Volume 10, Issue 12, December 2024,
Publish Date: 05-12-2024
Doi https://doi.org/10.55640/ijmsdh-10-12-02

International Journal of Medical Science and Dental Health (Open Access)

PERIODONTAL DISEASE THE INVISIBLE (FORGOTTEN) DIABETES COMPLICATION: NEGATIVE IMPACT IN QUALITY OF LIFE

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ABSTRACT

Introduction: Periodontal disease and diabetes are prevalent, intricate, and chronic conditions characterized by well-established bidirectional relationships. Specifically, in the context of inadequate glycemic control, individuals with diabetes manifest an elevated prevalence and severity of periodontitis. Conversely, severe periodontitis is associated with compromised glycemic control. Interestingly, it is uncommon for healthcare providers managing diabetic patients to incorporate routine oral examinations as part of their comprehensive care, despite the intrinsic connection between periodontitis and oral health. This stands in contrast to other commonly assessed conditions such as retinopathy, neuropathy, or renal status. This disparity is notable both in the initial management and throughout the chronic care of diabetic individuals. **Methods:** A total of 220 individuals diagnosed with Type 2 diabetes were intentionally selected from the Diabetes and Stomatology Clinic at the Instituto Nacional de Ciencias Médicas y Nutrición Salvador Zubirán. The selection process involved a thorough review by the hospital's dental team to ensure adherence to specific inclusion criteria. These criteria included individuals aged between 34 and 64 years, with HbA1c levels less than 9. This deliberate patient selection process aimed to maintain a focused and homogeneous study population for robust research outcomes. **Results:** In our study, lower HbA1c levels were consistently linked to better periodontal health, emphasizing the association between glycemic control and oral well-being. This trend is evident across different CPI categories, reaffirming the inverse relationship between HbA1c

levels and periodontal health. **Conclusion:** This study underscores the intricate link between diabetes and periodontal disease, urging expanded care for individuals with diabetes. Integrating routine dental assessments can enhance overall health outcomes. Further research and awareness are crucial for a holistic diabetes care approach, emphasizing the need for additional studies.

KEYWORDS: periodontal disease, periodontitis, microvascular complications,

INTRODUCTION

Research indicates a compelling link between diabetes and periodontal disease, establishing both types—Type 1 Diabetes (T1D) and Type 2 Diabetes (T2D)—as predictors of this oral health complication. Recognizing periodontal disease as a significant complication of diabetes is crucial due to its bidirectional nature. Surprisingly, only 50% of individuals with diabetes are aware of their heightened risk for this often-undiagnosed complication.

Globally, periodontal disease is acknowledged as the sixth complication of diabetes, with a severe form affecting 11.2% of the diabetes population. The significance of maintaining optimal glycemic control cannot be overstated, as poor control is strongly correlated with an elevated risk of developing severe periodontal disease and subsequent tooth loss. Timely treatment of periodontal disease may even contribute to improved metabolic control in diabetes. [1,2.]

Despite these findings, both general and specialized medical practitioners frequently overlook periodontal disease as an additional complication of diabetes. Unlike routine referrals to ophthalmologists for the intentional detection of retinopathy, the practice of recommending dental check-ups for individuals with diabetes or pre-diabetes at the time of diagnosis is rare.

Notably, healthcare providers often lack awareness of key indicators of periodontal disease, such as gingival bleeding, tooth mobility, and alveolar bone loss, unlike dentists who are trained to recognize these signs. In this work, we aimed to look for an association between oral health, glucose control, and quality of life, and review relevant evidence around it.

METHODS

Study population

A total of 220 subjects diagnosed with Type 2 diabetes were recruited from the Diabetes and Stomatology Clinic at the Instituto Nacional de Ciencias Médicas y Nutrición Salvador Zubirá (INCMNSZ). The enrolment process involved comprehensive assessments conducted during the initial consultation, which included a detailed medical history, physical examination, and dental evaluation. Additionally, fasting blood samples were obtained for biochemical measurements, encompassing lipid profiles, glucose levels, and A1C.

