Original Article

Knowledge and Perception of Bidirectional Relationship Between Periodontal Disease and Type 1 Diabetes Mellitus: A Questionnaire Study

Zaridah Zainal Abidin[1], Rohaida Abdul Halim[1], Erni Noor[2], Noor Shafina Mohd Nor[3,4], Nor Shafina Mohamed Nazari[5], Azriyanti Anuar Zaini[6], Nurul Zeety Azizi[7], Shahrul Aiman Soelar[8]

[1]Centre of Studies for Paediatric Dentistry & Orthodontics, Faculty of Dentistry, Universiti Teknologi MARA (UiTM), [2]Centre of Studies for Periodontology, Faculty of Dentistry, Universiti Teknologi MARA (UiTM) , [3]Department of Paediatrics, Faculty of Medicine, Universiti Teknologi MARA (UiTM), [4]Institute for Pathology, Laboratory and Forensic Medicine (I-PPerForM), Faculty of Medicine, Universiti Teknologi MARA (UiTM), Sungai Buloh, Selangor, [5]Department of Restorative Dentistry, Faculty of Dentistry, Universiti Malaya, [6]Department of Paediatric, Faculty of Medicine, Universiti Malaya, [7]Department of Paediatric Dentistry & Orthodontics, Faculty of Dentistry, Universiti Malaya, Kuala Lumpur, [8]Clinical Research Centre, Hospital Sultanah Bahiyah, Alor Setar, Kedah, Malaysia

ABSTRACT

Aim: The bidirectional relationship between type 1 diabetes mellitus (T1DM) and inflammatory periodontal disease (PD) is globally recognized. However, oral health components are often given lower priority, and studies related to knowledge and the bidirectional association are limited. This study assesses the knowledge and perceptions of PD and its associated risk factors among T1DM patients and/or their parents. **Materials and Methods:** Patients under 18 with T1DM at Universiti Teknologi MARA and Universiti Malaya were invited to participate. Structured interviews were conducted to assess participants' knowledge and perceptions of T1DM, and statistical analysis was performed to examine their associations using Pearson's chi-squared test and Fisher's exact test. **Results:** A total of 113 T1DM patients, with a mean age of 11.4 ± 4, completed the interviews. Poor knowledge was observed among parents and T1DM patients (P-value = 0.007) and those who exercised regularly (P-value = 0.047). A significant association with good perception was found among individuals with uncontrolled HbA1c levels (P-value = 0.0018) and those experiencing bleeding symptoms (P-value = 0.021). **Conclusions:** The study highlights the importance of increasing awareness, a key factor in improving oral health knowledge. Interestingly, despite poor control of clinical parameters, the population displayed good perception, suggesting a potential lack of understanding regarding disease control.

KEYWORDS: *Diabetes mellitus, oral health, periodontal disease, self-perception, type 1 diabetes mellitus*

INTRODUCTION

*T*ype 1 diabetes mellitus (T1DM) and periodontal disease (PD) are two chronic systemic illnesses

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that are closely related. T1DM is a chronic metabolic disorder commonly diagnosed in children and adolescents, causing hyperglycemia and long-term damage to distinct organs. This includes the eyes, heart, nerves, and kidneys, as well as a vascular system, including periodontium.[1,2] Meanwhile, PD is a type of microvascular complication[3] considered the sixth complication of diabetes and to the extent that affects the prevalence, evolution, and therapeutic management of diabetes.[4,5] Studies have revealed that poor glycemic control in DM patients is related to a rise in the prevalence and severity of periodontitis, two complex chronic diseases connected by an established bidirectional association.[6-8]

In the period of 8 years (from 2001 to 2009), the prevalence of DM in the USA has risen by 21.1%.[9] This is similar to the reported incidence in Europe, a rising trend of 3%–5% annually.[10] However, a lower incidence of childhood-onset T1DM was seen in Japan and other Asian countries, including Malaysia.[11] Malaysia, considered a rapidly developing Asian nation, is estimated to experience a surge leading to an increase in the incidence and prevalence of T1DM. Young diabetic individuals in their late 20s or early 30s rapidly requiring insulin were reported to be 35.5%.[12]

