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ORIGINAL ARTICLE

# Oral Symptoms and Oral Health-Related Quality of Life among Malaysian Patients with Diabetes Mellitus

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**ABSTRACT**

**Objective:** To determine the association between oral health-related symptoms and oral health-related quality of life (OHRQoL) among diabetic patients. **Material and Methods:** This cross-sectional study involved 202 diabetic patients. The Malay version of the Short Oral Health Impact Profile [S-OHIP(M)] questionnaire was used to assess OHRQoL. A higher S-OHIP(M) score indicates greater oral impact and worse OHRQoL. The prevalence of oral impact was determined by the percentage of participants who reported experiencing one or more impacts 'very often' or 'fairly often'. An additional self-administered questionnaire was used to obtain perceived oral health symptoms. Data were analyzed using descriptive analysis, independent t-test, and ANOVA. **Results:** 45.6% of respondents reported at least one oral health symptom. The most common symptoms were bad breath (30.2%), cavities (29.7%), and toothache (16.8%). The prevalence of oral impact was 33.7%, and the total mean S-OHIP(M) score was 6.15 (SD=6.09). The mean of the S-OHIP(M) score was significantly higher in participants with toothache, cavities, sore gums, swollen gums, bleeding gums, mobile teeth, and bad breath. **Conclusion:** Oral health symptoms are significantly associated with poorer OHRQoL among diabetic patients. Preventive care and timely treatment of oral health issues are critical to improving the overall quality of life and well-being of this population.

**Keywords:** Metabolic Diseases; Oral Health; Quality of Life.

## Introduction

Diabetes mellitus is one of the most common worldwide public health issues, posing a significant global burden on both public health and socioeconomic development. Although the incidence of diabetes has begun to decline in some countries, the prevalence of diabetes has increased in other developing and developed countries in recent decades [1]. In Malaysia, the 2023 National Health and Morbidity Survey reported a diabetes mellitus prevalence of 15.6% among adults, decreasing from 18.3% in 2019, with an estimation of 84% do not know they have diabetes mellitus [2,3].

Diabetes mellitus is a systemic disease that has important oral manifestations and influences on oral health [4]. A study found that more than 90% of diabetic patients suffered from oral complications. The well-recognized oral complications among diabetes mellitus include periodontal disease, dental caries, oral infections, salivary dysfunction, taste dysfunction, delayed wound healing, tongue abnormalities, halitosis, and lichen planus [5]. Diabetes has a bidirectional relationship with periodontal disease [6]. Individuals with diabetes have at least three times greater risk of periodontitis than those without diabetes [7]. Possible mechanisms for an explanation of increased susceptibility to periodontal diseases include alterations in host defense response (such as neutrophil dysfunction), subgingival microflora, structure and metabolism of collagen, vascularity, gingival crevicular fluid, and inheritance patterns [8]. Furthermore, several risk factors have been reported that make these patients more susceptible to the development of periodontal disease, including poor oral hygiene, poor metabolic control, longer duration of diabetes, and smoking [8,9].

Periodontitis has recently been assumed to be the sixth complication of diabetes [10]. There is evidence that chronic oral complications among diabetes patients negatively affect blood glucose control. So, prevention and management of oral complications are important [11]. Most recent evidence-based studies propose that having a controlled periodontal situation with proper and timely therapy could improve glycemic management in diabetic patients [10].

Oral health-related quality of life (OHRQoL) is a multidimensional construct that includes a subjective evaluation of individuals' oral health, functional well-being, emotional well-being, expectations and satisfaction with care [12]. OHRQoL is an essential indicator of individuals' overall health and health-related quality of life. Poor oral health among diabetes mellitus patients, including hyposalivation, halitosis, periodontitis, burning mouth sensation, candidiasis, and taste alteration, leads to poor OHRQoL, subsequently causing numerous negative consequences that can increase the burden on the healthcare system [8,13]. United States Surgeon General's report defines OHRQoL as "a multidimensional construct that reflects (among other things) people's comfort when eating, sleeping, and engaging in social interaction, their self-esteem, and their satisfaction with respect to their oral health" [14]. Oral complications in diabetic patients are considered major complications which can affect patients' quality of life [11]. Evidence shows that oral diseases can impact patients' well-being, daily living, and quality of life [15]. Dental diseases can cause pain, discomfort, and affect proper physical functions like chewing, talking and smiling. It also can influence the individual's social roles and quality of life [15]. Results from various clinical and interventional research show that dental treatments and public health interventions can improve OHRQoL [15].

