

Research Article**Periodontal Status, Behavioral Risk Factors, and Community-Based Surveillance of Type 2 Diabetes Mellitus****Muhammad Azhar Khan¹, Touseef Ansar², Shabir Ahmad³, Muhammad Akram Cheema⁴, Misbah Ul Hasan Ghani⁵, Muhammad Sami Iqbal⁶****Affiliations:**¹ Assistant Professor, Community Medicine, CMH Kharian Medical College, Kharian.² Senior Lecturer, Community Medicine, Nawaz Sharif Medical College, Gujrat.³ Assistant Professor, Community Medicine, Poonch Medical College, Rawalakot, AJK.⁴ Demonstrator, Community Medicine, Abwa Medical College, Faisalabad.⁵ Associate Professor, Community Medicine, Poonch Medical College, Rawalakot, AJK.⁶ Associate Professor, Preventive and Public Health Dentistry, College of Dentistry, Bolan Medical College, Quetta.**Corresponding author; Muhammad Azhar Khan****Abstract**

The bidirectional relationship between periodontal disease and type 2 diabetes mellitus (T2DM) has been increasingly recognized as a critical determinant of systemic and oral health. This cross-sectional community-based surveillance study assessed periodontal status, behavioral risk factors, and their association with glycemic outcomes in adults with T2DM. A representative sample of 420 participants was recruited through household enumeration in an urban population registry. Periodontal parameters included community periodontal index (CPI), loss of attachment, probing depth, and bleeding on probing. Behavioral determinants assessed through structured interviews included tobacco and alcohol use, oral hygiene practices, dietary habits, and physical activity. Glycemic status was determined by HbA1c. Epi-Info sample size computation (anticipated 20% difference in periodontal disease prevalence between controlled and uncontrolled T2DM, $\alpha = 0.05$, power 80%) yielded a minimum of 384 participants; additional recruitment accounted for non-response. Results indicated that 72% of participants exhibited moderate to severe periodontitis, with higher prevalence in those with HbA1c $\geq 7.0\%$ (81.3% vs 60.5%, $p < 0.001$). Tobacco use and infrequent toothbrushing were significant predictors of periodontitis (OR 2.3 and 1.9, respectively). Awareness of the diabetes–oral health link was low (18%). Findings underscore the need for integrated surveillance strategies, including periodontal assessment within diabetes care, and highlight the impact of modifiable behavioral risk factors on oral–systemic disease burden.

Introduction

Type 2 diabetes mellitus (T2DM) is a major public health challenge worldwide, with rising prevalence linked to urbanization, sedentary lifestyles, and dietary transitions. Chronic hyperglycemia in T2DM leads to multi-organ complications, including cardiovascular, renal, ocular, and neuropathic disease. Less frequently emphasized, but equally significant, is the impact of diabetes on oral health, particularly periodontal disease. Periodontitis, a chronic inflammatory disease affecting supporting tissues of the teeth, is highly prevalent among individuals with T2DM and has been proposed as both a consequence and a contributing factor to poor metabolic control.¹⁻⁴ The bidirectional relationship between periodontitis and diabetes is well established: hyperglycemia impairs host immune response, increases advanced glycation end-products, and enhances inflammatory pathways, thereby worsening periodontal tissue destruction. Conversely, periodontal infection induces systemic inflammation and elevates pro-inflammatory mediators, contributing to insulin resistance and poor glycemic regulation. This interplay creates a vicious cycle that exacerbates both conditions and increases the risk of systemic complications.⁵⁻⁷

Global epidemiological studies have consistently shown that individuals with poorly controlled diabetes are two to three times more likely to develop severe periodontitis compared with non-diabetic individuals. Recent longitudinal analyses (2021–2024) confirm that intensive periodontal treatment can modestly improve glycemic control, with reductions in HbA1c of 0.3–0.4%. Despite this, routine integration of oral health into diabetes surveillance remains limited, particularly in community and primary care settings.⁸⁻¹⁰

Behavioral risk factors add another layer of complexity. Tobacco use, high-sugar diets, physical inactivity, and inadequate oral hygiene are shared risk factors for both diabetes and periodontitis. These commonalities present opportunities for integrated preventive interventions. Yet awareness among patients regarding the oral–systemic connection remains low, with surveys from diverse settings reporting that less than 25% of diabetic patients receive advice on oral health during routine care.

Community-based surveillance offers a powerful approach to understanding the epidemiology of diabetes-related oral conditions. Surveillance frameworks, combining clinical assessments with behavioral and biomedical data, can inform prevention strategies, prioritize resource allocation,

and strengthen interdisciplinary health systems. Moreover, surveillance data can bridge the gap between endocrinology, primary care, and dentistry, fostering collaborative models of care.

This study was conducted to assess periodontal status, behavioral risk factors, and their association with glycemic control in an urban adult population with T2DM. The objectives were: (1) to determine the prevalence of periodontitis among community-based T2DM patients, (2) to evaluate associations between behavioral determinants and periodontal outcomes, and (3) to explore awareness levels regarding diabetes–oral health interactions. By embedding periodontal surveillance within diabetes monitoring, this study seeks to contribute evidence for integrated chronic disease management.

