RELATIONSHIP BETWEEN TYPE II DIABETES MELLITUS AND ORAL HEALTH STATUS

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Abstract

Background and Aim: Type 2 diabetes is among the most prevalent endocrine disruptors. One of the most significant symptoms reported by diabetic patients is dry mouth, which results in reduced saliva buffering capacity and an increased risk of dental caries. So, the purpose of this study was to compare the oral health indicators of type 2 diabetic patients with non-diabetic controls.

Materials and Methods: In this case-control study, A total of 306 individuals included in the study (103 T2DM cases 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 and to identify any mucosal lesions. Data analysis was performed using SPSS software with a significance level set at 5%.

Results: 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 ± 1.09 and 19.33 ± 9.54, 15.48 ± 6.93 in the case and control groups respectively. 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.

Conclusion: 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.

Highlights: The study highlights the need for healthcare providers to prioritize the assessment and management of oral health complications in patients with T2DM. By implementing routine screenings, providing appropriate treatment, and educating patients on the importance of oral hygiene, healthcare professionals can help mitigate the impact of oral health issues on the overall well-being of individuals with diabetes. Additionally, public health interventions aimed at raising awareness about the oral health challenges faced by patients with T2DM can contribute to improving their quality of life and preventing potential complications.

Keywords: Oral health status, mucosal lesions, and dry mouth.

Introduction

Type II Diabetes Mellitus (T2DM) is a prevalent chronic metabolic disorder characterized by insulin resistance and hyperglycemia [1]. It poses significant health challenges globally, contributing to

numerous comorbidities, including cardiovascular disease, neuropathy, and complications related to the oral cavity [2]. The impact of T2DM on oral health has gained increasing attention in recent years, as evidence suggests that individuals with diabetes may experience a higher incidence of oral health issues, such as periodontal disease, xerostomia, and dental caries [3, 4]. The rising prevalence of T2DM among the middle-aged population has raised concerns regarding the associated complications, particularly in relation to oral health. Oral diseases not only affect the quality of life but may also exacerbate glycemic control, creating a bidirectional relationship between diabetes and oral health [5, 6]. Understanding this relationship is crucial, especially in culturally and epidemiologically distinct populations where dietary habits, oral hygiene practices, and access to dental care may differ from those in other regions [7, 8].

Limited research has explored the prevalence of dental caries among patients with T2DM. Studies have shown that the number of decayed, missing, and filled teeth (DMFT) is greater in individuals with T2DM compared to those without the condition [9,10,11].

Additionally, Leung et al. [12] found that T2DM patients are twice as likely to experience dental caries compared to healthy controls. However, some research has challenged this association [13].

 While a clear relationship has been observed between diabetes and root surface caries, rather than coronal caries, individuals with T2DM tend to have a higher prevalence of root surface caries than their non-diabetic counterparts [14]. Nonetheless, this evidence is mixed, as certain studies report no significant difference in root surface caries between those with and without T2DM [15].

This case-control study aims to investigate the relationship between T2DM and the oral health status of middle-aged patients. By comparing the oral health conditions of diabetic patients with those of non-diabetic controls.
Ultimately, the findings of this study may provide valuable insights for healthcare providers and inform strategies for managing oral health in diabetic patients, fostering a holistic approach to diabetes care that encompasses both metabolic and oral health considerations.

Materials and methods
Study design and participants
This study was designed as a case-control study with a ratio of 2 controls per 1 case nearly and was conducted in Govt Doon Medical college and hospital Dehradun to evaluate the association between oral health status and type 2 diabetes.

The study population included adult individuals with a confirmed diagnosis of type 2 diabetes who visited to Department of General Medicine, Government Doon Medical College and Hospital Dehradun. Participants were recruited through convenience sampling. Written informed consent was obtained for all participants. The objectives, steps of oral clinical examination and were explained for them. All participants were informed about their dental diagnosis and referred to Department of Dentistry Government Doon Medical College and Hospital Dehradun for dental treatment as needed.