A study conducted in Malaysia found that 55.3% of diabetes patients were diagnosed with periodontal disease [16]. Recent research among diabetes mellitus patients in Malaysia found that the most common oral problem reported by the patients were cavitated tooth (42.2%), toothache (17.8%), mobile tooth (17.8%), and swollen gums (16.3%) [17]. These findings will lead to poor OHRQoL among diabetes mellitus patients. A study in Iran found that diabetic patients had poor oral health status, and OHRQoL scores were high in these patients,

indicating oral problems affected the oral health-related quality of life [4]. Another study conducted in Iran found that OHRQoL among most diabetic patients as being in the "good" category reflecting that those oral complications of diabetes have not adversely affected OHRQoL in these patients [18]. A similar finding was reported in a study conducted in the United Kingdom, demonstrating that there are no significant differences in the overall OHRQoL among diabetic and non-diabetic patients. Type 2 diabetes mellitus does not impact on overall OHRQoL as measured by oral health impact profile (OHIP-49) [19]. The conflicting results found in previous research on OHRQoL among diabetes patients highlight the complexity of this relationship and the need for further investigation. Understanding how diabetes affects oral health and quality of life is crucial for developing effective interventions and improving overall health outcomes for individuals with diabetes.

Given the well-established relationship between diabetes and periodontitis [7], understanding how periodontal health influences OHRQoL among diabetes patients is crucial for improving overall health outcomes. Hence, identifying OHRQoL among diabetes mellitus patients is very important because it will raise awareness among primary physicians for early screening of oral health status. This is important to avoid oral health complications related to diabetes mellitus as evidence has shown that treating periodontal disease can positively impact diabetes control [6]. Therefore, this study was conducted to determine the proportion of self-reported oral symptoms, the prevalence of oral impact, and the mean score of the Oral Health Impact Profile (OHIP) for assessing OHRQoL among patients with type 2 diabetes mellitus. Additionally, the study aimed to evaluate OHIP levels based on patients' socio-demographic characteristics, diabetes profiles, and oral health-related symptoms.

## Material and Methods

### Study Design and Ethical Clearance

This cross-sectional study was conducted between September 2023 and November 2023, involving patients with type 2 diabetes mellitus attending the diabetes clinic at Hospital University Sains Malaysia (USM). This study was approved by the Human Research and Ethics Committee, University Sains Malaysia (JEPeM-USM), with a protocol code USM/JEPeM/KK/23040330. Written informed consent was obtained from each participant who met the inclusion criteria and agreed to participate in the study.

### Population and Sample

Patients who were aged 18 and above, diagnosed with type 2 diabetes mellitus for at least one year, and able to read and write in Malay language were included in the study. Those who were illiterate, diagnosed with cognitive, vision or hearing problems, and suffering from a psychiatric illness were excluded.

The sample size was calculated using the single proportion formula with a 95% confidence interval (CI) based on the objective of determining the proportion of self-reported oral symptoms among type 2 diabetes mellitus patients attending the diabetes clinic at Hospital USM. The expected proportion of diabetes patients with at least one oral symptom was estimated at 62.2%, according to Saddki et al. [17]. Sample sizes were calculated for various precision and a sample size of 184 was chosen with a precision of 0.07 while taking into consideration available resources. However, after considering the non-response rate of 10%, a sample size of 202 was selected for this study. The diabetes clinic is estimated to serve 60 patients per day, with a total of 180 patients per week, as the clinic operates 3 days per week. Over the study duration of 8 weeks, the total number of patients is expected to be 1,440 (180 patients per week multiplied by 8 weeks). In this study, a systematic random sampling method with an interval of seven was utilized to select the participants.

Data Collection

A self-administered questionnaire was utilized to collect the variables of interest for this study. The questionnaire has four parts. The first part was about participants' demographic characteristics, including sex, race, age, educational level, and smoking status. The second part of the questionnaire is a structured, self-administered questionnaire to determine self-reported oral problems among the respondents: 1) perceived current oral health status, either very poor, poor, fair, good, and very good; 2) current oral symptoms (toothache, cavitated tooth, sore gums, swollen gums, bleeding gums, gum abscess, loose tooth, bad breath, oral ulcer); 3) denture wearing, and the last one is on last dental visit [20]. The third questionnaire used the Malay version of the short Oral Health Impact Profile [S-OHIP(M)] questionnaire to assess OHRQoL. This questionnaire was validated by Saub et al. with Cronbach's alpha of 0.89 and intraclass correlation coefficients (ICC) of 0.89 [21].

The S-OHIP(M) questionnaire consists of 14 items and 7 domains. A 5-point Likert scale was used to assess the frequency of oral impacts during the previous 12 months. The following scale was used: '0' for 'never', '1' for 'hardly ever', '2' for 'occasionally', '3' for 'fairly often' and '4' for 'very often'. The total score of all 14 items (range: 0 to 56) was calculated to determine the overall severity of the impacts. A higher S-OHIP(M) score indicates greater oral impact and a poorer OHRQOL. The prevalence of oral impact was measured by the percentage of participants reporting 1 or more impacts 'very often' or 'fairly often'[21].

The fourth part of the questionnaire was on the diabetes profile of the respondents, including disease duration, latest glycated hemoglobin (HbA1c) level for measuring the average blood sugar for the past three months, medications taken, presence of hypertension and dyslipidemia. All questions were self-administered except the diabetes profile obtained from the patient's medical records.

Patients attending the diabetes clinic were approached individually and given a detailed explanation of the study's significance, objectives, and procedures. After providing consent, participants were brought to the counseling room to complete a hardcopy questionnaire. All questions were self-administered except for the diabetes profile, which was obtained from medical records. The questionnaire took approximately 20 minutes to complete.