Despite the increasing prevalence trend in T1DM, adolescence was found to have low or limited awareness concerning their rising risk of oral diseases compared to their understanding of systemic diseases.[13] Additionally, DM patients had a threefold increased risk of needing advanced periodontal treatment compared to the general population.[14] Notably, 44% knew there was a bidirectional relationship between PD and DM, and 32% knew bleeding gum is an early sign of gingivitis in childhood.[15] However, more than 50% of adolescents are unaware that poor oral health may compromise the management of T1DM.[15,16]

A systematic review by Akl *et al.*[17] shared a similar finding, where poor knowledge and awareness concerning oral health associations were discovered in patients with significant systemic diseases (<50%). Correspondingly, these findings agreed with two other studies. The first was a review in 2018 by Poudel *et al.*[18], where they reported poor oral health behaviors and knowledge of patients with DM. A recent Maia *et al.*[19] investigation said that less than 50% of diabetic patients knew about their increased risk for PD.

The PD and dental caries were potentially higher in T1DM children with a lower level of oral hygiene, where brushing teeth was performed once a day and dental visit was commenced when necessary.[20] A similar finding of T1DM oral hygiene practice was found in an earlier study by Eldarrat[21], who reported mean toothbrushing frequency was only once daily, and 42% did not even floss. Another study reported similar toothbrushing frequency in T1DM and highlighted the practice level was even lower in adolescents (13–18 years).[16]

Despite the known complication of T1DM and their periodontal health, there is limited literature conducted in Malaysia regarding the knowledge and perception of the bidirectional association. On top of that, only a few studies in type 2 diabetes mellitus (T2DM) related to their knowledge level in oral health. An earlier study by Badiah in 2007 reported low awareness in 26.5% of patients with diabetes.[22] Another study by Nordin *et al.*[14] reported a similar percentage of 26.9% of oral health complications in T2DM.

These findings highlighted a need for more data on knowledge of PD with T1DM and awareness regarding the bidirectional association, especially in Malaysia. Hence, the next goal of the current study was to compile baseline data on the knowledge and perceptions of T1DM patients in Malaysia concerning their periodontal health and its associated factors. In addition, based on the findings, it creates an opportunity to improve PD knowledge and adopt preventive oral hygiene behaviors in adolescents with DM.[15]

MATERIALS AND METHODS

Universiti Teknologi MARA (UiTM), Selangor, and the University of Malaya (UM), Kuala Lumpur, were the locations of this cross-sectional study, performed between October 2020 and May 2022. The UM (DF RD2018/0110(L) and UiTM (REC/07/2020(MR/169) ethical committees provided their permission. The Item Content Validity Index (I-CVI) and Face Validity were used to validate the questionnaire. Twenty individuals participated in a reliability study conducted before the study.

Everyone diagnosed with T1DM at UiTM and UM who was younger than 18 years old was invited to take part in the investigation. Patients were identified, and an appointment was made through a phone call. Written consent was taken prior to the interview session. English and/or Bahasa Melayu communication skills are required. Nevertheless, those with active orthodontic treatment and those who had taken any medications or antibiotics within the previous three months that could have altered the gingiva, such as drug-induced gingival enlargement, were excluded from the study. Moreover, the reason for exclusion criteria was in the next stage of the study. Patients were examined periodontally to

crossmatch their perceived periodontal assessment, which was not reported in this article.

The sample size was examined using Epi-Info StatCal® software according to the total number of eligible T1DM patients (*n* = 166).[23] Meanwhile, the prevalence concerning diabetes test knowledge was 50.4% (11.6/23 × 100).[24] The final sample was calculated to be 118 (108% + 10%), taking into account an attrition rate of 10%, having a 95% confidence level and an acceptable 5.6% margin error. Consequently, 113 patients with T1DM in total were enrolled. Throughout their follow-up visits, the participants and their caregiver(s) or parent(s) filled out the questionnaire. Parents of children under 16 years old would respond to the questionnaire.