All participants provided informed consent upon entering the study, demonstrating their willingness to participate. The study protocol adhered to the ethical guidelines outlined in the 1975 Declaration of Helsinki and received approval from the Research and Ethics Committee of the hospital.

The inclusion criteria comprised adults within the age range of 34 to 64 years who were proficient in reading and writing, with an A1c level of less than 9%. Conversely, exclusion criteria encompassed pregnancy, lactation, and individuals with a minimum of 20 teeth. Patients experiencing dental

emergencies, such as odontogenic abscesses or acute stress infections, were also excluded within the six weeks preceding the study.

This rigorous selection process ensures the study's focus on a specific demographic within the diabetic population, minimizing confounding variables and contributing to the robustness of the research findings.

Biochemical parameters

All measurements were conducted following a 12-hour fasting period. Blood samples were collected by venous puncture using BD Vacutainer® RST tubes. The samples were immediately stored on ice until clot formation and then centrifuged at 1500 rpm for 15 minutes. Glucose, total cholesterol, and HDL-C levels were determined using Synchron CX Delta (Beckman Coulter) colorimetric enzymatic methods.

Anthropometric measurements, including weight and height estimations, were carried out with calibrated scales and stadimeters. The waist circumference was measured at the midpoint between the lower border of the costal margin and the iliac crest during exhalation, ensuring precision and consistency.

Arterial hypertension was defined as a systolic blood pressure (SBP) ≥ 140 mmHg, diastolic blood pressure (DBP) ≥ 90 mmHg, or self-reported use of antihypertensive medications. Smoking status was meticulously recorded, categorizing individuals as current smokers (having smoked at least one cigarette in the previous month), former smokers (with the last cigarette smoked more than 6 months ago), or never smokers.

These standardized measurement and classification procedures contribute to the accuracy and reliability of the collected data, providing a comprehensive understanding of the subjects' health profiles and facilitating robust statistical analyses.

Quality of Life Assessment:

In evaluating the quality-of-life parameters, two distinct scoring systems were employed. The first, Diabetes-39 (D39), is a multidimensional scale validated for use in the Mexican population. Comprising 39 items, this scale assesses the health-related quality of life in diabetic patients across five domains: [3]

- Mobility and Energy
- Diabetes Control
- Anxiety
- Social Overload
- Sexual Functionality

The second scoring system, Community Periodontal Index (CPI), classifies periodontal disease through the utilization of a periodontal probe. In certain cohorts, CPI has been correlated with "all-cause mortalities." The classifications under CPI are as follows: [4]

- **Classification 0:** Healthy
- **Classification 1:** Bleeding (Inside the gums)
- **Classification 2:** Calculus (Gums)
- **Classification 3:** Presence of a Moderate Periodontal Pocket (4-5mm)

- **Classification 4:** Presence of a Profound Periodontal Pocket (>6mm)

These scoring systems provide a comprehensive assessment of various aspects of individuals' lives, ranging from health-related concerns specific to diabetes to the classification of periodontal disease, which has implications for overall well-being, including potential associations with mortality in certain populations.

Statistical analysis

All data management and statistical analyses were performed using R version 2023.09.0 + 463, and all data manipulation was performed using dplyr. Comparison, statistical analysis, and correlations between scores and HbA1c were done using the package ggplot2.

RESULTS

Table 1 summarizes the clinical and demographic characteristics of our population. More than half of our sample were females and only 40% of our patients were adequately controlled (defined as having an HbA1c <7.0 %). The vast majority of our patients (85%) had positive findings for periodontitis.

