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Review Article

Exploring the Oral Health Implications of Diabetes Mellitus: A Systematic Review

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Abstract:
The purpose of this systematic review is to provide a clear evidence-based medicine guideline for future use and to further examine the exploring the Oral Health Implications among Diabetes Mellitus patients. Using keywords and MESH search phrases, a comprehensive electronic literature search was conducted in the databases of PubMed/Medline, Cochrane Central, Scopus, EBSCO, and Google Scholar. Furthermore, a manual search was conducted via the reference lists of the systematic reviews that were part of the study. Prospective and experimental studies that offered the strongest level of evidence were used to gather data on patient satisfaction and complications. Critical evaluation of the articles was conducted, and the risk of bias was assessed using the Joanna Briggs Institute Prevalence Critical Appraisal Tool. According to this systematic review, Diabetes Mellitus leads to multiple complications, which increase when glycemic control of the patient is inadequate. This makes management and prevention important. It has been shown that diabetes exists in a bidirectional relationship with periodontal disease and may lead to other oral pathologies. For this reason, doctors and dentists must be vigilant with regard to the various oral manifestations of diabetes in order to make an early diagnosis.
Keywords: Diabetes Mellitus, Oral health, Oral Manifestation.

Introduction:

Diabetes Mellitus (DM) is a metabolic disorder characterized by the presence of chronic hyperglycaemia accompanied to greater or lesser extent by alterations to carbohydrate, protein, and lipid metabolisms. DM has become a global epidemic, the complications of which significantly impact on the quality of life and longevity of the sufferers, as well as healthcare costs. The number of people with diabetes has increased from 108 million in 1980 to 422 million in 2014. The overall prevalence of diabetes among adults over 18 years of age has increased from 4.7% in 1980 to 8.5% in 2014 and the World Health Organization (WHO) predicts this will increase to 439 million, almost 10% of adults in 2030 [1].

Patients with diabetes present impaired function of polymorphonuclear leukocytes (leukocyte adhesion, chemotaxis, and phagocytosis), impaired bactericidal activity, altered response to exposure to antigens, and alteration to the function of T lymphocytes (2). Many studies have shown a clear link between chronic inflammation and the development of Type 2 Diabetes Melli-tus (DM2) [2-3].

Both Diabetes Mellitus type 1 (DM1) and type 2 diabetes (DM2) present numerous possible long-term complications. Epidemiological studies indicate that the severity of diabetic complications is generally proportional to the degree and duration of hyperglycemia [4]. Among the oral manifestations related to DM described are: dry mouth, tooth decay, periodontal disease and gingivitis, oral candidiasis, burning mouth syndrome (BMS), taste disorders, rhinocerebral zygomycosis (mucormycosis), aspergillosis, oral lichen planus, geographic tongue and fissured tongue, delayed wound healing, and increased incidence of infection, salivary dysfunction, altered taste and other neurosensory disorders, impaired tooth eruption, and benign parotid hypertrophy [5]. The objective of this systematic review was to provide a overview of the literature on the various oral manifestations that may occur in diabetic patients.

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Material & methods:
The search protocol is designed based on the PRISMA (Preferred reporting Items for systematic Reviews and meta-analysis) guidelines 2020.

Search strategy
We looked through MEDLINE, Embase, Cochrane, Google Scholar, Scopus, and PubMed, among other electronic databases. Additionally, the bibliographies of all relevant books and articles were manually searched. The relevant publications were selected independently by two reviewers using the inclusion and exclusion criteria. After discussing any differences, the two reviewers reached a consensus.
Methodological Medical Subject Heading (MeSH) phrases were created using the PICO-format inquiry to increase the sensitivity of the search technique when identifying research. utilising simple keyword combinations and medical subject heading (MeSH) terms, such as further search was then performed using the terms "Diabetes Mellitus" combined with different oral manifestations: "Dental Caries"; "Periapical lesions"; "Periodontal disease"; "Salivary dysfunction"; "Oral mucosal pathology"; "Oral health". Our search turned up 125 studies in PubMed & other sources. We looked through the databases for English-language publications, including meta-analyses and systematic reviews.

Inclusion & exclusion criteria:
Studies were included in this systematic review if they met the following criteria: human studies published between 2000 and 2025, The studies had to be (a) original articles published in scientific journals. Studies were excluded if: (1) Clinical case report, review, meta-analysis of cell, animal model; (2) Evidence-based information comes from books, conferences, notes, thesis, case series, letters, or unpublished studies; (3) unreliable extracted data, overlapped data sets, and paragraphs only abstract available.