Good knowledge and perception were set at >75% good, whereas 74.9% and lower was considered poor.[25] A knowledge score was determined for each of the four questions, with the correct response receiving one point and the incorrect response receiving 0 points. The score, which could not exceed 4, was then converted to a percentage. On the other hand, a score was determined for each of the three perception questions, with the correct response receiving one point and the incorrect response receiving 0. The score, which could not exceed 3, was then converted to a percentage.

STUDY INSTRUMENT

Sociodemographic of T1DM

The diabetic history for each patient was obtained based on the information in the medical record of each diabetic child. Diabetic history included date of diagnosis, duration of diabetes, age at diagnosis, latest reading for HbA1c, and latest height and weight for body mass index (BMI) calculation. The calculated BMI was plotted on the CDC BMI-to-age chart for the respective gender.[26] All the diabetic patients had their glycosylated hemoglobin (HbA1c) in their 3-monthly medical visits. For children, adolescents, and young adults ≤25 years old. With access to comprehensive care, HbA1c of <53 mmol/dL (7.0%) is recommended.[27]

Guided Questionnaire (GQ)

Self-report questionnaires utilized in this investigation were translated from two previous studies and validated.[28,29] Before this study, the questionnaire was adapted to our study population and underwent content and face validation to ensure reliability. As a result, it was given a good GQ rating. Table 1 presents the GQ consisting of periodontal assessment, knowledge, and perception. There are 18 items with dichotomous

Table 1: Guided questionnaire

GQ	Gum assessment
No.	Part A (self-perception)
1	Do you think you have gum disease?
2	Overall, how do you rate your teeth and gum health?
3	Have you ever had gum treatment for gum disease, such as the scaling of the upper or lower gum?
4	Have you ever had loose teeth without injury?
5	Have you ever been told by a dental professional that you have gum disease?
6	During the past 3 months, have you ever noticed that your gum doesn't look good?
7	Did you use dental floss or "other devices" for tooth cleaning in the last 7 days?
8	Did you use mouthwash or other dental rinses for "dental problems" treatment in the last 7 days?
No.	Part B (periodontal disease symptoms)
1	Bleeding when brushing, flossing, or eating food
2	Swelling, red, or painful gums for no apparent reason
3	Teeth look longer, and the smile appears more "toothy"
4	Bad breath/halitosis/foul mouth odor
5	Loosening or shifting of teeth in the affected area
6	Pus oozing between the teeth
GQ	Knowledge
1	Do you know DM is related to periodontal disease?
2	Do you know that periodontal disease screening can be done using self-reported questionnaires?
3	Did you do dental check-up within last 1 year?
4	Have you ever done Periodontal Disease screening using self-reported questionnaires at medical clinic?
GQ	Perception
1	Do you agree to do periodontal Disease screening using self-reported questionnaires at medical clinics?
2	Do you agree that periodontal disease effect the glycaemic control of DM patients?
3	Do you agree that you will benefit from screening Periodontal disease for your general health, especially diabetes?

"yes or no" options on periodontal evaluations and knowledge. Eight items were on patients' baseline characteristics (Part A), six items on symptoms of PD (Part B), and four items on knowledge assessment.

Patients' perception was measured using a five-point Likert scale.

The Statistical Package for the Social Sciences (SPSS) (IBM SPSS, Chicago, IL, USA) Version 20.0 was utilized to evaluate the data. The Pearson Chi-square and Fisher exact tests were employed to determine the relationship between the GQ and clinical evaluation. A *P*-value <0.05 was deemed statistically significant.

RESULTS

Table 2 demonstrates the female-to-male ratio is almost equal, about 1:1.01. More than half of the participants are in secondary school (58%), aged between 13 and 18. Most of the participants are Malay (48.7%), followed by Indian (26.5%) and Chinese (23.9%). Our study

Table 2: Distribution of sociodemographic data, diabetic-related factors, smoking, and oral hygiene practice