Methodology

This cross-sectional community-based study was conducted at CMH Kharian Medical College, Kharian. Sampling was based on household enumeration lists, with eligible participants recruited through door-to-door visits. Sample size was calculated using Epi-Info, assuming a 20% prevalence difference in periodontitis between controlled and uncontrolled diabetics (expected prevalence 70% vs 50%, $\alpha = 0.05$, power 80%). The minimum required sample was 384, increased to 420 to account for non-response. Inclusion criteria: adults aged 30–70 years with physician-diagnosed T2DM for at least 1 year. Exclusion criteria: pregnancy, edentulism, systemic conditions affecting periodontal status (e.g., immunodeficiency, malignancy), and recent periodontal therapy. Informed written consent was obtained, and ethical approval secured from the institutional review board. Periodontal examination was performed by calibrated dentists using the WHO Community Periodontal Index probe, recording bleeding on probing, probing depth, and clinical attachment loss. HbA1c was measured using standardized laboratory methods, with values $\geq 7.0\%$ considered uncontrolled. Behavioral data—including smoking, alcohol consumption, oral hygiene practices, dietary patterns, and physical activity—were collected via structured interviewer-administered questionnaires. Awareness regarding the diabetes–oral health relationship was also assessed. Data were analyzed using SPSS v27; chi-square tests and logistic regression were applied, adjusting for age, sex, BMI, and diabetes duration.

Results

Table 1. Demographic and clinical profile of participants

Variable	Controlled T2DM (n=210)	Uncontrolled T2DM (n=210)	p-value
Mean age (years $\pm$ SD)	53.4 $\pm$ 8.1	54.7 $\pm$ 7.9	0.12
Female sex, n (%)	114 (54.3)	118 (56.2)	0.71
Mean BMI (kg/m ² $\pm$ SD)	27.1 $\pm$ 3.9	28.2 $\pm$ 4.1	0.03
Mean diabetes duration (years $\pm$ SD)	7.8 $\pm$ 3.2	9.4 $\pm$ 3.8	<0.01

Table 2. Periodontal status by glycemic control

Periodontal outcome	Controlled T2DM	Uncontrolled T2DM	p-value
Moderate/severe periodontitis, n (%)	127 (60.5)	171 (81.3)	<0.001
Mean probing depth (mm $\pm$ SD)	3.6 $\pm$ 0.7	4.4 $\pm$ 0.9	<0.001
Mean attachment loss (mm $\pm$ SD)	4.1 $\pm$ 1.0	5.2 $\pm$ 1.3	<0.001
Bleeding on probing, n (%)	152 (72.4)	186 (88.6)	<0.001

Table 3. Behavioral risk factors associated with periodontitis (multivariate model)

Risk factor	Adjusted OR (95% CI)	p-value
Current smoking	2.3 (1.5–3.6)	<0.001
Irregular toothbrushing (<2/day)	1.9 (1.2–2.8)	0.004
High-sugar diet ($\geq$ 5 days/week)	1.6 (1.1–2.4)	0.02
Physical inactivity (<150 min/week)	1.4 (0.9–2.1)	0.08

Explanatory note: Uncontrolled diabetes was significantly associated with worse periodontal outcomes. Tobacco use, irregular oral hygiene, and high-sugar diets were independent predictors of periodontitis severity.

Discussion

First, this study confirms a high prevalence of periodontitis among adults with T2DM, with

significantly worse periodontal outcomes in uncontrolled diabetics. The findings align with global surveillance data showing hyperglycemia as a major determinant of periodontal tissue destruction.¹¹⁻¹³

Second, behavioral risk factors, particularly tobacco use and inadequate oral hygiene, were strong predictors of periodontal disease. These modifiable factors amplify inflammatory burden, worsening both periodontal and metabolic outcomes, highlighting opportunities for targeted interventions.¹⁴⁻¹⁵

Third, the study underscores low awareness of the diabetes–oral health link, with only 18% of participants reporting prior counseling on oral hygiene in relation to diabetes. This finding echoes reports from diverse regions, emphasizing the neglect of oral health in diabetes management guidelines.¹⁶⁻¹⁸

Fourth, integration of periodontal surveillance into diabetes care has practical benefits. Incorporating simple screening tools, such as CPI, within primary care or endocrinology visits could facilitate early detection and referral, reducing downstream complications.²⁰

Fifth, the bidirectional nature of the diabetes–periodontitis relationship offers a compelling case for interprofessional collaboration. Evidence from intervention trials suggests that periodontal therapy improves HbA1c modestly, reinforcing the systemic impact of oral health interventions.

Sixth, strengths of this study include a community-based design, standardized periodontal and glycemic assessments, and adjustment for key confounders. Limitations include its cross-sectional nature, which prevents causal inference, and reliance on self-reported behavioral data, which may be subject to recall bias.

Seventh, future research should explore longitudinal surveillance, intervention effectiveness in community settings, and cost-effectiveness of integrating oral health into chronic disease management frameworks. Public health campaigns should emphasize the shared risk factors and mutual benefits of addressing both diabetes and periodontal disease.

Conclusion

Periodontitis is highly prevalent among individuals with T2DM, particularly those with poor glycemic control. Tobacco use, poor oral hygiene, and unhealthy diets exacerbate risk. Integrating periodontal surveillance into diabetes care could reduce dual disease burden and improve overall health outcomes.

References

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