

# An Evaluation of School Oral Health Caries Prevention and Control Program for 5 And 12-Year-Old Children in Benin City, Nigeria

**\*CHUKWUMAH NM, \*\*ENABULELE JE, \*\*\*EHIZELE AO, \*\*\*AZODO CC.**

Department of *\*Paedodontics, \*\*Restorative Dentistry, Periodontics, School of Dentistry, College of Medical Sciences, University of Benin, Benin City, Nigeria.*

## ABSTRACT

**Objective:** To assess the effectiveness and impact of school oral health caries preventive and control program in 5- and 12-year-old children in Benin City.

**Methods:** This was an interventional study carried out in public and private primary and secondary schools in the Benin Metropolis, Edo State among 5 and 12-year-old children attending selected schools. Age-appropriate oral health education and oral hygiene tools were given every three months and participants followed up. Data was collected using a structured interviewer-administered questionnaire which generated information on the participant's sociodemographic background (age, gender and socioeconomic status), oral examination was done, oral hygiene assessed using the Simplified Oral hygiene index (S-OHI). Caries risk was assessed using the Association for Pediatric Dentistry (AAPD) assessment form for 0-5-year-olds and >6 years to categorize participants into low, moderate and high risk for dental caries. This was done at baseline, 3 months and 6 months post intervention.

**Results:** A total of 226 children were recruited for the study, with 103 (45.6%) 5-year-olds and 123 (54.4%) 12-year-olds, all four Local Government Areas within the Benin metropolis were represented Egor (38.1%), Ikpoba-Okha (13.7%), Oredo (36.7%), Ovia North East (11.5%), while the public-school participants made up 54% of the study participants and 46% were private school participants. Prevalence of dental caries was 5.97% among 5-year-old and 5.29% among 12-year-old children. Mean oral hygiene scores differed slightly between baseline and 3 months post intervention assessment but was not statistically significant ( $P=0.834$ ) however, there was a positive difference between baseline mean score and 6 months post intervention assessment as well as the difference between the 3 months and 6 months post intervention period mean scores were statistically significant ( $P<0.001$ ) respectively. The oral hygiene status of participants at baseline was good (27.0%), fair (55.8%), and poor oral hygiene (17.3%) by the 3- and 6-months post intervention assessment the oral hygiene was good (40.7% and 58%); fair (52.2% and 42.0%) while poor was (7.1% and 0%) respectively. Caries risk assessment at baseline and 6 month post intervention assessment was low risk for caries (27% and 58%), moderate risk (55.8% and 42.0%) and high risk (17.3% and 0%) respectively.

**Conclusion:** The school oral health caries prevention and control program was very effective and had a positive impact on the oral health and caries risk of 5- and 12-year-old children in Benin City.

## Correspondence

Dr Nneka Chukwumah  
Department of Paedodontics  
School of Dentistry  
College of Medical Sciences  
University of Benin, Benin City, Nigeria.  
Email: nneka.chukwumah@uniben.edu

**Keywords:** dental caries, oral hygiene, caries risk assessment, children, school oral health program.

## INTRODUCTION

Dental caries in children is considered one of the most chronic diseases of childhood (CDC, 2022; IHME, 2020) and, has been documented to be on the increase in developing countries in the past decades (Frencken et al, 2017; Andegiorgish et al, 2017). It usually stems from factors such as poor oral hygiene, poor feeding/nutritional habits, and low awareness of oral health of parents and teachers, and these factors should be considered when developing oral health programs for preschool and school-aged children (Shirzad et al, 2016). Pre-school children are particularly vulnerable and at high risk for dental caries (Anil & Anand, 2017). Reinforcing oral health education is important during preschool and throughout school years because this is a period in the lives of children when beliefs, positive attitudes, and personal skills are being developed (Shirzad et al, 2016). It is believed that the earlier habits are developed, the longer their impact on oral health will be (Mueller et al., 2022).