In this study, 103 adult patients with T2DM who met the inclusion criteria, were included in the study. In the other hand, 203 non-diabetic matched subjects were included as the control group.

The inclusion criteria included the age range of 40 to 60 years and having T2DM with confirmation of the diagnosis of diabetes during at least one year, having at least 10 remaining natural teeth, no antibiotic, no steroidal and/or non-steroidal anti-inflammatory medication used during the last 3 weeks, no professional periodontal treatment received during the last 6 months and no pregnancy or lactation for the case group. The non-diabetic controls were selected according to the same criteria except for being diagnosed with T2DM.

Exclusion criteria included a history of type 1 diabetes and gestational diabetes, after which these people were excluded from the study.

The sample size was determined to be 300 using Openepi version 3.01, based on a power of 80%, an alpha level of 0.05, a control-to-case ratio of 2, an exposure percentage of 50% among controls, and a minimum odds ratio (OR) of 2 to identify significant differences between groups.

Data collection
Data on oral health status were obtained through clinical examinations and self-reported questionnaires. The clinical examination assessed periodontal health, dental caries, oral infections, and various other oral health indicators. Participants were also asked to complete a questionnaire that gathered information on their oral hygiene practices, dental care usage, and any oral health symptoms they had experienced. All participants completed a dry mouth questionnaire, and an examiner conducted an oral examination to evaluate the DMFT (Decayed, Missing, and Filled Teeth) index and check for the presence of oral lesions. The DMFT index for permanent teeth includes the number of decayed teeth (Decay), teeth extracted due to decay (Missing), and teeth filled due to decay (Filling), as well as the total sum of these items.

Additionally, participants were required to fill out a standardized Xerostomia Inventory(XI) questionnaire [16]. Those who answered positively to at least three questions were categorized as having dry mouth, while those who did not respond affirmatively to any questions were considered not to have dry mouth.

The Cronbach's alpha coefficient for the XI questionnaire was determined to be 0.81, indicating good reliability. Clinical examinations were carried out using a probe and a mirror under the illumination of a dental unit. The criteria for diagnosing the condition of the teeth in terms of decay, filling, and loss were based on standards set by the World Health Organization.

Data analysis
Statistical Package for Social Sciences (SPSS) version 21 was used to analyze the data. Chi-square and independent sample T tests were used to assess the differences in categorical and continuous variables between the cases and controls and to identify possible confounding variables. The binary logistic regression model was used to identify the odds of dry mouth in DM patients. Adjusted odds ratios (ORs) and their 95% confidence intervals (CI) were reported with T2DM status (cases/controls) as the outcome variable at a significant level of 5%.

Results
This study was conducted on 103 T2DM patients, along with 203 non-diabetic individuals recruited for the study with a mean age of 55.6 ± 8.6 years, and 53.6 ± 4.3 years with a minimum age of 40 and a maximum age of 75 years in the case and control group respectively. The mean duration of diabetes mellitus was (4 ± 1.6) years, with a minimum of 1 and a maximum of 17 years. Most of the participants were female in the both groups(case/control) (64.1%/ 59.7%), most were literate in terms of education level too (73.1%/69.3%), and also most of them were unemployed (64.9/63.4%) (Table 1).

Table 1 Frequency distribution of demographic information of the case and control groups

Variables	Categories	N (%)		p.value
		Case (n =103)	Control (n = 203)	
Sex, n(%)	Male	37(35.9)	82(40.3)	0.061
	Female	66(64.1)	121(59.7)	
Educational level, n(%)	Illiterate	28(27.9)	63(30.7)	0.24
	literate	75(73.1)	140(69.3)	
Employment status, n(%)	employed	36(35.1)	74(36.6)	0.19
	Unemployed	67(64.9)	129(63.4)	

The mean scores for the case group were as follows: dry mouth 3.38 ± 2.64, decayed teeth 2.81 ± 3.94, missing teeth 11.86 ± 10.2, filled teeth 2.67 ± 3.7, and DMFT 19.33 ± 9.54. In contrast, the mean scores for the control group were 2.17 ± 1.09, 2.01 ± 1.65, 9.58 ± 7.68, 2.12 ± 1.64, and 15.48 ± 6.93, respectively (Table 2).

