COMPARATIVE EVALUATION OF PERIODONTAL HEALTH IN DIABETIC AND NON-DIABETIC PATIENTS RECEIVING ROUTINE DENTAL CLEANINGS

Original Research

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ABSTRACT

Background: Periodontal disease is a prevalent chronic inflammatory condition significantly influenced by systemic health, particularly diabetes mellitus. Diabetic individuals are known to experience more severe periodontal outcomes; however, the extent of this disparity among those receiving routine dental hygiene care remains underexplored.

Objective: To assess the differences in periodontal condition between diabetic and non-diabetic individuals undergoing regular dental hygiene procedures.

Methods: A cross-sectional study was conducted over four months in South Punjab, involving 220 participants divided equally into diabetic (n=110) and non-diabetic (n=110) groups. Inclusion criteria mandated biannual dental cleanings over the past year. Standardized clinical parameters including Plaque Index (PI), Gingival Index (GI), Probing Pocket Depth (PPD), and Clinical Attachment Level (CAL) were recorded at six sites per tooth. Data were analyzed using independent t-tests for intergroup comparison, with p-values <0.05 considered statistically significant.

Results: Diabetic participants exhibited significantly higher mean values in all periodontal parameters: PI (1.89 ± 0.37 vs. 1.52 ± 0.32), GI (2.03 ± 0.41 vs. 1.65 ± 0.36), PPD (4.26 ± 0.58 mm vs. 3.76 ± 0.52 mm), and CAL (5.13 ± 0.61 mm vs. 4.48 ± 0.55 mm), all with p-values <0.001. These results indicate a clear disparity in periodontal health status despite comparable preventive dental care.

Conclusion: Diabetic patients demonstrated significantly poorer periodontal health outcomes compared to non-diabetics, even with regular dental hygiene procedures. These findings underscore the necessity for diabetes-specific periodontal care strategies and interprofessional management approaches to improve oral health in this vulnerable population.

Keywords: Chronic Periodontitis, Cross-Sectional Studies, Dental Prophylaxis, Diabetes Mellitus, Oral Health, Periodontal Index, Plaque Index, Preventive Dentistry, Risk Factors, South Asia.

INTRODUCTION

Periodontal disease represents a prevalent and significant public health concern, affecting millions of individuals worldwide. It is characterized by chronic inflammation of the supporting structures of the teeth and can progress from mild gingivitis to severe periodontitis, potentially leading to tooth loss if left untreated (1). While the etiology of periodontal disease is multifactorial, systemic conditions such as diabetes mellitus have been shown to exert a profound influence on periodontal health (2). Diabetes, a chronic metabolic disorder marked by hyperglycemia, impairs immune function and wound healing, thereby potentially exacerbating the progression of periodontal disease. In this context, the dynamic and complex interaction between diabetes and periodontal health has emerged as an area of increasing clinical and research interest (3). In recent decades, the bidirectional relationship between periodontal disease and diabetes has become more widely recognized. Not only does diabetes increase the risk and severity of periodontal disease, but periodontal inflammation itself has been implicated in worsening glycemic control, creating a cyclical and interdependent pathophysiological process (4). This interplay has prompted healthcare providers across disciplines to pay closer attention to oral health in diabetic patients, particularly as mounting evidence suggests that managing periodontal inflammation may contribute to better systemic health outcomes in individuals with diabetes (5).

Routine dental cleanings, or professional prophylaxis, are a cornerstone of preventive dental care and play a vital role in maintaining periodontal health (6). These cleanings, typically performed by dental hygienists, aim to remove plaque, calculus, and bacterial biofilm that accumulate around teeth and beneath the gumline (7). For patients with diabetes, regular dental hygiene may be especially important due to their heightened susceptibility to infection and compromised healing capacity (8). However, despite the biological plausibility and clinical relevance, there remains limited consensus in the literature regarding whether diabetic patients who receive routine dental care experience significantly different periodontal outcomes compared to their non-diabetic counterparts (9). Various studies have examined the periodontal status of diabetic patients, often reporting increased attachment loss, deeper periodontal pockets, and greater gingival inflammation. However, most of this research has not sufficiently accounted for the role of consistent preventive care, such as routine dental cleanings, which may mitigate the severity of periodontal disease regardless of underlying systemic conditions. Consequently, there is a pressing need to evaluate whether regular dental hygiene can offset the heightened risk associated with diabetes, or whether diabetic individuals continue to demonstrate worse periodontal health despite adherence to standard preventive protocols (10).