Table 1 *(Demographic and Clinical Characteristics of the Studied Population.)*

Level Overall	
n	213
Age (mean (SD))	52.58 (8.85)
Men (%)	83 (39.0)
Women (%)	130 (61.0)
IMC (mean (SD))	29.69 (6.14)
HbA1c (mean (SD))	8.02 (2.06)
With Diabetes Medications (%)	169 (79.3)
Without Diabetes Medications (%)	44 (20.7)
With Insulin (%)	95 (44.6)
Without Insulin (%)	118 (55.4)
Controlled DM (%)	87 (40.8)
Uncontrolled DM (%)	126 (59.2)

D39_Score (mean (SD))	30.86 (20.58)
Tobacco Users (%)	54 (25.4)
Non-Tobacco Users (%)	159 (74.6)
Normal CPI (%)	32 (15.0)
Anormal CPI (%)	181 (85.0)

As observed in Figure 1, lower HbA1c levels are associated with a better periodontal. state (P=0.05). As indicated in the graph, individuals with the lowest mean HbA1c mdemonstrate healthier periodontal parameters.

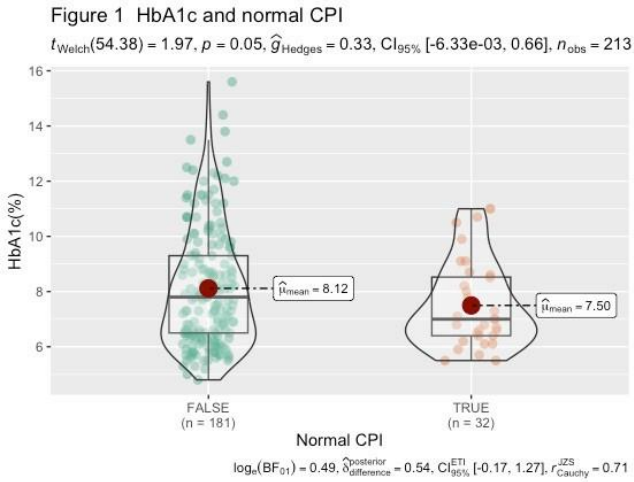
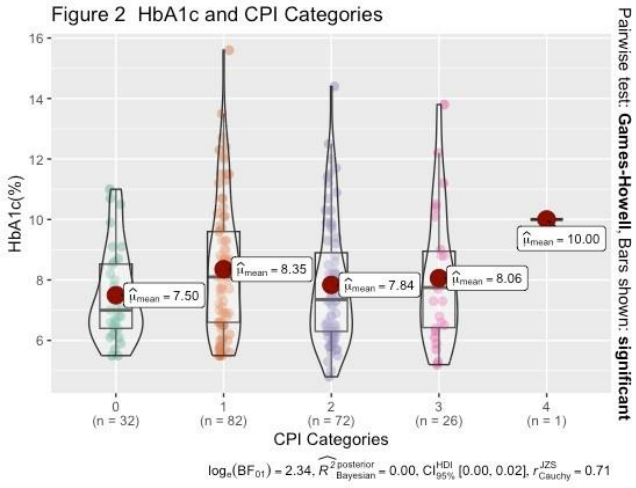


Figure 2 illustrates the association between HbA1c levels and each CPI category, as previously described. A trend emerges: the higher the CPI category, the less glycemic control observed (PB= 0.00).



DISCUSSION

We observed periodontitis was highly prevalent and an association between poor glucose control and poor oral health. Likewise, we observed poor oral health significantly and negatively impacted quality of life.

Periodontal disease, defined as an infectious and inflammatory ailment, impacts the supportive structures of teeth, triggering both local and systemic inflammatory responses. This, in turn, adversely affects the well-being of individuals living with diabetes. [5,6]

The association between periodontal disease and diabetes mellitus has been reported since the last century. Multiple authors have elucidated the bidirectional influence between these two conditions, primarily involving inflammatory processes that contribute to uncontrolled lesions in periodontal tissues and target organs in individuals with diabetes. [7,8]

The primary etiological factor for periodontal disease is bacteria and their virulence factors. Periodontal infections can induce a chronic state of insulin resistance, culminating in the formation of advanced glycated products (AGEs) 9. This amplifies pathways leading to connective tissue degradation and destruction. Clinical manifestations include erythema, edema, and gingival bleeding upon mild stimuli, attributed to biofilm and dental calculus accumulation, increased interdental spaces due to dental migration, gingival recession, and premature tooth loss. Similarly, poorly controlled diabetes heightens the risk, extent, and severity of periodontitis. [10]

