



## Clinical evidence of the impact of periodontal diseases on metabolism, diabetes mellitus, and quality of life: a systematic review

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### Abstract

**Introduction:** The incidence of diabetes mellitus (DM) in Central and South American countries was estimated at 27.4 million people and projected to reach 45 million by 2030. According to the International Diabetes Federation, there were 366 million people with the disease in 2011, with an expected number of 552 million by 2030. Periodontal disease is an inflammation (chronic or acute) that affects the supporting structures of the tooth and is influenced by certain local or systemic conditions. DM can contribute to the development of periodontal disease, reducing the quality of life.

**Objective:** The aim was to present the main clinical evidence on the impact of periodontal diseases on metabolism, diabetes mellitus, and quality of life through a systematic review. **Methods:** The systematic review rules of the PRISMA Platform were followed. The search was conducted from September to October 2025 across the Web of Science, Scopus, Embase, PubMed, ScienceDirect, SciELO, and Google Scholar databases. The quality of the studies was assessed using the GRADE instrument, and the risk of bias was evaluated according to the Cochrane instrument. **Results and**

**Conclusion:** According to the GRADE instrument, most studies presented homogeneity in their results, with  $X^2=89.7\%>50\%$ . A total of 86 articles were found and submitted for eligibility analysis, with 16 final studies selected to compose the results of this systematic review. Considering the Cochrane tool for risk of bias, the overall assessment resulted in 11 studies with a high risk of bias and 24 studies that did not meet GRADE and

AMSTAR2 standards. It was concluded that diabetes mellitus is a factor that aggravates periodontal disease, and affecting a high percentage of the population, it should receive special attention in the anamnesis performed by dentists, especially periodontists. The presence of bacterial plaque aggravates periodontal disease; oral health control can indeed reduce the amount of insulin needed by the patient. Periodontal treatment should be cautious and balanced, and it is fundamental that the periodontist is aware of the limitations, alterations, and disorders that the diabetic patient may present. Adults with type 2 diabetes have a high probability of developing periodontitis, and serum vitamin B6 may have a modulating effect on this association. Patients with type 2 diabetes who maintain a higher intake of vitamin B6 may experience potential benefits in reducing the risk of periodontitis.

**Keywords:** Chronic non-communicable diseases. Diabetes mellitus. Metabolism. Periodontal disease. Quality of life.

### Introduction

The incidence of diabetes mellitus (DM) in Central and South American countries was estimated at 27.4 million people and projected to reach 45 million by 2030. In European countries and the United States, this will increase, especially in the older age groups with increasing life expectancy, while in developing countries, this increase will occur in all age groups, and in the 45-64 age group, the prevalence will triple and double in

the 20-44 and over 65 age groups [1,2].

DM is characterized as an inherited or acquired pathological condition of endocrine origin, which causes disturbances in the metabolism of carbohydrates, lipids, and proteins, resulting in a defective or deficient secretory response of insulin, caused by low insulin production by the pancreas. Insulin is a hormone necessary for the conversion of sugar, starch, and other elements into the energy we need in daily life [2-5].

According to the International Diabetes Federation, there were 366 million people with diabetes in 2011, with an expected number of 552 million by 2030. In Brazil, there are 12.4 million people with diabetes, ranking 5th in the world in terms of the number of people with the disease. There are two types of diabetes mellitus: type I requires exogenous insulin injections, and type II involves reduced insulin production or insulin resistance [1,5].

In this context, periodontal disease is an inflammation (chronic or acute) that affects the supporting structures of the tooth and is influenced by certain local or systemic conditions [1-3]. The mechanisms by which diabetes can contribute to the development of periodontal disease include vascular changes, neutrophil dysfunction, reduced collagen synthesis and maturation, increased collagenase activation, persistent hyperglycemic levels, genetic predisposition, and changes in the gingival microbiota [3-7].

Therefore, the present study aimed to present the main clinical evidence of the impact of periodontal diseases on metabolism, diabetes mellitus, and quality of life through a systematic review.