Formulating the review question
The research question was set in accordance with the PICO format (Population, Intervention, Comparison, and Outcome).

Table 1: Pico Format

S.No	Category	Search items
1	Population	Diabetes Mellitus (DM) Patient
2	Intervention	Oral Manifestation
3	Comparison	Comparison of DM with oral manifestation
4	Outcome	Effect of DM on oral manifestation

Selection
The selection of the study was done in three ways. In the first round, the selection criteria only applied to the abstract and title. Every possible eligible study's full text was acquired. The full-text papers were evaluated by two impartial reviewers in order to be chosen for the second stage. After retrieving and analysing full-text articles for each selected abstract, the final collection of articles was compiled while taking the selection criteria into account.

TABLE NO: 2

Initial search	125
Duplicates and non-relevant	38
Case reports and series	29
Reviews	21
Abstract	17

Data extraction
After the final study sample was determined, data from each experiment was extracted. These were the design of the study, the number of participants, the average age, the original author, the year of publication, and the image modality employed for the participants.

Qualification of methodological quality
The methodological quality in the final selection of eligible studies was evaluated following the Joanna Briggs Institute Prevalence Critical Appraisal Tool [6], which incorporates 10 domains:

(1) Was the sample representative of the target population?
(2) Were study participants recruited in an appropriate way?
(3) Was the sample size adequate?
(4) Were the study subjects and the setting described in detail?
(5) Was the data analysis conducted with sufficient coverage of the identified sample?
(6) Were objective, standard criteria used for the measurement of the condition?
(7) Was the condition measured reliably?
(8) Was there appropriate statistical analysis?
(9) Are all the important confounding factors/subgroups/ differences identified and accounted for?
(10) Were subpopulations identified using objective criteria?

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A study was considered to have a low-quality assessment if 0–5 criteria were met and high-quality assessment if studies met 5–10 criteria. Two conducted a critical appraisal independently of each other. The reviewers met to discuss the results of their critical appraisal; if the two reviewers disagreed on the final critical appraisal, a third reviewer was required.

Results:

Out of a total of 125 articles of the database search, after removal of duplicates and elimination based on eligibility criteria, a total of 15 studies were included for analysis (table 3).

