooth). For comparison purposes, all tables and figures display data for the 2000 and the 2003 surveys. The tables contained both the overall and the disaggregated (by age and sex) estimates.

Results

Demographic profile of study participants

Six hundred and thirty-three children were examined in 2000 while 513 children were examined in 2003. In both years, there was adequate representation of both sexes [Table 1]. Over the study period however, only 192 school children who were examined in 2000 were examined again in 2003. A large number of students had passed out of the school and a few others had changed school.

Dental caries in primary teeth

Among children aged 2-12 years, 17.9% had caries experience in their teeth in 2000 and 20.4% had in 2003. This change was higher among female though the sex difference was not significant. Also, a significant decrease in dental caries prevalence in children aged 2-4 years (100%) and age 10-12 years (46.5%) between years 2000 and 2003 was also observed [Table 2].

Approximately 18% of children had untreated tooth decay in 2003: An increase from 2000. There was a significant increase in the prevalence of untreated decay between years 2000 and 2003 (26.1%). Significant age and gender differences were noticed in the prevalence of untreated dental caries [Table 3].

The change in mean deft among the study population between 2000 and 2003 was 11.9%. Between 2000 and 2003, there was a significant decrease in deft for children aged 10-12 years, and a significant increase in deft for females. Significant age and gender differences were observed [Table 4].

Table 1: Number of children aged 2-12 years who had completed the oral health examination

Characteristics	2000		2003	
	No	Total weight	No	Total weight
Age (years)				
2-4	181	7,061	1	39
5-9	417	13,530	457	14,828
10-12	35	999	54	1,541
Sex				
Female	318	15,995	255	12,826
Male	320	15,904	258	12,823

All estimates were adjusted by age to the 2006 Census population for Lagos state, Nigeria

Among those with at least one decayed, extracted, or filled tooth (deft >0), about 12.0% of the deft were decayed teeth (% dt/deft) in 2000 and 16.6% in 2003. On the other hand, the extracted teeth decreased from 2.5% in 2000 to 1.5% in 2003 [Table 5].

Dental caries in permanent teeth of children

Among children and adolescents aged 5-12 years, 2.3% had caries experience in their permanent teeth [Table 6]. Caries experience in permanent teeth was higher among males in both years though this sex difference was not significant. The overall absolute reduction in the prevalence of dental caries from 2000 to 2003 was 34.8%; the decline was larger among children aged 5-9 years (62.1%) [Table 6].

Approximately 1.9% of children aged 5-12 years had untreated tooth decay in their permanent teeth [Table 7]. A trend towards lower prevalence of untreated tooth decay was observed in 2003 compared with 2000. There were observed sex differences with males and children aged 5-9 years having no untreated dental caries in the permanent teeth in 2003.

The mean DMFT among children aged 5-12 years was 0.02 in both years. Absolute reductions were larger among females (75%) [Table 8]. Also, there was observed absolute reduction in the decayed teeth between 2000 and 2003 [Table 8]. Decay was the main significant contributor to the DMFT for this study population [Table 9].

Table 2: Prevalence of dental caries among children aged 2-12 years: 2000 and 2003

Characteristics	2000		2003		Difference in percentage	Percentage change
	Percentage	SE	Percentage	SE		
Age (years)						
2-4	7.7	0.3	0	0	-7.7	-100.0
5-9	23.3	0.4	21.7	0.3	-1.6	-6.9
10-12	17.1	1.2	9.3	0.7	-7.8	-45.6
Sex						
Female	19.0	0.4	21.8	0.5	+2.8	+14.7
Male	16.8	0.4	19.1	0.4	+2.3	+13.7
Total	17.9	0.3	20.4	0.3	+2.5	+14.0

All estimates were adjusted by age to the 2006 Census population for Lagos state, Nigeria, SE=Standard error

Table 3: Prevalence of untreated tooth decay among children aged 2-12 years: 2000 and 2003

Characteristics	2000		2003		Difference in percentage	Percentage change
	Percentage	SE	Percentage	SE		
2-4	7.2	0.3	0	0	0	0
5-9	18.2	0.3	19.0	0.3	+0.8	+4.4
10-12	8.6	0.9	7.4	0.7	-1.2	-14.0
Female	15.1	0.3	18.6	0.4	+3.5	+23.2
Male	13.2	0.3	17.2	0.4	+4.0	+30.3
Total	14.2	0.2	17.9	0.3	+3.7	+26.1

All estimates were adjusted by age to the 2006 Census population for Lagos state, Nigeria, SE=Standard error