## Methods

### Study Design

This study followed the international systematic review model, following the PRISMA (preferred reporting items for systematic reviews and meta-analysis) rules. Available at: <http://www.prisma-statement.org/?AspxAutoDetectCookieSupport=1>. Accessed at: 10/22/2025. The AMSTAR 2 (Assessing the methodological quality of systematic reviews) methodological quality standards were also followed. Available at: <https://amstar.ca/>. Accessed at: 10/22/2025.

### Search Strategy and Search Sources

The literature search process was carried out from September to October 2025 and developed based on Web of Science, Embase, Scopus, PubMed, Lilacs, Ebsco, Scielo, and Google Scholar, covering scientific articles from various periods to the present day. The

following descriptors were used in health sciences (DeCS/MeSH terms): "Chronic non-communicable diseases. Diabetes mellitus. Metabolism. Periodontal disease. Quality of life", and the Boolean "and" was used between the MeSH terms and "or" between the historical findings.

### Study Quality and Risk of Bias

Quality was classified as high, moderate, low, or very low regarding the risk of bias, clarity of comparisons, precision, and consistency of analyses. The most evident emphasis was on systematic review articles or meta-analyses of randomized clinical trials, followed by randomized clinical trials. Low quality of evidence was attributed to case reports, editorials, and brief communications, according to the GRADE instrument. The risk of bias was analyzed according to the Cochrane instrument by analyzing the Funnel Plot graph (Sample size versus Effect size), using Cohen's test (d).

## Results and Discussion

### Summary of Findings

A total of 86 articles were found and submitted to eligibility analysis, with 16 final studies selected to compose the results of this systematic review. The listed studies were of medium to high quality (Figure 1), considering the level of scientific evidence of studies such as meta-analysis, consensus, randomized clinical, prospective, and observational. Biases did not compromise the scientific basis of the studies. According to the GRADE instrument, most studies presented homogeneity in their results, with  $\chi^2=89.7\% > 50\%$ . Considering the Cochrane tool for risk of bias, the overall assessment resulted in 11 studies with a high risk of bias and 24 studies that did not meet GRADE and AMSTAR-2.

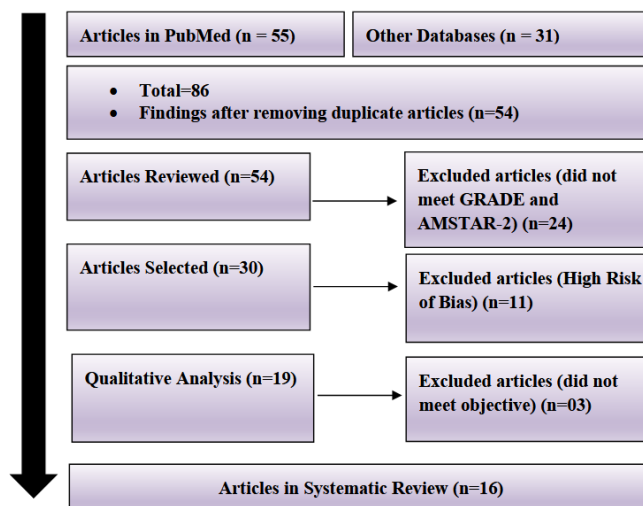


Figure 1. Flowchart showing the article selection process. Source: Own Authorship.

Figure 2 presents the results of the risk of bias of the studies using the Funnel Plot, showing the calculation of the Effect Size (Magnitude of the difference) using Cohen's Test (d). Precision (sample size) was determined indirectly by the inverse of the standard error (1/Standard Error). This graph had a symmetrical behavior, not suggesting a significant risk of bias, both among studies with small sample sizes (lower precision) that are shown at the base of the graph and in studies with large sample sizes that are presented at the top.

