

## Knowledge and Awareness of Oral Manifestations of Diabetes Mellitus among Health Practitioners in Saudi Arabia

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### Abstract

**Objectives:** The objective of the present study was to assess the knowledge and awareness about oral manifestations of diabetes mellitus and the risk of developing oral diseases due to complications associated with diabetes mellitus among health professionals in the Kingdom of Saudi Arabia.

**Methodology:** An observational cross-sectional study was undertaken using a structured questionnaire that was distributed to 277 health-care practitioners. The questionnaire consisted of 12 questions that collected demographic data and asked about 10 oral manifestations related to diabetes mellitus.

**Results:** The study group comprised 277 participants. The responses highlighted low levels of knowledge about the oral manifestations of diabetes mellitus, with a mean value of 4.48 out of a possible score of 12. There were no significant relationships of total knowledge score with the variables, including age, gender, qualifications, or having a relative with diabetes mellitus. However, dental professionals had significantly higher total knowledge scores than medical professionals ( $p < 0.001$ ).

**Conclusion:** The present study revealed that there is a need to enhance the levels of knowledge and awareness about oral health and diabetes mellitus among health-care providers and also a need to develop appropriate patient-centered protocols to ensure patients with diabetes mellitus have appropriate oral health care to prevent and lessen the risk of possible related oral diseases. A collaborative approach between medical and dental professionals may result in accurate patient assessments and education that results in better overall health outcomes.

**Keywords:** Knowledge; Awareness; Oral Manifestations; Diabetes Mellitus; Saudi Arabia

### Abbreviations

AGES: Advanced Glycation End Products; DM: Diabetes Mellitus; PD: Periodontal Disease; T1D: Type 1 Diabetes Mellitus; T2D: Type 2 Diabetes Mellitus; WHO: World Health Organization

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## Introduction

Diabetes mellitus (DM) is a global metabolic disorder that, by virtue of its many possible features, has the potential to adversely affect general health, impact oral health care and lessen quality of life [1]. The prevalence of DM varies across the globe and it has been reported that the overall prevalence of diabetes among adults over 18 years of age has increased from 4.7% in 1980 to 8.5% in 2014. The World Health Organization (WHO) predicts that this will increase to 439 million, almost 10% of adults, by 2030. Furthermore, the incidence of DM is expected to increase in view of the improved awareness of clinical disease, improved diagnostic methods, and perhaps the influence of any likely causative environmental and/or lifestyle factors [2]. DM tends to manifest in middle to late life. However, the disease can arise at any age. The well-known systemic manifestations of the disease include heart attack, kidney disease, limb loss, blindness, and peripheral nerve damage; hence, it is evident that DM can affect general health and the related quality of life among affected populations [2].

The classification criteria for DM established by the WHO [3] include fasting plasma glucose  $> 7.0$  mmol/L (126 mg/dL), or 2-hour plasma glucose  $> 11.1$  mmol/L (200 mg/dL). In 2010, a classification system was developed principally to aid in research, but also to help clinical practice and diagnosis. The American Diabetes Association adopted the following criteria for the diagnosis of diabetes [4]:

- Fasting plasma glucose  $> 7.0$  mmol/L (126 mg/dL), or
- 2-hour plasma glucose  $> 11.1$  mmol/L (200 mg/dL), or
- Random plasma glucose  $> 11.1$  mmol/L (200 mg/dL) in a patient with classic symptoms of hyperglycemia (i.e. polyuria, polydipsia, polyphagia, weight loss) or hyperglycemic crisis, or
- Hemoglobin A1c (HbA1c)  $> 48$  mmol/mol ( $> 6.5\%$ ); the test should be performed in a laboratory using a method that is certified by the National Glycohemoglobin Control and Complications Trial reference assay.