Table 4: Mean number of decayed (dt); filled (ft); extracted (et); and decayed, extracted, and filled primary teeth (deft): 2000 and 2003

Characteristics	2000								2003								Difference in deft	Percentage change in deft
	deft		dt		ft		et		deft		dt		ft		et			
	No	SE	No	SE	No	SE	No	SE	No	SE	No	SE	No	SE	No	SE		
Age (years)																		
2-4	0.19	0.01	0.14	0.007	0.03	0.004	0.02	0.003	0.00	0.00	0.00	0.000	0.00	0.000	0.00	0.000	-0.19	-100
5-9	0.54	0.01	0.33	0.007	0.12	0.005	0.09	0.004	0.50	0.01	0.37	0.007	0.09	0.004	0.05	0.003	-0.04	-7.4
10-12	0.29	0.03	0.11	0.013	0.09	0.009	0.09	0.012	0.20	0.02	0.09	0.009	0.11	0.011	0.00	0.000	-0.09	-31.0
Sex																		
Female	0.45	0.01	0.28	0.01	0.08	0.01	0.09	0.004	0.56	0.02	0.42	0.01	0.10	0.01	0.10	0.005	+0.11	+24.4
Male	0.39	0.01	0.24	0.01	0.10	0.01	0.04	0.003	0.38	0.01	0.26	0.01	0.09	0.005	0.09	0.005	-0.01	-2.6
Total	0.42	0.008	0.26	0.01	0.09	0.004	0.07	0.002	0.47	0.009	0.34	0.007	0.09	0.004	0.05	0.002	+0.05	+11.9

All estimates were adjusted by age to the 2006 Census population for Lagos state, Nigeria, SE=Standard error

Table 5: Contribution of decayed (dt/deft), extracted (et/deft), and filled (ft/deft) teeth to the deft among children aged 2-12 years with at least one decayed or filled primary teeth: 2000 and 2003

Characteristics	2000						2003					
	Percentage dt/deft		Percentage ft/deft		Percentage et/deft		Percentage dt/deft		Percentage ft/deft		Percentage et/deft	
	No	SE	No	SE	No	SE	No	SE	No	SE	No	SE
Age (years)												
2-4	6.28	0.28	1.18	0.12	0.28	0.04	0.00	0.00	0.00	0.00	0.00	0.00
5-9	15.28	0.29	4.41	0.16	3.57	0.14	17.95	0.35	3.03	0.13	1.67	0.08
10-14	6.86	0.76	6.29	0.74	4.00	0.56	4.01	0.41	5.25	0.49	0.00	0.00
Sex												
Female	12.89	0.31	2.44	0.13	3.66	0.16	17.79	0.52	3.98	0.20	1.82	0.11
Male	11.02	0.29	4.43	0.19	1.38	0.09	15.43	0.39	2.50	0.15	1.20	0.10
Total	11.95	0.21	3.44	0.11	2.51	0.09	16.60	0.32	3.23	0.12	1.51	0.08

All estimates were adjusted by age to the 2006 census population for Lagos state, Nigeria, SE=Standard error

Table 6: Prevalence of dental caries in permanent teeth among children aged 5-12 years: 2000 and 2003

Characteristics	2000		2003		Difference in percentage	Percentage change
	Percentage	SE	Percentage	SE		
Age (years)						
5-9	2.9	0.1	1.1	0.1	-1.8	-62.1
10-12	11.4	1.0	5.6	0.6	-5.8	-50.9
Sex						
Female	2.3	0.1	1.5	0.1	-0.8	-34.8
Male	2.4	0.1	1.6	0.1	-0.8	-33.3
Total	2.3	0.1	1.5	0.1	-0.8	-34.8

All estimates were adjusted by age to the 2006 Census population for Lagos state, Nigeria, SE=Standard error

Table 7: Prevalence of untreated tooth decay in permanent teeth among children aged 5-12 years: 2000 and 2003

Characteristics	2000		2003		Difference in percentage	Percentage change
	Percentage	SE	Percentage	SE		
Age (years)						
5-9	2.2	0.1	0	0	-2.2	-100.0
10-14	11.4	1.0	5.6	0.6	-5.8	-50.9
Sex						
Female	2.0	0.1	1.1	0.1	-0.9	-45.0
Male	1.8	0.1	0	0	-1.8	-100.0
Total	1.9	0.1	0.5	0.1	-1.4	-73.7

All estimates were adjusted by age to the 2006 Census population for Lagos state, Nigeria, SE=Standard error

Discussion

Data from this study suggests that there was a significant increase in the prevalence and severity of dental caries in primary teeth, a decrease in caries prevalence in the permanent dentition, and no change in severity of caries in the permanent teeth between 2000 and 2003.

