v2: 13 May 2025

Research Article

The Influence of Glycemic Status and Sociodemographic Factors on Patients′ Dental Caries Risk and Experience in Lagos, Nigeria

Peer-approved: 12 May 2025

Qeios, Vol. 7 (2025)
ISSN: 2632-3834

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Background: Diabetes mellitus (DM) is a chronic metabolic disorder with systemic and oral health implications, including an increased risk of dental caries. This study investigates the associations between glycemic status, sociodemographic factors, and caries risk and experience, utilizing robust statistical analyses to understand these relationships comprehensively.
Methods: A cross-sectional study was conducted among diabetic and non-diabetic individuals, with data collected on sociodemographic characteristics, glycemic status, and oral health indicators. Caries risk and experience were assessed using standard clinical diagnostic criteria. Bivariate analyses (chi-square and t-tests) were performed to examine associations between categorical and continuous variables. At the same time, multivariate logistic regression models were employed to adjust for potential confounders and determine independent predictors of caries risk and experience. Adjusted odds ratios [aOR] with 95%CI were reported.
Results: Diabetics had a significantly higher mean age (59.49±13.06) than non-diabetics (48.39±16.97, $p<0.001$). Female participants were more prevalent among diabetics (56.4%, $p=0.002$), and lower educational attainment was more common (69.4% had primary education, $p=0.010$). Income disparities were observed, with diabetics more frequently belonging to the lowest income category (<10,000; 88.9%, $p<0.001$). Bivariate analyses revealed a strong association between diabetes and high caries risk ($p<0.001$). Among diabetics, individuals with lower income and education had significantly higher odds of developing new caries over 36 months. Ethnicity was also a significant factor, with Yoruba participants showing the highest proportion of moderate caries risk, while Igbo participants exhibited greater caries prevalence.
Conclusion: Diabetes is a determinant of caries risk and experience, with sociodemographic disparities further exacerbating oral health inequalities. The findings emphasize the necessity of targeted preventive interventions, routine dental screenings, and oral health education tailored to high-risk

 doi.org/10.32388/XH6P7X.4

diabetic populations. Future longitudinal studies are recommended to explore the causal pathways underlying these associations.

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Introduction

Diabetes mellitus (DM) encompasses a group of metabolic disorders marked by elevated blood glucose levels due to impairments in insulin production, insulin function, or a combination of both.[1] Diabetes mellitus (DM) is a globally prevalent chronic metabolic disorder, In 2021, there were 529 million (95% uncertainty interval [UI] 500-564) people living with diabetes worldwide, and the global age-standardised total diabetes prevalence was 6·1% (5·8-6·5). At the super-region level, the highest age-standardised rates were observed in north Africa and the Middle East (9·3% [8·7-9·9]) and, at the regional level, in Oceania (12·3% [11·5-13·0]).[2] In 2025, DM was responsible for an estimated USD 1.015 trillion in global health expenditure in 2024, a 338% increase over the past 17 years.[3] DM involves a complex interaction of factors that affect both microvascular and macrovascular structures.[4] The microvascular complications associated with diabetes mellitus include retinopathy, nephropathy, and neuropathy, while it also has detrimental effects on the macrovascular system, leading to the development of atherosclerosis, coronary artery disease (CAD), stroke, and peripheral arterial disease (PAD). [4] Additionally, diabetes has significant oral health implications, with a well-documented association with periodontal disease, salivary dysfunction, and increased susceptibility to oral infections. [5][6] Despite this, the relationship between diabetes and dental caries remains an area of ongoing investigation, with conflicting epidemiological evidence regarding the caries risk and experience in diabetic individuals, with some studies reporting a greater history of dental caries among people with DM. [7][8]