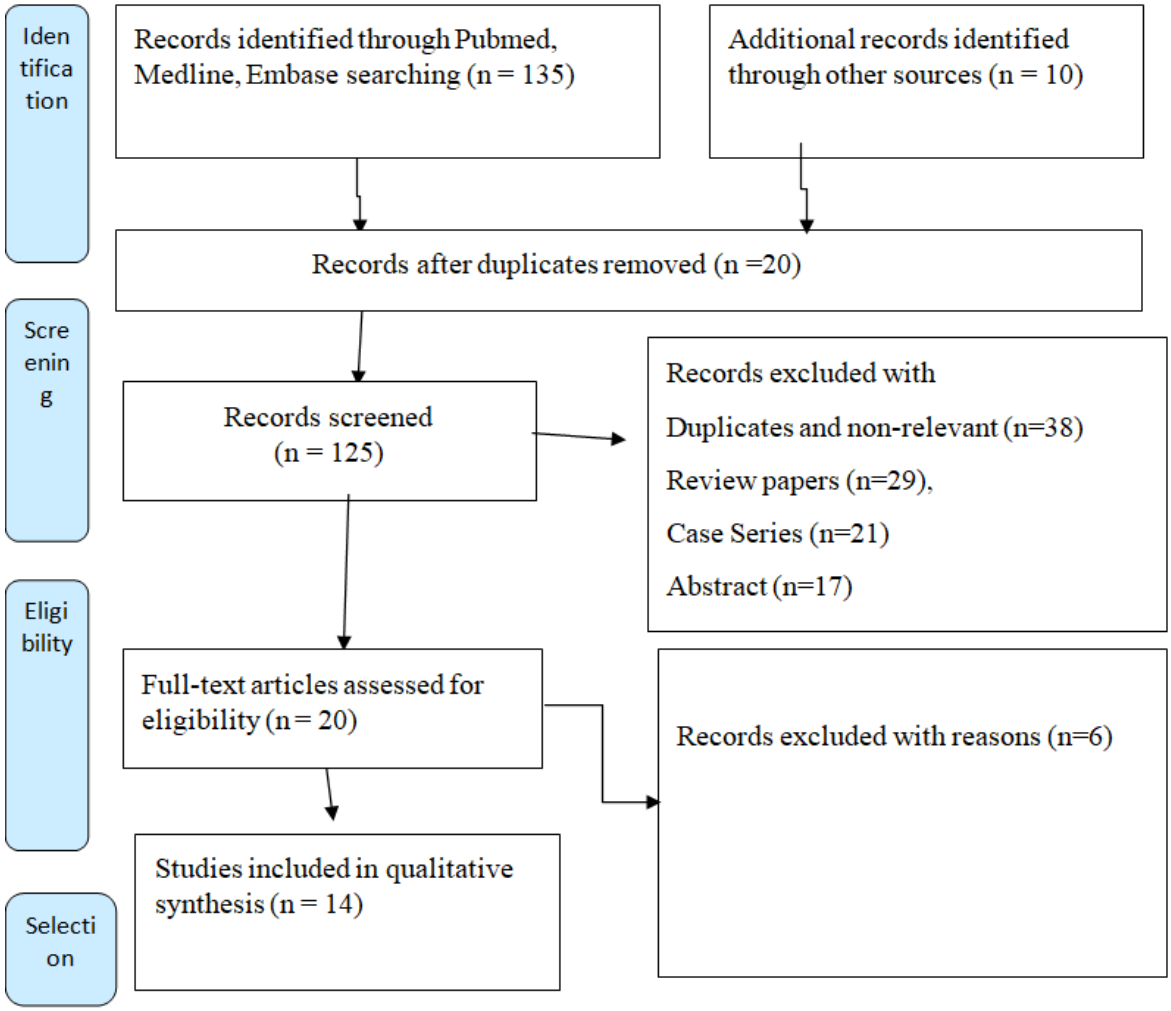

Figure: PRISMA flow chart

Table 3: The data extracted has been presented in the tabular form

Study	Design of study	Study group	Examination	Outcome	Conclusion
Guggenheimer J et al, 2000 [6]	**Cross-sectional study**	405 subjects with IDDM and 268 non-diabetics control subjects	Cytologic samples for *Candida* pseudohyphae were obtained by scraping a wet tongue depressor 4 times across the posterior midline dorsal tongue.	More subjects with IDDM than control subjects without IDDM (I 5.1% vs 3.0%) were found to have clinical manifestations of candidiasis, including median rhomboid glossitis, denture stomatitis, and angular cheilitis. IDDM subjects were also more likely to have any Candida pseudohyphae	Candida pseudohyphae and oral soft tissue manifestations of candidiasis were more prevalent in subjects with IDDM than in control subjects without diabetes.

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				in their cytologic smears (23.0% vs 5.7%; P< .0001), as well as pseudohyphae counts of >I Olcm 2 (7.1% vs 0.8%; P < .0001).	
Sandberg GE et al. 2000 [7]	Controlled cross-sectional study	102 randomly sampled diabetic patients and 102 age- and gender-matched non-diabetic subjects ≤ 75 years of age	Oral conditions were measured at clinical and X-ray examinations. Index used GI, BI, Pocket depth, periodontal bone loss, Dental caries	Diabetic patients suffered from xerostomia (dry mouth) to a significantly higher degree than non-diabetic controls did (53.5 vs. 28.4%; *P*_0.0003). Sites with advanced periodontitis were more frequent in the diabetic group (*P*_0.006) as were initial caries lesions (*P*_0.02). Diabetic subjects showed a greater need of periodontal treatment (*P*_0.05), caries prevention (*P*_0.002) and prosthetic corrections (*P*_0.004). Diabetes duration or metabolic control of the disease was not related to periodontal status. However, patients with longer duration of diabetes had more manifest caries lesions (*P*_0.05) as had those on insulin treatment when compared with patients on oral:diet or combined treatment (*P*_0.0001).	Individuals with type 2 diabetes in some oral conditions exhibited poorer health and a more comprehensive need for certain oral prevention and treatments than did their age- and gender-matched controls without diabetes.
do Egito Vasconcelos BC et al, 2008 [8]	Cross-sectional study	30 patients	The diagnosis of lesions was established by the anamnesis and physical examination, and when necessary, by the incision biopsy and histopathological examination.	Of the 30 patients, 9 (30%) were males and 21 (70%) females. Of the studied patients, 40% were below 60 years of age, and 60% were older than 60 years. Thirteen different types of mucosal alterations were diagnosed. Tongue varicose veins (36.6%) and candidiasis (27.02%) were the most prevalent. Such alterations can be associated with the fact	Most of the diabetic patients presented at least one type of oral mucosa lesion or alteration.

