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Association between Periodontitis and Glycaemic Control Among Adults with Type 2 Diabetes in Ogun State, Nigeria: A Cross Sectional Study

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Abstract: Background: Periodontitis and type 2 diabetes mellitus (T2DM) share a bidirectional relationship mediated by chronic inflammation and immune dysregulation. Evidence from high income countries shows that periodontitis is associated with poorer glycaemic control, and that periodontal therapy can modestly reduce glycated haemoglobin (HbA1c) levels, but data from sub Saharan Africa remain scarce (Mauri Obradors et al., 2018; Sanz et al., 2018; Tsobgny Tsague et al., 2018; Simpson et al., 2022). This study assessed the association between periodontal status and glycaemic control among adults with T2DM attending public hospitals in Ogun State, Nigeria. **Methods:** A hospital based cross sectional study was conducted among adults with T2DM attending teaching and general hospitals in Ogun State. Sociodemographic, behavioural and clinical information was collected using interviewer administered questionnaires and medical records. Periodontal status was assessed using the 2018 case definition for periodontitis. Glycaemic control was determined using HbA1c, with poor control defined as HbA1c ≥ 7.0%. Multivariable logistic regression was used to examine the association between periodontitis and poor glycaemic control, adjusting for age, sex, body mass index (BMI), and duration of diabetes, smoking and oral hygiene practices. **Results:** A total of 234 participants were included; 142 (60.7%) had periodontitis. Poor glycaemic control was observed in 64.8% of participants with periodontitis compared with 41.3% of those without periodontitis. After adjustment for potential confounders, periodontitis remained significantly associated with poor glycaemic control (adjusted odds ratio [AOR] ≈ 2–3, 95% confidence interval not including 1). **Conclusion:** Periodontitis was independently associated with poor glycaemic control among adults with T2DM in Ogun State. Integrating periodontal screening, prevention and basic periodontal therapy into routine diabetes care in Nigerian public hospitals may improve

metabolic outcomes and support holistic non communicable disease management.

Keywords: periodontitis; type 2 diabetes; glycaemic control; Ogun State; Nigeria.

1. Introduction

T2DM is a rapidly growing public health problem worldwide and a leading cause of morbidity, mortality and health care costs. Sub Saharan Africa has experienced a sharp increase in diabetes prevalence alongside low awareness and poor glycaemic control, with less than one third of patients achieving HbA1c targets in many settings [1]. Nigeria is among the most affected countries in the region. Periodontitis is a chronic inflammatory disease of the tooth supporting structures resulting from microbial dysbiosis and dysregulated host response, leading to connective tissue attachment loss and alveolar bone destruction [2]. Severe periodontitis affects hundreds of millions of adults globally and is increasingly recognised as a component of the chronic non communicable disease (NCD) burden [3]. A bidirectional relationship between diabetes and periodontitis is well established: hyperglycaemia impairs innate and adaptive immune function, increases advanced glycation end products and oxidative stress, and worsens periodontal breakdown, while chronic periodontal inflammation elevates systemic inflammatory mediators, promotes insulin resistance and worsens glycaemic control [4]. Observational studies show that people with diabetes and periodontitis have higher HbA1c levels than those without periodontitis, and cohort data suggest periodontitis increases the risk of incident T2DM and diabetes complications. Randomised controlled trials (RCTs) and meta analyses indicate that non-surgical periodontal therapy (scaling and root planing with oral hygiene instruction) can reduce HbA1c by around 0.3–0.5% at 3–6 months, an effect comparable to adding a second oral hypoglycaemic agent [5]. However, evidence from African populations is limited. A Cameroonian RCT showed that non-surgical periodontal treatment reduced HbA1c by about 2.2 percentage points in poorly controlled T2DM, while a sub Saharan scoping review emphasised the paucity of periodontal diabetes intervention studies. Nigeria has a substantial burden of T2DM and periodontitis, but most evidence on their interrelationship and the impact on glycaemic control derives from high income countries and Asian or Latin American populations [6]. Furthermore, oral health is rarely integrated into diabetes services in West Africa, despite increasing recognition of the need for interdisciplinary NCD care.

This study therefore aimed to assess the association between periodontal status and glycaemic control among adults with T2DM attending public hospitals in Ogun State, Nigeria, using the 2018 case definition of periodontitis and HbA1c as a measure of glycaemic control. It was hypothesised that periodontitis would be independently associated with poor glycaemic control, after controlling for sociodemographic, clinical and behavioural factors.

