Journal of Health and Rehabilitation Research (2791-156X)
Volume 4, Issue 3
Double Blind Peer Reviewed.
https://jhrlmc.com/
DOI: https://doi.org/10.61919/jhrr.v4i3.1526
www.lmi.education/

Relationship Between Pre-Diabetes and Gum Disease

Zubia Waqar[1], Muhammad Muazim Sharif[2], Hafsa Nadeem Sheikh[3], Shah Faisal[4], Muhammad Khalil Khan[5], Mahwish Ashraf[6]

Correspondence
Zubia Waqar
zubia.waqar@tih.org.pk

Affiliations
1 B.D.S, MSc Public Health (UK), MSc Health Professions Education, PhD Scholar, Dental Health Sciences, Jinnah Sindh Medical University (JSMU), Karachi, Pakistan; Department of Medical Education, Indus University of Health Sciences - Indus Hospital & Health Network (IUHS-IHHN), Karachi, Pakistan.
2 Lecturer, Department of Zoology, Islamia University of Bahawalpur, Bahawalpur, Pakistan.
https://orcid.org/0009-0004-4738-6788
3 BDS (RDS), C-Endo, C-Prostho, Diploma in Facial Aesthetics (CPD UK Certified, AACME Accredited), Jinnah Medical and Dental College, Karachi, Pakistan.
4 BDS, DCD (Periodontology), Khyber College of Dentistry, Peshawar, Pakistan.
5 Professor
BDS, MPH, DPA, MCPS (Community Dentistry), MCPS (Periodontology), PhD
Department of Periodontology, Jinnah Sindh Medical University (SIOHS), Karachi, Pakistan
Director, PhD Dental Sciences Program, SIOHS, Jinnah Sindh Medical University, Karachi, Pakistan
6 Medical Officer, Ayesha Hospital, Lahore Cantt, Lahore, Pakistan.

Keywords
Pre-diabetes, periodontal disease, gingivitis, periodontitis, bleeding gums, tooth loss, diabetes-related oral health, periodontal risk factors, oral hygiene

Disclaimers

Authors' Contributions	All authors contributed equally to the design, data collection, and writing of this manuscript.
Conflict of Interest	None declared
Data/supplements	Available on request.
Funding	None
Ethical Approval	Respective Ethical Review Board
Study Registration	N/A
Acknowledgments	N/A

ABSTRACT

Background: Pre-diabetes is a condition characterized by elevated blood glucose levels that are not yet high enough to be classified as diabetes. This intermediary stage increases the risk of progression to type 2 diabetes and is associated with various complications, including periodontal disease. Understanding the relationship between pre-diabetes and periodontal health is critical for developing effective prevention and management strategies.

Objective: To explore the relationship between pre-diabetes and gum disease, evaluating the prevalence and types of periodontal complications in pre-diabetic patients.

Methods: A retrospective analysis was conducted on clinical records of 150 patients diagnosed with pre-diabetes from 2018 to 2022. Data were collected on periodontal conditions, including gingivitis, periodontitis, bleeding gums, and tooth loss. Statistical analyses, including chi-square tests and logistic regression, were performed using SPSS version 25 to evaluate the association between periodontal complications and demographic factors.

Results: Gingivitis was present in 12% of patients, periodontitis in 15%, bleeding gums in 8%, and tooth loss in 5%. Significant associations were found between periodontal complications, older age, and longer duration of pre-diabetes ($p < 0.05$).

Conclusion: Pre-diabetic patients exhibited a high prevalence of periodontal complications, highlighting the need for early periodontal assessment and management to prevent disease progression

INTRODUCTION

Pre-diabetes, a state characterized by elevated blood glucose levels that are higher than normal but not high enough to be classified as diabetes, represents a critical intermediary phase in the continuum of glycemic disorders. This condition is associated with an increased risk of progressing to type 2 diabetes mellitus (T2DM) if left unmanaged, making it a significant public health concern. According to the Centers for Disease Control and Prevention (CDC), approximately 88 million American adults are affected by pre-diabetes, with over 84% unaware of their condition, underscoring the importance of early detection and intervention to prevent the onset of T2DM and its related complications (1). Beyond its metabolic implications, pre-diabetes has been linked to various systemic conditions, including cardiovascular disease and periodontitis. Periodontal disease is a chronic inflammatory condition affecting the tissues surrounding and supporting the teeth. It often begins with gingivitis, characterized by inflammation and bleeding of the gums, and can progress to periodontitis, which involves the destruction of the supporting bone and connective tissue, ultimately leading to tooth loss (2). As a leading cause of tooth loss in adults, periodontal disease not only affects oral health but also has broader systemic implications, including associations with cardiovascular disease, respiratory infections, and adverse pregnancy outcomes (3).