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				that these conditions are commonly found in senile patients and are also associated with prolonged wear of dentures. Xerostomia was diagnosed in only 1 (3.33%) patient, disagreeing with most of the studies observed in the literature	
Sousa MG et al, 2011 [9]	Observational individualized cross-sectional study	The final sample consisted of 196 patients, of which 96 were diabetic and 100 were non-diabetic	A questionnaire was applied to gather data on the clinical history, the social and economic profile, and the dental history. A glucometer (Accucheck roche) was used to measure glucose levels (capillary glucose), which was dichotomized as follows: postprandial values ≤ 140mg/ dL - controlled glucose levels; and postprandial values ≥ 140mg/dL - uncontrolled glucose levels. A World Health Organization (WHO) form for epidemiological studies was used	The last blood glucose mean was 177.0 mg/dl for diabetics and 89.46 mg/dl for nondiabetics. Mean capillary blood glucose was elevated in diabetics (215.95 mg/dl); it was 102.31 mg/dl in non-diabetics. The family history confirmed the heredity nature of the disease in 68.8% of diabetic patients (n = 66) ($p < 0.001$); salivary flow was 49% (n = 47) in diabetics, and 34% (n = 34) in non-diabetics. Candidiasis was present in 30.5% of diabetic patients (n=29) and 36% of nondiabetics (n=36). Both groups had lesions in the palate - 81.4% (n = 35) in diabetics, and 71.1% in non-diabetics (n = 27) ($p = 0.68$).	The findings of this study were unrelated to the presence or absence of type 2 diabetes; there are several factors that may give rise to these changes in the oral cavity, one of them being the use of dental prosthetic appliances
Silva MF et al, 2015 [10]	A cross-sectional observational study	51 diabetic patients (type 1 and type 2)	The study comprised two stages. Stage one involved data collection through a questionnaire. Stage two involved intraoral clinical examination. Initially the data were collected via a questionnaire that featured the sample, overall health of the patients, and questions about their oral health.	The prevalence of oral lesions was 78.4%. Traumatic ulcers (16.4%) and actinic cheilitis (12.7%) were the most prevalent lesions. The lips (35.3%) and tongue (23.5%) were the most common location. The bivariate analysis showed an association with the type of diabetes, and two variables (age and comorbidity) were quite close to the significance level. In the Poisson Regression analysis, only diabetes type 2 remained significant after adjusting the	The results of this study show a high prevalence of oral mucosal lesions in diabetic patients. The oral mucosal lesions are mostly associated with diabetes type 2.

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				model.	
Rawal I et al , 2019 [12]	Cross-sectional study	2045 diabetic patient	Oral health was assessed through a combination of interviewer-administered questionnaire and clinical examination performed by World Health Organization's Oral Health Assessment Questionnaire was used to capture information on oral hygiene practices, self-reported oral health problems, and service utilisation	Out of 2045 participants, 47% were women and the mean age of study participants was 42.17 (12.8) years. The age-standardised prevalence (95% confidence interval) estimates were 78.9% (75.6–81.7) for dental caries, 35.9% (32.3–39.6) for periodontitis. Nearly 85% participants suffered from at least one oral disease. Compared to diabetes-free counterparts, participants with diabetes had more severe caries experience [Mean Count Ratio (MCR) = 1.07 (1.03–1.12)] and attachment loss [MCR = 1.10 (1.04–1.17)]. Also, the adjusted prevalence of periodontitis was significantly higher among participants with diabetes [42.3%(40.0–45.0)] compared to those without diabetes [31.3%(30.3–32.2)].	We found that eight out of ten participants in urban Delhi suffered from some form of oral disease and participants with diabetes had worse oral health.
Hassan K et al, 2021 [13]	Retrospective cohort research	5183 diabetics over the age of 40	Self-administered questionnaire along with Oral health status recorded	38 percent of those with "poor to fair" oral health had a diabetes problem. Chronic problems were found to be prevalent in 33% of this subgroup. In comparison, 34% of individuals who said their oral health was "good to excellent" had a problem. Chronic problems were found to be prevalent in roughly 29% of this population. Acute problems occurred at a comparable rate in both groups, around 5% in both.	Overall, the findings of this study indicate the need to better understand the link between oral health and diabetes problems. Within its limitations, "poor to fair" oral health was linked to a higher risk of chronic complications than acute difficulties, offering useful information for diabetes patients in the province of Ontario, Canada.
Gibson AA et al, 2023 [14]	Prospective cohort study	The study participants were 213,389 men and women,	The oral health of participants was assessed by questionnaire. Incident diabetes	During 2,232,215 person-years of follow-up, 20,487 (9.6%) participants developed diabetes. Compared with	Simple measures of oral health were associated with risk of developing diabetes,