As of 2017-2018, the World Health Organization (WHO) estimated the percentage of dental caries in 5-6-year-old to be less than 35% in Nigeria (WHO, 2019). With dental caries being a common childhood disease, the consequences of untreated caries are numerous. Children with poor oral health have been documented to be 12 times more likely to have limited activity days, including missing school (WHO, 2003a). Millions of school hours are lost annually due to oral hygiene-related diseases (Righolt et al., 2015; Naaval & Kelekar, 2018).

Preventive measures in the control of dental caries have been categorized into various groups which include: (a) control of risk factors such as feeding and diet in young children (b) control of population based fluoride exposure (c) arresting carious lesions through application of fissure sealants, fluoride varnish and minimally invasive techniques for restoration (d) health education and community engagement for prevention of dental caries (e) involvement of primary care teams, including parents, teachers, community health workers, pediatricians, family physicians and other health professionals in the prevention of dental caries (f) monitoring and evaluation (g) building a supportive framework for integration of dental caries prevention and control in overall health initiatives (WHO, 2019). In line with these measures for prevention of dental caries, continuous effort should be put in place to institute good oral hygiene measures and caries prevention strategies early in a child's life by using all possible methods to achieve a caries-free society. Where preventive measures fail, there is an increased

need to manage the progression and consequences of dental caries with the scarce resources and health facilities available. Oral health education is thus very important when planning preventive programs.

**Citation:** Chukwumah NM, Enabulele JE, Ehizele AO, Azodo CC. (2025). An evaluation of school oral health caries prevention and control program for 5 and 12-year-old children in Benin City, Nigeria. *Nig J Med Dent Educ*; 7(2):110-117.

The prevalence of dental caries in Benin City among primary school children ranges from 15.7-40% (Alakija, 1983; Chukwumah et al., 2012), while for 12-15-year-olds is 21.9-33% (Okeigbemen, 2004; Chukwumah et al., 2016). It has been reported to affect 60-90% of school aged children, while it is reducing in industrialized countries it is on the rise in developing countries like Nigeria and this disparity has been attributed to poor prevention oriented oral health programs, increased intake of cariogenic foods, low exposure to fluorides, poor access to oral health services and lifestyle (Mehta, 2018; Okeigbemen & Ibiyemi, 2020). It is highly prevalent globally as a non-communicable disease of medical, social, and economic importance. The WHO encourages countries to develop strategies for the prevention and control of the disease (WHO, 2003b). To achieve the WHO goal of at least 90% caries-free children, prevention and control at the school/community level are essential (WHO, 1998). This program aims to effectively educate and reinforce education on good oral health practices in preschool and school-aged children, apply caries preventive measures with regular dental checks to see its effectiveness and impact on caries prevention and control. It would also provide guidelines on incorporating these measures in school health programs. The objectives of this study include assessing the prevalence of dental caries, the effectiveness and impact of the school oral health caries preventive and control program in 5 and 12-year-old children in Benin City.

## MATERIALS AND METHODS

**Ethical considerations:** Ethical approval for this study was obtained from the Health Research Ethics Committee of the University of Benin Teaching Hospital (ADM/E'22/A/VOL.VII/148311660). Permission was obtained from the State Ministry of Education and the Head teachers of the participating schools. Written informed consent was sought from parents/legal guardians of participants after duly explaining the study objectives and procedures to

them, and assent was sought from the 12-year-olds. Only children whose parents gave written informed consent and 12-year-old children who gave assent were recruited for the study.

**Study design:** This was an interventional study.

**Study location:** The study was carried out in public and private primary and secondary schools in the four Local Government areas in the Benin Metropolis, Edo State.

**Study population:** Included 5 and 12-year-old children attending selected primary and secondary schools in the study location.

**Study duration:** One year.

**Sample size determination:** The prevalence of dental caries in primary school children in Benin City is 15.7% (Chukwumah et al., 2012). Using this value, the sample size was calculated using the Cochran formula (Cochran 1977). A minimum sample size of 202, with a 10% attrition rate added, gave a total of 222 children; however, a total of 226 participated in the study.

