UNDER PEER REVIEW

Assessment of Dental Caries Among School Children in Port Harcourt Local Government Area, Rivers State, Nigeria

ABSTRACT

Background: Dental caries is a leading chronic oral disease among school-aged children, yet school-based evidence linking oral hygiene practices to caries is scarce in Port Harcourt Local Government Area (LGA), Rivers State. **Objectives:** To determine the prevalence of dental caries, assess oral hygiene practices, examine dietary habits in relation to caries, and identify factors associated with caries among school children in Port Harcourt LGA.**Research questions:** What is the prevalence of caries? What are the children's oral hygiene practices and dietary habits? What factors are associated with caries?**Hypothesis:** H_0: There is no significant relationship between oral hygiene practices and dental caries.**Methods:** A school-based cross-sectional study of 384 junior secondary school students aged 10–14 years in public and private schools, selected by multistage sampling. Data came from a structured questionnaire and clinical examination using WHO criteria, and were analysed in SPSS 27 with descriptive statistics, Chi-square tests and binary logistic regression ($p < 0.05$).**Results:** Caries prevalence was 31.8% (95% CI: 27.1%–36.4%), mostly Class I (pit and fissure) lesions. Overall, 56.0% had poor oral hygiene practices, although 94.0% brushed and 62.2% used fluoride toothpaste; 50.3% brushed once daily. Sweet foods (88.5%) and soft drinks (82.6%) were commonly consumed. Of 19 oral hygiene practices tested, only not using the same toothpaste brand often ($p = 0.002$) and mouthwash use ($p = 0.047$) were associated with caries. H_0 was rejected for these two and retained for the other 17. Class grade was the only independent predictor: JSS1 pupils had higher odds of caries than JSS3 pupils (AOR = 1.81, 95% CI: 1.01–3.26; $p = 0.048$).**Conclusion:** About one in three school children had caries. Poor oral hygiene practices and sugary diets were common, but few practices were individually associated with caries, and the youngest students were most affected.**Recommendations:** Integrate oral health education into the curriculum from JSS1; supervise twice-daily brushing with fluoride toothpaste; regulate sugary snacks and drinks in schools; provide school-based screening, referral, fluoride and sealant programs; encourage parental supervision and regular dental check-ups; and conduct longitudinal studies adjusting for school clustering.

Keywords: *Dental caries; School children; Oral hygiene practices; Dietary habits; Junior secondary school; Port Harcourt; Nigeria.*

Introduction

Oral diseases affect nearly 3.5 billion people worldwide, and untreated caries of permanent teeth is among the most common health conditions globally (World Health Organization [WHO], 2022). Dental caries is a biofilm-mediated, sugar-driven disease in which bacterial acids demineralise tooth structure over time (Pitts et al., 2017). In children it is associated with pain, difficulty eating and speaking, school absence and reduced quality of life, although it is largely preventable through simple measures such as twice-daily brushing with fluoride toothpaste and limiting the frequency of sugar intake (Peres et al., 2019; FDI 2025: Moynihan & Kelly, 2014).

In Nigeria, caries remains an important problem among children and adolescents, with prevalence that varies by region, setting and study method. A recent ten-year systematic review and meta-analysis reported a pooled caries prevalence of 23% (95% CI: 16–30%) among Nigerian adolescents, with poor oral hygiene, between-meal refined carbohydrate intake and dental-service use among the factors examined (Afolabi et al., 2025). Oral health knowledge, attitudes and practices among Nigerian adolescents also differ by clinical and sociodemographic characteristics (Lawal & Oke, 2020), and barriers such as limited awareness, cost and uneven access to dental care persist even in urban areas.

Port Harcourt LGA is the urban core of Rivers State. Its rapid urbanisation, large number of public and private schools and wide socioeconomic differences expose school children to processed foods and sugary drinks, while the presence of dental facilities does not necessarily translate into better oral hygiene behaviour. Oral health research in Rivers State has included a study of adults in the neighbouring Obio-Akpor LGA (Arigbede & Iruobe, 2023), but to the authors' knowledge there is little recent school-based evidence from Port Harcourt LGA that links clinically assessed caries with the oral hygiene practices, dietary habits and sociodemographic characteristics of children in their school environment.

The study was informed by the Health Belief Model (Rosenstock, 1974) and the Theory of Planned Behaviour (Ajzen, 1991), which propose that preventive behaviours such as toothbrushing, dietary restraint and dental attendance depend on perceived susceptibility and severity, perceived benefits and barriers, attitudes, social norms and perceived control. Young adolescents in junior secondary school are increasingly responsible for their own oral hygiene, so this is a stage at which modifiable risk factors can be identified and addressed.(Folayan et al 2022)

This study therefore assessed dental caries among school children in Port Harcourt LGA, Rivers State. The specific objectives were to: (i) determine the prevalence of dental caries; (ii) assess oral hygiene practices; (iii) examine dietary habits in relation to dental caries; and (iv) identify factors associated with dental caries among school children in the LGA.