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		aged ≥45 years.	cases were ascertained based on self-report in follow-up questionnaires, linked data on medical and pharmaceutical claims, and hospitalisation data up until 2019.	those with ≥20 teeth, the adjusted hazard ratio (aHR) for incident diabetes was 1.12 (95% Confidence Interval (CI): 1.08, 1.17) for 10–19 teeth, 1.20(1.14, 1.26) for 1–9 teeth and 1.15 (1.09, 1.21) for no teeth. Compared with those with excellent/very good teeth and gums, the aHR for incident diabetes was 1.07 (1.03, 1.12)for fair and 1.13 (1.07, 1.20) for poor teeth and gums.	demonstrating the potential importance of oral health screening for diabetes prevention
Ghanem AS et al, 2024 [15]	National Survey	Sample of 11,429 participants	Oral health indicators included self-perceived oral health status, categorized into 'Average,' 'Good,' and 'Bad.' Additionally, quantifiable metrics such as the number of teeth extracted due to decay and left unreplaced were delineated into discrete categories, namely 'None,' '1 to 5,' '6 to 19,' and 'More than 20.' Other dimensions of oral health included the presence of filled teeth, active dental caries, tooth mobility, and gingival bleeding. The composite measure of overall oral health was stratified into 'Optimal' and 'Suboptimal,' while the time since the last dental visit was segmented into 'More than a year ago,' 'Less than 6 months ago,' and an intermediate category covering	The study identified 'Bad' self-perceived oral health as a diabetes risk (OR=1.35; 95% CI: [1.04-1.75]), with filled teeth being protective (0.65 [0.51-0.84]). Subgroup analysis revealed higher diabetes odds among individuals with primary education (1.41 [1.02-1.96]) and rural residents with tooth loss from decay (3.54 [1.36-9.19]). The bootstrap analysis with 1,000 iterations reaffirmed the model's stability and predictive accuracy for diabetes.	Enhanced oral health is associated with lower risk factors for diabetes. This research highlights the importance of including oral health measures in comprehensive diabetes management approaches.

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			visits that occurred between 6 months to a year ago.		
Kumar BA et al, 2024 [16]	Cross-sectional study	70 patient of T2DM aged 35-65 years.	Glycemic control levels were categorized as good control (≤7% of HbA1c) and poor control (>7% of HbA1c). Full mouth plaque score (FMPS), full mouth bleeding score (FMBS), probing depth (PD), and clinical attachment level (CAL) were determined, along with xerostomia (using a standard questionnaire) and hyposalivation (using modified Schirmer test, MST).	This study included 70 individuals with T2DM, comprising 49 males (70%) and 21 females (30%) with a mean age of 55.36±8.3 and 49.36±6.8 years, respectively. Among those with poor glycemic control, a significantly higher prevalence of xerostomia (52.2%), hyposalivation (47.8%), and periodontitis (moderate; 47.8% and severe; 21.7%) was observed compared with those with good control (p=0.027, 0.001, 0.007, respectively). HbA1c exhibited a significant moderate positive correlation with FMPS (r=0.447; p=0.001) and a low correlation with FMBS (r=0.283; p=0.018) and CAL (r=0.301; p=0.011).	The study concluded that individuals with poor glycemic control for T2DM have a higher incidence of xerostomia, hyposalivation, and compromised periodontal health, resulting in a decline in their oral health status.
Schädlich P et al, 2024 [17]	Case-control study	The total population comprised 92 children and adolescents, 54 of whom had diabetes.	The children and adolescents were examined according to WHO standards with DMFT, DMFS, PUFA index, Saliva examination. The diabetes parameters (HbA1c, CPR, albumin content in urine, BMI) were collected to perform ELISA.	Patients with diabetes mellitus showed a significantly lower salivary flow rate with higher concentrations of MMP-8 and IL-1β. The data indicate that at this age, regular visits to the dentist are of great importance for the promotion of oral health in children and adolescents regardless of diabetes and that patients with diabetes mellitus in particular benefit from prevention, as they belong to the periodontitis risk group	Patients with low salivary flow rates and increased inflammatory mediators are high-risk patients for whom dental preventive measures play a major role.
Yu SY et al, 2024 [18]	Nationwide Korean Survey	The study population included 9,090 individuals diagnosed with diabetes and 61,164	The association between glycemic control, defined by mean glycated hemoglobin (HbA1c) values, and various oral health measures,	Compared to the control group, patients with diabetes exhibited a higher prevalence of periodontitis (88.6% vs. 73.3%), complete dentures (5.0% vs. 1.5%), and elevated	Author found a positive association between diabetes and poor oral health, as well as a noteworthy relationship