**Sample selection:** A multi-stage sampling method was employed for the study.

a. Selection of schools: A list of accredited public and private primary and secondary schools and estimated populations in the four Local Government areas (LGA): Egor, Ovia North East, Ikpoba Okha, and Oredo LGAs of the State was obtained from the Ministry of Education after ethical approval had been obtained for the study. The participating schools were selected using a simple random method, which was representative of the total number of schools in each Local Government Area, to get a representative sample of children to participate in the study.

b. Selection of classes: The classes with the highest number of 5 and 12-year-olds were selected to participate.

c. Selection of participants: After the schools and classes had been selected, children in those classes who fell within the age range of the study population were selected till the sample size for each school was reached. Only children whose parents gave written informed consent and 12-year-old children who gave assent on the day of data collection were recruited to participate in the study.

**Inclusion criteria:** Children aged 5 and 12 years old in the selected schools. Children 5-year-old who had all deciduous teeth present and 12-year-olds with all permanent teeth present except the third molars.

**Exclusion criteria:** Children whose parents refused to give written informed consent to participate in the study. Children with extensive dental caries

and its sequelae requiring immediate dental treatment.

**Methodology:** Selected participants were placed in a classroom where they were seated. The participants were given age-appropriate education on oral diseases and prevention, oral hygiene instructions with age-appropriate demonstrations. Participants were then examined in the classroom while seated, under natural light, using sterile mouth mirrors and blunt probes, tooth surfaces were cleaned using sterile gauze, and oral findings were documented. Fluoride varnish was applied to all study participants. These study participants were followed up for 6 months with regular dental checks, reinforcement of oral hygiene instructions, and provision of age-appropriate toothpaste and toothbrushes every 3 months.

**Data collection:** Data was collected using a structured interviewer-administered questionnaire that generated information on the participant's sociodemographic background (age, gender and socioeconomic status), the child's socioeconomic status was determined by the fathers' occupation and mothers' level of education (Blisshen 1957), and validated for use in the study location (Chukwumah et al., 2016). The socioeconomic status for the 5-year-olds was taken from the class records for each participating child recruited.

Data was also collected on participants' oral hygiene using the Simplified Oral hygiene index (S-OHI) by Greene and Vermillion (1964) to determine the participants' oral hygiene status as a measure of the oral health status. The S-OHI has two components, the debris index (DI-S) and the calculus index (CI-S). Six surfaces were examined S-OHI, four from the posterior and two from the anterior. The buccal surfaces of the upper molars, lingual surfaces of the lower molars, and the labial surfaces of the central incisors and scored.

The DI-S and CI-S values range from 0-3, and S-OHI values range from 0-6 (i.e. DI-S + CI-S).

The OHI was then categorized as follows: 0-1.2= Good; 1.3-2.9= Fair;  $\geq 3$ = Poor.

Caries risk was assessed using the Association for Pediatric Dentistry (AAPD) assessment form for 0-5-year-olds (see Appendix II) and the form for 6 years and older (see Appendix III) to categorize participants into low, moderate, and high risk for dental caries (AAPD, 2014). Caries was assessed using the decayed, missing, and filled teeth (dmft/DMFT) index for primary and permanent teeth, respectively.

**Data analysis:** Data was analyzed using SPSS version 27 for Windows. Prevalence of dental caries was assessed from all participants assessed during patient selection. Frequency and percentages of

participant age, gender, socioeconomic status, LGA's as well as type of school was documented using tables, bar charts and pie charts. Mean of oral hygiene scores was determined across all visits (baseline, first and second visits). Associations between oral hygiene status and caries risk assessment of participants and treatment visits were made as well as the caries risk status of participants at baseline and terminal visit. Statistically significant associations were considered if P was <0.05 at a 95% confidence interval.

## RESULTS

### *Sociodemographic characteristics of study participants*

A total of 763 children were assessed for this study, with 385 of them being 5-year-olds and 378 being 12-year-olds; only 226 were recruited for the study, with 103 (45.6%) 5-year-olds and 123 (54.4%) 12-year-olds who met the inclusion criteria and were recruited to participate in the study. All four Local Government Areas within the Benin metropolis were represented Egor (38.1%), Ikpoba-Okha (13.7%), Oredo (36.7%), Ovia North East (11.5%), while the public-school participants made up 54% of the study participants and 46% were private school participants.