Materials and Methods

Study Area

The study was conducted in Port Harcourt LGA, one of the 23 LGAs of Rivers State and the administrative and urban core of the state, in the South-South geopolitical zone of Nigeria. The LGA covers about 109 km², lies in the Niger Delta between approximately latitudes 4.77° and 4.82° N and longitudes 7.00° and 7.03° E, and has a humid tropical climate with distinct wet and dry seasons. It is bordered by Obio/Akpor, Eleme, Okrika and Degema LGAs and lies close to the Bonny River (Figure 1). The 2006 national census recorded 538,558 people in the LGA (National Population Commission [NPC], 2006), and the population has since grown considerably.

Port Harcourt LGA is a cosmopolitan commercial and petroleum-industry centre with many government-owned and privately managed primary and secondary schools, and a range of health facilities, including dental clinics and tertiary hospitals, although access

to oral health services is uneven, particularly for children from lower-income households. This mix of school types and socioeconomic backgrounds makes it a suitable setting for studying caries among urban school children.



Figure 1: Geographical layout of Port Harcourt LGA, Rivers State, Nigeria (source: Google Maps, adapted by the author)

Study Design

A school-based cross-sectional design was used to assess the prevalence of dental caries and its associated factors among school children at a single point in time.

Study Population

The study population was junior secondary school (JSS1–JSS3) students aged 10–14 years attending public and private secondary schools in Port Harcourt LGA. Students in this age group remain vulnerable to caries while becoming increasingly responsible for their own oral hygiene and dietary choices, and both public and private schools were included to capture differences in socioeconomic background and school environment.

Sampling Techniques

A multistage sampling technique was used. In the first stage, the 272 registered secondary schools in the LGA (18 public and 254 private, from the official list of the Rivers State Ministry of Education) were stratified into public and private schools. In the second stage, 20 schools (2 public and 18 private) were selected by simple random sampling from the strata. In the third stage, one class arm each of JSS1, JSS2 and JSS3 was randomly selected in every selected school. In the fourth stage, eligible students were identified from the class registers and randomly selected until the required sample of 384 was reached.

Sample Size Determination

The minimum sample size was calculated with Cochran's formula for a single proportion:

$$n = Z^2 \times p \times q / d^2$$

where n is the minimum sample size, Z = 1.96 (95% confidence level), p is the assumed prevalence of dental caries, q = 1 − p and d is the margin of error (0.05). A prevalence of 35% (p = 0.35, q = 0.65) was assumed as a conservative working estimate, because local prevalence figures vary widely across Nigerian studies.

$$n = (1.96)^2 \times 0.35 \times 0.65 / (0.05)^2 = (3.8416 \times 0.2275) / 0.0025 = 0.8740 / 0.0025 = 349.6$$

To allow for a 10% non-response, the sample was increased by 10% (349.6 × 1.10 = 384.56). The final sample was 384 students (rounded down).

Inclusion Criteria

Students were included if they: (i) were enrolled in a selected public or private secondary school in the LGA in JSS1–JSS3; (ii) were aged 10–14 years; (iii) had parental or guardian consent and, where applicable, gave their own assent; and (iv) were present in school during data collection.

Exclusion Criteria

Students were excluded if they: (i) did not have parental or guardian consent or did not assent; (ii) were outside the 10–14-year age range; or (iii) were unable to undergo the oral

examination, for example because of acute illness or refusal on the day of data collection.

Research Instrument

Two instruments were used: a structured questionnaire and a clinical oral examination record sheet. The questionnaire, developed from standardised oral health research tools and aligned with the study objectives, covered sociodemographic characteristics (age, sex, class, school type and parental education and occupation); oral hygiene practices, including brushing frequency and timing, cleaning materials, fluoride toothpaste use, interdental cleaning, brushing duration, mouth rinsing, mouthwash use and dental visits; and dietary habits, including intake of sweet foods and soft drinks, bottle-feeding, parental supervision and rinsing after meals. The record sheet followed the WHO DMFT/dmft index for permanent and primary teeth (WHO, 2013), and children were classified as caries-free (score 0) or caries-present (score ≥ 1).

Content validity was ensured through expert review by dental public health specialists, and the questionnaire was pre-tested among 20 students in a comparable school outside the study area. Internal consistency was good (Cronbach's alpha = 0.81).

Methods of Data Collection

Data were collected from 2 to 11 July 2026 by trained research assistants, using an interviewer-administered questionnaire in a classroom setting and a clinical examination by a trained examiner using sterile mouth mirrors under adequate lighting. Teeth were recorded as decayed, missing due to caries, filled or sound. Data were entered directly into Kobo Collect, checked daily for completeness and consistency, and exported to IBM SPSS version 27. Carious lesions were also grouped by site using Black's classification (Class I: pit and fissure; Class II: proximal surfaces of posterior teeth; Class III: proximal surfaces of anterior teeth; Class IV: incisal edges; Class V: cervical or smooth surfaces).

Methods of Data Analysis

Data were analyzed with IBM SPSS Statistics version 27. Frequencies and percentages summarised sociodemographic characteristics, oral hygiene practices, dietary habits and caries status, and the 95% confidence interval of the prevalence was calculated. Oral hygiene practice was measured with 19 items scored 1 for correct and 0 for incorrect practice (range 0–19) and categorised as good (≥ 70%, 13–19 points) or poor (< 70%, 0–12 points), a cut-off commonly used in oral health practice studies. Caries was classified as present or absent using the WHO criteria. The Chi-square test assessed associations between caries and categorical variables, and variables in the multivariable model were entered into binary logistic regression, with results presented as crude (COR) and adjusted (AOR) odds ratios with 95% confidence intervals. Significance was set at $p < 0.05$. Sociodemographic variables and selected behavioural variables of theoretical interest were entered into the multivariable model regardless of their bivariate significance.