Prior reports have noted low prevalence and severity of dental caries in Africa.^[29] This study however showed that in the study population, the behavior of caries in the primary dentition differed from what may be observable in the permanent dentition. The increasing prevalence and severity in dental caries in the primary dentition should be a cause for concern as this may actually result in a future

increase in the prevalence of caries in the permanent dentition after a certain threshold. Past study reports have shown the association between prevalence of caries in the primary dentition and that in the permanent dentition in the same individual.^[30] While Li and Wang^[30] may actually be reporting observations made at the individual level, such gradual changes may eventually peak to become of public health significance. A surveillance system to systematically monitor this potential public health risk may therefore be important for school children in Lagos State.

There were observable sex differences in the prevalence and severity of dental caries in this study population. While the DMFT decreased between 2000 and 2003 for both sexes, the deft however increased significantly between

Table 8: Mean number of decayed, filled, missing and decayed, filled, and missing permanent teeth among children aged 5-12 years: 2000 and 2003

Characteristics	2000								2003								Difference in DMFT	Percentage change in DMFT		
	DMFT		DT		FT		MT		DMFT		DT		FT		MT					
	No	SE	No	SE	No	SE	No	SE	No	SE	No	SE	No	SE	No	SE				
Age (years)																				
5-9	0.04	0.002	0.03	0.002	0.00	0.001	0.00	0.00	0.01	0.001	0.00	0.000	0.01	0.001	0.00	0.00	0.00	0.00	-0.03	-75.0
10-12	0.29	0.033	0.29	0.033	0.00	0.00	0.00	0.00	0.06	0.006	0.06	0.006	0.00	0.000	0.00	0.00	0.00	0.00	-0.23	-79.3
Sex																				
Female	0.04	0.001	0.04	0.003	0.00	0.00	0.00	0.00	0.01	0.001	0.01	0.001	0.00	0.000	0.00	0.001	0.00	0.001	-0.03	-75.0
Male	0.03	0.001	0.02	0.002	0.01	0.001	0.00	0.00	0.02	0.001	0.00	0.00	0.02	0.001	0.00	0.00	0.00	0.00	-0.01	-33.3
Total	0.02	0.001	0.03	0.002	0.00	0.00	0.00	0.00	0.02	0.001	0.01	0.001	0.01	0.001	0.00	0.00	0.00	0.00	0.00	0.00

All estimates were adjusted by age to the 2006 Census population for Lagos state, Nigeria. SE=Standard error, DMFT=Decayed, missing, and filled permanent teeth

Table 9: Contribution of decayed (DT/DMFT), filled (FT/DMFT), and missing (MT/DMFT) teeth to the number of decayed, filled and missing teeth among children aged 2-12 years with at least one decayed, filled, or missing permanent teeth: 2000 and 2003

Characteristics	2000						2003					
	Percentage DT/DMFT		Percentage FT/DMFT		Percentage MT/DMFT		Percentage DT/DMFT		Percentage FT/DMFT		Percentage MT/DMFT	
	No	SE	No	SE	No	SE	No	SE	No	SE	No	SE
Age (years)												
5-9	2.16	0.12	0.48	0.06	0.00	0.00	0.00	0.00	0.88	0.08	0.22	0.04
10-12	11.43	1.01	0.00	0.00	0.00	0.00	5.56	0.58	0.00	0.00	0.00	0.00
Sex												
Female	1.97	0.13	0.00	0.00	0.00	0.00	1.06	0.00	0.00	0.00	0.40	0.07
Male	1.79	0.13	0.60	0.07	0.00	0.00	0.00	0.00	1.57	0.14	0.00	0.00
Total	1.88	0.09	0.30	0.04	0.00	0.00	0.52	0.06	0.79	0.07	0.20	0.03

All estimates were adjusted by age to the 2006 Census population for Lagos state, Nigeria, SE=Standard error, DMFT=Decayed, missing, and filled permanent teeth

2000 and 2003 for females. The reason for this observed differences in the percentage change in deft between the sexes cannot be readily explained. It will be important to study potential phenomenon that could have contributed to this observation.

There were also observable age differences in the prevalence of dental caries: The prevalence of untreated decayed teeth increased by 4.4% for children between the ages of 5-9 years old but decreased by 11.4% for children between the ages of 10-12 years. The reason for this observation can however, not be readily deduced.