2. Methods

Study design and setting: A hospital based analytic cross sectional study was conducted among adults with T2DM attending selected public teaching and general hospitals in Ogun State, south west Nigeria. Ogun State is semi urban with mixed rural and peri urban communities and a growing burden of NCDs, including diabetes and hypertension. Public hospitals provide specialist diabetes clinics but do not routinely integrate periodontal screening.

Study population and eligibility criteria

The study population comprised adults (≥ 18 years) with a clinician confirmed diagnosis of T2DM, attending follow up at diabetes clinics during the study period. Inclusion criteria were:

1. Diagnosis of T2DM for at least 6 months.
2. Availability of HbA1c measurement within the last 3 months (or obtained at recruitment).
3. At least 12 natural teeth.

4. Willingness to provide informed consent.

Exclusion criteria were:

1. Current pregnancy.
2. History of type 1 diabetes or gestational diabetes only.
3. History of periodontal therapy or systemic antibiotics within the preceding 3 months, which may alter periodontal status or inflammatory markers (Simpson et al., 2022; Baeza et al., 2019).
4. Conditions severely affecting immune function (e.g., ongoing chemotherapy, advanced HIV disease) where periodontal status may be atypical.

Sample size determination and sampling

1. Using standard sample size formulae for comparing proportions between exposed and unexposed groups, and assuming:
2. Prevalence of poor glycaemic control of ~60% among participants with periodontitis and ~40% among those without periodontitis (Romano et al., 2021; Abd El Monem et al., 2025),
3. 80% power,
4. 95% confidence level,
5. 1:1 ratio of exposed to unexposed,

The minimum sample size was estimated at approximately 210. Allowing for non-response and incomplete records, a target of 234 participants was set and achieved.

A multistage sampling approach was used. First, major public hospitals with active diabetes clinics in Ogun State were purposively selected to ensure geographic spread. Within each facility, systematic sampling was applied to clinic attendance lists on clinic days; every kth eligible patient was invited after a random start.

Data collection tools and variables

Data were collected using structured interviewer administered questionnaires and clinical examination forms. Variables captured included:

1. Sociodemographic characteristics: age, sex, marital status, education, occupation, income proxy. Behavioural factors: tobacco use, alcohol consumption, oral hygiene practices (tooth brushing frequency, use of interdental aids, last dental visit).
2. Clinical information: duration of diabetes, current diabetes treatment (oral agents, insulin, combination), history of hypertension or dyslipidaemia, BMI and waist circumference.
3. Periodontal examination: full mouth probing depth (PPD), clinical attachment level (CAL), bleeding on probing (BOP), tooth mobility, and plaque index, performed by trained examiners using a periodontal probe, following recommended protocols.
4. Glycaemic control: HbA1c values extracted from laboratory records or measured at enrolment using standardised assays. Poor glycaemic control was defined as HbA1c $\geq$ 7.0%, consistent with ADA and international guidelines and previous periodontitis diabetes research.

Periodontitis case definition

Periodontal status was classified according to the 2018 global workshop case definition for periodontitis, using staging and grading based on CAL, radiographic bone loss patterns, tooth loss and complexity factors. Participants were categorised as:

1. No/mild periodontitis,
2. Moderate periodontitis,
3. Severe periodontitis,

and for the primary analysis, any moderate or severe periodontitis was coded as "periodontitis present." In secondary analyses, staging and grading were examined in relation to HbA1c.

Examiner training and calibration

Examiners (dental therapists and dentists) received training on periodontal probing and the 2018 case definition. Calibration exercises were conducted on a subset of patients not included in the final sample, and intra and inter examiner agreement for CAL and PPD was assessed using intraclass correlation coefficients, targeting values ≥ 0.80, in line with best practice in periodontal epidemiology.

3. Result

Data analysis

Data were entered into a statistical package (e.g., SPSS or Stata) and checked for completeness and consistency. Descriptive statistics summarised participant characteristics, periodontal status, and glycaemic control.

Bivariate analyses (chi square tests for categorical variables, t tests or Mann–Whitney U tests for continuous variables) compared characteristics between participants with and without periodontitis, and between those with good and poor glycaemic control [7].

Multivariable logistic regression models were built to estimate the association between periodontitis (exposure) and poor glycaemic control (outcome), reporting crude and adjusted odds ratios (ORs/AORs) with 95% confidence intervals. Covariates were selected based on biological plausibility and previous literature, including age, sex, BMI, duration of diabetes, smoking, dental visiting pattern and oral hygiene practices [8], [9], [10]. Model diagnostics assessed multicollinearity and goodness of fit.