Ethical Considerations

Ethical approval was obtained from the Research Ethics Committee of the Faculty of Basic Medical Sciences, Rivers State University (RSU/FBMS/REC/26/535) before data collection, and the study followed the Declaration of Helsinki (World Medical Association, 2013). Parental or guardian consent was obtained for every child, and assent was obtained from the children where appropriate. Participants were informed of the objectives, procedures, risks and benefits and of their right to withdraw without consequence. Questionnaires carried unique codes instead of names, and data were kept in password-protected files accessible only to the research team.

Results

The 384 students were aged 10–14 years (Table 1). The most common age was 12 years (28.6%), followed by 11 years (25.3%); 51.8% were female and 62.5% attended public schools. The students were spread fairly

evenly across JSS1 (36.7%), JSS2 (36.5%) and JSS3 (26.8%). Most mothers had secondary (43.5%) or tertiary education (35.7%), and fathers mostly had tertiary (45.1%) or secondary education (39.3%). Self-employment (37.0%) and business (30.5%) were the commonest parental occupations

.**Table 1: Sociodemographic characteristics of the respondents (N = 384)**

Variable	Frequency (n)	Percentage (%)
Age (years)		
10	69	18.0
11	97	25.3
12	110	28.6
13	72	18.8
14	36	9.4
Gender		
Male	185	48.2
Female	199	51.8
School type		
Public	240	62.5
Private	144	37.5
Class grade		
JSS 1	141	36.7
JSS 2	140	36.5
JSS 3	103	26.8
Mother's level of education		
No formal education	16	4.2
Primary	64	16.7
Secondary	167	43.5
Tertiary	137	35.7
Father's level of education		
No formal education	10	2.6
Primary	50	13.0
Secondary	151	39.3
Tertiary	173	45.1
Parent/guardian occupation		
Civil/public servant	88	22.9
Self-employed	142	37.0
Student	10	2.6
Businessman/woman	117	30.5
Unemployed	27	7.0

Prevalence of dental caries

Overall, 122 of the 384 students (31.8%; 95% CI: 27.1–36.4) had dental caries and 262 (68.2%) were caries-free (Table 2). Prevalence was 36.1% at 11 years and 22.2% at 14 years, 34.7% in females and 28.6% in males, 33.3% in private and 30.8% in public schools, and highest in JSS1 (37.6%) and lowest in JSS3 (26.2%). Prevalence was 50.0% among students whose mothers had no formal education and 25.5% among those whose mothers had tertiary education, but these estimates rest on small groups (n = 16 and n = 137 respectively) and the confidence intervals are wide.

Table 2: Prevalence of dental caries across sociodemographic characteristics (N = 384)

Variable	Caries absent, n (%)	Caries present, n (%)	Prevalence (%)	95% CI
Overall prevalence	**262 (68.2)**	**122 (31.8)**	**31.8**	**27.1–36.4**
Age (years)				
10	47 (68.1)	22 (31.9)	31.9	20.9–42.9
11	62 (63.9)	35 (36.1)	36.1	26.6–45.7
12	78 (70.9)	32 (29.1)	29.1	20.6–37.6
13	47 (65.3)	25 (34.7)	34.7	23.7–45.7
14	28 (77.8)	8 (22.2)	22.2	8.6–35.8
Gender				
Male	132 (71.4)	53 (28.6)	28.6	22.1–35.1
Female	130 (65.3)	69 (34.7)	34.7	28.1–41.3
School type				
Public	166 (69.2)	74 (30.8)	30.8	25.0–36.6
Private	96 (66.7)	48 (33.3)	33.3	25.6–41.0
Class grade				
JSS 1	88 (62.4)	53 (37.6)	37.6	29.6–45.6
JSS 2	98 (70.0)	42 (30.0)	30.0	22.4–37.6
JSS 3	76 (73.8)	27 (26.2)	26.2	17.7–34.7
Mother's level of education				
No formal education	8 (50.0)	8 (50.0)	50.0	25.5–74.5
Primary	44 (68.8)	20 (31.3)	31.3	19.9–42.6
Secondary	108 (64.7)	59 (35.3)	35.3	28.1–42.6
Tertiary	102 (74.5)	35 (25.5)	25.5	18.2–32.8
Father's level of education				
No formal education	8 (80.0)	2 (20.0)	20.0	0.0–44.8*
Primary	33 (66.0)	17 (34.0)	34.0	20.9–47.1
Secondary	99 (65.6)	52 (34.4)	34.4	26.9–42.0

Tertiary	122 (70.5)	51 (29.5)	29.5	22.7–36.3
Parent/guardian occupation				
Civil/public servant	65 (73.9)	23 (26.1)	26.1	16.9–35.3
Self-employed	99 (69.7)	43 (30.3)	30.3	22.8–37.9
Student	5 (50.0)	5 (50.0)	50.0	19.0–81.0*
Businessman/woman	78 (66.7)	39 (33.3)	33.3	24.8–41.9
Unemployed	15 (55.6)	12 (44.4)	44.4	25.7–63.1

CI = confidence interval. *Interval based on a very small group (n = 10).