Table 2 Descriptive statistics of dry mouth and DMFT in the case and control groups

Variables	Groups	Mean	Standard division	p. value
Dry Mouth	Case	3.38	2.64	0.032
	Control	2.17	1.09	
Decayed Teeth (D)	Case	2.81	3.94	0.015
	Control	2.01	1.65	
Missing Teeth (M)	Case	13.86	12.2	0.001
	Control	9.58	7.68	
Filled Teeth (F)	Case	2.67	3.71	0.012
	Control	2.12	1.64	
DMFT	Case	19.33	9.54	0.001
	Control	15.48	6.93	

Reported dry mouth was more common in the cases than the controls (37.7% versus 10.9%, $P < 0.001$). Visible dental plaque, furcation involvement, tooth mobility, root surface caries and less than 21 remaining teeth were all more frequently observed in the cases group ($P < 0.05$). No significant difference in the average DMFT index was found between male and female patients; however, females had a significantly higher average dry mouth index than males ($p < 0.05$). Additionally, significant differences were noted in both the dry mouth index and DMFT index based on education level, with illiterate and primary school participants reporting higher dry mouth scores compared to those with secondary or higher education. The DMFT scores also varied significantly by education level. While there was no significant difference in dry mouth scores across age groups

($p = 0.51$), DMFT scores increased significantly with age ($p < 0.001$). A notable difference in average dry mouth scores was found based on occupation ($p < 0.001$), but DMFT scores did not vary significantly with occupation. Furthermore, neither dry mouth nor DMFT scores showed a significant association with the duration of diabetes.

Of the participants, 43 individuals (41.7%) reported experiencing dry mouth, with a higher prevalence in women (69.7%) compared to men (37.8%). No significant differences in the prevalence of oral lesions were found based on gender, education level, age, occupation, or duration of diabetes. Dry mouth prevalence was highest among illiterate individuals (76.7%) and lower in those with secondary (29.4%) and university education (38.1%), demonstrating significant differences. The condition was most common among housewives (72.9%) and least common among retirees (33.3%), which was also statistically significant. However, there was no significant relationship between the prevalence of dry mouth and the duration of diabetes.

The results of logistics regression analysis, adjusting for possible confounding variables, showed statistically significant covariates associated with dry mouth including: tooth mobility (OR = 9.63, 95% CI: 4.29–21.58), furcation involvement (OR = 5.23, 95% CI: 2.79–9.80), root surface caries, (OR = 1.80, 95% CI: 1.07–3.02), and having more than 21 remaining teeth (OR = 0.34, 95% CI: 0.17–0.68) (Table 3).

Table 3 All main explanatory variables according to T2DM status adjusted for possible confounding variables, ($n = 306$)

Confounding factors	OR(CI)	p. value
Age	0.99 (0.95–1.02)	0.29
Gender		
Male	1	
Female	3.45 (1.67–7.14)**	< 0.001
Regular dental attendance		
No	1	
Yes	0.57 (0.15–2.18)	0.61
Number of present teeth		
> 21 teeth	0.34 (0.17–0.68)**	< 0.001
< 21 teeth	1	
Tooth mobility		
No	1	
Yes	9.63 (4.29–21.58)**	< 0.001
Furcation involvement		
No	1	
Yes	5.23 (2.79–9.80)**	< 0.001
Dental caries (DMFT)		
DMFT = 0	1	
DMFT > 0	0.82 (0.28–2.37	
Root surface caries		
No	1	
Yes	1.80 (1.07–3.02)*	0.021