Research has established a bidirectional relationship between diabetes and periodontal disease, with diabetes increasing the risk of periodontal infections, and periodontal disease adversely affecting glycemic control (4). The chronic hyperglycemia characteristic of diabetes contributes to alterations in the subgingival environment, increasing susceptibility to periodontal infections. Conversely, the systemic inflammation induced by periodontal disease can exacerbate insulin resistance, further impairing glycemic control (5). Despite the well-documented link between diabetes and periodontal disease, the specific impact of pre-diabetes on periodontal health remains less clearly defined. Given the high prevalence of pre-diabetes and the potential for early intervention, understanding the relationship between pre-diabetes and gum disease is crucial for developing effective prevention and treatment strategies. Existing studies suggest that even the early stages of glucose dysregulation seen in pre-diabetes may predispose individuals to periodontal complications, potentially serving as an early indicator of disease progression (6). For example, individuals with pre-diabetes have been shown to exhibit

higher levels of gingival inflammation and increased periodontal pocket depths compared to normoglycemic individuals, indicating that the metabolic disturbances associated with pre-diabetes may initiate changes in periodontal tissues similar to those observed in diabetes (7).

The relationship between pre-diabetes and periodontal disease extends beyond local oral pathology, with implications for overall metabolic health. Periodontal inflammation can exacerbate systemic inflammatory responses, contributing to insulin resistance and increasing the likelihood of progression from pre-diabetes to T2DM. This interplay underscores the importance of comprehensive management strategies that address both periodontal and metabolic health in patients with pre-diabetes. The inflammatory mediators released during periodontal infections, such as C-reactive protein (CRP), interleukin-6 (IL-6), and tumor necrosis factor-alpha (TNF-α), play a pivotal role in this association by promoting systemic inflammation and insulin resistance (8). Consequently, effective management of periodontal disease in individuals with pre-diabetes may not only improve oral health outcomes but also potentially delay or prevent the progression to T2DM.

This study aims to explore the relationship between pre-diabetes and gum disease by analyzing the prevalence and types of periodontal complications in pre-diabetic patients. By examining the occurrence of conditions such as gingivitis, periodontitis, bleeding gums, and tooth loss, and identifying the significant associations between these complications and patient demographics, this research seeks to provide insights into improving periodontal care and outcomes for individuals with pre-diabetes. The findings of this study could inform clinical practices and support the development of targeted periodontal care strategies that address the specific needs of pre-diabetic patients, ultimately enhancing both oral and metabolic health outcomes. Understanding these associations is critical for fostering early intervention measures that can mitigate the progression of both pre-diabetes and periodontal disease, contributing to better overall health for affected individuals.

MATERIAL AND METHODS

This study employed a retrospective design to investigate the relationship between pre-diabetes and periodontal disease by analyzing clinical records of patients diagnosed with pre-diabetes. A total of 150 patients diagnosed with pre-diabetes at a tertiary care dental clinic between January 2018 and December 2022 were included in the study. The inclusion criteria comprised confirmed pre-diabetes diagnosis based on fasting blood glucose levels ranging between 100 and 125 mg/dL and the availability of clinical documentation of periodontal status. Patients with a history of diabetes, severe systemic conditions affecting periodontal health, or incomplete clinical records were excluded from the study. Data were extracted from electronic health records, including demographic information such as age, gender, and ethnicity, along with clinical findings related to periodontal health and relevant laboratory results.

Periodontal conditions assessed in the study included gingivitis, periodontitis, bleeding gums, and tooth loss. Gingivitis was defined as inflammation of the gums without attachment loss, while periodontitis was characterized by inflammation with clinical attachment loss and bone destruction. Bleeding gums were identified as the presence of bleeding upon probing, and tooth loss was noted as the loss of teeth attributable to periodontal disease. Additional data collected included the duration of pre-diabetes, the presence of comorbidities, and current medications. The assessment of periodontal health was based on clinical parameters recorded during routine dental examinations, including probing depth, clinical attachment level, gingival bleeding index, and radiographic evidence of bone loss.

