

Research Article

Assessment of Periodontal Health Status and Its Association with Diabetes Mellitus among Adult Dental Patients

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ABSTRACT

Background: Periodontal disease is a common chronic inflammatory condition affecting the supporting structures of the teeth and has been increasingly associated with systemic disorders such as diabetes mellitus.

Objective: To assess periodontal health status and determine its association with diabetes mellitus among adult dental patients.

Methodology: This was a cross-sectional analytical study conducted at Sheikh Zayed Hospital, Rahim Yar Khan, Pakistan, from February 2022 to November 2024. A total of 165 adult dental patients were enrolled using consecutive non-probability sampling. Demographic and clinical data were recorded, and periodontal health was assessed using plaque index, gingival index, probing pocket depth, and clinical attachment loss. Participants were grouped as diabetic and non-diabetic, and periodontal disease severity was compared between the groups. Data were analyzed using SPSS version 26.0, with $p \leq 0.05$ considered statistically significant.

Results: The mean age of participants was 45.8 ± 12.4 years, and 94 (57.0%) were male. Diabetes mellitus was present in 68 (41.2%) participants, while 97 (58.8%) were non-diabetic. Moderate-to-severe periodontitis was significantly more prevalent among diabetic individuals (76.5%) compared to non-diabetics (40.2%) ($p < 0.001$). Mean probing pocket depth was significantly higher in diabetic patients (4.8 ± 1.2 mm vs. 3.5 ± 1.0 mm, $p < 0.001$), as was clinical attachment loss (5.2 ± 1.4 mm vs. 3.8 ± 1.2 mm, $p < 0.001$).

Conclusion: Diabetes mellitus is significantly associated with poorer periodontal health and increased severity of periodontitis among adult dental patients.

Keywords: Periodontitis, Diabetes Mellitus, Periodontal Health, Clinical Attachment Loss, Probing Pocket Depth.

INTRODUCTION

Periodontal disease is a chronic inflammatory condition affecting the supporting structures of the teeth, including the gingiva, periodontal ligament and alveolar bone [1]. It is a significant public health problem because

progressive periodontal inflammation can result in irreversible attachment loss, alveolar bone loss, tooth mobility and tooth loss if not treated appropriately [2]. Diabetes mellitus is an important systemic risk factor for the development and progression of periodontal

disease [3]. Diabetes mellitus is a chronic metabolic disease that occurs when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin it produces, leading to hyperglycemia [4]. The global burden of diabetes continues to increase, with recent estimates showing hundreds of millions of adults living with diabetes worldwide [5]. Pakistan has a particularly high diabetes burden, with national estimates reporting a high adult prevalence and a large number of adults living with diabetes [6]. Diabetes can affect the oral cavity and is associated with oral manifestations such as xerostomia, delayed wound healing, oral infections and periodontal disease [7]. Diabetes mellitus and periodontal disease have a bidirectional relationship: diabetes can worsen periodontal destruction, while periodontal inflammation may adversely affect glycemic control [8]. Chronic hyperglycemia contributes to inflammatory and immune changes in periodontal tissues, including oxidative stress and dysregulated host responses, which may accelerate periodontal tissue breakdown [9,10]. Clinical studies have shown that individuals with diabetes may have greater probing pocket depth, clinical attachment loss, plaque accumulation and gingival inflammation than non-diabetic individuals [11]. Poor glycemic control has also been associated with worse periodontal parameters and greater periodontal destruction [12]. Periodontal therapy has been reported to improve glycemic control in patients with diabetes, supporting the clinical relevance of integrating periodontal care into diabetes management [13]. Although Pakistani studies have examined the relationship between diabetes, oral hygiene and periodontal status, further evidence from local tertiary dental settings remains important for understanding this association in routine dental care populations [14].

Objective: To assess periodontal health status and determine its association with diabetes mellitus among adult dental patients.

METHODOLOGY

This was a cross-sectional analytical study conducted at Sheikh Zayed Hospital, Rahim Yar Khan, Pakistan, from February 2022 to November 2024, including 165 adult dental patients to assess periodontal health status and its association with diabetes mellitus.

A total of 165 adult dental patients were recruited using consecutive non-probability sampling. The sample size was calculated using the formula for comparison of two proportions, taking moderate-to-severe periodontitis as the primary outcome. Based on previous literature, the expected prevalence of moderate-to-severe periodontitis was assumed to be 70% among diabetic patients and 45% among non-diabetic patients. Using a 95% confidence level, 80% power, and 5% margin of error, the minimum required sample size was 158 participants. After allowing for incomplete records, a final sample size of 165 adult dental patients was included. Participants were recruited using consecutive non-probability sampling from the dental outpatient department. This sampling method was used because eligible patients were enrolled as they presented during the study period. However, its potential for selection bias was acknowledged as a methodological limitation.