Discussion

The current study validated the hypothesis that clinical indicators of periodontal disease such as furcation involvement, tooth mobility, and the number of teeth present, effectively distinguished between patients with T2DM and non-diabetic controls. Additionally, it was partially confirmed that

patients with poorly controlled and long-duration T2DM exhibited more oral disease compared to those with well-controlled and short-duration T2DM. Notably, the mobility index and dental caries were the primary clinical indicators that significantly differentiated the sub-groups of T2DM patients. Before delving deeper into the findings, it is essential to acknowledge the study's limitations and strengths. Both the T2DM patients and the control group were receiving dental treatment, which likely indicates a higher severity of oral diseases and treatment needs compared to individuals not seeking dental care. Identifying mild oral issues that could signify early T2DM would have been beneficial, as it would allow dentists to refer potentially affected patients. However, the study's findings were limited to participants already diagnosed with T2DM. The control group was questioned about T2DM signs and symptoms, but a more thorough screening for undiagnosed T2DM among controls, as suggested by Wang et al. [17], would have enhanced the internal validity of the results.

Dry mouth as a result tooth decay is one of the oral complications of diabetes patients that can cause many clinical and psychological problems for patients and affect their quality of life [18].
The study focused on dry mouth, or xerostomia, a widespread oral health issue that can significantly compromise an individual's quality of life and oral health outcomes. The research revealed a high prevalence of dry mouth among patients with type 2 diabetes, with a substantial proportion of participants experiencing persistent symptoms of oral dryness. This finding emphasizes the importance of routine dry mouth screening by healthcare providers for patients with diabetes and the implementation of appropriate management strategies to alleviate symptoms and prevent potential oral health complications.

The result of the present study showed the average of DMFT above 19, which is consistent with the results of studies by Wu-Chen et al. [19] and Singh et al. [20], but it is different from the study of Seethalakshim et al. [21]. This difference may be attributed to the small sample size of Seethalakshim's study [21]. In this study, the prevalence of dry mouth was about 40%, which is consistent with the findings of the study by Mohamed et al. [22]. Also, the prevalence of mucosal lesions obtained 13.6%. This finding is consistent with the results of Parvaei et al. study [23].

However, in the study of Mohamed et al. [22], the prevalence of mucosal lesions was more than that of the present study, and this difference could be due to the large sample size in this study.
The presence of more dental plaque and poorer oral hygiene among diabetic individuals has been attributed to higher levels of glucose in gingival crevicular fluid (GCF) and saliva [24, 25]. Additionally, a greater number of missing teeth among T2DM patients has been associated with poor oral hygiene in populations, which was not observed in populations with good oral hygiene.

The study provides a valuable contribution to the literature by investigating the relationship between T2DM and periodontal disease.

However, the prevalence of chronic periodontitis, as defined by pocket depths rather than clinical attachment level, might have been underestimated. Moreover, the lack of a generally accepted case definition across studies impedes the comparison of prevalence figures. Clinical signs such as tooth mobility and furcation involvement were more frequent among the T2DM cases compared to non-diabetic controls, consistent with findings from previous studies [22, 25].

Despite the higher prevalence of visible dental plaque and missing teeth among T2DM patients, there was no difference in DMFT status between the groups, corroborating findings from other researchers [23, 26, 27]. The lack of a significant relationship between T2DM and dental caries has been attributed to confounding factors such as xerostomia, periodontal disease, and a strict carbohydrate diet.

However, a recent study reported higher DMFT levels among individuals with T2DM [28]. Notably, both the cases and controls in the present study had a high prevalence of DMFT (95%), highlighting

an urgent need for treatment and preventive oral health care programs. Nevertheless, this study used convenience sampling, which may limit the generalizability of the findings.

Conclusion

The study findings reveal that chronic periodontitis, tooth mobility and furcation involvement, were more prevalent among patients with T2DM compared to their non-diabetic matched controls. Although pocket depths, as a measure of chronic periodontitis, did not associate with the duration of T2DM, there was an association in the expected direction with tooth mobility and dental caries. The present findings have significant implications for both diabetes and oral health care provision. For future prevention and management, it is crucial to determine whether periodontitis plays a role in the development and control of T2DM and its complications. Further large-scale prospective studies are needed to investigate the effect of periodontitis treatment on the management and control of T2DM.

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