### *Prevalence of dental caries among study participants*

The prevalence of dental caries among 5-year-old children in Benin City was 5.97% with a mean dmft of 0.06. While for the 12-year-old children was 5.29% with a mean DMFT of 0.05. Only the decayed (d/D) component of the dmft/DMFT was present as there were no missing or filled

components in both the primary and permanent dentitions.

### *Changes in mean oral hygiene scores at baseline and post intervention assessments*

The mean oral hygiene scores showed only a slight difference between baseline and 3-month post intervention assessment and this was not statistically significant ( $P=0.834$ ) however, the difference between baseline mean score and 6-month post intervention assessment as well as the difference between 3-and 6-month post intervention assessment mean scores were statistically significant ( $P<0.001$ ) respectively.

### *Oral hygiene status and caries risk assessment of participants at baseline and post intervention visits*

The oral hygiene status of the study participants at baseline for most of the participants was fair oral hygiene 126 (55.8%) while 39 (17.3%) had poor oral hygiene and 61 (27.0%) had good oral hygiene. At the 3-month post intervention assessment the oral hygiene status was 92 (40.7%) had good oral hygiene, 118 (52.2%) had fair and only 16 (7.1%) had poor oral hygiene. At 6-month post intervention assessment the oral hygiene was 131 (58.0%) having good oral hygiene, 95 (42.0%) having fair oral hygiene while no participant had poor oral hygiene.

The caries risk assessment at baseline was 61 (27.0%) had low risk for caries, 126 (55.8%) had moderate risk while 39 (17.3%) had high risk for caries. At the 6-month post intervention assessment 131 (58.0%) were low risk for caries, 95 (42.0%) were at moderate risk for caries. No participant had high risk for caries at this visit.

**Table 1: Sociodemographic characteristics of study participants**

Variable	Frequency (n)	Percent (%)
Age		
5 years	103	45.6
12 years	123	54.4
Gender		
Male	133	58.8
Female	93	41.2
Socioeconomic status		
Low	131	58.0
Middle	48	21.2
High	47	20.8
<b>Total</b>	<b>226</b>	<b>100.0</b>

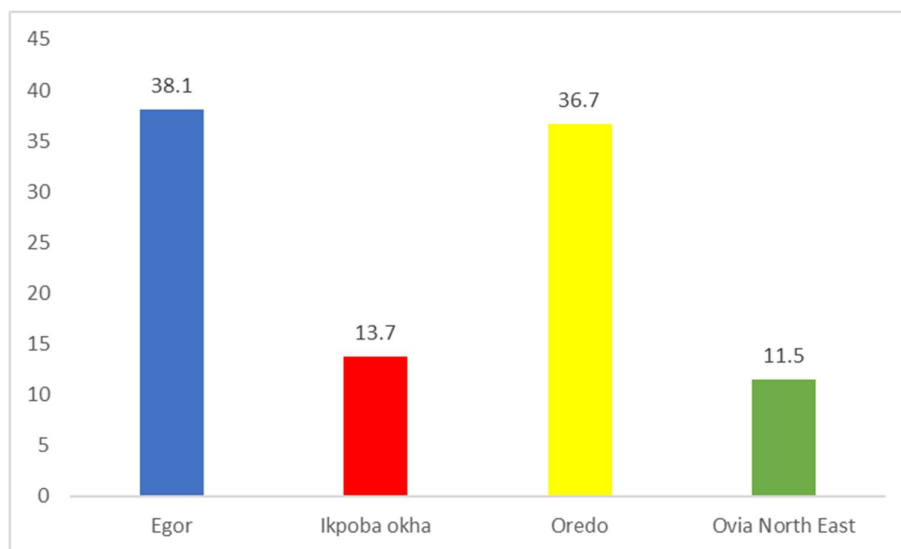


Figure 1: Chart showing participants representation from the four Local Government Areas