Dental caries is a multifactorial, biofilm-mediated, and sugar-driven disease that results in the demineralization of dental hard tissues due to acid production by bacterial metabolism of fermentable carbohydrates. It is characterized by a dynamic mineral loss and gain process, ultimately leading to cavitation if left untreated.[9] Some studies report a higher prevalence of dental caries among diabetic individuals, particularly root caries, due to salivary dysfunction and alterations in the oral microbiome. [10][11] A previous Nigerian study also observed a positive association, even though it was descriptive without matched controls.[12] Conversely, other studies find no significant difference in caries experience between diabetic and non-diabetic populations, highlighting the need for further research to elucidate the mechanisms linking diabetes to caries risk. [13][14][15][16] These inconsistencies may stem from variations in glycemic control, oral hygiene practices, dietary habits, and healthcare accessibility among individuals with diabetes. [10][11][12][13][14][15][16]

The pathophysiological mechanisms by which diabetes influences caries risk are multifaceted. Persistent hyperglycemia leads to an increase in advanced glycation end products (AGEs), which promote inflammatory responses and impair tissue repair. Additionally, diabetes-induced changes in salivary flow and composition reduce its protective buffering capacity, leading to a lower pH and increased demineralization of dental enamel.[17] The presence of increased glucose levels in saliva may also promote the proliferation of cariogenic bacteria such as Streptococcus mutans and Lactobacillus species, further exacerbating caries risk.[10] Individuals with uncontrolled diabetes are particularly vulnerable, as impaired immune responses and delayed wound healing contribute to a greater burden of oral infections, including caries and periodontal disease. [17]

Given the possibility of a heightened risk of dental caries and other oral health complications in diabetic populations and the inconclusive evidence surrounding the association between diabetes and caries experience, as well as the dearth of research on this field in Nigeria, we aim to determine how the caries experience differ between individuals with T2DM and non-diabetic controls, and what the implications are for caries risk management. Thus, this study aims to determine the clinical and subjective oral health indicators among individuals with type 2 diabetes mellitus (T2DM) and compare them with non-diabetic controls. The findings will contribute to a better understanding of caries risk in diabetic individuals and inform strategies for improving oral health outcomes in this vulnerable population.

 doi.org/10.32388/XH6P7X.4

Methodology

Study Design and Ethical Considerations: This study was designed as a controlled cross-sectional investigation aimed at assessing the oral health status and its association with glycemic control in individuals with type 2 diabetes mellitus (T2DM) at the Lagos State University Teaching Hospital (LASUTH), Lagos, Nigeria. Ethical approval was obtained from the Health Research and Ethics Committee of Lagos State University Teaching Hospital (LASUTH), ensuring compliance with ethical standards for human research. All participants provided written informed consent after being adequately informed about the study's objectives, procedures, and potential implications. In addition, participants received education on their oral health status and were referred for appropriate dental care when necessary.

Study Population and Sampling Strategy: A total of 301 participants were recruited for this study, consisting of 151 individuals diagnosed with T2DM and 150 non-diabetic controls. The diabetic group comprised 37 males and 114 females, while the non-diabetic group consisted of 62 males and 88 females. Participants in the diabetic cohort were selected from the specialized diabetes clinic at LASUTH, while the non-diabetic control group was drawn from the outpatient family medicine clinic of the same institution. A simple random sampling method was employed to ensure adequate representation of both diabetic and non-diabetic individuals while maintaining similarity in key demographic characteristics such as age and gender. Simple random sampling was done using balloting, with the appointment register serving as the sampling frame. Eligible patients were assigned numbers, and selections were made by blindly drawing numbered slips to ensure unbiased participant selection.