The study also showed the high level of unmet dental treatment need for the primary dentition. Untreated decayed teeth were 12% of the deft in 2000. This increased to 16.6% in 2003. There was a corresponding nonsignificant decline in the percentage of the filled primary teeth over the study period (3.4 vs 3.2%). This is unlike what was observed in the permanent dentition: A decrease in the untreated decayed teeth between 2000 and 2003 (1.9 vs 0.5%), an increase in the filled teeth (0.3 vs 0.8%), and an increase in missing teeth (0.0 vs 0.2%). This observation may be a reflection of the possible poor attention being given to

the health of the primary dentition despite the potential unpleasant sequelae associated with dental caries. This is an issue that should be focused on in oral health education for mothers and caregivers.

While this study may have contributed to better understanding of the role played by age and to a lesser extent sex, in the changes in prevalence of dental caries in both the primary and permanent dentition, it does have its limitations. Efforts were made to ensure that the 'e' and the 'M' component of the caries indices actually represent tooth lost due to caries, yet the method used to capture this data depended on study participant's recall and deductive assessments by the examiners. This may very well introduce bias into the data and a possible overestimation or underestimation of that piece of information. Despite this potential, this study limitation cannot undermine the contributory value of this study outcome for use in the planning of dental caries management for school children in Lagos State.

In addition, the Restorative Index and the DMFT% were not calculated. The Restorative index is a good measure of the level of restorative care in a community and may be deduced

to be quite low in this study going by the percentage of untreated decay reported. The DMFT% index on the other hand, has been described as being a better index for use for comparison, as it corrects for certain variables such as may result from differences in the total number of total teeth present in different mouths which may impact on the DMFT index calculation.^[17] The focus of this study was to assess for caries prevalence and changes in caries prevalence over a time period. The Restorative Index will therefore not have been beneficial for data interpretation for this study. While the DMFT% would have been indeed beneficial, none of the comparative study used this index and thus would have made it difficult to compare the findings of this study with that of other studies.

Conclusion

This study showed no changes in caries severity but a decrease in caries prevalence in the permanent dentition over the study period. However, there was an increase in the prevalence and severity of caries in the primary dentition of school children in Lagos State over the same period. Prevalence of untreated tooth decay is highest in the age group of 5-9 years. The observed increase in primary dentition caries severity was worse in females. Caries prevention programs in the study location should be strategically targeted at controlling caries in the primary dentition without losing the gains made with the control of dental caries in the permanent dentition.

Acknowledgment

The contributions of Dr. B. Adeniyi and Dr. E. Oziegbe who reviewed this manuscript and made useful suggestions are hereby acknowledged.