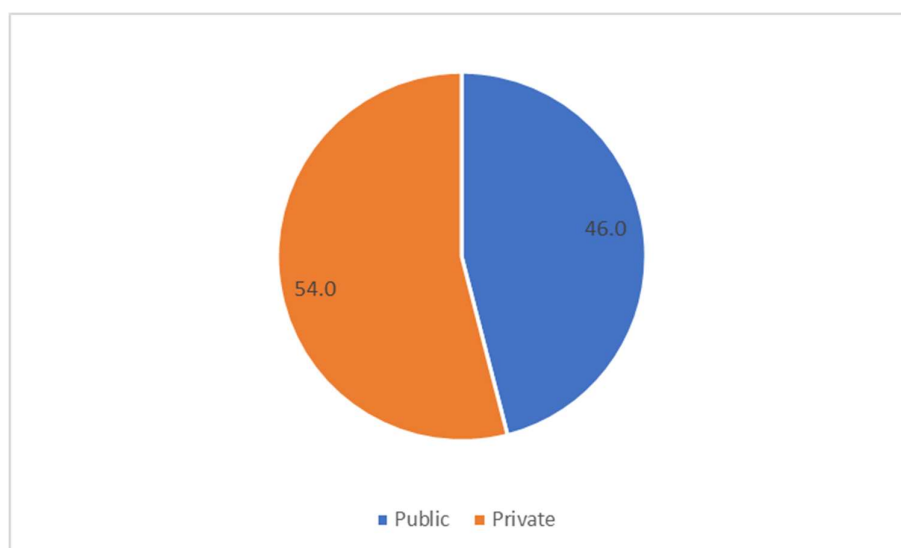


Figure 2: Chart showing participant representation from schools

**Table 2: Mean Oral Hygiene score and standard error of mean at baseline, 3-month and 6-month post intervention assessment**

Variable		Mean +SEM	P value
Pair I	To	2.26±0.06	0.834
	T1	2.06±0.36	
Pair II	To	2.26±0.06	<0.001
	T2	2.58±0.03	
Pair III	T1	2.06±0.36	<0.001
	T2	2.58±0.03	

**Table 3: Oral hygiene status and caries risk assessment of participants at baseline and post intervention assessments.**

Variable	To n(%)	T1 n(%)	T2 n(%)
<b>Oral Hygiene status</b>			
Good	61 (27.0)	92 (40.7)	131 (58.0)
Fair	126 (55.8)	118 (52.2)	95 (42.0)
Poor	39 (17.3)	16 (7.1)	0 (0.0)
Total	226 (100.0)	226 (100.0)	226 (100.0)
<b>Caries risk assessment</b>			
Low risk	61 (27.0)	-	131 (58.0)
Moderate risk	126 (55.8)	-	95 (42.0)
High risk	39 (17.3)	-	0 (0.0)
Total	226 (100.0)	-	226 (100.0)

## DISCUSSION

This study found a prevalence of dental caries of 5.97% for 5-year-olds and 5.29% for 12-year-olds respectively. This was low compared to other studies which reported 21.2% for 6-71-month (Olatosi et al., 2015) and 22.9% among 10–12-year-old boys in Northern Nigeria (Okolo et al., 2022). The mean dmft/DMFT for primary and permanent teeth found in this study was 0.06/0.05 which was also low compared with findings from a South Eastern Nigeria study which reported dmft/DMFT for primary and permanent teeth to be 0.45/0.10 respectively (Onyejaka et al., 2021). The reason for this low prevalence may be because of the single age focus of this study which was 5- and 12-year-olds only as other studies report findings for age range (e.g. 6- to 12-year-olds). The strength of this study lies in the fact that it reports the caries prevalence in 5-year-old children only which is usually the last in which most children are presumed to have their primary teeth complete before they reach the mixed dentition stage while at 12 years of age most children are also presumed to have all their permanent teeth erupted except for the third molars. This study also provides information on the state of the children's dentition at the end of the life span of the primary and the state of the permanent dentition early in its life span.