Inclusion and Exclusion Criteria: Participants were included in the study based on well-defined eligibility criteria. For the diabetic group, only individuals with a confirmed diagnosis of T2DM for at least one year were included, evidenced by glycosylated hemoglobin (HbA1c) levels ≥6.5% (≥48 mmol/mol). Additionally, participants were required to be actively receiving care at a specialized diabetes clinic and to have a minimum of ten natural teeth remaining. Those with a history of antibiotic, steroidal, or non-steroidal anti-inflammatory drug use within the past six months were excluded, as were individuals undergoing immunosuppressive therapy or chemotherapy. The study also excluded participants with any acute illness at the time of assessment, those who had received professional dental treatment such as dentures, implants, or orthodontic appliances within the past six months, and pregnant or lactating women. For the non-diabetic control group, participants met the same criteria except for the absence of a diabetes diagnosis. To ensure the validity of their non-diabetic status, those with glycosylated hemoglobin (HbA1c) levels ≤5.6% (≤39 mmol/mol), and only those with normal blood glucose levels were included. Due to the descriptive and exploratory design of this study, detailed clinical indicators of glycaemic status, such as repeat HbA1c levels, duration of diabetes, and comprehensive blood glucose profiles, were not included in the data collection. Participants were identified based on recent blood glucose testing for patients with diabetes, and the study focused on characterizing dental caries patterns within this population rather than establishing causal relationships.

Data Collection and Questionnaire Administration: A structured questionnaire, which was adapted from previous authors, as well as the CAMBRA caries assessment tool[7][8][12][18] was administered to all participants in English language by trained research assistants who were resident doctors. The questionnaire was designed to capture relevant demographic, medical, and behavioral information. Data on socio-demographic characteristics such as age, gender, education level, and employment status were recorded. Education level was categorized as illiterate (no formal education) or literate (having primary, secondary, or tertiary education), while employment status was classified as either employed or unemployed, with the latter category including retirees, students, and homemakers. Lifestyle factors, including smoking status, alcohol consumption, sugary drink intake, and frequency of dental visits, were also assessed.

Oral Clinical Examination: A single, calibrated examiner, with intra-examiner reliability assessed using a Kappa (score of 0.95 from 20 patients examined), conducted all oral examinations to ensure consistency. Calibration and training were carried out at the Department of Preventive Dentistry, LASUTH. The clinical assessment involved an evaluation of oral tissues and an assessment for dental caries. Oral examinations were done using plane mouth mirrors and blunt dental probes in a well-lit and airy room, using portable LED headlamps, supplemented by natural light and reflective mirrors, to ensure adequate illumination. Dental caries was assessed using the Decayed, Missing, and Filled Teeth (DMFT) index. Caries risk assessment was conducted using an

objective framework incorporating clinical and behavioral factors. Patients were categorized into low, moderate, or high risk based on caries history, dietary habits, topical fluoride exposure, oral hygiene status, and systemic conditions. Low risk included individuals with no new carious lesions, good oral hygiene, minimal sugar intake, and regular fluoridated toothpaste use. Moderate risk comprised those with occasional caries, inconsistent oral hygiene, moderate sugar consumption, and irregular fluoride exposure. High risk was defined by multiple active caries, poor oral hygiene, frequent sugar intake, low fluoride exposure, and other underlying systemic conditions like Sjögren's syndrome that may predispose to caries.

Statistical Analysis: All data were analyzed using SPSS version 26.0, with statistical significance set at $p < 0.05$. Descriptive statistics, including means and standard deviations, were computed for continuous variables, while categorical variables were presented as frequencies and percentages. To compare characteristics between the diabetic and non-diabetic groups, chi-square tests were used for categorical variables, while independent sample t-tests were employed for continuous variables. To assess the association between diabetes status and dental caries, binary logistic regression was used to calculate adjusted odds ratios (ORs), accounting for potential confounders such as employment status, education level, smoking, and sugary drink consumption. High and moderate caries risk were dichotomized into high, while low caries risk was retained as low for the analysis.