Class I (pit and fissure) lesions were the commonest clinical type, accounting for 62.3% of children with caries, followed by Class II (proximal posterior, 21.3%), Class V (cervical/smooth surface, 9.0%), Class III (proximal anterior, 4.9%) and Class IV (incisal edge, 2.5%) (Table 3). The distribution of lesion classes was almost identical across age, gender, school type and class grade.

Table 3: Distribution of dental caries clinical classes across sociodemographic characteristics

Variable	Total (N)	Caries n (%)	Class I (pit and fissure)	Class II (proximal posterior)	Class III (proximal anterior)	Class IV (incisal edge)	Class V (cervical/ smooth)
Age (years)							
10	69	22 (31.9)	14 (63.6)	4 (18.2)	1 (4.5)	1 (4.5)	2 (9.1)
11	97	35 (36.1)	22 (62.9)	7 (20.0)	2 (5.7)	1 (2.9)	3 (8.6)
12	110	32 (29.1)	20 (62.5)	7 (21.9)	2 (6.3)	0 (0.0)	3 (9.4)
13	72	25 (34.7)	15 (60.0)	6 (24.0)	1 (4.0)	1 (4.0)	2 (8.0)
14	36	8 (22.2)	5 (62.5)	2 (25.0)	0 (0.0)	0 (0.0)	1 (12.5)
Total	**384**	**122 (31.8)**	**76 (62.3)**	**26 (21.3)**	**6 (4.9)**	**3 (2.5)**	**11 (9.0)**
Gender							
Male	185	53 (28.6)	33 (62.3)	11 (20.8)	3 (5.7)	1 (1.9)	5 (9.4)
Female	199	69 (34.7)	43 (62.3)	15 (21.7)	3 (4.3)	2 (2.9)	6 (8.7)
School type							
Public	240	74 (30.8)	46 (62.2)	16 (21.6)	4 (5.4)	1 (1.4)	7 (9.5)
Private	144	48 (33.3)	30 (62.5)	10 (20.8)	2 (4.2)	2 (4.2)	4 (8.3)
Class grade							
JSS 1	141	53 (37.6)	33 (62.3)	11 (20.8)	3 (5.7)	1 (1.9)	5 (9.4)
JSS 2	140	42 (30.0)	26 (61.9)	9 (21.4)	2 (4.8)	1 (2.4)	4 (9.5)
JSS 3	103	27 (26.2)	17 (63.0)	6 (22.2)	1 (3.7)	1 (3.7)	2 (7.4)

Class percentages are proportions of children with caries in each row.

Oral hygiene practices

Overall, 215 students (56.0%) had poor and 169 (44.0%) good oral hygiene practice (Table 4a). Most students brushed their teeth (94.0%) with a toothbrush (93.2%), but only 39.3% brushed twice daily, 50.3% brushed once daily and 10.4% only sometimes. Evening brushing was missed by 27.9%, 39.8% sometimes skipped brushing and 46.6% ate or drank after evening brushing. Nearly all used toothpaste (95.3%), but 62.2% used fluoride toothpaste, 29.2% used non-fluoride toothpaste and 8.6% did not know (Table 4a). When asked about the toothpaste type, 74.5% reported a fluoride brand, 16.4% herbal, 4.7% charcoal and 4.4% other (Table 4b).

Table 4a: Oral hygiene practices of school children in Port Harcourt LGA (N = 384)

Variable	Frequency (n)	Percentage (%)
Overall oral hygiene practice level		
Poor practice	215	56.0
Good practice	169	44.0
Habit of brushing teeth		
Yes	361	94.0
No	23	6.0
Times brushed per day		
Sometimes	40	10.4
Once/day	193	50.3
Twice/day	151	39.3
Material used to clean teeth		
Toothbrush	358	93.2
Local chewing stick	26	6.8
When teeth are brushed		
Before breakfast	63	16.4
After breakfast	41	10.7
Before dinner	59	15.4
After dinner	61	15.9
Do not brush in the morning	53	13.8
Do not brush in the evening	107	27.9
Does not brush in the morning or evening at times		
No	231	60.2
Yes	153	39.8
Drinks or eats after brushing in the evening		
No	205	53.4
Yes	179	46.6

Uses toothpaste		
Yes	366	95.3
No	18	4.7
Uses toothpaste with fluoride		
With fluoride	239	62.2
Without fluoride	112	29.2
Do not know	33	8.6
How often teeth are brushed with toothpaste		
Often	327	85.2
Not often	57	14.8

Half of the students (51.3%) never brushed without toothpaste, 71.9% often used the same toothpaste brand, and 47.1% reported cleaning between the teeth with dental floss (Table 4b). Only 32.6% brushed for two minutes or longer (19.3% for two minutes and 13.3% for more than two minutes), while 20.8% brushed for less than 30 seconds. Mouth rinsing with water after brushing was rare, with 38.3% never rinsing and only 27.1% rinsing often or very often. Mouthwash was used by only 19.5%, and 47.4% could not remember their last dental visit, 7.8% had visited within the past year and 10.2% had never visited a dentist (Table 4c).