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		healthy controls	such as tooth brushing frequency, periodontitis, denture wearing, Decayed, Missing, and Filled Teeth (DMFT) index, number of remaining teeth, and past-year dental clinic visits	DMFT index (33.2% vs. 26.7%) (all P < 0.001). Multivariate analyses revealed significant associations between diabetes and several oral health factors: denture status (No denture: adjusted odds ratio [aOR], 0.784; 95% confidence interval [CI], 0.627–0.979), and having fewer permanent teeth (0–19) (aOR, 1.474; 95% CI, 1.085–2.003). Additionally, a positive correlation was found between higher HbA1c levels and the risk of having fewer remaining teeth (0–19) (HbA1c < 6.5%: aOR, 1.129; 95% CI, 0.766–1.663; 6.5% ≤ HbA1c < 8.0%: aOR, 1.590; 95% CI, 1.117–2.262; HbA1c ≥ 8%: aOR, 1.910; 95% CI, 1.145–3.186) (P for trends = 0.041).	between reduced permanent teeth (≤ 19) and glycemic control. These insights emphasize the critical role of oral health management in diabetic care and underscore the importance of maintaining effective glycemic control strategies for overall health and well-being in patients with diabetes.
Khoshbakhti T et al, 2025 [19]	Case-control study,	A total of 306 individuals included in the study (103 T2DMcases and 203 non-diabetic controls) in the age range of 40 to 60 years old	Participants were interviewed using a structured questionnaire including socio-demographics and oral health related to dry mouth factors. The clinical examination included full-mouth probing depths and an assessment of oral mucosal conditions to determine the DMFT index and identify any mucosal lesions	The patients had more probing depths >4 mm, tooth mobility, furcation involvement and missing teeth. The mean score of dry mouth and DMFT indexes were 3.38±2.64, 2.17±1.09and 19.33±9.54, 15.48±6.93 in the case and control groups respectively. Also, the adjusted odds ratios (AOR) and their 95 % confidence Intervals (CI) reported a significant association as 2.96 (1.36–6.45), 5.90 (2.26–15.39), 0.23 (0.08–0.63) and 4.07 (1.74–9.49) for the above variables respectively	Overall, the results of this study highlight that chronic periodontitis, tooth mobility, furcation and involvement were more prevalent among T2DM patients compared to non-diabetic controls. By recognizing these relationships and implementing targeted interventions, healthcare providers can improve oral health outcomes.
Natarajan P et al, 2025 [20]	Cross-sectional study utilizing the National Health and Nutrition Examination Survey (NHANES) data from 2017-2020.	13,772 adults with complete data on oral and systemic health variables	Oral health indicators were periodontitis and dental caries, while systemic health variables included diabetes and hypertension.	The study found statistically significant associations between oral and systemic health conditions. There was a moderate association between periodontitis and diabetes (Cramer's V	The results underscore the interconnected nature of oral and systemic health, suggesting that poor oral health can be an indicator of

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				= 0.14) and a moderate association between dental caries and hypertension (Cramer's V = 0.12).	broader health issues. These associations could guide integrated health care strategies, emphasizing the need for dental health evaluations in patients with diabetes and hypertension.