Results

Table 1 presents participants' sociodemographic characteristics and their association with caries risk and experience. The mean age was significantly higher among diabetics (59.49±13.06) than non-diabetics (48.39±16.97, $p<0.001$). Gender distribution shows a higher proportion of females among diabetics (56.4%) than males (37.4%, $p=0.002$). Education levels varied, with primary education being more common among diabetics (69.4%) than non-diabetics (30.6%, $p=0.010$), while university education was more common among non-diabetics (60.8%). Income distribution revealed that the lowest income category (<10,000) was significantly more common among diabetics (88.9%) than non-diabetics (11.1%, $p<0.001$). Yoruba ethnicity was the most represented among diabetics (52.2%, $p=0.002$), while Igbo participants had a higher proportion among diabetics (63.6%) than non-diabetics (36.4%). Among diabetics, 75.0% had a high caries risk, compared to 25.0% of non-diabetics. The proportion of participants with no new caries over 36 months was similar across groups (49.8% diabetics vs. 50.2% non-diabetics, $p=0.751$). Participants with lower educational attainment had higher caries risk, with 69.4% of diabetics with primary education reporting caries compared to 30.6% of non-diabetics ($p=0.010$). Individuals in the lowest income bracket (<10,000) had the highest prevalence of caries (88.9%) compared to higher-income groups ($p<0.001$).

	Glycemic status			
	Diabetic (%)	**Non-diabetic (%)**	X^2	**P value**
Age (Mean ± SD)	59.49±13.062	48.39±16.968	t=6.359	<0.001*
Gender				
Male	37 (37.4%)	62 (62.6%)	9.656[a]	0.002*
Female	114 (56.4%)	88 (43.6%)		
Education				
Primary	25(69.4)	11 (30.6)	13.209[a]	0.010*
Junior secondary	9 (60.0)	6 (40.0)		
Senior secondary	43 (56.6)	33 (43.4)		
Polytechnic	25 (51.0)	24 (49.0)		
University	49 (39.2)	76 (60.8)		
Income				
<10,000	16 (88.9)	2 (11.1)	41.721[a]	<0.001*
10,000-20,000	11 (73.3)	4 (26.7)		
20,000-50,000	12 (54.5)	10 (45.5)		
50,000-100,000	24 (77.4)	7 (22.6)		
100,000-150,000	19 (54.3)	16 (45.7)		
>150,000	21 (42.9)	28 (57.1)		
Don't know	18 (58.1)	13 (41.9)		
Choose not to answer	30 (30.0)	70 (70.0)		
Ethnicity				
Yoruba	109 (52.2)	100 (47.8)	11.990[a]	0.002*
Igbo	28 (63.6)	16 (36.4)		
Others	14 (29.2)	34 (70.8)		

Table 1. Sociodemographic Characteristics

Table 2 examines the distribution of caries risk and experience across glycemic groups. A higher proportion of diabetics (75.0%) had high caries risk compared to non-diabetics (25.0%). The moderate caries risk group was nearly equally distributed between diabetics

doi.org/10.32388/XH6P7X.4

(49.8%) and non-diabetics (50.2%). Over 36 months, 52.5% of diabetics developed 1 or 2 new caries compared to 47.5% of non-diabetics. The overall presence of cavitated lesions was comparable across groups, suggesting similar caries progression despite glycemic differences.

doi.org/10.32388/XH6P7X.4

	Glycemic status			
	Diabetic (%)	**Non-diabetic (%)**	X^2	**P value**
Caries risk				
Low risk	11 (50.0%)	11 (50.0%)	0.958[b]	0.724
Moderate risk	137 (49.8%)	138 (50.2%)		
High risk	3 (75.0)	1 (25.0)		
Cavitation				
No new caries (36 months)	130 (49.8)	131 (50.2)	0.101[a]	0.751
1 or 2 caries (36 months)	21 (52.5)	19 (47.5)		

Table 2. Association between Glycemic status and Caries risk/ Caries experience

Table 3 assesses the distribution of caries experience across sociodemographic characteristics. Participants with 1 or 2 caries had a lower mean age (47.95±17.33) compared to those with no new caries (54.88±15.74, p=0.011). Females were more likely to have new caries (52.5%) compared to males (47.5%, p=0.035). Among participants earning >150,000, 30.0% had new caries, the highest among income groups (p=0.011). Yoruba participants had the highest proportion of those without new carious lesions (69.0%), whereas the presence of caries was higher among Igbo participants (15.0%).