The school oral health program which involved visiting the participants in school at baseline, educating them on their oral health and then providing them with oral health tools to achieve these goals with 3 monthly follow up visits to reinforce these new oral habits taught, showed significant improvements in oral hygiene scores over time, with statistically significant differences between baseline and second visit scores. The baseline means scores differed only slightly from the first visit mean scores and this was not statistically significant however the first visit and

second visit which reemphasized oral hygiene education and instructions showed that the oral hygiene mean scores improved significantly. This elucidated the effectiveness of the school health oral program in improving the oral hygiene of children which in turn would improve their oral health and decrease their chances of developing dental caries as poor oral hygiene is an important risk factor for caries development and progression. There was paucity of information to compare with among Nigerian studies however a systematic review (Akeru et al, 2022) reported that a narrative synthesis of school based interventions had a positive effect on oral health outcomes as seen in this study and that the school based interventions may be effective in reducing the burden of oral diseases in low-and-middle-income countries however they concluded that further research is required to provide evidence of its effectiveness to improve oral health which this study tried to achieve.

The program led to a notable improvement in oral hygiene status with significant reduction in participants with poor oral hygiene becoming fair or good and an increase in those at low risk for caries from moderate and high risks. The study findings suggest that the school oral health caries prevention and control program had a significant impact as it improved the oral hygiene and reduced the dental caries risk among 5- and 12-year-old children in Benin City. The program's success can be attributed to its ability to promote and institute good oral hygiene practices and provision of the tools required to achieve good oral hygiene which is in keeping with the findings of a previous study (Das et 2024).

## CONCLUSION

The school oral health caries prevention and control program was very effective and had a positive impact on 5- and 12-year-old children in

Benin City. This study highlights the importance of school-based oral health programs in promoting good oral health and preventing dental caries risk among children.

## RECOMMENDATIONS

We recommend that future studies investigate the long-term sustainability of such oral health programs and integrate them into existing healthcare programs such as the school handwashing/hand hygiene programs in schools.

## ACKNOWLEDGEMENT

The authors would like to appreciate Tertiary education trust fund (Tetfund) for Tetfund Institutional Based Research (Tetfund-IBR) grant 2023 and acknowledge all the study participants, parents and teachers who gave their time to participate in this study to add to the body of knowledge.

## Financial support and sponsorship

The authors appreciate the Tertiary education trust fund (Tetfund) through which this research was sponsored by the Tetfund Institutional Based Research (Tetfund-IBR) grant 2023.

## Conflicts of interest

The authors declare that they have no conflicts of interest.