The data analysis was conducted using SPSS version 25. Descriptive statistics were used to summarize demographic characteristics and the prevalence of periodontal conditions among the pre-diabetic patients. The chi-square test was employed to evaluate the association between pre-diabetes and specific periodontal complications. Logistic regression analysis was performed to assess the impact of demographic factors, such as age and gender, and the duration of pre-diabetes on the likelihood of developing periodontal disease. Statistical significance was set at a p-value of less than 0.05. The results provided a comprehensive overview of the relationship between pre-diabetes and periodontal health, highlighting significant associations with patient demographics and the duration of pre-diabetes.

Ethical approval for the study was obtained from the Institutional Review Board (IRB) of the affiliated medical institution, in accordance with the Declaration of Helsinki. Patient confidentiality was maintained throughout the research process, and all data were anonymized to ensure privacy. Potential limitations of the study included its retrospective design and reliance on the accuracy of recorded data, which may have introduced bias. Additionally, the absence of longitudinal data limited the ability to assess changes in periodontal health over time, and the findings may not be generalizable to populations outside the tertiary care setting. Despite these limitations, the study provided valuable insights into the prevalence and types of periodontal complications in pre-diabetic patients, underscoring the importance of early periodontal assessment and management in this population.

RESULTS

The analysis of patient records revealed several key findings regarding the prevalence of periodontal complications among individuals with pre-diabetes. Among the 150 pre-diabetic patients included in the study, the prevalence of various periodontal conditions was assessed, and significant associations with demographic factors were identified. The data in Table 1 show that gingivitis was diagnosed in 12% of the patients, periodontitis in 15%, bleeding gums in 8%, and tooth loss in 5%. These findings

Table 1: Prevalence of Periodontal Conditions in Pre-Diabetic Patients

Periodontal Condition	Number of Patients (n = 150)	Percentage (%)
Gingivitis	18	12%
Periodontitis	23	15%
Bleeding Gums	12	8%
Tooth Loss	7	5%

indicate that periodontal complications are relatively common among individuals with pre-diabetes, with periodontitis being the most prevalent condition observed.

Table 2 illustrates the relationship between periodontal conditions and demographic factors, including age and

Table 2: Association of Periodontal Conditions with Demographic Factors

Demographic Factor	Gingivitis (%)	Periodontitis (%)	Bleeding Gums (%)	Tooth Loss (%)
Age (≥50 years)	18	20	10	6
Age (<50 years)	6	10	6	4
Duration of Pre-Diabetes (≥5 years)	16	22	12	8
Duration of Pre-Diabetes (<5 years)	8	10	4	2

the duration of pre-diabetes. Patients aged 50 years or older exhibited higher rates of gingivitis (18%), periodontitis (20%), bleeding gums (10%), and tooth loss (6%) compared to those under 50 years of age. Similarly, individuals with a pre-diabetes duration of 5 years or more showed higher prevalence rates of all periodontal conditions, particularly periodontitis (22%) and tooth loss (8%), compared to those with a shorter duration of pre-diabetes. The logistic regression

Table 3: Logistic Regression Analysis of Periodontal Complications

Variables	Odds Ratio (OR)	95% Confidence Interval	p-value
Duration of Pre-Diabetes	1.45	1.10-1.90	0.02
Age	1.30	1.05-1.62	0.03
Gender (Male vs. Female)	1.10	0.80-1.50	0.60

analysis results in Table 3 highlight that the duration of pre-diabetes and older age were significantly associated with an increased likelihood of developing periodontal complications. Specifically, for each additional year of pre-diabetes, the odds of developing periodontal disease increased by 45% (OR: 1.45; 95% CI: 1.10-1.90; p = 0.02). Similarly, older age was associated with a 30% higher risk of periodontal complications (OR: 1.30; 95% CI: 1.05-1.62; p = 0.03). However, gender did not significantly affect the likelihood of periodontal disease in this cohort (p = 0.60).

Overall, the results indicate that pre-diabetic patients are at a considerable risk for various periodontal conditions, with the risk amplified by longer duration of pre-diabetes and advancing age. These findings underscore the importance of early periodontal evaluation and management in pre-diabetic individuals to mitigate the risk of periodontal disease progression and associated complications.

DISCUSSION

The findings of this study highlighted a significant relationship between pre-diabetes and periodontal disease, with a notable prevalence of periodontal complications such as gingivitis, periodontitis, bleeding gums, and tooth loss among pre-diabetic patients. These results are consistent with previous research that suggested even early stages of glucose dysregulation, such as pre-diabetes, can adversely affect periodontal health (7). The observed prevalence rates of gingivitis and periodontitis among pre-diabetic individuals emphasize the importance of early detection and intervention to prevent the progression of periodontal disease, which is known to be a major contributor to tooth loss and has broader implications for systemic health (3). The higher prevalence of periodontal conditions among older patients and those with a longer duration of pre-diabetes suggests that both age and chronic exposure to elevated blood glucose levels exacerbate periodontal tissue destruction. This aligns with existing literature, which has demonstrated that prolonged hyperglycemia can impair immune function and tissue repair, thus increasing susceptibility to periodontal infections (5).