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	Caries			
	No new caries (%)	**1 or 2 caries (%)**	X^2	**P value**
Age (Mean ± SD)	54.88±15.737	47.95±17.334	t=2.558	0.011*
Gender				
Male	80 (30.7%)	19 (47.5%)	4.461[a]	0.035*
Female	181 (69.3%)	21 (52.5%)		
Education				
No tertiary education	109 (41.8)	18 (45.0)	0.149[a]	0.699
Tertiary education	152 (58.2)	22 (55.0)		
Income				
<10,000	12 (4.6)	6 (15.0)	16.903 [b]	0.011*
10,000-20,000	12 (4.6)	3 (7.5)		
20,000-50,000	20 (7.7)	2 (5.0)		
50,000-100,000	26 (10.0)	5 (12.5)		
100,000-150,000	33 (12.6)	2 (5.0)		
>150,000	37 (14.2)	12 (30.0)		
Don't know	28 (10.7)	3 (7.5)		
Choose not to answer	93 (35.6)	7 (17.5)		
Ethnicity				
Yoruba	180 (69.0)	29 (72.5)	0.411[a]	0.814
Igbo	38 (14.6)	6 (15.0)		
Others	43 (16.5)	5 (12.5)		

Table 3. Association between Sociodemographic Characteristics and Caries experience

Table 4 evaluates the association of sociodemographic factors with caries risk. Participants with high caries risk had the highest mean ages (58.50±11.27), while those with low risk had the lowest (48.36±14.98, p=0.210). Among individuals with tertiary education, 81.8% had low-risk compared with those without tertiary education 18.25 had low risk (p=0.043). Yoruba participants had the highest proportion of moderate caries risk (70.5%), while those categorized as 'Others' had the highest prevalence of high caries risk (50.0%).

doi.org/10.32388/XH6P7X.4

	Caries risk				
	Low risk (%)	Moderate (%)	High risk (%)	X^2	P-value
Mean Age ± SD	48.36±14.975	54.34±16.196	58.50±11.269	F=1.571	0.210
Gender					
Male	6 (27.3)	91 (33.1)	2 (50.0)	1.003[b]	0.637
Female	16 (72.7)	184 (66.9)	2 (50.0)		
Education					
No tertiary education	4 (18.2)	121 (44.0)	2 (50.0)	5.945[b]	0.043*
Tertiary education	18 (81.8)	154 (56.0)	2 (50.0)		
Ethnicity					
Yoruba	14 (63.6)	194 (70.5)	1 (25.0)	6.076[b]	0.140
Igbo	5 (22.7)	38 (13.8)	1 (25.0)		
Others	3 (13.6)	43 (15.6)	2 (50.0)		

Table 4. Association between Sociodemographic characteristics and Caries risk

Table 5 presents the association of glycemic status with caries experience. Among diabetics, individuals with no new caries had a higher mean age (60.07±12.62) than those with new caries (55.90±15.38). In contrast, among non-diabetics, those with new caries had a significantly lower mean age (39.16±15.25) compared to those without (49.73±16.84). Among Igbo participants, the prevalence of 1 or 2 caries was highest among diabetics (83.3%) compared to non-diabetics (16.7%). There were no significant differences in caries experience based on education levels between diabetics and non-diabetics.