The nexus between periodontitis and glycemic control arises from proinflammatory mediators expressed at periodontal sites, leading to bacteremia that adversely affects normal insulin receptor function. This, in turn, heightens insulin resistance, contributing to the hyperglycemic condition.[11]

The disease, characterized by anaerobic infection from gram-negative bacteria, results from dysbiosis in the biofilm-host relationship, influenced by hyper or hypo immune reactivity to microbial presence. Factors such as variations in microflora, genetic profiles, risk factors, and immune system conditions contribute to tissue breakdown, mediated by proinflammatory cytokines in the local environment, including Necrosis Tumor Factor and interleukins induced by lipopolysaccharide. [12,13]

Periodontitis is considered the sixth chronic complication of diabetes, affecting 11.2% of the adult population in its severe forms. This poses a global burden economically, socially, and in terms of public health, closely linked to overall well-being. [11]

The disease represents an anaerobic infection by gram-negative bacteria, resulting from dysbiosis between the biofilm and the host due to hyper or hypo-immune reactivity to microbial presence. This leads to tissue breakdown, mediated by the host through the release of proinflammatory cytokines in the local environment and immune cells responding to metabolites and bacterial flora, especially lipopolysaccharide. [12]

In the hyperglycemic state of diabetes, especially with poor glycemic control, lipid and protein oxidation occurs, accompanied by an accumulation of Advanced Glycation End Products (AGEs). This

accumulation, particularly of N ε-(carboxymethyl) lysine, occurs in plasma and tissues, including the periodontium, resulting in marked changes in cells and extracellular matrix components. 14 These changes lead to the development of chronic complications of Type 2 Diabetes (DM2) and intensify the immune-inflammatory response of monocytes and macrophages to periodontal pathogens due to the presence of AGE receptors.

Serum elevation of AGEs is closely related to the extent of periodontitis. Although AGEs are the primary link to diabetes-related complications, their effect depends on the Receptor for AGEs (RAGE), a multi-ligand member of the immunoglobulin family present on cell surfaces. Its expression increases in gingival tissues of diabetes patients. The interaction between AGEs and receptors in inflammatory cells leads to increased production of proinflammatory cytokines such as IL-1β and TNF-α in crevicular fluid in diabetes patients. This contributes to the severity of periodontal disease, and increased interaction of the AGE-RAGE axis leads to greater bone loss, translating into more significant inflammation and severe periodontal destruction in the presence of bacteria. [6]

Therefore, patients with Type 2 diabetes are up to three times more likely to have periodontitis compared to healthy individuals. Those with uncontrolled diabetes present up to an 11 times higher risk of bone loss compared to healthy or normoglycemic individuals. [14]

In patients with good glycemic control, a reduction in destructive activity and disease progression is expected, but not necessarily a positive effect on clinical parameters of insertion level, as irreversible bone loss is associated. [17]

Additional evidence suggests that Type 2 diabetes mellitus can trigger or accelerate periodontal disease, especially in individuals with poor glycemic control (average HbA1c > 7.5%).[18]

CONCLUSION

This study supports an interplay between diabetes and periodontal disease, urging healthcare providers to broaden their scope of care for individuals with diabetes. The integration of routine dental assessments, especially during the initial and chronic management of diabetes, has the potential to improve overall health outcomes and enhance the quality of life for this population. Further research and awareness initiatives are warranted to promote a holistic approach to diabetes care that includes comprehensive oral health assessments.