Statistical Analysis

Data entry and analysis were conducted using IBM SPSS Statistics for Windows, version 27.0 (IBM Corp., Armonk, NY, USA). Data checking and cleaning were done before the data analysis. Descriptive statistics were used to describe the socio-demographic characteristics of the respondents and to determine self-reported oral health symptoms and OHRQoL. An independent T-test or ANOVA was used to determine the level of OHRQoL among type 2 diabetes mellitus patients and socio-demographic, diabetes profile, and oral health-related symptoms. The level of significance was set if the P value $< 0.05$.

## Results

A total of 202 patients were invited to participate in this study, and 202 responded, yielding a 100% response rate. The socio-demographic profile of the respondents is shown in Table 1. Their ages ranged from 22 to 89, with a mean age of 64.35 (SD=10.38). The majority of the respondents were Malay (86.1%). Nearly half (48.5%) of the respondents attained secondary education, and most (87.6%) of the respondents are unemployed. More than half of the respondents were diagnosed with diabetes mellitus for more than 10 years and above (64.9%) and had uncontrolled diabetes mellitus with an HbA1c reading ≥7% (69.8%). Most respondents also have hypertension (87.6%) and dyslipidemia (91.6%).

**Table 1. Socio-demographic data and diabetes profile of the participants.**

| Variables | N (%) | Mean (SD) |
|---|---|---|
| Age (Years) | | 64.35 (10.38) |
| <60 years old | 54 (26.7) | |
| ≥60 years old | 148 (73.3) | |
| Gender | | |
| Female | 90 (44.6) | |
| Male | 112 (55.4) | |
| Ethnic | | |
| Malays | 174 (86.1) | |
| Others | 28 (13.9) | |
| Educational Level | | |
| No education /primary education | 26 (12.9) | |
| Secondary education | 98 (48.5) | |
| Tertiary education | 78 (38.6) | |
| Occupation | | |
| Employed | 25 (12.4) | |
| Unemployed | 177 (87.6) | |
| Smoking | | |
| Yes | 10 (5.0) | |
| No | 192 (95.0) | |
| Diabetes Duration | | 12.84 (7.62) |
| <10 years | 71 (35.1) | |
| ≥10 years | 131 (64.9) | |
| HbA1c Reading | | 8.37 (2.18) |
| <7 | 61 (30.2) | |
| ≥7 | 141 (69.8) | |
| Diabetic Medication | | |
| Oral hypoglycemic only | 80 (39.6) | |
| Oral hypoglycemic with insulin | 93 (46.0) | |
| Insulin only | 29 (14.4) | |
| Hypertension | | |
| Yes | 177 (87.6) | |
| No | 25 (12.4) | |
| Dyslipidemia | | |
| Yes | 185 (91.6) | |
| No | 17 (8.4) | |

The results of self-reported oral health symptoms and dental visits of the participants are shown in Table 2. Most of the respondents perceived their oral health status as good (70.8%). Nearly half of the respondents reported having at least one oral health symptom (45.6%). The most common symptoms were bad breath (30.2%), a cavitated tooth (29.7%), and toothache (16.8%). More than half of the respondents do not wear upper dentures (50.5%) and lower dentures (66.8%). More than half of the respondents (59.4) were symptomatic attendees and visited the dentist only when in pain.

**Table 2. Self-reported oral health symptoms and dental visits.**

| Variables | N (%) |
|---|---|
| Perceived Oral Health Status | |
| Very good | 19 (9.4) |
| Good | 143 (70.8) |
| Fair | 31 (15.3) |
| Poor | 6 (3.0) |
| Very poor | 3 (1.5) |
| Presence of Oral Health Symptoms | |
| Yes | 92 (45.6) |
| No | 110 (54.4) |
| Oral Symptoms | |

| | |
|---|---|
| Toothache | 34 (16.8) |
| Cavitated tooth | 60 (29.7) |
| Gum pain | 26 (12.9) |
| Gum swelling | 8 (4.0) |
| Gum bleeding | 23 (11.4) |
| Gum abscess | 3 (1.5) |
| Loose tooth | 26 (12.9) |
| Bad breath | 61 (30.2) |
| Mouth ulcer | 10 (5.0) |
| Upper Denture Wearing | |
| Yes | 100 (9.5) |
| No | 102 (50.5) |
| Lower Denture Wearing | |
| Yes | 67 (33.2) |
| No | 135 (66.8) |
| Last Dental Visit | |
| Last 12 months ago | 58 (28.7) |
| Last 1 to 2 years ago | 21 (10.4) |
| Only when in pain | 120 (59.4) |
| Never go for a dental visit | 3 (1.5) |

The prevalence of oral impact was 33.7%, and the total mean S-OHIP(M) score was 6.15 (SD=6.09). Table 3 shows the mean S-OHIP(M) score for each domain and item, and the proportion of participants reporting impact for each item. The most affected oral health domain was the physiological discomfort domain. An item within the physiological discomfort domain – discomfort due to food getting stuck – had the highest mean score, which is 1.21 (SD=1.18), with a prevalence of impact of 14.4%. The lowest oral impact was for social disability, and no participant reported having impacts of 'fairly often' or 'very often' for 'avoided going out' and 'problems in carrying out daily activities'.