doi.org/10.32388/XH6P7X.4

Variables			No caries	1 or 2 caries	X^2	p-value
Mean Age± SD	Diabetic Non-diabetic	60.07±12.621 49.73±16.838	55.90 ±15.381 39.16±15.254	1.588	0.209	
Gender	Male	Diabetic Non-diabetic	27 (33.8) 53 (66.3)	10 (52.6) 9 (47.4)	2.339[a]	0.126
	Female	Diabetic Non-diabetic	103 (56.9) 78 (43.1)	11 (52.4) 10 (47.6)	0.157[a]	0.692
Ethnicity	Yoruba	Diabetic Non-diabetic	93 (51.7) 87 (48.3)	16 (55.2) 13 (44.8)	0.123[a]	0.726
	Igbo	Diabetic Non-diabetic	23 (60.5) 15 (39.5)	5 (83.3) 1 (16.7)	1.165[a]	0.280
	Others	Diabetic Non-diabetic	14 (32.6) 29 (67.4)	0 (0.0) 5 (100.0)	2.298[a]	0.130
Education	No tertiary education	Diabetic Non-diabetic	66 (60.6) 43 (39.4)	11 (61.1) 7 (38.9)	0.002[a]	0.964
	Tertiary education	Diabetic Non-diabetic	64 (42.1) 88 (57.9)	10 (45.5) 12 (54.5)	0.088[a]	0.766

Table 5. Association between Sociodemographic characteristics and Caries experience among the glycemic groups

Table 6 examines the distribution of caries risk across glycemic groups. Among diabetics, the mean age increased with caries risk: low (54.73±12.76), moderate (59.84±13.12), and high (61.33±11.93). Among non-diabetics, the highest mean age was observed in the moderate-risk group (48.89±17.13). Female diabetics were more likely to have moderate caries risk (56.5%), and high caries risk, while no cases of high risk were recorded among non-diabetic females. Yoruba participants were most prevalent in the moderate-risk group for both diabetics (51.0%) and non-diabetics (49.0%). Among diabetics, those with no tertiary education were more likely to have moderate caries risk (59.5%). These findings emphasize variations in caries risk based on glycemic status and sociodemographic factors.

doi.org/10.32388/XH6P7X.4

Variables			Low	Moderate	High risk	X^2	p-value
Mean Age± SD	Diabetic Non-diabetic	54.73±12.760 42.00±14.799	59.84±13.118 48.89±17.135	61.33±11.930 50.00	F=0.035	0.965	
Gender	Male	Diabetic Non-diabetic	3 (50.0) 3 (50.0)	33 (36.3) 58 (63.7)	1(50.0) 1 (50.0)	1.020[b]	0.715
	Female	Diabetic Non-diabetic	8 (50.0) 8 (50.0)	104 (56.5) 80 (43.5)	2 (100.0) 0 (0.0)	1.476[b]	0.476
Ethnicity	Yoruba	Diabetic Non-diabetic	9 (64.3) 5 (35.7)	99 (51.0) 95 (49.0)	1 (100.0) 0 (0.0)	1.749[b]	0.414
	Igbo	Diabetic Non-diabetic	1 (20.0) 4 (80.0)	26 (68.4) 12 (31.6)	1 (100.0) 0 (0.0)	4.642[b]	0.051
	Others	Diabetic Non-diabetic	1 (33.3) 2 (66.7)	12 (27.9) 31 (72.1)	1 (50.0) 1 (50.0)	1.109[b]	0.740
Education	No tertiary education	Diabetic Non-diabetic	4 (100.0) 0 (0.0)	72 (59.5) 49 (40.5)	1 (50.0) 1 (50.0)	2.665[b]	0.337
	Tertiary education	Diabetic Non-diabetic	7 (38.9) 11 (61.1)	65 (42.2) 89 (57.8)	2 (100.0) 0 (0.0)	2.403[b]	0.347

Table 6. Association between Sociodemographic characteristics and Caries risk among the glycemic groups

Table 7 presents the binary logistic regression analysis examining the association between predictor variables and caries risk. Individuals with diabetes had an increased odds (1.386 95% CIl: 0.500 – 3.841), though not statistically significant (p = 0.530). The odds of females being at high caries risk was 1.711 times higher than males (95% CI: 0.619 – 4.732), though not statistically significant (p = 0.301). Compared to the reference group, Yoruba individuals had an aOR of 0.853 (95% CI: 0.227 – 3.207, p = 0.814), and Igbo individuals had an aOR of 0.465 (95% CI: 0.099 – 2.189, p = 0.333), suggesting no significant ethnic association with caries risk. The odds of having -high caries risk increased slightly with age (aOR = 1.022, 95% CI: 0.990 – 1.054), but this effect was not statistically significant (p = 0.179). Having a tertiary education was significantly associated with a higher caries risk (aOR = 3.700, 95% CI: 1.170 – 11.704, p = 0.026).