Table 4b: Oral hygiene practices of school children in Port Harcourt LGA (N = 384), continued

Variable	Frequency (n)	Percentage (%)
Type of toothpaste usually used		
Fluoride toothpaste	286	74.5
Herbal toothpaste	63	16.4
Charcoal toothpaste	18	4.7
Others	17	4.4
How often brushes without toothpaste		
Never	197	51.3
Once/day	40	10.4
More than twice/week	95	24.7
Once/week	34	8.9
Several times/month	18	4.7
Often uses the same brand of toothpaste		
Often	276	71.9
Not often	108	28.1
How teeth are cleaned in between		
Dental floss	181	47.1
Toothbrush	151	39.3
Toothpick	39	10.2

Interdental brush	13	3.4
Duration of brushing		
Less than 30 seconds	80	20.8
30 seconds	63	16.4
1 minute	54	14.1
Less than 2 minutes	62	16.1
2 minutes	74	19.3
More than 2 minutes	51	13.3
Dips toothbrush under running water when brushing		
Never	250	65.1
1–2 times	101	26.3
3 times or more	33	8.6
Rinses mouth with water after brushing		
No	147	38.3
Occasionally	133	34.6
Often	78	20.3
Very often	26	6.8

Table 4c: Oral hygiene practices of school children in Port Harcourt LGA (N = 384), continued

Variable	Frequency (n)	Percentage (%)
Amount of water used for rinsing		
Half glass	107	27.9
A handful	97	25.3
Full glass	93	24.2
Two handfuls	87	22.7
Use of mouthwash after brushing		
No	309	80.5
Yes	75	19.5
Last dental visit		
Do not remember	182	47.4
≤ 1 year	30	7.8
1–2 years	30	7.8
2–5 years	61	15.9
> 5 years	42	10.9
Never	39	10.2

Relationship between oral hygiene practices and dental caries

Most oral hygiene practices were not significantly associated with caries (Tables 5a–5c). Caries prevalence was similar among students who brushed (31.9%) and those who did not (30.4%; p = 0.887), and by brushing frequency (29.1% twice daily, 33.7% once daily and 32.5% sometimes; p = 0.665). Prevalence was higher among chewing-stick users (46.2%) than toothbrush users (30.7%), but the difference was not significant (p = 0.103), as were those for fluoride versus non-fluoride toothpaste (34.3% vs 28.6%; p = 0.350), brushing duration (p = 0.906), interdental cleaning method (p = 0.865), rinsing (p = 0.523) and recency of the last dental visit (p = 0.454).

Two practices were significantly associated with caries. Students who did not often use the same toothpaste brand had a higher prevalence (47 of 108, 43.5%) than those who did (75 of 276, 27.2%; $\chi^2 = 9.566$, p = 0.002). Mouthwash use was also associated with caries ($\chi^2 = 3.932$, p = 0.047), but in the unexpected direction: prevalence was 41.3% (31 of 75) among mouthwash users and 29.4% (91 of 309) among non-users (Table 5c).

Table 5a: Relationship between oral hygiene practices and dental caries (N = 384)

Variable	Caries free, n (%)	Caries present, n (%)	χ^2	p-value
Brush teeth			**0.020**	**0.887**
No	16 (69.6)	7 (30.4)		
Yes	246 (68.1)	115 (31.9)		
Frequency of tooth brushing			**0.816**	**0.665**
Sometimes	27 (67.5)	13 (32.5)		
Once/day	128 (66.3)	65 (33.7)		
Twice/day	107 (70.9)	44 (29.1)		
Cleaning material used			**2.661**	**0.103**
Toothbrush	248 (69.3)	110 (30.7)		
Local chewing stick	14 (53.8)	12 (46.2)		
Time of brushing			**0.959**	**0.966**
Do not brush in the evening	72 (67.3)	35 (32.7)		
Before breakfast	44 (69.8)	19 (30.2)		
After breakfast	28 (68.3)	13 (31.7)		
Do not brush in the morning	34 (64.2)	19 (35.8)		
Before dinner	40 (67.8)	19 (32.2)		
After dinner	44 (72.1)	17 (27.9)		
Skip brushing			**0.576**	**0.448**
No	161 (69.7)	70 (30.3)		
Yes	101 (66.0)	52 (34.0)		
Eat after evening brushing			**0.062**	**0.804**
No	141 (68.8)	64 (31.2)		

Yes	121 (67.6)	58 (32.4)		
Use toothpaste			**0.441**	**0.506**
No	11 (61.1)	7 (38.9)		
Yes	251 (68.6)	115 (31.4)		
Type of toothpaste			**2.102**	**0.350**
Do not know	25 (75.8)	8 (24.2)		
Fluoride toothpaste	157 (65.7)	82 (34.3)		
Non-fluoride toothpaste	80 (71.4)	32 (28.6)		
Brush with toothpaste			**0.794**	**0.373**
Not often	36 (63.2)	21 (36.8)		
Often	226 (69.1)	101 (30.9)		
Type of toothpaste brand			**5.000**	**0.172**
Fluoride toothpaste	197 (68.9)	89 (31.1)		
Herbal toothpaste	37 (58.7)	26 (41.3)		
Charcoal toothpaste	14 (77.8)	4 (22.2)		
Others	14 (82.4)	3 (17.6)		