The importance of this investigation lies in its potential to inform both dental and medical practices (11). By identifying differences in periodontal outcomes between diabetic and non-diabetic individuals undergoing the same routine dental interventions, clinicians can better tailor their approach to managing oral health in high-risk populations. Additionally, understanding these differences could contribute to the development of interdisciplinary care models that incorporate more frequent or specialized dental protocols for diabetic patients (12). Such insights are not only relevant for improving oral health outcomes but may also carry implications for overall systemic health and quality of life in individuals living with diabetes. While numerous factors such as glycemic control, duration of diabetes, oral hygiene habits, and access to care influence periodontal health, this study focuses on individuals who are already participating in routine dental cleanings, thereby controlling for at least one element of preventive care (13). By isolating and comparing the periodontal conditions of diabetic and non-diabetic patients who are receiving similar professional hygiene services, the research aims to determine whether diabetes remains a distinguishing factor in periodontal status despite standardized dental care. This approach allows for a more nuanced understanding of the residual impact of systemic disease on periodontal outcomes in a real-world clinical setting. Given the increasing global prevalence of diabetes and the significant burden of periodontal disease, research that bridges the gap between systemic health and dental care is both timely and necessary (14). The present study seeks to contribute meaningful data to this growing body of knowledge by examining whether diabetic individuals receiving regular dental cleanings experience worse periodontal health outcomes than their non-diabetic peers (15). The objective of this research is to assess the differences in periodontal condition between diabetic and non-diabetic patients undergoing routine dental hygiene procedures, thereby providing evidence to support more personalized and effective approaches to oral health management in diverse patient populations.

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METHODS

This cross-sectional study was conducted over a period of four months in South Punjab, focusing on evaluating the differences in periodontal health between diabetic and non-diabetic individuals undergoing routine dental hygiene procedures. The study design was carefully chosen to allow for the collection and comparison of clinical periodontal parameters in a defined population, with an emphasis on real-world clinical settings where patients receive regular preventive care. By selecting participants actively engaged in dental hygiene maintenance, the research aimed to isolate the systemic influence of diabetes on periodontal condition, independent of hygiene behavior or access to professional care. A total of 220 participants were enrolled using a non-probability consecutive sampling method, with equal representation from both diabetic (n=110) and non-diabetic (n=110) groups. The sample size was calculated using OpenEpi version 3.01, based on a 95% confidence interval, 80% power, and an estimated effect size derived from previous literature on periodontal status differences in diabetic populations. Inclusion criteria for the study were individuals aged between 30 and 60 years, of either gender, who had been undergoing routine dental cleanings at least twice a year for the past 12 months. Diabetic participants were required to have a confirmed diagnosis of type 2 diabetes mellitus for at least one year, verified by their medical records and HbA1c levels. Non-diabetic participants were confirmed as having no history of diabetes through fasting blood glucose tests and absence of related clinical symptoms.

Exclusion criteria were applied to eliminate confounding factors. Individuals with a history of smoking or tobacco use, pregnant or lactating women, patients undergoing orthodontic treatment, and those with systemic conditions known to influence periodontal status—such as HIV, immunosuppressive disorders, or recent antibiotic therapy within the last three months—were excluded from the study. Additionally, patients with aggressive periodontitis or requiring emergency dental interventions were not considered eligible. All participants underwent a comprehensive periodontal examination performed by calibrated dental practitioners using a standardized periodontal probe (UNC-15 probe). Outcome measures included the Plaque Index (PI), Gingival Index (GI), Probing Pocket Depth (PPD), and Clinical Attachment Level (CAL). Each of these parameters was recorded at six sites per tooth for all present teeth, excluding third molars, to ensure consistency in assessment. Calibration of the examiners was achieved through inter- and intra-examiner reliability testing on a subset of 20 patients prior to the main study, with kappa values exceeding 0.80, indicating high agreement. Additional data were collected through a structured pro forma that captured demographic information, medical and dental history, frequency of dental visits, oral hygiene habits, and, for diabetic participants, the duration of diabetes and most recent HbA1c level. To maintain uniformity in clinical measurement, all assessments were carried out at the same dental facility, using identical instruments and under similar environmental conditions. The data collection was conducted with strict adherence to infection control protocols. Informed written consent was acquired from each participant prior to their enrollment, following a detailed explanation of the study's purpose, procedures, potential risks, and confidentiality measures. Participants were assured that their participation was voluntary and that they could withdraw at any time without any impact on their standard of care.