**Table 3. Prevalence of oral impact (S-OHIP(M) score.**

| S-OHIP (M) Domain and Item | Prevalence of Impact % | S-OHIP (M) Score Mean (SD) |
|---|---|---|
| Functional Limitation | | |
| Difficulty chewing any food | 13.9 | 0.81 (1.24) |
| Problems caused bad breath | 3.5 | 0.61 (0.93) |
| Physical Pain | | |
| Discomfort eating any food | 13.4 | 0.88 (1.23) |
| Ulcers in mouth | 1.0 | 0.15 (0.48) |
| Physiological Discomfort | | |
| Discomfort due to food getting stuck | 14.4 | 1.21 (1.18) |
| Felt shy | 3.0 | 0.43 (0.86 |
| Physical Disability | | |
| Avoided eating certain foods | 14.3 | 0.96 (1.29) |
| Avoided smiling | 3.0 | 0.28 (0.73) |
| Psychological Disability | | |
| Sleep been disturbed | 1.0 | 0.08 (0.38) |
| Concentration been disturbed | 0.5 | 0.12 (0.45) |
| Social Disability | | |
| Avoided going out | 0 | 0.05 (0.32) |
| Problems in carrying out daily activities | 0 | 0.07 (0.32) |
| Handicap | | |
| Had to spend a lot of money | 1.5 | 0.33 (0.69) |
| Felt less confident | 1.0 | 0.17 (0.56) |

Table 4 shows the severity of oral impacts among the respondents based on the socio-demographic, diabetes profile and oral health-related symptoms. The mean of the S-OHIP(M) score was significantly higher in participants with toothache, cavities, sore gums, swollen gums, bleeding gums, mobile teeth, and bad breath.

**Table 4. The severity of oral impacts (S-OHIP(M) score among type 2 diabetes mellitus patients according to socio-demographic, diabetes profile, and oral health-related symptoms.**

| Variables | Mean (SD) | Mean Difference (95% CI) | t-statistics[a] (df) | p-value |
|---|---|---|---|---|
| Gender | | | | |
| Male | 6.85 (6.07) | 1.570 | 1.832 (200) | 0.068 |
| Female | 5.28 (6.04) | | | |
| Age (Years) | | | | |
| <60 years old | 6.55 (7.39) | 0.556 | 0.573 (200) | 0.568 |
| ≥60 years old | 6.00 (5.56) | | | |
| Ethnicity | | | | |
| Malay | 6.20 (6.10) | 0.380 | 0.305 (200) | 0.760 |
| Others | 5.82 (6.12) | | | |
| Educational Level | | | | |
| No education / Primary education | 5.81 (5.04) | | 0.333 (2.199)[b] | 0.717 |
| Secondary education | 5.89 (6.00) | | | |
| Tertiary education | 6.59 (6.55) | | | |
| Occupation | | | | |
| Employed | 6.08 (7.65) | -0.078 | -0.060 (200) | 0.952 |
| Unemployed | 6.16 (5.86) | | | |
| Smoking | | | | |
| Yes | 5.20 (4.64) | -0.998 | -0.504 (200) | 0.615 |
| No | 6.20 (6.16) | | | |
| Diabetes Duration | | | | |
| <10 years | 6.26 (6.15) | 0.184 | 0.204 (200) | 0.839 |
| ≥10 years | 6.08 (6.07) | | | |
| HbA1c Level | | | | |
| <7% | 6.47 (5.87) | 0.468 | 0.501 (200) | 0.617 |
| ≥7% | 6.00 (6.19) | | | |
| Hypertension | | | | |
| Yes | 6.21 (5.90) | 0.489 | 0.375 (200) | 0.708 |
| No | 5.72 (7.46) | | | |
| Dyslipidemia | | | | |
| Yes | 6.24 (6.22) | 1.061 | 0.687 (200) | 0.493 |
| No | 5.18 (4.50) | | | |
| Last Dental Visit | | | | |
| Last 12 months ago | 6.91 (6.82) | | 0.765 (3.198)[b] | 0.515 |
| Last 1 to 2 years ago | 6.00 (5.33) | | | |
| Only when in pain | 5.90 (5.91) | | | |
| Never go for dental visit | 2.33 (1.53) | | | |
| Toothache | | | | |
| Yes | 9.76 (7.42) | 4.348 | 3.240 (40.74) | 0.002 |
| No | 5.42 (5.53) | | | |
| Cavities | | | | |
| Yes | 8.55 (6.99) | 3.416 | 3.386 (89.94) | 0.001 |
| No | 5.13 (5.38) | | | |
| Sore Gums | | | | |
| Yes | 10.15 (6.56) | 4.597 | 3.703 (200) | 0.001 |
| No | 5.56 (5.81) | | | |
| Swollen Gums | | | | |
| Yes | 12.00 (8.49) | 6.093 | 2.820 (200) | 0.005 |
| No | 5.91 (5.88) | | | |
| Bleeding Gums | | | | |
| Yes | 9.57 (5.23) | 3.856 | 2.910 (200) | 0.004 |
| No | 5.71 (6.07) | | | |