Inclusion Criteria

- Adult patients aged 18 years and above.
- Patients willing to participate and provide informed consent.
- Patients undergoing routine dental examination or periodontal assessment.
- Patients with complete medical and dental records.

Exclusion Criteria

- Pregnant women.
- Patients with systemic diseases other than diabetes mellitus known to affect periodontal health (e.g., immunodeficiency disorders, leukemia).
- Individuals who had received periodontal treatment within the previous six months.
- Patients currently receiving antibiotics or anti-inflammatory medications.
- Patients with incomplete clinical records.

Data Collection Procedure

After obtaining ethical approval and informed consent, eligible participants were recruited from the dental outpatient department. Demographic and clinical information including age, gender, smoking status, oral hygiene practices, duration of diabetes mellitus, and relevant medical history were recorded using a structured proforma. Participants were categorized into diabetic and non-diabetic groups based on documented medical history and available laboratory records. Among diabetic patients, glycemic control was classified using the most recent HbA1c value available within the previous three months.

Patients with HbA1c <7.0% were classified as having controlled diabetes, while those with HbA1c ≥7.0% were classified as having poorly controlled diabetes. [16]

Periodontal disease severity was classified as mild, moderate, or severe periodontitis according to the 2017 World Workshop Classification of Periodontal and Peri-Implant Diseases and Conditions. Classification was based on clinical periodontal parameters, including probing pocket depth, clinical attachment loss, and extent of periodontal tissue involvement. [15]

Information regarding glycemic control among diabetic patients was obtained from recent medical records and categorized as controlled or poorly controlled diabetes according to standard clinical guidelines.

Data Analysis

Data were entered and analyzed using Statistical Package for Social Sciences (SPSS) version 26.0. Quantitative variables such as age, probing pocket depth, and clinical attachment loss were presented as mean ± standard deviation. Qualitative variables such as gender, diabetes status, smoking status, and severity of periodontitis were expressed

as frequencies and percentages. The independent sample t-test was used to compare mean periodontal parameters between diabetic and non-diabetic groups, while the Chi-square test was applied to assess associations between categorical variables. Multivariate logistic regression analysis was performed to identify independent predictors of moderate-to-severe periodontitis. A p-value ≤ 0.05 was considered statistically significant.

RESULTS

The study included 165 adult dental patients with a mean age of 45.8 ± 12.4 years. Most participants were aged 40–59 years, 72 (43.6%), followed by <40 years, 58 (35.2%), and ≥60 years, 35 (21.2%). Males were slightly more common, 94 (57.0%), while females were 71 (43.0%). Smoking was reported in 47 (28.5%) patients, and 96 (58.2%) had irregular brushing habits. Diabetes mellitus was present in 68 (41.2%) participants, while 97 (58.8%) were non-diabetic, with a mean diabetes duration of 8.1 ± 4.6 years.

Table 1. Baseline Demographic and Clinical Characteristics of Participants (N = 165)

Variable	Category	n (%) / Mean ± SD
Age (years)	Mean ± SD	45.8 ± 12.4
Age Group	<40 years	58 (35.2%)
	40–59 years	72 (43.6%)
	≥60 years	35 (21.2%)
Gender	Male	94 (57.0%)
	Female	71 (43.0%)
Smoking Status	Smoker	47 (28.5%)
	Non-smoker	118 (71.5%)
Oral Hygiene Practice	Regular Brushing (≥2/day)	69 (41.8%)
	Irregular Brushing	96 (58.2%)
Diabetes Mellitus	Diabetic	68 (41.2%)
	Non-diabetic	97 (58.8%)
Duration of Diabetes (years)	Mean ± SD	8.1 ± 4.6

The mean plaque index was higher among diabetics, 2.48 ± 0.54 versus 1.89 ± 0.49, and the mean gingival index was also higher, 2.31 ± 0.47 versus 1.76 ± 0.42. Similarly, diabetic patients had deeper probing pocket depth, 4.8

± 1.2 mm versus 3.5 ± 1.0 mm, and greater clinical attachment loss, 5.2 ± 1.4 mm versus 3.8 ± 1.2 mm. All differences were statistically significant with p < 0.001.