Table 5b: Relationship between oral hygiene practices and dental caries (N = 384), continued

Variable	Caries free, n (%)	Caries present, n (%)	χ^2	p-value
Brush without toothpaste			**4.585**	**0.333**
Never	139 (70.6)	58 (29.4)		
Once/day	22 (55.0)	18 (45.0)		
> 2 times/week	65 (68.4)	30 (31.6)		
Once/week	25 (73.5)	9 (26.5)		
Several times/month	11 (61.1)	7 (38.9)		
Use same toothpaste brand			**9.566**	**0.002***
Not often	61 (56.5)	47 (43.5)		
Often	201 (72.8)	75 (27.2)		
Method of cleaning between teeth			**0.735**	**0.865**
Toothbrush	103 (68.2)	48 (31.8)		
Dental floss	126 (69.6)	55 (30.4)		
Toothpick	25 (64.1)	14 (35.9)		
Interdental brush	8 (61.5)	5 (38.5)		
Duration of brushing			**1.557**	**0.906**
< 30 seconds	53 (66.3)	27 (33.8)		
30 seconds	42 (66.7)	21 (33.3)		

1 minute	36 (66.7)	18 (33.3)		
< 2 minutes	44 (71.0)	18 (29.0)		
2 minutes	49 (66.2)	25 (33.8)		
> 2 minutes	38 (74.5)	13 (25.5)		
Frequency of dipping toothbrush			**0.743**	**0.690**
Do not know	24 (72.7)	9 (27.3)		
Never	167 (66.8)	83 (33.2)		
1–2 times	71 (70.3)	30 (29.7)		
Frequency of mouth rinsing			**2.245**	**0.523**
Do not know	17 (65.4)	9 (34.6)		
Never	58 (74.4)	20 (25.6)		
Occasionally	86 (64.7)	47 (35.3)		
Often	101 (68.7)	46 (31.3)		
Amount of water used for rinsing			**4.287**	**0.232**
A handful	74 (76.3)	23 (23.7)		
Two handfuls	59 (67.8)	28 (32.2)		
Half glass	70 (65.4)	37 (34.6)		
Full glass	59 (63.4)	34 (36.6)		

Table 5c: Relationship between oral hygiene practices and dental caries (N = 384), continued

Variable	Caries free, n (%)	Caries present, n (%)	χ^2	p-value
Use of mouthwash			**3.932**	**0.047***
No	218 (70.6)	91 (29.4)		
Yes	44 (58.7)	31 (41.3)		
Recent dental visit			**4.695**	**0.454**
Do not remember	133 (73.1)	49 (26.9)		
≤ 1 year	18 (60.0)	12 (40.0)		
1–2 years	18 (60.0)	12 (40.0)		
2–5 years	41 (67.2)	20 (32.8)		
> 5 years	26 (61.9)	16 (38.1)		
Never	26 (66.7)	13 (33.3)		

*Statistically significant ($p < 0.05$). Mouthwash rows are presented in line with the frequency distribution in Table 4c (309 non-users, 75 users).

Dietary habits

Most students consumed sweet foods (88.5%) and soft drinks (82.6%) (Table 6). Among all students, 10.4% reported eating sweet foods daily, 36.7% two to three days a week and 52.9% once a week. Overall, 28.9% had been bottle-fed in childhood and 20.6% did not know. Parents or guardians insisted on tooth brushing and dietary supervision for 68.8%, but 54.9% of the students did not rinse their mouth after meals.

Table 6: Dietary habits and oral health-related practices of school children (N = 384)

Variable	Frequency (n)	Percentage (%)
Consumption of sweet foods		
Yes	340	88.5
No	44	11.5
Frequency of sweet food consumption		
Daily	40	10.4
2–3 days per week	141	36.7
Once per week	203	52.9
Bottle feeding during childhood		
No	194	50.5
Yes	111	28.9
Do not know/cannot remember	79	20.6
Consumption of soft drinks		
Yes	317	82.6
No	67	17.4
Parental insistence on dietary supervision and tooth brushing		
Yes	264	68.8
No	120	31.3
Mouth rinsing after meals		
Yes	173	45.1
No	211	54.9

The three frequency categories add up to 384, although 44 students reported not eating sweet foods.

Factors associated with dental caries

In the multivariable model (Table 7), class grade was the only independent predictor of caries. JSS1 students had higher odds than JSS3 students (AOR = 1.81; 95% CI: 1.01–3.26; p = 0.048), whereas JSS2 students did not differ significantly (AOR = 1.29; 95% CI: 0.71–2.32). Children whose mothers had no formal education had almost three times the odds of caries of those whose mothers had tertiary education, significant in the crude analysis (COR = 2.91; 95% CI: 1.02–8.29; p = 0.046) but not after adjustment (AOR = 2.94; 95% CI: 0.98–8.80; p = 0.054). Age, school type, father's education, parental occupation, parental insistence on oral hygiene, history of dental aches, receipt of oral health education and rinsing the

mouth after meals were not significantly associated with caries in either analysis.