Risk of bias assessment

The methodological quality in the final selection of eligible studies was evaluated following the Joanna Briggs Institute Prevalence Critical Appraisal Tool was used to evaluate the risk of bias. According to 10 questions, for each judgement study was considered to have a low-quality assessment if 0–5 criteria were met and high-quality assessment if studies met 5–10 criteria.

Table. 4 Risk of bias assessment.

Authors name	Was the sample representative of the target population?	Were study participants recruited in an appropriate way?	Was the sample size adequate?	Were the study subjects and setting described in detail?	Is the data analysis conducted with sufficient coverage of the identified sample?	Were objective, standard criteria used for measurement of the condition?	Was the condition measured reliably?	Was there appropriate statistical analysis?	Are all the important confounding factors/subgroups/differences identified and accounted for?	Were subpopulation identified using objective criteria?	Total score	Quality assessment
Guggenheimer J et al, 2000 [6]	Y	Y	N	Y	U	Y	N	Y	Y	N	6	High
Sandberg GE et al. 2000 [7]	Y	Y	U	N	U	N	N	Y	Y	N	4	Low
do Egito Vasconcelos BC et al, 2008 [8]	Y	U	N	Y	U	Y	N	U	U	N	3	Low
Sousa MG et al, 2011 [9]	Y	Y	N	Y	U	Y	N	Y	Y	N	6	High

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Silva MF et al, 2015 [10]	Y	Y	N	Y	U	Y	N	Y	Y	N	6	High
Rawal I et al , 2019 [12]	Y	N	N	Y	U	Y	N	U	Y	N	4	Low
Hassan K et al, 2021 [13]	Y	Y	Y	Y	U	Y	N	Y	Y	N	7	High
Gibson AA et al, 2023 [14]	Y	Y	Y	Y	U	Y	N	Y	Y	Y	8	High
Ghanem AS et al, 2024 [15]	Y	Y	N	Y	U	Y	Y	Y	Y	N	7	High
Kumar BA et al, 2024 [16]	Y	Y	N	Y	U	Y	Y	Y	Y	N	7	High
Schädlich P et al, 2024 [17]	Y	Y	Y	Y	U	Y	N	Y	Y	N	7	High
Yu SY et al, 2024 [18]	Y	Y	U	Y	U	Y	Y	Y	Y	Y	8	High
Khoshbakhti T et al, 2025 [19]	Y	Y	N	Y	N	Y	N	Y	Y	N	6	High
Natarajan P et al, 2025 [20]	Y	Y	U	Y	U	Y	Y	Y	Y	N	7	High

Y: yes; N: no; U: unclear; N/A: not applicable.

Discussion:

In the present systematic review, higher prevalence of oral mucosal disorders was found in patients with DM compared to non-DM patients. This prevalence ranged from 45–88% in T2DM patients to 38.3–45% in non-DM groups and from 44.7% in T1DM patients to 25% in non-DM population. This increased prevalence of oral disorders in DM groups may be due to an inadequate metabolic control of DM or a slow healing process [21]. According to some authors, its cause might be oxidative stress, a decreased antioxidant capacity, or higher levels of inflammatory cytokines, as they are considered as major alternative pathways contributing to the pathogenesis of diabetic complications [22-23].

DM patients are more susceptible to suffering from fungal infections by *Candida albicans*, especially if they wear prostheses [24]. Guggenheimer et al. [7] and Saini et al. [25] showed that DM patients suffered significantly more denture stomatitis compared to the control groups. Guggenheimer et al. found that the use of dentures was a factor significantly associated with the presence of *Candida* pseudohyphae in T1DM subjects [7]. Thus, diabetes patients using prostheses should have dental check-ups more frequently to prevent this infection. Dental professionals should also provide hygiene measures in order to prevent fungal infections.

Information presented in the literature about the relationship between the DM and tooth decay is inconsistent [26]. Arrieta-Blanco *et al*. [27] in a study

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of 144 patients (70 diabetic and 74 non-diabetic) found no significant difference in mean caries between the two groups. The prevalence of carious lesions was 7.39% in diabetic patients and 6.91% in non-diabetics (26). Another study with a sample of 600 patients (300 with diabetes and 300 healthy) showed that the prevalence of dental caries was higher in non-diabetics (32.3%) than in diabetics (13.6 %). Patients with DM had greater need for treatment than healthy subjects, but nevertheless presented a lower rate of tooth decay. Bharateesh *et al*., suggest that patients with DM may have fewer cavities due to the content of their diet which usually contains more protein and fewer fermentable carbohydrates [28].