doi.org/10.32388/XH6P7X.4

Variables	S.E	Wald	p-value	aOR	Confidence interval	
					Lower	Upper
Glycemic group (Diabetic)	0.520	0.395	0.530	1.386	0.500	3.841
Gender (Female)	0.519	1.071	0.301	1.711	0.619	4.732
Tribe		1.343	0.511			
Tribe (Yoruba)	0.676	0.055	0.814	0.853	0.227	3.207
Tribe (Igbo)	0.790	0.938	0.333	0.465	0.099	2.189
AGE	0.016	1.805	0.179	1.022	0.990	1.054
Education (Tertiary)	0.588	4.958	**0.026**	3.700	1.170	11.704
Constant	1.107	0.781	0.377	2.658		

Table 7. Binary logistic regression analysis for Caries risk and predictor variables.

Discussion

In alignment with existing literature, our findings suggest a potential association between suboptimal glycemic control in individuals with diabetes and an elevated risk of dental caries, highlighting a trend that warrants further investigation.[19][20] *Although diabetics showed higher caries risk descriptively, this association did not reach statistical significance in adjusted models.* In the regression analysis, they also had 1.38 increased odds of having a high caries risk, though the association was not significant. The increased risk was seen in previous findings that suggested an association between diabetes mellitus and an increased susceptibility to oral diseases, particularly dental caries and periodontal disease.[21] The moderate caries risk group was, however, nearly equally distributed between diabetics and non-diabetics. Despite the increased risk of dental caries in diabetics, the overall presence of cavitated lesions was comparable across groups, suggesting that glycemic control alone may not fully explain differences in caries progression.

Among diabetic individuals, an increasing mean age was observed with increasing caries risk levels, suggesting that prolonged exposure to hyperglycemia may contribute to heightened susceptibility to dental caries. This trend aligns with existing literature highlighting the cumulative impact of chronic hyperglycemia on oral health, including impaired salivary function and increased cariogenic bacterial activity. In contrast, among non-diabetics, the highest mean age was recorded in the moderate-risk group, suggesting that age-related factors may influence caries risk differently in individuals without diabetes. Reduced salivary flow among diabetics is widely regarded as the principal factor underlying this association.[22]An alternative hypothesis suggests that the heightened risk of dental caries in individuals with diabetes mellitus may be attributed to the direct effects of chronic hyperglycemia, which enhances lactic acid production, thereby lowering salivary pH. A more acidic oral environment may, in turn, promote the proliferation of aciduric microbial species, ultimately contributing to oral dysbiosis. However, no conclusive evidence has been established regarding the role of elevated salivary or blood glucose levels in caries activity or root caries development.[23][24]

Gender disparities in caries risk were particularly notable. Female diabetics were predominantly in the moderate and high-risk category, whereas no cases of high caries risk were recorded among non-diabetic females. These findings underscore the potential gender-specific biological and behavioral factors, such as hormonal fluctuations and differences in oral hygiene practices, that may influence caries susceptibility among female diabetics.[25] This is also likely explained by a higher prevalence of xerostomia in females[26][27], highlighting that xerostomia may be an important mediating factor in the association between diabetes and dental caries. Educational attainment also emerged as a significant determinant of caries risk

doi.org/10.32388/XH6P7X.4

among diabetic individuals. Those without tertiary education were more likely to fall into the moderate-risk category, reinforcing the well-established link between lower educational status and poorer health outcomes. Limited access to oral health knowledge, financial constraints, and lower health literacy levels may contribute to inadequate preventive dental care, thereby increasing caries risk. These findings emphasize the need for targeted educational programs aimed at promoting oral health literacy, particularly among diabetic individuals with lower educational attainment.