References

- Petersen P. The World Oral Health Report 2003: Continuous improvement of oral health in the 21st century--the approach of the WHO Global Oral Health Programme. *Community Dent Oral Epidemiol* 2003;31(Suppl 1):3-23.
- US Department of Health and Human Services. Oral Health in America: A Report of the Surgeon General. Rockville, MD: US Department of Health and Human Services, National Institutes of Health, National Institute of Dental and Craniofacial Research; National Institutes of Health; 2000:2.
- Graves RC, Stamm JW. Decline of dental caries. What occurred and will it continue? *J Can Dent Assoc* 1985;51:693-9.
- Ripa LW. Has the decline in caries prevalence reduced the need for fissure sealants in the UK? A review. *Pediatr Dent* 1990;6:79-83.
- Burt BA. Trends in caries prevalence in North American children. *Int Dent J* 1994;44 (4 Suppl 1):403-13.
- Whelton H. Overview of the impact of changing global patterns of dental caries experience on caries clinical trials. *J Dent Res* 2004;83 Spec No C: C29-34.
- Milgrom P, Riedy CA, Weinstein P, Tanner AC, Manibusan L, Bruss J. Dental caries and its relationship to bacterial infection, hypoplasia, diet, and oral hygiene in 6- to 36-month old children. *Community Dent Oral Epidemiol* 2000;28:295-306.
- Forss H. Efficiency of fluoride programs in the light of reduced caries levels in young populations. *Acta Odontol Scand* 1999;57:348-51.
- Bratthall D, Petersen PE, Stjernswärd JR, Brown LJ. Oral and craniofacial disease and disorders. Chapter 38. In: Jamison DT, Breman JG, Measham AR, editors. *Disease Control Priorities in Developing Countries*. 2nd ed. Washington, DC: World Bank; 2006. Available from: <http://www.ncbi.nlm.nih.gov/books/NBK11725/>. [Last accessed on 2011 Oct 10].
- Touger-Decker R, van Loveren C. Sugar and dental caries. *Am J Clin Nutr* 2003;78:S881-92.
- Cleaton-Jones P. Dental caries trend in 5 to 6 year-old and 11 to 13 year-old children in two UNICEF designated regions: Sub-Saharan African, and Middle East and North Africa, 1970-2000. *Refuat Hapeh Vehashinayim* 2001;18:11-22.
- Egri M, Gunay O. Association between some educational indicators and dental caries experience of 12-year-old children in developing countries: An ecological approach. *Community Dent Health* 2004;21:227-9.
- Adekoya-Sofowora CA, Nasir WO, Oginni AO, Taiwo M. Dental caries in 12-year-old suburban Nigerian school children. *Afr Health Sci* 2006;6:145-50.
- Adegbembo AO, el-Nadeef MA, Adeyinka A. National survey of dental caries status and treatment needs in Nigeria. *Int Dent J* 1995;45:35-44.
- Okeigbemen SA. The prevalence of dental caries among 12 to 15-year-old school children in Nigeria: Report of a local survey and campaign. *Oral Health Prev Dent* 2004;2:27-31.
- Okoye LO, Chukweneke FN, Akaji EA, Folaranmi N. Caries experience among school children in Enugu, Nigeria. *J Coll Med* 2010;14:17-23.
- Umehi-Koleosho DC, Ayanbadejo PO, Oremusu OA. Dental caries trend among adolescents in Lagos, South-West Nigeria. *West Afr J Med* 2007;26:201-5.
- Folayan MO, Khami MR, Folaranmi N, Orenuga O, Popoola BO, O Olatosi O, *et al.* Determinants of preventive dental practice for children among final-year dental students in Nigeria. *Int J Paediatr Dent* 2013.
- Folayan MO, Sofola OO, Oginni AB. Caries incidence in a cohort of primary school students in Lagos State, Nigeria followed up over a 3 years period. *Eur Arch Paediatr Dent* 2012;13:312-8.
- Folayan MO, Otuyemi OD, Esan TA, Adeleke AA, Adedigba MA. Pattern of dental extraction in children in a Nigerian tertiary hospital. *J Contemp Dent Pract* 2005;6:80-90.
- Ashiwaju MO, Folayan MO, Sote EO, Isikwe MC. Pattern of tooth extraction in children attending tertiary health care centres in Nigeria: A prospective study. *J Clin Pediatr Dent* 2011;36:107-10.
- Folayan M, Sowole A, Kola-Jebutu A. Risk factors for caries in children from south-western Nigeria. *J Clin Pediatr Dent* 2008;32:171-5.
- Cohen JA. A coefficient of agreement for nominal scales. *Educ Psychol Meas* 1960;20:37-46.
- Hunt RJ. Percent agreement, Pearson's correlation, and kappa as measures of inter-examiner reliability. *J Dent Res* 1986;65:128-30.
- Klein H, Palmer CE, Knutson JW. Studies on dental caries: I. Dental status and dental needs of elementary school children. *Public Health Rep* 1938;53:761-5.
- Gruebbel AO. A measurement of dental caries prevalence and treatment service for deciduous teeth. *J Dent Res* 1944;23:163-8.
- Kaste LM, Selwitz RH, Oldakowski RJ, Brunelle JA, Winn DM, Brown LJ. Coronal caries in the primary and permanent dentition of children and adolescents 1-17 years of age: United States, 1988-1991. *J Dent Res* 1996;75 Spec No: 631-41.
- Beltrán-Aguilar ED, Barker LK, Canto MT, Dye BA, Gooch BF, Griffin SO, *et al.* Surveillance for dental caries, dental sealants, tooth retention, edentulism, and enamel fluorosis--United States, 1988-1994 and 1999-2002. *MMWR Surveill Summ* 2005;54:1-44.
- World Health Organisation. Oral health disease burden and common risk factors. Available from: http://www.who.int/oral_health/disease_burden/global/en/index.html. [Last accessed on 2011 Oct 10].
- Li Y, Wang W. Predicting caries in permanent teeth from caries in primary teeth: An eight-year cohort study. *J Dent Res* 2002;81:561-6.

How to cite this article: Sofola OO, Folayan MO, Oginni AB. Changes in the prevalence of dental caries in primary school children in Lagos State, Nigeria. *Niger J Clin Pract* 2014;17:127-33.

Source of Support: Nil, **Conflict of Interest:** None declared.