| | | | | |
|---|---|---|---|---|
| Gum Abscess | | | | |
| Yes | 12.00 (6.56) | 5.940 | 1.684 (200) | 0.094 |
| No | 6.06 (6.06) | | | |
| Mobile Teeth | | | | |
| Yes | 10.08 (6.12) | 4.509 | 3.628 (200) | 0.001 |
| No | 5.57 (5.89) | | | |
| Bad Breath | | | | |
| Yes | 9.41 (6.36) | 4.672 | 5.336 (200) | 0.001 |
| No | 4.74 (5.41) | | | |
| Oral Ulcer | | | | |
| Yes | 12.50 (9.69) | 6.682 | 2.162 (9.33) | 0.058 |
| No | 5.82 (5.69) | | | |
| Upper Denture | | | | |
| Yes | 6.24 (6.19) | 0.181 | 0.211 (200) | 0.833 |
| No | 6.06 (6.02) | | | |
| Lower Denture | | | | |
| Yes | 6.45 (6.48) | 0.448 | 0.491 (200) | 0.624 |
| No | 6.00 (5.91) | | | |

Mean (SD) is referring to mean and standard deviation for group comparison; [a]Independent t-test; [b]One way Anova.

## Discussion

Diabetic patients display an increased risk of oral disorders and oral health-related quality of life might affect their management and treatment modalities [18]. Diabetes mellitus is usually linked to a variety of oral health issues such as xerostomia, dental caries, gingivitis, periodontal disease, increased tendency of oral infections, burning mouth, taste disturbance, and poor wound healing. These oral complications in diabetic patients can affect the patient's quality of life [11].

In this study, nearly half of the respondents have at least one oral health symptom (45.6%). The finding is lower compared to a previous study conducted among diabetic patients in Malaysia, which found that 62.2% of the respondents had at least one oral health symptoms [17]. The most common oral symptom reported by the respondents in this study is bad breath (30.2%). Our finding is higher than that of a study conducted among diabetes patients in India and the Netherlands, which found that 23% and 12% of the respondents had bad breath, respectively [22, 23]. Bad breath is due to the volatile sulfur compounds produced by bacteria [24]. In addition, periodontal disease may lead to sulfide compound odor [25]. Bad breath or halitosis is one of the early diabetes symptoms, a typical ketone smell in people with diabetes [25]. The decrease of saliva flow in diabetic patients leads to the destruction of the natural cleaning of the oral cavity which favors the growth of bacteria that produce sulfur compounds that cause bad breath [26].

A second common symptom reported by the patients is a cavitated tooth (29.7%). The prevalence of cavitated teeth in this study is comparable with a study conducted in Brazil (29.5%) [27], but lower compared to a previous study conducted in Malaysia (42.2%) [17]. In India, a study involving 120 diabetic and non-diabetic patients found that dental caries prevalence is higher among diabetic patients (73%) than non-diabetic patients (33%). They also found that dental caries prevalence and mean dental caries are significantly higher among uncontrolled diabetic patients than among well-controlled patients [28].

In this study, nearly 70% of the respondents had uncontrolled diabetes with HbA1c more than 7%. This explains the high prevalence of dental caries in the study population. Dental caries formation among diabetes patients has been linked to several factors, including elevated glucose levels in saliva, reduced saliva flow, changes in the biochemical composition of saliva, decreased salivary buffering function, poor oral hygiene, consumption of a diet that promotes tooth decay, and the presence of existing dental plaque [29]. The development of dental caries among diabetes patients could also be related to reduced saliva production and elevated glucose levels in

the saliva due to a lack of insulin [30]. In people with diabetes, saliva loses protective, buffering, and cleansing function [31]. Apart from that, diabetes patients who consume sugar without any limitations are more susceptible to acquiring dental caries compared to those who have well-controlled blood glucose. In the current study, we also found that 16.8% of the respondents complained of having toothache. It could be related to the frequency of dental visits, as evidence indicated that patients who had regular dental visits had a significantly lower prevalence of toothache [32]. In the present study, more than half (59.4%) of the respondents only visit the dentist when in pain.

The prevalence of oral impact in our study is 33.7%. Our finding is lower than that of a study conducted among diabetic patients in Brazil (47%) [27], but higher than that of a study conducted among diabetic patients in the Netherlands (19%) [23]. The prevalence of oral impacts in the current study is comparable with a study conducted among adults living with HIV/AIDS in Malaysia [20]. The total mean S-OHIP(M) score in this study was higher (6.15±6.09) compared to the mean score found among diabetes patients in the Netherlands (2.5±5.2) [23]. The greatest impacts were the OHIP-14 items related to physiological discomfort, physical disability, functional limitation, and physical pain. Consistent findings are a study conducted among diabetes patients in Brazil, which found that 74.5%, 56.3%, 51%, and 41.7% of respondents reported impacts on physical pain, physical inability, psychological discomfort, and functional limitation domain, respectively [27]. The respondents in this present study reported greater impact by experiencing discomfort due to food getting stuck (14.4%), difficulty in chewing any food (13.9%), and discomfort while eating any food (13.4%) that leads to avoiding certain foods (14.3%). These findings are comparable with a study conducted in Malaysia, which reported that 19.8%, 13.2%, and 9.9% of the respondents reported discomfort due to food getting stuck, difficulty in chewing any foods, and discomfort in eating food (9.9%). These findings align with the high number of respondents in this study who reported having oral symptoms related to the impacts, namely a cavitated tooth (29.7%), toothache (16.8%), gum pain (12.9%), and a loose tooth (12.9%). This is probably because 49.5% of the respondents wear an upper denture and 33.2% of the respondents wear a lower denture.