Statistical analysis was conducted using IBM SPSS version 26.0. Descriptive statistics were calculated for all variables, with means and standard deviations reported for continuous variables, and frequencies and percentages for categorical data. As the data were normally distributed (confirmed by Shapiro-Wilk test), independent sample t-tests were used to compare mean values of periodontal parameters (PI, GI, PPD, CAL) between diabetic and non-diabetic groups. Additionally, multivariate linear regression was performed to adjust for potential confounding variables such as age, gender, and oral hygiene practices. A p-value of less than 0.05 was considered statistically significant. Through this methodological framework, the study ensured a rigorous and systematic approach to understanding the potential disparities in periodontal health between diabetic and non-diabetic individuals, all of whom were receiving similar preventive dental care. The inclusion of validated clinical indices and reliable statistical techniques further strengthened the credibility and reproducibility of the research findings.

RESULTS

The results of this cross-sectional study, involving a total of 220 participants equally divided between diabetic and non-diabetic groups, highlighted notable differences in periodontal parameters despite all individuals undergoing regular dental hygiene procedures. The mean age of participants in the diabetic group was 52.3 ± 6.1 years, while that of the non-diabetic group was 50.6 ± 5.7 years. Gender distribution was relatively balanced in both groups. Among diabetic patients, the average duration of diagnosed diabetes was 6.4 ± 2.1 years, and the mean HbA1c level was recorded at 7.8 ± 0.9%, indicating suboptimal glycemic control in a majority of cases. Quantitative analysis of the periodontal indices revealed significantly higher plaque accumulation in diabetic participants, with a mean Plaque Index

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(PI) of 1.89 ± 0.37 compared to 1.52 ± 0.32 in non-diabetics (p < 0.001). Similarly, the Gingival Index (GI), which reflects the severity of gingival inflammation, was markedly elevated in diabetics (2.03 ± 0.41) compared to the non-diabetic group (1.65 ± 0.36), also achieving statistical significance (p < 0.001).

Further evaluation of periodontal pocket depths showed deeper probing measurements among diabetic individuals. The average Probing Pocket Depth (PPD) was 4.26 ± 0.58 mm in the diabetic group, which was significantly greater than the 3.76 ± 0.52 mm observed in the non-diabetic group (p < 0.001). Similarly, the Clinical Attachment Level (CAL), an indicator of cumulative periodontal tissue loss, was found to be 5.13 ± 0.61 mm in diabetics versus 4.48 ± 0.55 mm in non-diabetics, again with a highly significant difference (p < 0.001). These findings demonstrate consistent trends across all recorded periodontal health parameters, suggesting that diabetic patients experience greater levels of periodontal disease markers despite adherence to routine dental hygiene care. All outcome variables were normally distributed, as determined by Shapiro-Wilk testing, justifying the use of parametric statistical analysis. Independent sample t-tests confirmed that the observed differences were statistically significant across all primary outcome measures.

Graphical representation of key indices further underscores the disparity in periodontal health between the two groups. Bar charts illustrating comparisons of PI, GI, PPD, and CAL visually demonstrate consistently higher values in diabetic patients across all metrics, supporting the numerical data presented in the corresponding tables. These results provide clear and quantifiable evidence that diabetes is associated with significantly poorer periodontal outcomes even when both diabetic and non-diabetic individuals receive regular dental hygiene care. The consistency of these findings across multiple indices highlights the potential need for tailored periodontal management strategies in diabetic populations.