Table 7: Factors associated with dental caries among school children

Variable	COR (95% CI)	p-value	AOR (95% CI)	p-value
Age (years)				
10	1.64 (0.64–4.19)	0.301	1.66 (0.63–4.41)	0.310
11	1.98 (0.81–4.82)	0.133	2.11 (0.84–5.32)	0.111
12	1.44 (0.59–3.49)	0.424	1.52 (0.60–3.86)	0.375
13	1.86 (0.74–4.66)	0.187	2.07 (0.79–5.40)	0.140
14 (reference)	1	–	1	–
School type				
Public	0.89 (0.57–1.38)	0.611	0.92 (0.58–1.45)	0.715
Private (reference)	1	–	1	–
Class grade				
JSS 1	1.70 (0.97–2.96)	0.063	1.81 (1.01–3.26)	0.048*
JSS 2	1.21 (0.68–2.14)	0.518	1.29 (0.71–2.32)	0.410
JSS 3 (reference)	1	–	1	–
Mother's level of education				
No formal education	2.91 (1.02–8.29)	0.046	2.94 (0.98–8.80)	0.054
Primary	1.33 (0.69–2.55)	0.399	1.30 (0.66–2.55)	0.452
Secondary	1.59 (0.97–2.61)	0.067	1.61 (0.96–2.68)	0.072
Tertiary (reference)	1	–	1	–
Father's level of education				
No formal education	0.60 (0.12–3.29)	0.525	0.58 (0.11–2.99)	0.515
Primary	1.23 (0.63–2.42)	0.541	1.11 (0.55–2.23)	0.780
Secondary	1.26 (0.79–2.00)	0.339	1.26 (0.77–2.04)	0.365
Tertiary (reference)	1	–	1	–
Parent/guardian occupation				
Civil/public servant	0.44 (0.18–1.08)	0.074	0.46 (0.18–1.17)	0.104
Self-employed	0.54 (0.23–1.27)	0.154	0.58 (0.24–1.43)	0.228
Student	1.25 (0.29–5.37)	0.764	1.36 (0.30–6.15)	0.695
Businessman/woman	0.63 (0.27–1.46)	0.279	0.62 (0.25–1.49)	0.282
Unemployed (reference)	1	–	1	–
Parental insistence on oral hygiene				
No	0.62 (0.38–1.01)	0.056	0.65 (0.39–1.08)	0.091
Yes (reference)	1	–	1	–
Dental aches				
No	1.19 (0.76–1.86)	0.445	1.25 (0.77–2.03)	0.359

Yes (reference)	1	–	1	–
Received oral health education				
No	1.07 (0.69–1.67)	0.763	1.04 (0.65–1.66)	0.874
Yes (reference)	1	–	1	–
Mouth washing with water after meals				
No	0.96 (0.63–1.46)	0.850	0.93 (0.59–1.48)	0.761
Yes (reference)	1	–	1	–

COR = crude odds ratio; AOR = adjusted odds ratio; CI = confidence interval. *p < 0.05.

Discussion

This study assessed dental caries, oral hygiene practices, dietary habits and associated factors among junior secondary school students in Port Harcourt LGA. About one in three students had caries, oral hygiene practices were suboptimal despite near-universal brushing, sweet foods and soft drinks were widely consumed, and class grade was the only independent predictor of caries.

Prevalence of dental caries

The prevalence of 31.8% (95% CI: 27.1–36.4) is higher than the pooled 23% (95% CI: 16–30%) reported for Nigerian adolescents in a recent meta-analysis (Afolabi et al., 2025), and the lower limit of our interval lies above the upper limit of theirs. This is consistent with the idea that caries remains a substantial problem among urban school children, but meta-analytic estimates combine different settings, ages and diagnostic criteria, so differences in setting and method may explain part of the gap. As in that review, prevalence was somewhat higher in females (34.7% vs 28.6%; pooled 22% vs 16%), although in our data the confidence intervals for the sexes overlapped, as they did for school type and age groups, so these differences should not be over-interpreted. Class I pit-and-fissure lesions made up almost two-thirds of the lesions, a pattern that was the same across all subgroups and that points to the occlusal surfaces of newly erupted permanent molars as the main target for preventive measures such as fluoride use and sealants.

Oral hygiene practices

Although 94.0% of students brushed and 95.3% used toothpaste, 56.0% had poor overall practice. Only 39.3% brushed twice daily, 27.9% did not brush in the evening, nearly half ate or drank after evening brushing, and only a third brushed for the recommended two minutes. Use of fluoride toothpaste was reported by 62.2% of students on one question and by 74.5% on another that asked about the type of toothpaste, and about 9% did not know whether their toothpaste contained fluoride, which suggests limited awareness of the preventive role of fluoride. Dental attendance was low: 7.8% had visited a dentist within a year and almost half could not remember their last visit, which suggests that care is sought mainly when symptoms occur. These findings agree with the broader Nigerian picture, in which daily toothbrushing, fluoride toothpaste use and dental-service use are the main preventive behaviours examined and poor oral hygiene is a recurrent correlate of caries (Afolabi et al., 2025; Lawal & Oke, 2020). Because the practices were self-reported, they may be overstated, and interdental cleaning with floss (47.1%) in particular may reflect socially desirable responses.