This study showed that respondents with oral symptoms such as toothache, cavities, sore gums, swollen gums, bleeding gums, mobile teeth, and bad breath have significantly more severe oral impacts. Hence, these individuals had poorer OHRQoL than those without symptoms. These findings align with a previous study conducted in Malaysia which also showed that participants with oral symptoms (toothache, cavitated tooth, gum abscess, or bad breath) have more severe oral impacts [20].

A study conducted among diabetic patients in Brazil found that xerostomia, denture need, and periodontitis are significantly associated with a negative impact on quality of life [27]. Bleeding gums, tooth pain, mobile teeth, swollen gums, pain on chewing, bad breath, and gums pain were found to be symptoms of periodontitis [33].

It was found that diabetes and periodontitis are complex chronic diseases with an established bidirectional relationship [34]. The prevalence of periodontitis is higher in diabetic patients than in non-diabetic patients [7]. A study conducted in India found that 95.1% of the diabetic participants had some degree of periodontal destruction [35]. A meta-analysis of the prevalence of periodontitis among diabetes patients found that the overall prevalence of periodontitis was 67.8% in patients with diabetes (combined types) compared to 35.5% in patients without diabetes [36]. A systematic review and meta-analysis on the prevalence of diabetes in people clinically diagnosed with periodontitis found that the prevalence of diabetes was 13.1% among respondents with periodontitis and 9.6% among respondents without periodontitis [34]. A previous study also found that poor glycemic control increased the risk for periodontitis in patients with diabetes and improvement

in HbA1c levels reduces periodontal inflammation by ameliorating inflammation at the gingival sites of periodontal tissue [37].

Studies have shown that patients with well-controlled diabetes have no increased risk of periodontitis compared to individuals without diabetes [7]. In addition, those with uncontrolled diabetes who underwent periodontal treatment demonstrated a more positive oral health-related quality of life compared to those who did not undergo treatment. These findings suggest that individuals with diabetes and inadequate control of blood sugar levels should adopt habits that promote periodontal health and seek appropriate periodontal therapy in order to enhance their oral health-related quality of life [38]. Besides, it is important for physicians to actively educate patients with diabetes about maintaining good periodontal health and engaging in self-care behaviors. This recommendation is in line with the Malaysia clinical practice guidelines on managing type 2 diabetes mellitus in 2020, which state that all diabetes patients should undergo an annual periodontal review [39].

This study has several limitations. First, the results of this study can only be extrapolated among diabetes patients attending Hospital USM in Kelantan, Malaysia. Kelantan is a state where Malays predominate as an ethnic group. Therefore, further research should involve a more ethnically diverse sample in a larger study population. In this study, self-reported oral health symptoms questionnaires were used to identify oral health symptoms experienced by the respondents. This study did not clinically evaluate the presence of periodontal disease. However, the questionnaire was a validated and reliable instrument for assessing the oral health condition of patients [20]. Future research should clinically evaluate the presence of periodontal diseases among patients with diabetes, considering the bidirectional relationship between diabetes and periodontal disease [6].

## Conclusion

This study highlights the significant association between oral health symptoms and OHRQoL among diabetic patients. Respondents with oral symptoms such as toothache, cavities, sore gums, swollen gums, bleeding gums, mobile teeth, and bad breath have significantly more severe oral impact, indicating that these individuals had poorer OHRQoL than those without symptoms. Therefore, addressing these oral health symptoms through prevention and timely treatment can significantly improve oral health and overall well-being among diabetic patients. In addition, integrating oral health care into diabetes management is essential for enhancing the quality of life for diabetic patients.

## Authors' Contributions

| | | |
|---|---|---|
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All authors declare that they contributed to critical review of intellectual content and approval of the final version to be published.

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## Conflict of Interest

The authors declare no conflicts of interest.

## Data Availability

The data used to support the findings of this study can be made available upon request to the corresponding author.

## References


[1] Akhtar S, Nasir JA, Ali A, Asghar M, Majeed R, Sarwar A. Prevalence of type-2 diabetes and prediabetes in Malaysia: A systematic review and meta-analysis. PLoS One 2022; 17(1): 1-14. https://doi.org/10.1371/journal. pone.0263139

[2] Institute for Public Health. National Institutes of Health. Ministry of Health Malaysia. National Health and Morbidity Survey 2023. Non-communicable Diseases and Healthcare Demand - Key Findings. Available at: https://iku.nih.gov.my/images/nhms2023/key-findings-nhms-2023.pdf. [Accessed on July 20, 2024].