The main oral complication attributed to diabetes is periodontal disease (PD), considered the sixth complication of DM [29]. Simple chewing can cause systemic dissemination of periodontal pathogens and their metabolic products in patients with periodontal disease causing endotoxemia or bacteremia, which results in an increase in serum levels of inflammatory mediators such as Interleukin 6 (IL-6), fibrinogen, and C-reactive protein (CRP). Furthermore, systemic inflammation can exacerbate insulin resistance and therefore the management of diabetes. For this reason, correct periodontal treatment can lower the level of proinflammatory mediators, and so contribute to better glycemic control [30]. It has been suggested that there is a degree of synergism between DM and PD. On the one hand, the severity and prevalence of PD increases in diabetics and is worse in diabetics with poor glycemic control. On the other hand, periodontitis may exacerbate diabetes, decreasing glycemic control. However, there is some controversy over this issue; diabetes clearly increases the risk of PD but the impact of PD on glycemic control and the mechanisms by which this occurs are not clear [31].

The scientific literature shows a higher prevalence of periapical lesions in patients with poorly controlled diabetes [32-33]. A clinical study showed that patients with DM2 presented a significant association with an increased incidence of periapical lesions and endodontic treatments [34]. Regarding the success rate of endodontic treatment, an article published in 2011 states that patients with DM had a lower success rate in primary root canal treatment in comparison with non-diabetic patients, while both groups presented the same success rate in secondary root canal treatment [35]. Another study found that patients with diabetes are at increased risk of the need for tooth extraction following endodontic treatment. This risk increases in patients with hypertension as well as DM and /or coronary artery disease [36].

The dental pulp of diabetic patients may have limited dental collateral circulation, impaired immune response, and an increased risk of infection or pulp necrosis. Regarding molecular pathology, hyperglycemia is a stimulus for bone resorption, inhibition of osteoblast differentiation, and a reduced capacity for bone recovery [37].

In a study conducted by Chavez *et al*. [38], a tendency for salivary flow to decrease was observed when HbA1c values increased. A recent study compared the salivary characteristics in 30 patients with diabetes compared with 30 healthy subjects. Eighty per cent of DM patients presented xerostomia, but only 10% of healthy subjects. Furthermore, urea and glucose levels in saliva were significantly higher in diabetics than healthy subjects. This suggests that DM can cause xerostomia and that there may be a significant correlation between the degree of xerostomia and glucose levels in saliva. In addition, in creased salivary glucose promotes the proliferation and colonization of bacteria in the oral cavity, and glucose is the basis for Candida development and decreases the activity of neutrophils [39]. Another study of 102 patients showed a significant association between DM1 and xerostomia but the results showed that clinical status and salivary conditions did not affect the presence of xerostomia [40].

Awareness and understanding of the possible associations between diabetes, oral health and general health need to be increased among diabetic patients. Dentists, doctors and other health professionals should conduct periodontal screening every time a diabetic patient attends a check-up, and should recommend attending regular check-ups by a specialist [41-42]. All the evidence registered in the present review highlights the importance of preventive and therapeutic control of DM and periodontal disease. The involvement of oral health professionals in strategies aimed at identifying individuals at risk from diabetes should be maximized in order to retard the development of possible complications [43].

Effective management of diabetic patients requires cooperation between the patient, the doctor, the dentist, and other healthcare professionals. Regular check-ups will allow dentists to anticipate patient needs and interact competently with other healthcare professionals. Careful examination of the oral cavity may discover indications of an underlying systemic condition, and allow early diagnosis and treatment. The examination should include an assessment of changes to the mucosa, periodontal inflammation, and bleeding, as well as the general state of the teeth.

Conclusion:

Diabetes Mellitus leads to multiple complications, which increase when glycemic control of the patient is inadequate. This makes management and prevention important. It has been shown that diabetes exists in a bidirectional relationship with periodontal disease and may lead to other oral pathologies. For this reason, doctors and dentists must be vigilant with regard to the various oral manifestations of diabetes in order to make an early diagnosis.

Full understanding and awareness of the pathophysiology, manifestations, and management of different types of diabetes-related orofacial infection

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by the endocrinologist and the dentist are essential to optimizing the care of diabetic patients.

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