Table 2. Comparison of Periodontal Parameters between Diabetic and Non-Diabetic Participants

Variable	Diabetic (n=68) Mean±SD	Non-Diabetic (n=97) Mean±SD	p-value
Plaque Index	2.48 ± 0.54	1.89 ± 0.49	<0.001
Gingival Index	2.31 ± 0.47	1.76 ± 0.42	<0.001
Probing Pocket Depth (mm)	4.8 ± 1.2	3.5 ± 1.0	<0.001

Clinical Attachment Loss (mm)	5.2 ± 1.4	3.8 ± 1.2	<0.001
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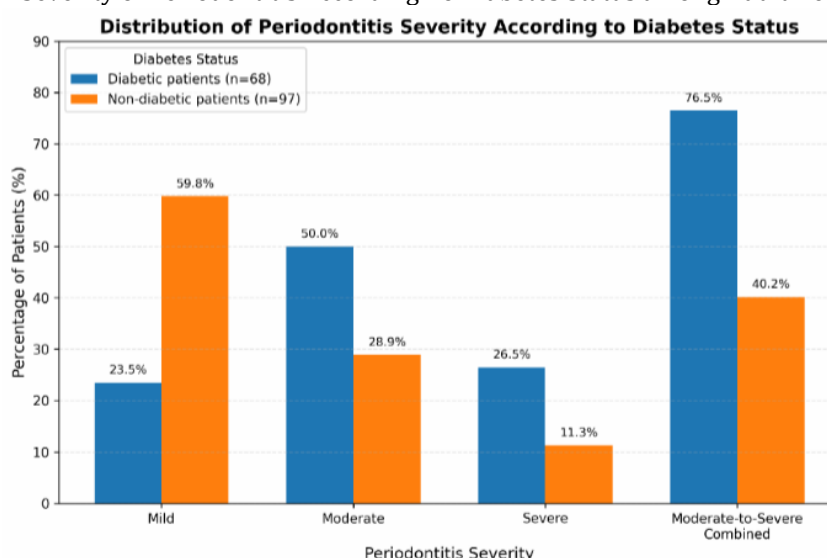
Moderate-to-severe periodontitis was more common among diabetic patients, affecting 52 (76.5%) compared with 39 (40.2%) non-diabetic participants. Among diabetics, 34 (50.0%) had moderate periodontitis and 18 (26.5%) had severe periodontitis, while only

16 (23.5%) had mild disease. In contrast, most non-diabetic participants had mild periodontitis, 58 (59.8%), followed by moderate disease, 28 (28.9%), and severe disease, 11 (11.3%).

Table 3. Severity of Periodontitis According To Diabetes Status

Severity	Diabetic (n=68)	Non-Diabetic (n=97)	Total (n=165)	p-value
Mild	16 (23.5%)	58 (59.8%)	74 (44.8%)	
Moderate	34 (50.0%)	28 (28.9%)	62 (37.6%)	
Severe	18 (26.5%)	11 (11.3%)	29 (17.6%)	
Moderate-to-Severe Combined	52 (76.5%)	39 (40.2%)	91 (55.2%)	<0.001

Figure 1. Severity of Periodontitis According To Diabetes Status among Adult Dental Patients



Other significant predictors included age ≥60 years (AOR: 2.18; 95% CI: 1.09–4.35; p = 0.027), smoking (AOR: 2.67; 95% CI: 1.31–5.43; p = 0.006), and irregular brushing (AOR:

2.24; 95% CI: 1.12–4.47; p = 0.021). Male gender was not significantly associated with disease severity (AOR: 1.29; 95% CI: 0.68–2.44; p = 0.421).

Table 4. Multivariate Logistic Regression Analysis for Predictors of Moderate-To-Severe Periodontitis

Variable	AOR	95% CI	p-value
Diabetes Mellitus	3.41	1.72–6.77	<0.001
Age ≥60 years	2.18	1.09–4.35	0.027
Smoking	2.67	1.31–5.43	0.006
Irregular Brushing	2.24	1.12–4.47	0.021
Male Gender	1.29	0.68–2.44	0.421