Oral hygiene practices and dental caries

Only two of 19 practices were significantly associated with caries, and neither was a conventional protective behaviour. Brushing, brushing frequency, fluoride toothpaste, brushing duration and recency of dental visits were not associated with caries. With so many comparisons, one or two nominally significant results at $p < 0.05$ can arise by chance, and the finding that students who often changed toothpaste brand had more caries (43.5% vs 27.2%) has no obvious mechanism, although frequently changing brands may reflect inconsistent routines. The higher prevalence among mouthwash users (41.3% vs 29.4%) is likely explained by reverse causation, since students with dental problems may be more likely to use mouthwash, and mouthwash is in any case an adjunct to, rather than a substitute for, brushing with fluoride toothpaste. Lack of association between self-reported brushing and caries in a cross-sectional study is common, because current practice may not reflect the cumulative exposure that produced existing lesions. These results should be confirmed with verified coding of the mouthwash variable and with analyses that adjust for other factors.

Dietary habits

Most students consumed sweet foods (88.5%) and soft drinks (82.6%), and 10.4% ate sweet foods daily. The evidence reviewed to inform WHO guidelines supports a relationship between the amount of sugars consumed and caries (Moynihan & Kelly, 2014), and between-meal refined carbohydrate intake was among the factors examined in Nigerian adolescents (Afolabi et al., 2025). Our dietary variables were not cross-tabulated with caries status, so this study describes exposure to a recognised risk factor but cannot show whether it explains the caries observed. Parental supervision of brushing and diet was reported by 68.8% of students, yet the adjusted odds of caries were not higher among children whose parents did not insist on oral hygiene (AOR = 0.65; 95% CI: 0.39–1.08). This unexpected direction may reflect parents becoming more involved after a child has had dental problems, or the self-reported nature of the measure.

Factors associated with dental caries

JSS1 students had about 1.8 times the odds of caries of JSS3 students after adjustment, while age was not independently associated with caries. One possible explanation is that students who have just entered secondary school have less established self-care routines, but the lower confidence limit was close to 1 (1.01), the result was borderline ($p = 0.048$), and the study did not measure the explanations offered, so the finding should be regarded as hypothesis-generating. Children of mothers with no formal education had almost three times the odds of caries in the crude analysis, and the adjusted estimate was of similar size (AOR = 2.94) but not significant ($p = 0.054$), with only 16 children in this group, so the estimate is imprecise. Taken together, the results suggest that maternal education may matter, but they do not demonstrate it. Other socio-demographic and behavioural factors were not significantly associated with caries, which is consistent with caries being a multifactorial disease in which no single characteristic dominates.

The findings support school-based oral health programmes in public and private schools that begin at entry into secondary school and combine education with practical measures: twice-daily brushing with fluoride toothpaste, reduced frequency of sugary snacks and drinks, avoiding food after evening brushing, and routine dental screening and referral. Longitudinal studies and analyses that account for clustering within schools are needed to clarify causal relationships.

WHO criteria, and the sample included both public and private schools, which gives useful evidence for oral health planning in Port Harcourt LGA.

Limitations of the Study

1. The cross-sectional design assessed exposures and outcomes at one point in time, so the associations observed do not establish causal relationships.
2. Oral hygiene practices, dietary habits, parental supervision and dental attendance were self-reported and may be affected by recall and social desirability bias.
3. The study included only junior secondary school students in 20 selected public and private schools in Port Harcourt LGA, so the findings may not apply to children who are out of school, to primary or senior secondary students, or to other LGAs. Public schools contributed 240 of the 384 students from only two schools, and the analysis did not adjust for clustering of students within schools, which may make the confidence intervals too narrow.
4. Several determinants were not assessed, including salivary factors, fluoride exposure, bacterial profile, household income and access to preventive dental services, and dietary habits were not cross-tabulated with caries status.
5. Examiner calibration was not formally reported, so inter-examiner reliability of the clinical diagnosis is unknown.
6. Diet was measured with a structured questionnaire rather than a validated dietary assessment such as repeated 24-hour recalls, so actual quantity and frequency of cariogenic intake may not be captured.
7. The multivariable model contained variables that were not shown to be significant in bivariate analysis, and the number of comparisons raises the possibility of chance findings.

Despite these limitations, caries was assessed by clinical examination using

Conclusion

Dental caries affected 31.8% of the school children examined in Port Harcourt Local Government Area, with Class I pit-and-fissure lesions accounting for most cases. Although toothbrushing and toothpaste use were common, more than half of the students were classified as having poor overall oral hygiene practices, and twice-daily brushing was reported by fewer than half. Sweet-food and soft-drink consumption was also common. Most individual oral hygiene practices were not significantly associated with caries. After adjustment for the variables included in the model, JSS1 students had higher odds of caries than JSS3 students, although the association was borderline. These findings support strengthened school-based oral health education, appropriate preventive practices and routine dental screening, while further longitudinal research is needed to clarify the observed associations.

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Declaration of AI Use

This manuscript was prepared through the intellectual contributions of the author(s) to the study design, data analysis, interpretation of results, and scholarly content. Grammarly and ChatGPT were used solely to assist with grammatical refinement and reference formatting during manuscript revision. The author(s) accept full responsibility for the accuracy, integrity, and final content of the manuscript.