DM can, in general, be divided into two main types of the disease—type 1 and type 2. Type 1 DM (T1D) is characterized by the destruction of pancreatic B cells, which are responsible for insulin production. About 70-90% of T1D patients have an immune-mediated loss of B cells, characterizing type 1A DM (T1DA), and the exact pathogenesis of this condition is still not clearly understood. Insulin replacement therapy is always required from the very beginning of T1D [5].

Type 2 DM (T2D) is responsible for more than 80% of cases of diabetes. T2D is commonly caused by insufficient insulin activity (insulin resistance), impaired pancreatic B cell action, or abnormal hepatic metabolism of glucose. The pathological pathway of T2D has not been completely ascertained. However, raised levels of pro-inflammatory cytokines, reactive oxygen species, adipokines, and free fatty acids have been associated with insulin resistance [6].

Furthermore, the oral cavity, in addition to other body organs, can be affected by pathological involvement that often includes an increased risk of dental caries, periodontal diseases, mucosal ulceration, decreased salivary gland function, and a variety of oral infections, as well as an increased risk of peripheral neuropathological alterations [7-10].

The precise association of periodontal diseases with the risk of uncontrolled DM has been reported extensively in many studies [11-13]. Although diagnostic criteria for DM have been advanced in recent decades, the therapeutic management of DM is still of concern and needs further advancement. It has recently been suggested that long-standing uncontrolled DM can lead to other autoimmune disorders and attendant side effects [14].

As noted earlier, patients with DM may have a significant degree of associated comorbidities, and this is linked mainly to the high incidence of disease complications and adverse therapeutic side effects. Both types of DM have several shared clinical and serological features, with variable clinical features and degrees of severity. Previous reports have highlighted that most increased manifestations of DM are linked to a late diagnosis of the disease, lack of awareness among patients and health-care providers, and impaired access to appropriate health-care services.

### Aim of the Study

The aim of the current study is to assess the knowledge and awareness about oral manifestations of DM and the risks of developing oral diseases due to complications associated with DM among health professionals in the Kingdom of Saudi Arabia.

### Materials and Methods

The design for this study was a cross-sectional questionnaire that aimed to evaluate the awareness of oral manifestations of DM among health practitioners in Saudi Arabia. The study was conducted from May 2022 to June 2022 among participants from all educational organizations and health-care centers in Saudi Arabia. All data were treated anonymously. The inclusion criterion was that the participant was a student, intern, resident, specialist, or consultant in medicine or dentistry.

Each participant was required to sign the study’s informed consent before answering the questions, which were sent via an online survey. The expected time for completion was 3 to 5 minutes. The questionnaire was derived from a previous study [15] and was composed of 12 questions. First, the questions asked about the respondent’s field of study, qualifications, age, gender, region of practice in Saudi Arabia, and personal and relative history of DM. Then, the questionnaire asked about 10 oral manifestations of DM, including bleeding gums, multiple periodontal abscesses, altered taste sensation, affected taste buds/taste, burning sensation in the oral cavity, slow wound healing, diabetic neuropathy, dental caries, dry mouth, and burning sensation in the corner of the mouth.

Data were analyzed using the SPSS statistical software package (IBM Corp., Armonk, NY). Statistical analyses were undertaken for demographics and other variables. For all statistical analyses, the threshold of significance was set at a P-value < 0.05. Using G\*Power software, it was determined that 279 was the required sample size for this study.

### Results

This study was conducted with 277 participants in Saudi Arabia. The demographic data for the participants are provided in table 1. Among the participants, only 9.4% (n = 26) had DM, while 57% (n = 158) of the participants had at least one relative with DM. Among the participants, 207 (74.7%) believed that a dentist can diagnose patients with DM. Also, 207 (74.7%) reported that they would need training on the manifestations of DM in the oral cavity.