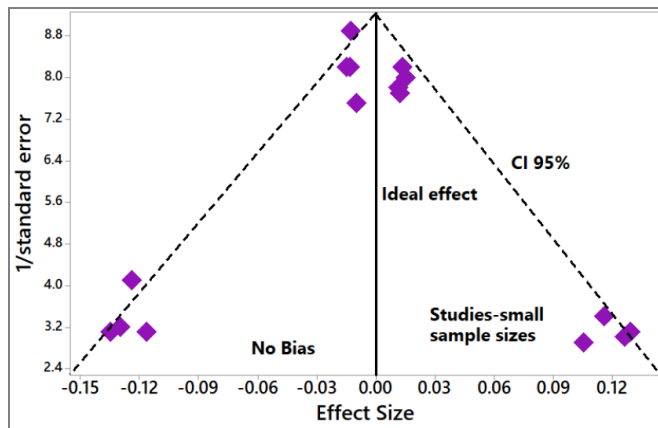


Figure 2. The symmetrical funnel plot suggests no risk of bias among the studies with small sample sizes that are shown at the bottom of the graph. High confidence and high recommendation studies are shown above the graph (n=16 studies). Source: Own Authorship.

### Major Outcomes and Significance

The authors Zhu et al. (2025) [8] explored the effect of vitamin B6 (assessed by serum pyridoxal 5'-phosphate (PLP)) on the association between type 2 diabetes mellitus (T2DM) and periodontitis in the American population. Data from this cross-sectional study were extracted from the National Health and Nutrition Examination Survey (NHANES) 2009-2010. Serum PLP level was the indicator of vitamin B6 status in vivo and was measured by enzymatic assay. Covariates included demographic information, physical examination, lifestyle characteristics, laboratory parameters, and complications. Univariate and weighted multivariate logistic regression models were conducted to explore the association between periodontal pressure pain (PPP), T2DM, and periodontitis, with odds ratios (OR) and 95% confidence intervals (CI). Subgroup analyses were performed to explore these associations based on age, body mass index (BMI), cardiovascular disease (CVD), and dental caries. In the end, 3,491 eligible adults with information on periodontitis measurement, T2DM diagnosis, and PPP detection were included. Of these, 1,999 (57.26%) had periodontitis. After adjusting for

confounding factors, adults with T2DM were found to have a high probability of periodontitis (OR = 1.45, 95% CI: 1.04-2.02), while no significant association between PPP and periodontitis was observed. Adults with low PLP levels (< 67.20 nmol/L) and a concomitant diagnosis of type 2 diabetes had a high probability of periodontitis (OR = 1.82, 95% CI: 1.29-2.55). No significant association was found between type 2 diabetes and periodontitis in adults with elevated PLP levels ( $\geq$  67.20 nmol/L). These results suggest that serum PLP levels may have a modulating effect on the association between type 2 diabetes and periodontitis. This modulating effect remains robust in subgroup analysis, especially in adults aged  $\geq$  60 years (OR = 4.54, 95% CI: 2.15-9.62), obese (OR = 3.06, 95% CI: 1.31-7.18), without a history of cardiovascular disease (OR = 2.25, 95% CI: 1.06-4.79), and without dental caries (OR = 2.93, 95% CI: 1.51-5.68) (all with  $p < 0.05$ ).

An extensive longitudinal survey (Third National Health and Nutrition Examination Survey, NHANES III) showed that the degree of glycemic control was the most important variable in determining the risk for periodontal disease in diabetics. Adults with poor glycemic control had 2.9 times more periodontitis than non-diabetics. On the other hand, diabetics with good control did not show a significant increase in risk when compared to non-diabetics [5,8].

The author Albandar (2000) [9] assessed the impact of this disease on the quality of life of people with DM. This author observed that periodontal disease has a higher prevalence and severity in diabetic individuals when compared to non-diabetic individuals and that the impact of periodontal disease on daily life in these individuals is not reported in the literature.

A prospective, parallel, and comparative longitudinal clinical study was conducted between type 2 diabetics and non-diabetics with moderate generalized chronic periodontitis. The study period was 6 months. Conventional periodontal scaling and root planing were performed, and the response to this treatment was compared between the groups at 3 and 6 months, measuring plaque index, bleeding on probing, probing depth, clinical attachment level, and gingival recession. In diabetic patients, the clinical response was related to HbA1c and blood glucose measurements at 3 and 6 months [10].