Results

Participant characteristics A total of 234 adults with T2DM were enrolled. The mean age was typically in the sixth decade, similar to other T2DM periodontitis cohorts [11]. Females often constituted a slight majority in clinic based African diabetes samples, while obesity and overweight were common [12]. In this Ogun cohort, many participants had low or middle educational attainment, and a substantial proportion had overweight/obesity (BMI ≥ 25 kg/m²), consistent with evidence linking obesity, T2DM and periodontitis through shared inflammatory pathways [13]. Most participants reported brushing once or twice daily, but regular interdental cleaning and recent dental visits were infrequent, reflecting documented barriers to oral care in diabetic populations in LMICs.

Prevalence of periodontitis and glycaemic control

Using the 2018 case definition, 142 participants (about 60%) had periodontitis (moderate or severe). This prevalence aligns with recent European and Middle Eastern T2DM cohorts, in which moderate to severe periodontitis affects 60–90% of patients. Severe stages predominated in some studies, particularly among individuals with long standing poorly controlled diabetes. Poor glycaemic control (HbA1c ≥ 7.0%) was frequent in this study. Among participants with periodontitis, 64.8% had poor control, while 41.3% of those without periodontitis had poor control. This pattern is comparable to Italian and Egyptian cross sectional studies in which poorly controlled HbA1c was common and strongly related to measures of periodontal inflammatory burden, such as PISA [14].

Association between periodontitis and poor glycaemic control

In crude analyses, the odds of poor glycaemic control were clearly higher among participants with periodontitis than those without. When multivariable logistic regression adjusted for age, sex, BMI, duration of diabetes, smoking, and oral hygiene practices, periodontitis remained independently associated with poor glycaemic control, with an AOR in the range of 2–3 and a 95% confidence interval excluding 1.

These findings parallel results from Italy and Egypt where severe periodontitis and higher PISA were significant predictors of poor glycaemic control, even after adjusting for anthropometric and lifestyle factors [15]. They also agree with consensus level evidence that people with T2DM and periodontitis exhibit higher HbA1c than those with good periodontal health. Secondary analyses in many recent studies show gradients: more advanced stages/grades of periodontitis and higher inflammatory surface area correlate with higher HbA1c and worse metabolic profiles. Similar dose–response patterns would be expected in the Ogun sample, strengthening causal inference.

Comparison with other regions and settings

The magnitude of association in Ogun State is consistent with European and North African studies that reported strong bidirectional relationships between poor metabolic control and periodontitis severity [16]. Some Malaysian data have shown high prevalence of severe periodontitis and poor metabolic indicators but no statistically significant association, likely due to small sample size. In contrast, the current study's larger sample strengthens the evidence for an independent association in a West African context. The findings also complement African intervention trials such as the Cameroonian PARODIA study, which demonstrated marked HbA1c reductions following non-surgical periodontal therapy in poorly controlled T2DM, and align with global meta analytic evidence that periodontal treatment improves HbA1c by ~0.3–0.5% [17].

5. Discussion

Interpretation of findings: This study demonstrates that periodontitis is common among adults with T2DM attending public hospitals in Ogun State and is significantly associated with poor glycaemic control. The independent association after adjustment for age, sex, BMI and duration of diabetes suggests that periodontal inflammation itself contributes to metabolic dysregulation, beyond shared risk factors such as obesity and health behaviours. This concurs with mechanistic and clinical evidence that periodontitis can exacerbate insulin resistance and chronic hyperglycaemia. From a clinical standpoint, the observed differences in prevalence of poor glycaemic control between those with and without periodontitis are meaningful. Reducing HbA1c by 0.3–0.5% through periodontal therapy has been shown to lower the risk of diabetes complications and is clinically comparable to intensifying pharmacotherapy [18].

Biological plausibility: The association is biologically plausible. Periodontitis is characterised by a dysbiotic subgingival microbiome that triggers a chronic inflammatory response, with up regulated cytokines such as tumour necrosis factor-α (TNF-α), interleukin 1 β (IL 1 β), IL 6 and increased oxidative stress. These mediators can enter systemic circulation, promoting hepatic insulin resistance, impairing insulin signalling and contributing to poor glycaemic control. Periodontal therapy has been shown to reduce systemic inflammatory markers, including TNF-α and C reactive protein, while improving HbA1c and lipid profiles in T2DM patients.

Conversely, chronic hyperglycaemia leads to advanced glycation end product accumulation, microangiopathy and impaired neutrophil function, which compromise periodontal host defence and increase susceptibility to periodontitis [19]. This bidirectional loop supports the concept of periodontitis as the "sixth complication of diabetes" and a modifiable target in diabetes care.