Characteristic	Variable	N	%
Age (in years)	< 30	187	67.5%
	30-50	84	30.3%
	> 50	6	2.2%
Gender	Male	88	31.8%
	Female	189	68.2%
Qualification	Student/intern	119	43.0%
	Resident	114	41.2%
	Specialist/consultant	44	15.9%
Region of Practice in Saudi Arabia	West	180	65.0%
	East	48	17.3%
	Central	36	13.0%
	South	9	3.2%
	North	4	1.4%
Field	Dentistry	167	60.3%
	Medicine	110	39.7%

**Table 1:** Baseline characteristics of participant demographic data (n = 277).

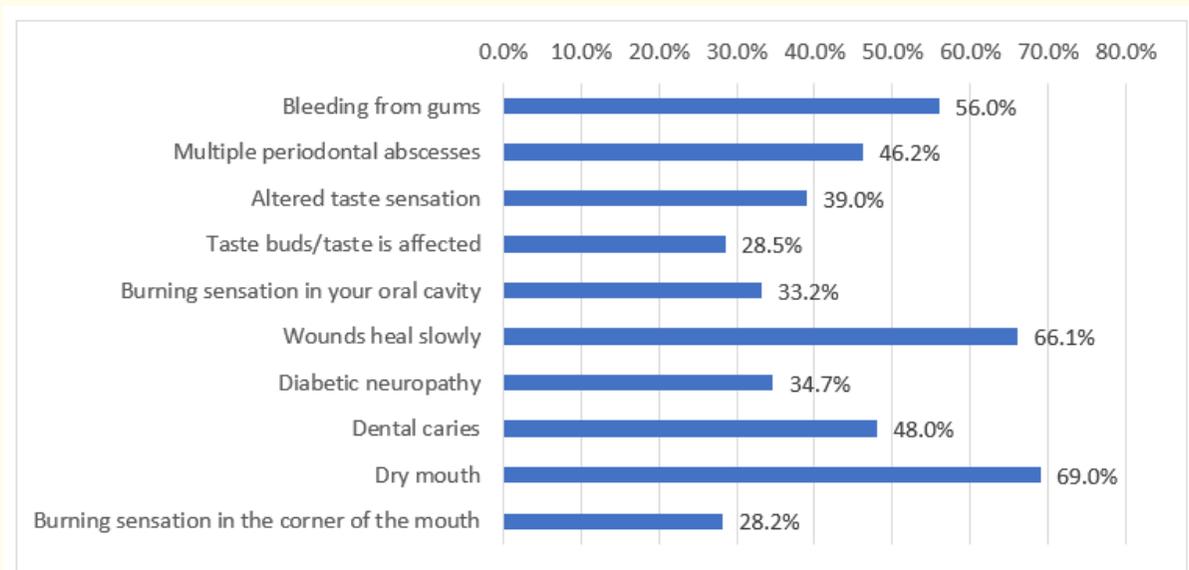
The participants were asked 10 questions about the symptoms found in patients that could be related to oral manifestations of DM. The correct answers are shown in table 2 and figure 1. When the correct answers of the participants were totaled, the mean of the total correct answers was 4.48 points, with a standard deviation of 2.46 points. A comparison of total knowledge scores is provided in table 3. Using t-test and ANOVA, we found that age, gender, qualification, and/or having a relative with DM had no significant relationship with the total knowledge score. However, dental professionals had significantly higher total knowledge scores than medical professionals, as shown in table 3.

Is This Feature an Oral Manifestation of Diabetes Mellitus?	Answer	N	%
Bleeding from gums	Yes	155	56.0%
	No	122	44.0%
Multiple periodontal abscesses	Yes	128	46.2%
	No	149	53.8%
Altered taste sensation	Yes	108	39.0%
	No	169	61.0%
Taste buds/taste affected	Yes	79	28.5%
	No	198	71.5%
Burning sensation in oral cavity	Yes	92	33.2%
	No	185	66.8%
Wounds heal slowly	Yes	183	66.1%
	No	94	33.9%
Diabetic neuropathy	Yes	96	34.7%
	No	181	65.3%
Dental caries	Yes	133	48.0%
	No	144	52.0%
Dry mouth	Yes	191	69.0%
	No	86	31.0%
Burning sensation in the corner of the mouth	Yes	78	28.2%
	No	199	71.8%

Table 2: Participant answers regarding oral manifestations of diabetes mellitus.