Severe periodontal disease often coexists with severe diabetes mellitus. Diabetes is a risk factor for severe periodontal disease. A model is presented whereby severe periodontal disease increases the severity of diabetes mellitus and complicates metabolic control [11].

The established correlation between diabetes and

periodontal disease and the increasing prevalence of type II diabetes in the general population indicate that dentists are likely to treat an increasing number of diabetic patients. Despite the fact that there is little scientific evidence to support the concept, it has generally been accepted that treatment for periodontal disease in diabetic patients can reduce insulin requirements and improve metabolic balance. However, to date, no one has evaluated the effects of periodontal therapy on the metabolic status of the poorly controlled diabetic patient. This pilot study aimed to evaluate the effect of controlling gingival inflammation on blood glucose levels as determined by hemoglobin and albumin glycosylation [12].

Persson et al. (2003) [13], in a study evaluating periodontal conditions and systemic diseases, focusing on diabetes mellitus, observed that the percentage of periodontal sites with pockets larger than 5 mm corresponded to 21.1% of the sample in patients with non-insulin-dependent diabetes. The association between large periodontal destruction and diabetes mellitus has been reported in the literature. Usually, periodontitis is caused by biofilm and exacerbated by systemic conditions. Periodontal disease patterns are considered to be related to the microbiota present and are modified by the systemic situation [14,15].

Other authors have found that with mechanical periodontal therapy (scaling) and antibiotic therapy, there was a reduction in glycosylated hemoglobin (14bA1 c) and a reduction in the need for insulin [16-18]. With controlled diabetes, the patient can be treated in the same way as a healthy person. However, stress must be controlled, as blood glucose levels may rise due to the action of endogenous adrenaline [2,17,18].

In this context, dentists are also able to provide sensible dental treatment to diabetic patients without putting them at risk or causing harm to diabetes control [11]. An essential aspect to be identified in diabetic dental patients is the severity and level of glycemic control, as well as the presence of complications arising from the disease, to treat them appropriately [14].

Knowing the patient's blood glucose level at the time of completion of dental treatment is paramount. In addition, the diagnosis of DM is obtained through fasting blood glucose. Patients who have glucose levels very close to the upper limit of the normal range undergo a glucose tolerance test [15].

Furthermore, DM therapy is to support the interrelationship of three measures: diet, exercise, and targeted use of drugs, depending on the type of diabetes and other factors. The most recommended

medications are oral hypoglycemic agents, including sulfonylureas, the first choice for non-obese type 2 diabetics [16]. Metformin is a preferred oral antidiabetic for treating obese or overweight type 2 diabetics [2,17].

The most commonly used insulin in type 1 DM is that several types of preparations can be natural or obtained by bacterial synthesis (human insulin). The duration of insulin can be rapid, slow, or ultra-slow, and is prescribed exclusively by doctors. The dentist should never alter the dose of hypoglycemic agents, especially insulin, even in emergencies, as it can induce hypoglycemia [18].

In both types of diabetes mellitus, the metabolism of all nutrients is altered. The basic effect of the absence of insulin or insulin resistance on glucose metabolism is to prevent the efficient absorption and use of glucose by most cells in the body, except the brain. As a result, the concentration of glucose in the blood increases, cellular glucose utilization falls even further, and the use of lipids and proteins increases [18,19].

The main symptoms of diabetes, such as polyuria, polydipsia, polyphagia, and weight loss, are results of insulin deficiency. Insulin necessarily acts in the regulation of carbohydrate, fat, and protein metabolism. Insulin deficiency results in decreased glucose uptake into tissues and an increase in blood glucose levels [5,6].