REFERENCES

1. Desai, R., Khobragade B., McCracken G. et al. Impact of diabetes and periodontal status on life quality. BDJ 2021 7-9. doi: org/10.1038/s41405-021-00061-w
2. Kebede TG, Holtfreter B, Kocher T, Meisel P, Dietrich T, Biffar R, et al. Association of Periodontal Destruction and Diabetes with Mortality. J Dent Res. 2017; 96(1):56- 63. doi: 10.1177/0022034516668839.
3. Alline De Queiroz, F., Emilia Pace, A., & Benedita Dos Santos, C. (2009). Adaptación Cultural Y Validación Del Instrumento Diabetes – 39 (D-39): VersiónPara Brasileños Con Diabetes

Mellitus Tipo 2 - Fase 11. Rev Latino-am Enfermagem. https://www.scielo.br/j/rlae/a/34ggKvtHwbcYZNVhzMJK6xL/?form at=pdf&lang=es#:~:text=La%20Diabetes%2D39%20(D%2D, social%20(5%20ítems)%20y%20funcionamiento

4. Gutiérrez, J. a. V., Calvo, J., Ortega, J. S., Sánchez, A. D., García, R. M., Carrillo, R.M. S. R., & Barreras, A. (2010). Análisis comparativo del índice periodontal comunitario en estudiantes de diversas licenciaturas universitarias. Revista De La Asociación Dental Mexicana,67(4),171 176. https://www.medigraphic.com/pdfs/adm/od-2010/od104e.pdf
5. Mealey BL, Rethman MP. Periodontal disease and diabetes mellitus. Bidirectional relationship. Dent Today 2003; 22: 107-13.
6. Grossi SG, Genco RJ. Periodontal disease and diabetes mellitus: a two-way relationship. Ann Periodontol 1998; 3: 51-61.
7. Sammarlkorpi K. Glucose intolerance in acute infections.J Intern Med 1989; 225: 15-9.
8. Casanova L, Hughes FJ, Preshaw PM, Diabetes and periodontal disease: a two-way relationship. Br Dent J 2014; 217: 433-437.
9. Gurav AN. Periodontitis and insulin resistance: casual or causal relationship? Diabetes Metab J 2012; 36: 404-411.
10. Genco RJ, Sanz M. Clinical and public health implications of periodontal and systemic diseases: An overview. J Periodontol 2020; 83(1):7-13. doi: 10.1111/prd.12344.
11. Gómez Pérez FJ, Almeda Valdés P, Gómez Sámano MG, La diabetes en México, orígenes, retosy soluciones. [Internet] México. 2015. Academia Nacional de Medicina de México. Disponible en: https://acortar.link/gHfgAD
12. Iacopino, A.M. Periodontitis and Diabetes Interrelationships: Role of Inflammation. Annals of Periodontology 2001,6:125-137. doi.org/10.1902/annals.2001.6.1.125
13. Kinane DF, Stathopoulou PG, Papanou PN.Periodontal diseases. Nat Rev Dis Primers. 2017, 22(3): 1-14. doi:10.1038/nrdp.2017.38
14. Chee B, Park B, Bartold PM. Periodontitis and type II diabetes: a two-way relationship. Int J Evid Based Healthc. 2013,1(4): 317-29. doi: 10.1111/1744-1609.12038.
15. Lalla, E., Lamster, I.B., Stern, D.M. and Schmidt, A.M. Receptor for Advanced Glycation End Products, Inflammation, and Accelerated Periodontal Disease in Diabetes: Mechanisms and Insights into Therapeutic Modalities. Annals of Periodontology 2001, 6: 113-118. doi.org/10.1902/annals.2001.6.1.113
16. Brian L. Mealey. Periodontal disease and diabetes. A two-way street. JADA 2006, 137(2): 26-31. doi.org/10.14219/jada.archive.2006.0404
17. Santos Tunes R, Foss MC, Nogueira-Filho G. Impact of Periodontitis on the Diabetes-Related Inflammatory Status. J Can Dent Assoc 2010 76: 1-7. doi: jcda.ca/article/a35
18. Garcia D, Tarima S, Okunseri C. Periodontitis and glycemic control in diabetes: 285 NHANES 2009 to 2012. J Periodontol 2015 86(4): 499-506. doi: 28610.1902/jop.2014.140364.