Variable	Mean	Total Knowledge Score		p-value
		Standard Deviation		
Age (in years)	< 30	4.5	2.5	0.994
	30-50	4.5	2.4	
	> 50	4.5	1.5	
Gender	Male	4.7	2.6	0.476
	Female	4.4	2.4	
Qualification	Student/intern	4.2	2.4	0.130
	Resident	4.8	2.6	
	Specialist/consultant	4.4	2.3	
Specialty	Dentistry	4.9	2.5	<0.001
	Medicine	3.9	2.4	
Have close relative (father, mother, brother, or sister) with diabetes mellitus	Yes	4.3	2.5	0.221

Table 3: Comparison of total knowledge scores on the oral manifestations of diabetes mellitus against different variables.



**Figure 1:** Participants who identified the oral manifestations of diabetes mellitus.

## Discussion

DM is a metabolic disorder characterized by persistent hyperglycemia, along with modifications to the metabolism of carbohydrates, proteins, and lipids to varying degrees. The complications of DM, which are common worldwide, have a serious negative influence on patients' quality of life, longevity, and cost of care.

In our study, only 9.4% of the respondents had DM. However, 57% of the participants had at least one relative with DM. The mean knowledge score about the oral manifestations of DM among the study subjects was 4.48 out of a possible score of 12. No significant relationships of total knowledge score with the variables of age, gender, qualification, or having a relative with DM were found. However, dental professionals had significantly higher total knowledge scores than medical professionals ( $p < 0.001$ ). Our findings concur with previous reports that demonstrated that patients with DM are not well-informed about oral symptoms [16-19].

When the participants' answers measuring knowledge about oral manifestations of diabetes were scored and tabulated, the percentage of correctly answered questions was 44.89%. This score highlights the urgent need for increasing awareness and understanding of the possible associations between DM and oral health among dental and medical professionals. It is crucial to perform a periodic periodontal examination every time a DM patient visits for a check-up, and regular dentist visits should also be strongly encouraged. Evidence from the past emphasizes the significance of DM and periodontal disease prevention and treatment [11].

The present study's results showed that 44% and 53.8% of participants could not identify gingival bleeding and periodontal abscesses, respectively, as correlated with DM. However, the main oral complication attributed to diabetes is periodontal disease (PD), which is considered the sixth complication of DM [12]. This manifestation is related to the accumulation of advanced glycation end products (AGEs) in periodontal tissues, decreased periodontal regenerative capacity, and defective immune regulation [20,21]. For this reason,

correct periodontal treatment can lower the level of pro-inflammatory mediators and thus contribute to better glycemic control. This is also related to the delayed wound healing that can be seen in patients with DM. Given that 33.9% of our respondents answered this question incorrectly, it can be inferred that diabetic patients are more susceptible to infection; therefore, preventive administration of antibiotics and good glycemic control may be indicated in some patients with DM prior to undergoing surgical procedures, including dental procedures. Delayed wound healing and an increased incidence of infections following surgery can be explained as a consequence of vascular dysfunction and decreased immune function with diabetes. Regarding dental caries and hyposalivation, 52% and 31% of respondents, respectively, were unaware that those oral manifestations are strongly related to patients with DM. The scientific literature reflects controversy regarding increased dental caries among patients with DM. However, some studies found a higher incidence of dental caries in patients with DM [9,10], which could be explained by salivary gland hypofunction among patients with DM. It is noteworthy that in one study, 80% of DM patients presented with xerostomia, compared to only 10% of healthy subjects, which suggests that DM can cause xerostomia and that there may be a significant correlation between the degree of xerostomia and/or salivary gland hypofunction and glucose levels in saliva. This could also explain the increased risk of bacterial and fungal infections [22].