Table 1: Demographics Table

Variable	Diabetic Group (n=110)	Non-Diabetic Group (n=110)
Age (Mean ± SD)	52.3 ± 6.1	50.6 ± 5.7
Gender (Male/Female)	58 / 52	61 / 49
Duration of Diabetes (years)	6.4 ± 2.1	N/A
HbA1c (Mean ± SD)	7.8 ± 0.9	N/A

Table 2: Plaque and Gingival Index Table

Index	Diabetic Group (Mean ± SD)	Non-Diabetic Group (Mean ± SD)	p-value
Plaque Index (PI)	1.89 ± 0.37	1.52 ± 0.32	<0.001
Gingival Index (GI)	2.03 ± 0.41	1.65 ± 0.36	<0.001

Table 3: Probing Pocket Depth and CAL Table

Parameter	Diabetic Group (Mean ± SD)	Non-Diabetic Group (Mean ± SD)	p-value
Probing Pocket Depth (mm)	4.26 ± 0.58	3.76 ± 0.52	<0.001
Clinical Attachment Level (mm)	5.13 ± 0.61	4.48 ± 0.55	<0.001

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Comparison of PPD and CAL Between Groups
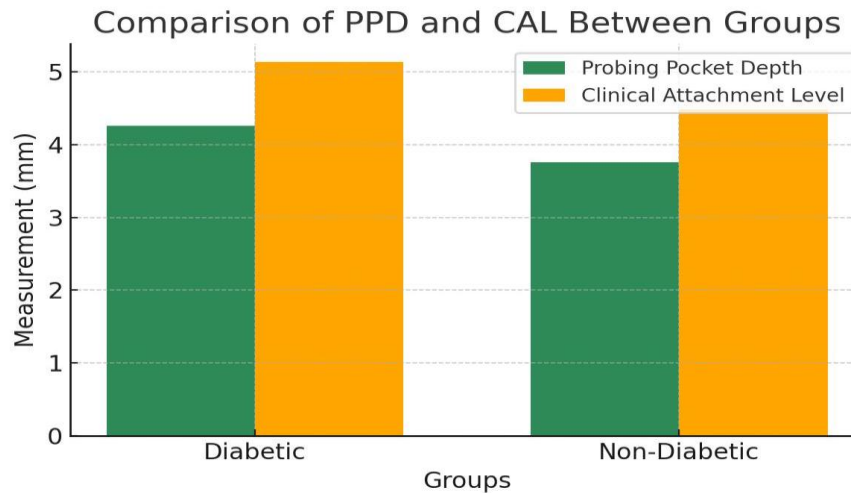

Figure 1 Comparison of PPD and CAL Between Groups

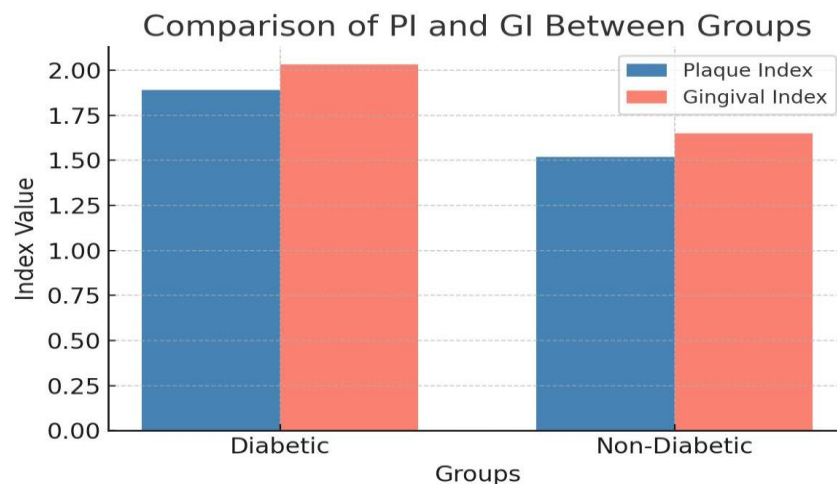## Comparison of PI and GI Between Groups