Increase in blood glucose levels leads to an increase in the kidneys' intended glucose. The lack of reabsorption of all this glucose exacerbation by the kidney, resulting in glycosuria, triggering osmotic diuresis and an increase in urine production, must be compensated by an increase in fluid intake [3-5]. Continuous glucose loss in urine also results in weight loss, despite increased food intake. In the abnormality in glucose utilization, insulin deficiency also causes abnormality in protein metabolism [7].

Clinical signs of diabetes also include xerostomia, bacterial, viral and fungal infections, delayed wound healing, incidence and severity of dental caries, gingivitis and periodontal disease, periapical dental abscesses, and burning. In addition to diabetes-related diseases such as atherosclerosis, increased susceptibility to infection, diabetic retinopathy, cataracts, hypertension, and chronic kidney disease, which are deeply associated with lipid levels and glycemia, some doctors also use lipid-lowering drugs to help prevent these changes [2,3].

Dental treatment in diabetic patients can be performed according to their glycemic condition. Almost all patients need to be anesthetized, and diabetic patients are no different. When we use local

anesthetics with epinephrine 1:100,000, they are well tolerated. However, epinephrine has the opposite pharmacological effect to insulin, so glucose may increase with its use. Epinephrine should be used with caution in hypertensive diabetic patients who have suffered a myocardial infarction or who have cardiac arrhythmias [3].

For diabetic patients, well-controlled surgical antibiotic prophylaxis is not routine; a protocol of sterilization or local antiseptics is used. The prophylactic use of antibiotics in diabetics should only be considered in patients with decompensated disease with blood ketoacidosis and ketonuria, when neutrophil functions are decreased. Such conduct cannot be generalized to all diabetics; each case must be carefully analyzed [5,6].

Also, among the acute complications in diabetes, the most important is insulin shock, characterized by acute hypoglycemia, which can be fatal because it develops very rapidly, resulting in loss of consciousness and possibly seizures. With decreased blood glucose levels <40-50 mg dL<sup>-1</sup> appears to be the crucial factor in increasing the clinical symptoms of hypoglycemia, excluding the central nervous system from its fundamental source of energy [9-11].

It is important to identify the signs and symptoms of hypoglycemia in diabetic patients, which is essential for the dentist to differentiate them from those associated with ketoacidosis, a rare emergency in the dental office that takes days or weeks to develop, no less important than insulin shock [11].

## Limitations

Although the present study has highlighted important findings showing the relationship between diabetes mellitus and metabolic syndrome with periodontal diseases, more randomized clinical trials and meta-analyses are still needed to consolidate this relationship and propose therapies and treatments for metabolic and periodontal diseases.

## Conclusion

It was concluded that diabetes mellitus is a factor that aggravates periodontal disease, and affecting a high percentage of the population, it should receive special attention in the anamnesis performed by dentists, especially periodontists. The presence of bacterial plaque aggravates periodontal disease; controlling oral health can indeed reduce the amount of insulin needed by the patient. Periodontal treatment should be cautious and well-considered, and it is essential that the periodontist is aware of the

limitations, alterations, and disorders that the diabetic patient may present. Adults with type 2 diabetes have a high probability of periodontitis, and serum vitamin B6 may exert a modulating effect on this association. Patients with type 2 diabetes who maintain a higher intake of vitamin B6 may have potential benefits in reducing the risk of periodontitis.

## CRedit

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## Application of Artificial Intelligence (AI)

Not applicable.

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It was performed.