[3] National Institutes of Health. Ministry of Health Malaysia. Institute for Public Health. National Health and Morbidity Survey 2019: Non-Communicable Diseases, Healthcare Demand and Health Literacy. Technical Report - Volume 1. Available at: http://iku.moh.gov.my/images/IKU/Document/REPORT/NHMS2019/Report_NHMS2019-NCD_v2.pdf. [Accessed on March 26, 2024].

[4] Nikbin A, Bayani M, Jenabian N, Khafri S, Motallebnejad M. Oral health-related quality of life in diabetic patients: comparison of the Persian version of Geriatric Oral Health Assessment Index and Oral Health Impact Profile: A descriptive-analytic study. J Diabetes Metab Disord 2014; 13(1):32. https://doi.org/10.1186/2251-6581-13-32

[5] Ahmad R, Haque M. Oral health messiers: Diabetes mellitus relevance. Diabetes Metab Syndr Obes 2021; 14:3001-3015. https://doi.org/10.2147/DMSO.S318972

[6] Kane SF. The effects of oral health on systemic health. Gen Dent 2017; 65(6):30-34.

[7] Alpert PT. Oral health: The oral-systemic health connection. Home Health Care Manag Pract 2017; 29(1):56-59. https://doi.org/10.1177/1084822316651658

[8] Indurkar MS, Maurya AS, Indurkar S. Oral manifestations of diabetes. Clin Diabetes 2016; 34(1):54-57. https://doi.org/10.2337/diaclin.34.1.54

[9] Trentin MS, Verardi G, De Carli JP, Da Silva, Soluete O, Lima IF, et al. Most frequent oral lesions in patients with type 2 diabetes mellitus. J Contemp Dent Pract 2017; 18(2):107-111. https://doi.org/10.5005/jp-journals-10024-1999

[10] Stoica SA, Valentini G, Dolci M, D'Agostino S. Diabetes and non-surgical periodontal therapy: What can we hope for? Hygiene 2022; 2(2):85-93. https://doi.org/10.3390/ hygiene2020007

[11] Rohani B. Oral manifestations in patients with diabetes mellitus. World J Diabetes 2019; 10(9):485-489. https://doi.org/10.4239/wjd.v10.i9.485

[12] Sischo L, Broder H. Oral health-related quality of life: what, why, how, and future implications. J Dent Res 2011; 90(11):1264-1270. https://doi.org/10.1177/0022034511399918

[13] Thirunavukkarasu A, Alotaibi AM, Al-Hazmi AH, Alruwaili BF, Alomair MA, Alshaman WH, et al. Assessment of Oral health-related quality of life and its associated factors among the young adults of Saudi Arabia: A multicenter study. Biomed Res Int 2022; 2022:5945518. https://doi.org/10.1155/2022/5945518

[14] U.S. Department of Health and Human Services. Oral Health in America: A Report of the Surgeon General. Rockville, MD: U.S. Department of Health and Human Services, National Institute of Dental and Craniofacial Research, National Institutes of Health, 2000. Available at: https://www.nidcr.nih.gov/sites/default/files/2017-10/hck1ocv.%40www.surgeon.fullrpt.pdf. [Accessed on March 26, 2024].

[15] Baiju RM, Peter E, Varghese NO, Sivaram R. Oral health and quality of life: Current concepts. J Clin Diagn Res 2017;11(6):21-26. https://doi.org/10.7860/JCDR/2017/25866.10110

[16] Nordin MM, Rahman SA, Raman RP, Vaithilingam RD.Periodontal status and oral health knowledge among a selected population of Malaysian type 2 diabetics. Sains Malays 2014; 43(8):1157-1163.

[17] Saddki N, Mohd Hashim MI, Mohamad N. Factors associated with oral health literacy among patients with type 2 diabetes mellitus attending Hospital Universiti Sains Malaysia. Pesqui Bras Odontopediatria Clín Integr 2022; 22: e210143. https://doi.org/10.1590/pboci.2022.056

[18] Sadeghi R, Taleghani F, Farhadi S. Oral health-related quality of life in diabetic patients. J Dent Res Dent Clin Dent Prospects 2014; 8(4):230-234.

[19] Irani FC, Wassall RR, Preshaw PM. Impact of periodontal status on oral health-related quality of life in patients with and without type 2 diabetes. J Dent 2015; 5(43):506-511. https://doi.org/10.1016/j.jdent.2015.03.001

[20] Mohamed NA, Saddki N, Yusoff A, Mat Jelani A. Association among oral symptoms, oral health-related quality of life, and health-related quality of life in a sample of adults living with HIV/AIDS in Malaysia. BMC Oral Health 2017; 17(119):1-11. https://doi.org/10.1186/s12903-017-0409-y

[21] Saub R, Locker D, Allison P. Derivation and validation of the short version of the Malaysian Oral Health Impact Profile. Community Dent Oral Epidemiol 2005;33(5):378-383. https://doi.org/10.1111/j.1600-0528.2005.00242.x