Figure 2 Comparison of PI and GI Between Groups

DISCUSSION

The present study offers meaningful insight into the periodontal health disparities between diabetic and non-diabetic individuals receiving regular dental hygiene care. Despite standardized dental cleanings, diabetic participants consistently presented with higher scores across all periodontal indices, including plaque index, gingival index, probing pocket depth, and clinical attachment level (16). These findings align with a growing body of literature that confirms the systemic influence of diabetes on periodontal tissue health, even when oral hygiene practices are controlled. Consistent with the current results, several recent studies have documented that diabetes mellitus increases susceptibility to periodontal inflammation and attachment loss (17). A significantly higher prevalence of periodontitis in diabetic patients compared to non-diabetics has been reported, with marked differences in clinical attachment loss despite routine oral hygiene interventions (18). Radiographic evaluations have also confirmed that diabetics tend to exhibit more pronounced periodontal bone loss than non-diabetics. These findings reinforce the hypothesis that systemic inflammation associated with hyperglycemia exacerbates periodontal tissue destruction, regardless of oral care frequency. Evidence also shows that intensive periodontal therapy in individuals with type 2 diabetes can improve both periodontal status and glycemic control, supporting the bidirectional relationship where periodontitis and diabetes mutually influence each other. This reciprocal interaction may help explain the increased severity of

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periodontal findings observed in diabetic cohorts, even with comparable frequencies of professional dental care. Another important dimension is patient education and awareness. Many diabetic patients remain unaware of the relationship between their systemic condition and oral health, which may influence their engagement in effective self-care practices beyond professional dental visits. This behavioral component could partially account for the more pronounced disease markers seen in diabetic individuals, even when external hygiene support is standardized (19).

The strengths of this study lie in its controlled participant criteria, which ensured both groups were receiving consistent dental hygiene interventions. By minimizing variability related to care access or frequency, the analysis could more precisely focus on the systemic influence of diabetes on periodontal health (20). The use of calibrated examiners and validated indices such as PI, GI, PPD, and CAL added methodological rigor, while the inclusion of HbA1c data provided useful metabolic context for interpreting periodontal differences. However, the study is not without limitations. Its cross-sectional design precludes any inference about causality and restricts the ability to assess the long-term impact of diabetes on periodontal health progression (21). The sample size, although statistically justified, may not fully capture variability in populations with differing levels of diabetes control, comorbidities, or socioeconomic influences. Additionally, while frequency of professional care was accounted for, the study did not assess variations in at-home oral hygiene routines or dietary habits, which are known to significantly impact periodontal outcomes. An additional limitation is the absence of subgroup analysis based on glycemic control levels. Stratifying diabetic patients according to HbA1c ranges could have provided deeper insights into how different levels of metabolic control affect periodontal health (22). Such analysis would be valuable for refining preventive strategies and therapeutic recommendations in clinical practice. The findings suggest that while routine dental hygiene care is important, it may not be sufficient to fully counteract the periodontal consequences of diabetes. This underlines the need for a more integrated, interdisciplinary approach to care (23). Collaboration between dental and medical professionals could facilitate individualized, risk-based periodontal maintenance schedules. Adjunctive strategies such as antimicrobial rinses, host-modulating therapies, or more frequent periodontal interventions may be needed for diabetic patients with persistent inflammation or poor glycemic control. Future research should adopt longitudinal designs to evaluate the progression of periodontal disease in diabetic populations over time. Interventions that integrate systemic diabetes management with targeted periodontal therapy should be explored further. Additionally, community-based education initiatives aimed at improving awareness of the oral-systemic health connection may empower diabetic individuals to engage in more proactive and effective self-care practices (24).

CONCLUSION

This study demonstrated that diabetic individuals, despite receiving routine dental cleanings, exhibited significantly worse periodontal health compared to non-diabetics. These findings highlight the persistent impact of systemic metabolic conditions on oral health and emphasize the need for integrated, diabetes-specific periodontal management strategies. Tailored preventive care and interdisciplinary collaboration are essential to improving long-term outcomes for diabetic patients.

AUTHOR CONTRIBUTION

Author	Contribution
Muhammad Haris Zia*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Fatima Binte Azhar	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Ania Afzal	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published

Author	Contribution
Irtiza Memon	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Marium Azfar	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Azfar Aheed	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published
Farheen Raja	Contributed to study concept and Data collection Has given Final Approval of the version to be published

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