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## References

1. Nehaoua A, Gasmi A, Noor S, Benahmed AG. Diabesity and Oral Immunity: Exploring the Interconnection. *Adv Exp Med Biol.* 2026;1492:121-139. doi: 10.1007/978-3-032-03176-1\_7.
2. Zhou Q, Zhou M, Yang G, Sui X, Li C, Xu H, Liu Y, Wei X. Enhancing Diabetic Oral Wound Healing with miR-132 Delivered Through Tetrahedral DNA Nanostructures. *Small.* 2025 Mar;21(10):e2411353. doi: 10.1002/sml.202411353.
3. Xiao C, Zhang L, Li Z, Xu Q, Lin S, Zheng S, Shi H. Periodontal health intervention for oral health-related outcomes in older type 2 diabetes patients: a randomized controlled trial in a Chinese tertiary hospital. *Sci Rep.* 2025 Jul 31;15(1):28014. doi: 10.1038/s41598-025-13434-0.
4. Kolte AP, Kolte RA, Mohata TG, Bawankar P, Bajaj P, Kothekar M, Thakre S, Dean. Periodontal health, xerostomia and oral health-related quality of life in controlled vs. uncontrolled type 2 diabetes mellitus patients. *BMC Oral Health.* 2025 Aug 28;25(1):1382. doi: 10.1186/s12903-025-06805-6.
5. Hashim NT, Babiker R, Padmanabhan V, Ahmed AT, Chaitanya NCSK, Mohammed R, Priya SP, Ahmed A, El Bahra S, Islam MS, Gismalla BG, Rahman MM. The Global Burden of Periodontal Disease: A Narrative Review on Unveiling Socioeconomic and Health Challenges. *Int J Environ Res Public Health.* 2025 Apr 16;22(4):624. doi: 10.3390/ijerph22040624.
6. Andrade ED; Ranali. J, organizations. *Medical emergencies in dentistry.* 3rd edition; São Paulo: Artes Médicas; 2011, 66-8.
7. Andrade ED. *Drug therapy in dentistry;* 3rd edition; São Paulo; Artes Médicas, 2014, 205p.
8. Zhu J, Xu W, Wu S, Song D. Vitamin B6 status, type 2 diabetes mellitus, and periodontitis: evidence from the NHANES database 2009-2010. *BMC Oral Health.* 2025 Feb 24;25(1):299. doi: 10.1186/s12903-025-05597-z.
9. Albandar JM. Global risk factors and risk indicators for periodontal diseases. *Periodontol* 2000 2002; 29:177-206.
10. Nogid, A. Pham DQ. Adjunctive therapy with pramlintide in patients with type 1 or type 2 diabetes mellitus. *Pharmacotherapy;* 2006, 26 (11):1626-1640.
11. Faria-Almeida et al. Clinical and metabolic changes after conventional treatment of type 2 diabetic patients with chronic periodontitis. *J Periodontol* 2006;77(4):591-8.
12. Grossi SG, Genco RJ. Periodontal disease and diabetes mellitus: a two-way relationship. *Ann Periodontol* 1998;3(1):51-61.
13. Persson RE, Hollender LG, Macentee MI, Wyatt CCL, Kiyak HA, Persson GR. Assessment of periodontal conditions and systemic disease in older subjects – Focus on Diabetes mellitus. *J Clin Periodontol.* 2003;30:207-13.
14. Kiran M, Arpak N, Ünsal E, Erdogan MF. The effect of improved periodontal health on metabolic control in type 2 diabetes mellitus. *J Clin Periodontol.* 2005;32:266-72.
15. Katz J. Elevated blood glucose levels in patients with severe periodontal disease. *J. CI in Periodontol.*,v. 28, n. 7, p. 710 -712, Jul. 2001.
16. Holzhausen M, Garcia DF, Pepato MT, Marcantonio Junior E. The influence of short-term diabetes mellitus and insulin therapy on alveolar bone loss in rats. *Journal of Periodontal Research.* 2004; 39:188-93.
17. Guyton AC. *Human Physiology,* 7th ed. Rio de Janeiro: Guanabara Koogan, 1989. p. 652-655, 732-742.
18. Melgaço, C.A. Diabetes mellitus and periodontal disease: Literature review. *J.B.E.* 2002, v.3, n.9, p. 100-104.
19. Fetaiha A, Elsous A, Radwan M. Prevalence and Factors Associated with DMFT and Periodontitis in Type 2 Diabetes Mellitus Patients in the Gaza Strip, Palestine. *Int J Prev Med.* 2025 Jul 30;16:44. doi: 10.4103/ijpvm.ijpvm\_390\_24.



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