[22] Rathy R, Deepa MG, Sruthi AK, Cherian K, Priya S, Sunil S, et al. Evaluation of oral health in type II diabetes mellitus patients. Oral Maxillofac Pathol J 2015; 6(1):525-531. https://doi.org/10.5005/10037-1030

[23] Verhulst MJL, Teeuw WJ, Gerdes VEA, Loos BG. Self-reported oral health and quality of life in patients with type 2 diabetes mellitus in primary care: a multi-center cross-sectional study. Diabetes Metab Syndr Obes 2019; 12:883-899. https://doi.org/10.2147/DMSO.S207087

[24] Seerangaiyan K, Jüch F, Winkel EG. Tongue coating: its characteristics and role in intra-oral halitosis and general health-a review. J Breath Res 2018;12(3):1-9. https://doi.org/10.1088/1752-7163/aaa3a1
[25] Aylıkcı BU, Çolak H. Halitosis: From diagnosis to management. J Nat Sc Biol Med 2013; 4(1):14-23. https://doi.org/10.4103/0976-9668.107255
[26] Asrorovna XN, Furkatovna TK, Elbekovna MZ, Davronbekovich XJ. Pathological changes in the oral mucosa in diabetes mellitus. Sci Innovation 2023; 2(12):493-496.
[27] De Sousa RV, Pinho RCM, Vajgel BCF, Paiva SM, Cimões R. Evaluation of oral health-related quality of life in individuals with type 2 diabetes mellitus. Braz J Oral Sci 2019; 18:1-16. https://doi.org/10.20396/bjos.v18i0.8655466
[28] Malvania EA, Sheth SA, Sharma AS, Mansuri S, Shaikh F, Sahani S. Dental caries prevalence among type II diabetic and nondiabetic adults attending a hospital. J Int Soc Prev Community Dent 2016; 6(3):232-236. https://doi.org/10.4103/2231-0762.197202
[29] Sampaio N, Mello S, Alves C. Dental caries-associated risk factors and type 1 diabetes mellitus. Pediatr Endocrinol Diabetes Metab 2011; 17(3):152-157.
[30] Moin M, Malik A. Frequency of dental caries and level of risk among type II diabetics. Dentistry 2015; 5(10):1-5. https://doi.org/10.4172/2161-1122.1000334
[31] Seethalakshmi C, Reddy RCJ, Asifa N, Prabhu S. Correlation of salivary pH, incidence of dental caries and periodontal status in diabetes mellitus patients: A cross-sectional study. J Clin Diagn Res 2016;10(3):12-14. https://doi.org/10.7860/JCDR/2016/16310.7351
[32] Kakoei S, Parirokh M, Nakhaee N, Jamshidshirazi F, Rad M, Kakooei S. Prevalence of toothache and associated factors: a population-based study in Southeast Iran. Iran Endod J 2013; 8(3):123-128.
[33] Soundarajan S, Malaippan S, Gajendran P.L. Relationship between chief complaints and severity of periodontitis in patients seeking periodontal therapy: A retrospective study. World J Dent 2020; 11(5):396-401. https://doi.org/10.5005/jp-journals-10015-1760
[34] Ziukaite L, Slot D, Weijden FVD. Prevalence of diabetes mellitus in people clinically diagnosed with periodontitis: A systematic review and meta-analysis of epidemiologic studies. J Clin Periodontol 2018; 45:650-662. https://doi.org/10.1111/jcpe.12839
[35] Singh M, Bains VK, Jhingran R, Srivastava R, Madan R, Maurya SC, et al. Prevalence of periodontal disease in type 2 diabetes mellitus patients: A cross-sectional study. Contemp Clin Dent 2019; 10(2):349-357. https://doi.org/10.4103/ccd.ccd_652_18
[36] Zheng M, Wang C, Ali A, Shih YA, Xie Q, Guo C. Prevalence of periodontitis in people clinically diagnosed with diabetes mellitus: a meta-analysis of epidemiologic studies. Acta Diabetol 2021; 58(10):1307-1327. https://doi.org/10.1007/s00592-021-01738-2
[37] Katagiri S, Nitta H, Nagasawa T, Izumi Y, Kanazawa M, Matsuo A, et al. Effect of glycemic control on periodontitis in type 2 diabetic patients with periodontal disease. J Diabetes Investig 2013; 4(3):320-325. https://doi.org/10.1111/jdi.12026
[38] Yuan-Jung H, Lin KD, Jen-Hao C, Mei-Yueh L, Ying-Chu L, Yen FC, et al. Periodontal treatment experience associated with oral health-related quality of life in patients with poor glycemic control in type 2 diabetes: A case-control study. Int J Environ Res Public Health 2019; 16(20):1-13. https://doi.org/10.3390/ijerph16204011
[39] Ministry of Health Malaysia. Clinical Practice Guidelines. Management of Type 2 Diabetes Mellitus. 6th Edition 2020. Available at: https://mems.my/cpg-management-of-type-2-diabetes-mellitus-6th-edition. [Accessed on March 26, 2024].