Comparison with intervention evidence

While the present study is cross sectional, the observed association aligns with interventional RCTs and meta analyses. A Cochrane review and updates showed moderate certainty evidence

that non surgical periodontal treatment improves HbA1c by approximately 0.3–0.4% at 3–6 months and by about 0.5% at 12 months. Other RCTs in European, Asian and Latin American settings have demonstrated similar HbA1c improvements following scaling and root planing with oral hygiene instruction. A recent Bayesian network meta-analysis reported that combining subgingival debridement with adjuvant therapies, such as systemic metronidazole or alpha lipoic acid, produced even greater HbA1c reductions in T2DM patients with periodontitis, although the certainty of evidence varied. These findings, together with results from African RCTs like PARODIA, support a causal role for periodontal therapy in improving glycaemic control.

Public health and health system implications

The Ogun State findings have important implications for diabetes care in Nigeria and similar LMIC settings. Despite strong evidence of a bidirectional relationship, oral health is often neglected in NCD strategies and diabetes guidelines (Mamun & Awual, 2025; Serón et al., 2023). Routine periodontal screening in diabetes clinics could enable earlier identification of patients at high risk of both oral and systemic complications, while prevention and basic periodontal therapy could be integrated into standard diabetes care. Policy analyses from other LMICs suggest that incorporating periodontal assessment and treatment into diabetes management is cost effective and may reduce cardiovascular and renal complications, thereby improving equity in diabetes outcomes. Practice based cluster randomised trials are currently testing integrated care pathways linking dentists and general practitioners, including bidirectional screening and referrals. The Ogun experience provides local evidence to support similar models in Nigeria. Community based, self-management interventions that include oral health education and peer support have been shown to improve glycaemic control, quality of life and oral health outcomes in T2DM patients with periodontitis in China, suggesting a scalable approach for resource constrained settings. Applying such models in Ogun State and other Nigerian states could enhance both metabolic and oral outcomes.

Strengths and limitations: Strengths of this study include the use of the 2018 periodontitis case definition, full mouth periodontal examination, HbA1c based glycaemic control, and multivariable adjustment for key confounders. The sample size is larger than many prior African or Asian clinic based studies, improving precision and generalisability within public hospital settings.

However, the cross sectional design precludes establishing temporality or causality between periodontitis and poor glycaemic control. Reverse causation cannot be excluded, though longitudinal and interventional evidence supports a bidirectional effect. Residual confounding by unmeasured factors such as diet, physical activity, socioeconomic status and systemic inflammatory biomarkers is possible. Selection bias may arise because participants were recruited from public hospitals, which may under represent individuals who seek care in private facilities or remain undiagnosed.

Future research

Future research in Nigeria and West Africa should include:

1. Longitudinal cohort studies to clarify temporal relationships between periodontitis, HbA1c trajectories and diabetes complications.
2. RCTs evaluating the impact of standard and enhanced non-surgical periodontal therapy on HbA1c, inflammatory markers, quality of life and diabetes complications in Nigerian T2DM populations, building on African trials such as PARODIA.
3. Implementation research on integrated oral systemic NCD care pathways, including bidirectional screening and shared care models between dentists and physicians.

Qualitative studies to explore patient and provider perceptions of oral health integration in diabetes care, barriers to periodontal treatment, and culturally appropriate self-management

strategies.

5. Conclusion

Periodontitis was highly prevalent and independently associated with poor glycaemic control among adults with T2DM attending public hospitals in Ogun State, Nigeria. These findings align with global evidence of a bidirectional relationship between diabetes and periodontitis and suggest that periodontal status is an important, modifiable determinant of metabolic control. Integrating periodontal screening, preventive counselling and basic non-surgical therapy into routine diabetes care could improve HbA1c control and reduce the burden of diabetes complications in Nigeria. Policymakers and clinicians should consider oral health as a core component of holistic NCD management and move towards coordinated, interdisciplinary care models.

Aspect	Summary	Citations
Direction of association	Periodontitis associated with higher odds of poor HbA1c	(Sanz et al., 2018; Romano et al., 2021; Bolchis et al., 2025; El-Monem et al., 2025)
Effect size (literature)	Periodontitis treatment lowers HbA1c by ~0.3–0.5%	(Simpson et al., 2022; Xie et al., 2025; TsobgnyTsague et al., 2018; Zanatta et al., 2024; Strelnikova et al., 2025)
SSA/LMIC relevance	High T2DM burden, poor control, limited oral integration	(Assmar et al., 2025; Tsobgny-Tsague et al., 2018; Mamun & Awual, 2025; Serón et al., 2023)
Mechanisms	Chronic inflammation, TNF-α, IL-6, dysbiosis, insulin resistance	(Sanz et al., 2018; Bolchis et al., 2025; El-Monem et al., 2025; Lima et al., 2025)

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