Diabetes is increasingly recognized as a significant public health concern, with a well-established bidirectional relationship between glycemic control and oral health. Hyperglycemia may exacerbate low salivary pH, reduce salivary flow, which may increase susceptibility to dental caries. Despite the well-documented link between diabetes and oral health complications, dental service utilization remains suboptimal. A review found that just over half of people with diabetes had visited a dentist in the last year, with cost being a primary barrier.[28]Studies also report that diabetic patients are more likely to undergo periodontal treatment, tooth extraction, and receive removable prostheses compared to non-diabetics.[29]National surveys indicate that diabetic adults visit dentists less frequently than non-diabetics (56.8% vs. 64.7%, respectively).[30]However, the frequency of beverage consumption, poor dietary counseling, and compromised nutritional status may synergistically elevate caries risk in diabetic patients by fostering a cariogenic oral environment. While oral hygiene practices, such as regular toothbrushing with fluoride toothpaste and routine dental visits, serve as critical mediators of caries risk, their effectiveness can mitigate caries development even in the presence of systemic disease. Socioeconomic status further complicates this interplay, as it influences both dietary choices and access to oral hygiene resources, thereby exacerbating caries susceptibility. Thus, while diabetes contributes to caries risk, its impact may be attenuated with optimal oral hygiene and controlled sugar intake, underscoring the need for integrated preventive strategies targeting both systemic and behavioral factors. Regular dental visits and professional care can improve oral health behaviors, including brushing frequency and adherence to preventive care.[31][32]

This study addresses a critical public health gap in Nigeria, by examining an underrepresented population, leveraging a robust sample size and systematic data collection to enhance validity. Multivariate analyses adjusted for key confounders to strengthen inferences, while the findings offer clear translational value for designing targeted clinical and community-based interventions. These methodological strengths underscore the study's contribution to evidence-based strategies for improving oral health outcomes in a high-risk group. A key limitation of this study is that the diabetic and non-diabetic groups were not fully matched on critical variables, which may introduce bias and residual confounding, affecting the comparability of findings. Additionally, the cross-sectional design prevents the establishment of causal relationships, limiting the ability to determine whether periodontal health influences the observed outcomes or is merely associated with them. Furthermore, several key findings, including those highlighted in the regression analysis, did not reach statistical significance, underscoring the need for cautious interpretation and further research with larger, well-matched cohorts and longitudinal designs to validate these associations. A limitation of this study is the lack of control for certain individual factors, such as diet, oral hygiene practices, glycemic control, and duration of diabetes, that may influence dental caries risk. While the primary aim was to explore broad associations, future studies incorporating these variables and metabolic indicators could provide a more nuanced understanding of the relationship between diabetes and oral health, including subgroup analyses based on glycemic control and disease duration. Future research employing matched cohorts and analytical study designs would enhance the robustness of findings and provide deeper insights into the underlying mechanisms driving the observed outcomes.

Conclusion

This study observed a trend toward increased caries risk among individuals with type 2 diabetes mellitus, although this association was not statistically significant. Despite an elevated caries risk among diabetics, caries progression was not significantly different between diabetic and non-diabetic groups over time. The findings highlight the need for integrated medical and dental care strategies to improve oral health outcomes in diabetic patients. Increased awareness, improved access to dental services, and routine periodontal screenings are essential to reducing the oral health burden in this population.

Statements and Declarations

Informed Consent

Written informed consent was obtained from all subjects involved in the study prior to participation. Participants were assured of confidentiality and their right to withdraw at any time.

Data Availability

The datasets generated for this study are available on reasonable request to the corresponding author. Restrictions may apply to safeguard participant privacy and confidentiality as per ethical approval guidelines.

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Declarations

Funding: No specific funding was received for this work.
Potential competing interests: No potential competing interests to declare.