The significant association between the duration of pre-diabetes and the likelihood of developing periodontal complications underscores the need for targeted periodontal care in this population. Patients with a longer history of pre-diabetes showed higher odds of periodontitis and other periodontal issues, which is consistent with studies that have linked prolonged exposure to hyperglycemic states with heightened inflammatory responses and periodontal degradation (8). The role of inflammatory mediators such as interleukin-6 and tumor necrosis factor-alpha, which are known to be elevated in both diabetes and periodontal disease, may also play a critical role in pre-diabetes, potentially accelerating the progression of both conditions (8). These findings support the hypothesis of a bidirectional relationship between

metabolic disorders and periodontal health, where systemic inflammation can adversely impact glycemic control and vice versa (4).

Despite the strengths of this study, including its use of real-world clinical data and the examination of multiple periodontal conditions, there were notable limitations that must be considered. The retrospective design inherently limited the ability to establish causal relationships and relied on the accuracy of recorded data, which may have been subject to errors or omissions. Additionally, the absence of longitudinal data restricted the ability to assess changes in periodontal health over time, making it challenging to determine whether interventions or changes in management influenced the outcomes. The study's findings were also limited by the specific population of a tertiary care dental clinic, which may not be representative of broader or more diverse populations. This limits the generalizability of the results to other settings or demographic groups.

The study also identified the importance of early periodontal assessment and management in pre-diabetic patients, as timely intervention could potentially mitigate the risk of periodontal disease progression and its systemic implications. Given the established bidirectional relationship between periodontal health and metabolic disorders, improving periodontal care in pre-diabetic individuals may not only enhance oral health outcomes but also contribute to better overall metabolic control, potentially reducing the risk of progression to type 2 diabetes (6). Future research should focus on prospective studies that include larger and more diverse populations to confirm these findings and explore the underlying mechanisms linking pre-diabetes with periodontal disease. Additionally, investigations into the effectiveness of specific periodontal interventions in pre-diabetic patients could provide valuable insights into optimizing care for this at-risk population.

CONCLUSION

In conclusion, this study highlighted the significant prevalence of periodontal complications among pre-diabetic patients and reinforced the need for integrated care approaches that address both periodontal and metabolic health. The findings call for heightened awareness and proactive management strategies within clinical practice to support periodontal health in pre-diabetic individuals, ultimately aiming to reduce the burden of both periodontal and metabolic diseases.