## REFERENCES

- Akera P, Kennedy SE, Lingam R, Obwolo MJ, Schutte AE, Richmond R (2022). Effectiveness of primary school-based interventions in improving oral health of children in low- and middle- income countries: a systematic review and meta-analysis. *BMC Oral Health*. 22: 264. <https://doi.org/10.1186/s12903-022-02291-2>.
- Alakija W (1983). Dental caries in primary school children in Benin City, Nigeria. *J Trop Pediatr*. 29 (6): 317-319.
- American Association of Pediatric Dentistry (2014). Guideline on caries risk assessment and management for infants, children and adolescents. Reference Manual 38 (6): 142-149
- Andegorgish AK, Weldemariam BW, Kifle MM, Mebrahtu FG, Zewde HK, Tewelde MG et al (2017). Prevalence of dental caries and associated factors among 12 year old students in Eritrea. *BMC Oral Health*. 17: 169.
- Anil S, Anand PS (2017). Early childhood caries: prevalence, risk factors and prevention. *Front Pediatr*. 18;5:157. [doi.org/10.3389/fped.2017.00157](https://doi.org/10.3389/fped.2017.00157)
- Blishen B. The Construction and Use of an Occupational Class Scale. *Can J Econ Political Sci.* 1958; 24(4); 519-525.
- Centre for Disease Control (CDC) (2020). Children's oral health. <https://www.cdc.gov/oralhealth/basics/childrens-oral-health/index.html>. Accessed February 10, 2023.
- Chukwumah N, Azodo C, Adeghe H, Enabulele J (2012). Relating dental caries experience with body mass index among Nigerian primary school children: A cross-sectional survey. *J Educ Ethics Dent*. 2(1): 28-32.
- Chukwumah NM, Folayan MO, Oziegbe EO, Umweni AA (2016). Impact of dental caries and its treatment on the quality of life of 12-15year old adolescents in Benin, Nigeria. *Int J Paediatr Dent*. 26(1):66-76.
- Cochran WG (1977). Sampling techniques. 3rd edition. New York. John Wiley and sons.
- Das H, Janakiram C, Kumar Vijay, Karuveettill V (2024). Effectiveness of school-based oral health education interventions among school children. *Int Dent J*. 74(1): S409 <https://doi.org/10.1016/j.identj.2024.07.1255>
- Frencken JE, Sharma P, Stenhouse L, Green D, Laverty D, Dietrich T (2017). Global epidemiology of dental caries and severe periodontitis- a comprehensive review. *J Clin Periodontol*. 44 (suppl. 18): S94-105.
- Greene JC, Vermillion JR (1964). The simplified oral hygiene index. *J Am Dent Assoc*. 68: 7-13.
- Institute for Health Metrics and Evaluation (IHME) (2020). GBD compare data visualization. Seattle, WA: IHME, University of Washington. <http://vizhub.healthdata.org/gbd-compare> Accessed February 10, 2023.
- Metha A (2018). Trends in dental caries in Indian children for the past 25 years. *Indian J Dent Res*. 29: 323-328.
- Mueller M, Schorle S, Vach K, Hartman A, Zeeck A, Schlueter N (2022). Relationship between dental experiences, oral hygiene education and self-reported oral hygiene behavior. *PLoS One*. Feb 24;17(2): e0264306. [doi.org/10.1371/journal.pone.0264306](https://doi.org/10.1371/journal.pone.0264306)
- Naavaal S, Kelekar U (2018). School hours lost due to acute/unplanned dental care. *Health Behav Policy Rev*. 18;5(2):66-73.



- Okeigbemen SA (2004). The prevalence of dental caries among 12-15 year old school children in Nigeria: Report of a local survey and campaign. *Oral Health Prev Dent.* 2:27-31.
- Okeigbemen SA, Ibiyemi O (2020). Prevention of dental caries in Nigeria: a narrative review of strategies and recommendations from 1999-2019. *J Int Soc Prev Community Dent.* 10(3): 240-245.
- Okolo CC, Oredugba, FA, Denloye OO, Adeyemo YI (2022). Dental caries prevalence, severity and pattern among male adolescents in Kano, Nigeria. *J West Afr Coll Surg.* 12:88-93.
- Olatosi OO, Inem V, Sofola OO, Prakash P, Sote EO (2015). The prevalence of early childhood caries and its associated risk factors among preschool children referred to a tertiary care institution. *Nig J Clinical Pract.* 18(4): 493-501.
- Onyejaka NK, Olatosi OO, Ndukwe NA, Amobi EO, Okoye LO, Nwamba NP (2021). Prevalence and associated factors of dental caries among primary school children in South-East Nigeria. *Nig J Clinical Pract.* 24(9): 1300-1306.
- Righolt AJ, Jevdjevic M, Marcenes W, Listl S (2018). Global-, regional-, and country-level economic impacts of dental diseases in 2015. *J Dent Res.* 97(5): 501-507.
- Shirzad M, Taghdisi MH, Dehdari T, Abolghasemi J (2016). Oral health education program among preschool children: an application of health-promoting schools approach. *Health Promot Perspect.* 6(3): 164-170. <https://doi.org/10.15171%2Fhpp.2016.26>
- World Health Organization (1998). WHO's global school health initiative. Health promoting schools. A healthy setting for living, learning and working. Geneva: World Health Organization.
- World Health Organization (2003a). The World oral health report, World Health Organization, Geneva, Switzerland.
- World Health Organization (2003b). WHO information series on school health: Document Eleven: Geneva.
- World Health Organization (2019). Ending childhood dental caries. WHO implementation manual. ISBN 978-92-4—000005-6.