DISCUSSION

In the present study, the relationship between diabetes mellitus and dental periodontal health was examined in adult dental patients and the

results indicated that there was a significant relationship between diabetes and the severity of periodontal disease. The mean age of the study population was 45.8 ± 12.4 years and

males accounted for 57.0%. The high prevalence of diabetes mellitus (41.2%) among the study population shows that there is a high burden of diabetes among people visiting a dental clinic. The results highlight the need to consider systemic health status in assessing periodontal status. One of the big conclusions of this research was that the periodontal health was significantly poorer in diabetics than in non-diabetics. The mean plaque index (2.48 ± 0.54 vs. 1.89 ± 0.49), gingival index (2.31 ± 0.47 vs. 1.76 ± 0.42), probing pocket depth (4.8 ± 1.2 mm vs. 3.5 ± 1.0 mm), and clinical attachment loss (5.2 ± 1.4 mm vs. 3.8 ± 1.2 mm) were all significantly higher among diabetic participants ($p < 0.001$). The findings confirm the already known notion that diabetes negatively influences periodontal tissues due to dysfunction in immune system, production of inflammatory mediators and changes in collagen metabolism.

Similar findings have been reported in clinical studies in which probing depth, attachment loss and gingival inflammation were higher among diabetic patients compared with non-diabetic patients [11, 14].

The present study also revealed that there was a great difference in the prevalence of moderate to severe periodontitis between diabetic and non-diabetic adults, with 76.5% of diabetics having moderate to severe periodontitis as compared to 40.2% of the non-diabetics. The moderate and severe periodontitis rates were 50% and over $\frac{1}{4}$ of the diabetic patients respectively. It indicates that diabetes not only makes people more susceptible to periodontal disease, but also hastens its progression.

Similar findings have been reported in previous Pakistani and international studies, where diabetes was associated with greater periodontal disease severity and poorer periodontal status [14,17].

Another significant finding was that there was a relationship between poor glycemic control and periodontal destruction. Patients with diabetes who had poor glycemic control had more plaque accumulation, gingival inflammation, deeper periodontal pockets, and attachment loss. Advanced glycation end products are produced with chronic hyperglycemia, and they activate inflammatory pathways, thereby increasing periodontal tissue destruction.

This finding is consistent with previous evidence showing that poorer glycemic control

is associated with deterioration of periodontal parameters and tooth-supporting tissue destruction [12, 18].

A multivariate logistic regression analysis also showed diabetes mellitus to be an independent predictor of moderate to severe periodontitis. Diabetic patients had over three times the likelihood of having severe periodontal disease (AOR: 3.41; 95% CI: 1.72–6.77; $p < 0.001$). Furthermore, smoking and age were independently related to disease severity, as was lack of regular brushing. The results of this study suggest that periodontal disease is due to the interplay of systemic and behavior risk factors. These previous studies also found that diabetes, smoking, poor oral hygiene habits and increasing age are significant factors in the development of periodontal disease. This study presents an especially interesting effect of cigarette smoking. Those who smoked were 2.67 times more likely to have moderate to severe periodontitis. Smoking is known to have effects on neutrophil function, decrease blood flow in the gums, affect host immune responses, and promote periodontal destruction.

Smoking has been identified as an important risk factor for the incidence and progression of periodontitis, with evidence showing a detrimental effect on periodontal outcomes [19].

These findings are congruent with evidence showing that fair to poor oral hygiene increases the risk of periodontitis and that regular toothbrushing and dental visits can reduce this risk [20].

Limitations

This study has several limitations. First, the cross-sectional design limits the ability to establish a causal relationship between diabetes mellitus and periodontal disease severity. Second, the study was conducted at a single dental center, which may limit the generalizability of the findings to other populations and healthcare settings. Third, information regarding oral hygiene practices and smoking status was partially based on self-reporting and may be subject to recall bias. Fourth, glycemic control assessment relied on available clinical records and did not include repeated measurements over time. Fifth, the use of consecutive non-probability sampling may have introduced selection bias, as participants were enrolled only from patients attending the dental outpatient department during the study period.

CONCLUSION

Diabetes mellitus was significantly associated with poorer periodontal health and increased severity of periodontitis among adult dental patients. Diabetic individuals demonstrated significantly higher plaque index, gingival index, probing pocket depth, and clinical attachment loss compared with non-diabetic participants. Moderate-to-severe periodontitis was substantially more prevalent among diabetic patients, and diabetes remained an independent predictor of periodontal disease severity after adjustment for other risk factors. Smoking, older age, and irregular oral hygiene practices were also significantly associated with adverse periodontal outcomes.

Declarations

Ethics approval: Ethical approval was obtained from the Ethical Review Committee of Sheikh Zayed Hospital, Rahim Yar Khan, Punjab, Pakistan.

Informed consent: Written informed consent was obtained from all participants before data collection.

Conflict of interest: The authors declare no conflict of interest.

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