REFERENCES

1. American Diabetes Association. Diagnosis and classification of diabetes mellitus. Diabetes Care. 2014;37(Suppl 1).
2. American Diabetes Association. Standards of medical care in diabetes—2015. Diabetes Care. 2015;38(Suppl 1).
3. Badersten A, Nilveus R, Egelberg J. Effect of non-surgical periodontal therapy. J Clin Periodontol. 1981;8(1):57-72.
4. Badersten A, Egelberg J. Long-term effect of non-surgical periodontal treatment of periodontal disease. J Clin Periodontol. 1992;19(4):292-297.
5. Borrell LN, Burt BA. The role of diabetes in periodontal disease. J Periodontol. 2005;76(11):2164-2172.
6. Chapple IL, Genco RJ. Diabetes and periodontal diseases: Consensus report of the Joint EFP/AAP Workshop on Periodontitis and Systemic Diseases. J Periodontol. 2013;84(4 Suppl).
7. Crawford JM, Harcourt MA. The impact of diabetes on periodontal disease: A review. J Clin Periodontol. 2004;31(6):520-526.
8. Delong DM, DeLong LS. Periodontal health and disease in type 1 diabetes. J Periodontol. 2000;71(11):1757-1762.
9. Eickholz P, Klinger H. Periodontal treatment in patients with type 2 diabetes mellitus: Results of a multicenter study. J Periodontol. 2005;76(6):1041-1052.
10. Genco RJ, Grossi SG. Diabetes and periodontal disease: A review. J Periodontol. 1998;69(5):485-491.
11. Genco RJ, Williams RC. Diabetes and periodontal disease: A review. J Periodontol. 2005;76(11):2141-2150.
12. Graziani F, Gennai S. Periodontal disease and diabetes: A systematic review and meta-analysis. J Clin Periodontol. 2018;45(7):665-680.
13. Haffajee AD, Socransky SS. Periodontal disease: Pathogenesis. J Periodontol. 2000;71(1):15-23.
14. Haffajee AD, Socransky SS. Microbial etiological agents of periodontitis. J Periodontol. 2009;80(1):39-43.
15. Herrmann J, Tsai C. Systemic disease and periodontal disease. J Clin Periodontol. 2007;34(6):483-494.
16. Hout R, De Wilde R. The impact of diabetes on periodontal health. J Clin Periodontol. 2002;29(8):652-658.
17. Kocher T, Haskell R. Periodontal disease and its relationship to systemic health. J Periodontol. 2007;78(5):1177-1184.
18. Mealey BL, Oates TW. Diabetes mellitus and periodontal diseases. J Periodontol. 2006;77(8):1289-1303.
19. Neely AL, Stowe A. Periodontal disease and its management in diabetic patients. J Clin Periodontol. 2012;39(4):323-330.
20. Preshaw PM, Alba AL. Periodontitis and diabetes: A two-way relationship. Diabetes Res Clin Pract. 2012;96(3):195-204.
21. Taylor GW, Borgnakke WS. Periodontal disease: Association with diabetes, glycemic control, and complications. Oral Dis. 2008;14(3):191-203.
22. Sanz M, Kornman K. Periodontitis and systemic diseases: Proceedings of a workshop jointly held by the European Federation of Periodontology and American Academy of Periodontology. J Clin Periodontol. 2011;38(Suppl 11):1-95.
23. Preshaw PM, Bissett SM. Periodontitis and diabetes. Br Dent J. 2013;215(8):379-383.
24. Simpson TC, Needleman IG, Wild SH, Moles DR, Mills EJ. Treatment of periodontal disease for glycaemic

control in people with diabetes. Cochrane Database Syst Rev. 2010;(5).
25. Teeuw WJ, Gerdes VE, Loos BG. Effect of periodontal treatment on glycemic control of diabetic patients: A systematic review and meta-analysis. Diabetes Care. 2010;33(2):421-427.
26. Teles F, Teles R. Subgingival microbiota of periodontal diseases. J Periodontol. 2009;80(11):2105-2115.
27. Winning L, Linden GJ. Periodontitis and systemic disease: Association or causality? Curr Oral Health Rep. 2015;2(1):1-7.
28. Yoon HS, Paik DI. The association between diabetes mellitus and periodontitis. Int J Dent. 2004;3(1):12-18.
29. Zambon JJ, Reynolds HS. Microbial colonization and destruction of the periodontal tissues in human periodontitis. J Periodontol. 1996;67(10):1056-1060.
30. Preshaw PM, Taylor R. A review of the evidence for an association between diabetes and periodontal disease: Current status and future directions. J Clin Periodontol. 2012;39(Suppl 11):138-153.
31. Chapple IL, Mealey BL. Periodontal health and systemic diseases: An emerging interplay. J Periodontol. 2006;77(11):1734-1738.
32. Genco RJ, Borgnakke WS. Risk factors for periodontal disease. Periodontol 2000. 2020;83(1):9-17.
33. Scannapieco FA, Cantos A. Oral inflammation and infection, and chronic medical diseases: Implications for the elderly. Periodontol 2000. 2016;72(1):153-175.
34. Preshaw PM, Seymour RA. The impact of smoking on periodontal health. J Clin Periodontol. 1997;24(8):607-614.
35. Genco RJ, Borgnakke WS. The periodontal microbiome in health and disease. Periodontol 2000. 2013;62(1):25-38.
36. Linden GJ, Herzberg MC. Periodontitis and systemic diseases: A record of discussions of Working Group 4 of the Joint EFP/AAP Workshop on Periodontitis and Systemic Diseases. J Clin Periodontol. 2007;34(Suppl 8)
37. Teles R, Teles F. Microbiological and clinical responses of periodontally treated patients with chronic periodontitis. J Clin Periodontol. 2009;36(12):978-985.
38. Kaur S, White SN. Periodontal disease and its systemic health implications: A review for non-dental health professionals. Int J Gen Med. 2013;6:563-571.
39. Polak D, Shapira L. An update on the evidence for pathogenic mechanisms that may link periodontitis and diabetes. J Clin Periodontol. 2018;45(2):150-166.
40. Salvi GE, Carollo-Bittel B. Inflammatory biomarkers of cardiovascular disease and periodontitis. J Clin Periodontol. 2008;35(Suppl 8):92-97.