In the present study, only 39% of participants thought that altered taste sensation is related to DM. Furthermore, 66.8% thought that a burning sensation in the oral cavity is not one of the oral manifestations of DM, and 71.8% thought a burning sensation in the corner of the mouth was not related to DM. In fact, all of these symptoms are considered common manifestations of DM. Moreover, taste alteration has been associated with DM and increased body mass index, and the sense of taste can be influenced by the appearance of neuropathies [23].

Furthermore, patients with DM often have burning mouth syndrome, but a relationship between DM and burning mouth syndrome has not been clearly identified. However, this may be correlated with the associated psychological factors, such as stress, anxiety, and depression [24]. To prevent the emergence of potential problems, oral health experts' participation in health-care strategies and decision-making targeted at identifying people at risk for DM should be further enhanced [25].

The mean score of knowledge about oral manifestations of DM among dentists was 4.9, while among physicians, it was 3.9 ( $p < 0.001$ ). This shows that dental professionals had better knowledge and awareness of oral manifestations of DM than medical professionals. Among the participants, 74.7% believed that a dentist can diagnose patients with DM. The dentist should be aware that diabetes is a common disease, with concurrent oral symptoms that can change dental care requirements when participating in such associated medical efforts. Dentists need to be totally knowledgeable about diagnostic and prevention methods in this situation. Effective management of diabetic patients requires good teamwork between the patient, doctor, dentist, and other health-care professionals. Regular check-ups will allow dentists to anticipate patient needs and interact competently with other health-care professionals. A thorough examination of the mouth cavity may reveal symptoms of a systemic disorder, enabling early detection and treatment. Along with evaluating the general health of the teeth, the examination should also check for mucosal changes, PD, and bleeding.

Additionally, the use of anti-diabetic medications may result in severe skin reactions. Insulin therapy may cause immediate and delayed type allergies, as well as localized severe side effects. In addition, oral diabetes medications have been linked to side effects, such as photosensitivity, vasculitis, and erythema multiforme. The proper diagnosis and treatment of diabetes may depend on the ability to recognize lesions [14].

Furthermore, severe PD may be a strong predictor of various diabetic complications, including nephropathy and renal and cardiovascular diseases [26,27]. Not surprisingly, 74.7% of the participants in the present study reported needing training on the manifestations of DM in the oral cavity. Despite being first described many years ago, this continues to be a challenging metabolic disorder for a considerable number of health-care workers, due perhaps to its multisystemic nature. There would seem to be a need to enhance the knowledge of health-care workers on relevant aspects of DM to lessen the risk of patients with DM being unable to access dental care services. The

maintenance of good oral hygiene is a fundamental component of oral disease prevention in all groups of individuals. Dentists and dental hygienists should thus consider educating patients about appropriate methods of oral hygiene and should explain that there is always an implicit risk of oral diseases, such as periodontal problems due to poor oral hygiene.

### Conclusion

Numerous consequences are brought on by DM, and they worsen when the patient's glycemic control is abnormal. Because of this, management and prevention are crucial, and to detect diabetes early, medical professionals, including dentists and doctors, must be diligent in recognizing its different mouth symptoms. Aiming to provide the ultimate care for patients with DM, medical and dental professionals must have a thorough understanding of the pathogenesis, symptoms, and therapy of diabetes-related orofacial infections, such as PD, periapical lesions, xerostomia, and taste disturbances that are more prevalent among patients with diabetes.

Despite the fact that DM has a variety of oral manifestations, there is insufficient knowledge about the links between diabetes, oral health, and overall general health. Thus, to make an early diagnosis of DM, doctors and dentists must be aware of the oral symptoms possibly related to the disease.

### Conflicts of Interest

The authors declare there are no conflicts of interest.

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