Variables	*n*	(%)
Sex		
Male	56	(49.6)
Female	57	(50.4)
Age (years)		
<6	16	(14.2)
7–12	39	(34.5)
13–18	58	(51.3)
Race		
Malay	55	(48.7)
Chinese	27	(23.9)
Indian	30	(26.5)
Others	1	(0.9)
BMI		
Underweight	11	(9.7)
Healthy weight	68	(60.2)
Overweight	27	(23.9)
Obesity	7	(6.2)
HbA1c		
Controlled	9	(8.0)
Uncontrolled	104	(92.0)
Duration of diabetes		
<5 years	66	(58.4)
5–10 years	38	(33.6)
>10 years	9	(8.0)
Frequency of brushing		
Morning	17	(15.0)
Morning/before going to sleep	72	(63.7)
Morning/before going to sleep and after eating food	22	(19.5)
Use flossing	1	(0.9)
Others/adjunct	1	(0.9)
Smoking status		
Nonsmoker	112	(99.1)
Ex-smoker	1	(0.9)

BMI = body mass index, HbA1c = glycated hemoglobin.

found that the BMI of 68 patients (60.2%) is healthy, only seven patients (6.2%) were found to be obese, and 27 (23.9%) were overweight. Table 3 shows that age (*P* = 0.007) was significantly associated with knowledge. Adolescents were found to have a better understanding among the group (28.7%). Participants discovered to have good knowledge were also found to have regular exercise (26.8%) (*P*-value = 0.047) more than those who never exercised and those who exercised irregularly. However, none of these factors were found to have a significant association with having good knowledge, as tabulated in Table 4.

Table 5 presents those without symptoms 1 "Bleeding when brushing, flossing or eating food" (80.6%). (*P*-value = 0.021) and uncontrolled HbA1c (97%) (*P*-value = 0.018) were discovered to be significantly linked with good perception. Furthermore, the multiple logistic regression confirmed that uncontrolled HbA1c is 6.68 times more likely to grasp a good perception, and those with symptoms of bleeding are 0.34 times less likely to have a good perception [Table 6].

DISCUSSION

In the current study, a slightly higher number of female participants (57/113) were seen; this is in accordance with the Malaysian T1DM prevalence reported by Fuziah *et al.*[23], but it contradicts the worldwide prevalence reported by Ostman *et al.*[30] This is probably due to females demonstrating greater insulin sensitivity than males.[31] However, due to the small and limited study population, our study may not reflect the gender allocation among T1DM children and adolescents in Malaysia. Over half of the adolescent participants had a healthy BMI (60.2%), and only 6.2% were considered obese in this group. This is in line with a UK study that discovered no correlation between obesity (higher BMI) and the occurrence of T1DM.[32] Although T1DM has historically been associated with slim persons, an increasing number of people having T1DM are overweight or obese.[33]

According to ISPAD in 2018, a target of HbA1c of <53 mmol (7.0%) is suggested for adolescents, children, and young adults less than 25 years old and with access to comprehensive care, and our study demonstrated that most patients have an uncontrolled HbA1C. As the majority of our patients are adolescents, the psychological and hormonal alterations, as well as increased independence in diabetes care, may be attributed to suboptimal diabetes care, leading to poor glycemic control.[34] Our study established more than half of T1DM patients have a habit of brushing their teeth twice daily, and only one participant has the habit

Table 3: Distribution of knowledge on PD based on the percentage

Variables	Poor knowledge (≤75%) (*n* = 86)		Good knowledge (>75%) (*n* = 27)		*P*-value
	n	(%)	*n*	(%)	
Age group (years)					0.007[a]
<15	67	(71.3)	27	(28.7)	
≥16	19	(100.0)	0	(0.0)	
Gender					0.475[a]
Male	41	(73.2)	15	(26.8)	
Female	45	(78.9)	12	(21.1)	
Duration T1DM					0.084[a]
<5 years	46	(69.7)	20	(30.3)	
5–10 years	31	(81.6)	7	(18.4)	
> 10 years	9	(100.0)	0	(0.0)	
Glycaemic control in HbA1c					0.349[a]
Controlled	8	(88.9)	1	(11.1)	
Uncontrolled	78	(75.0)	26	(25.0)	
BMI					0.706[b]
Underweight	10	(90.9)	1	(9.1)	
Healthy weight	50	(73.5)	18	(26.5)	
Overweight	20	(74.1)	7	(25.9)	
Obesity	6	(85.7)	1	(14.3)	
Oral hygiene practice					0.097[b]
Morning	14	(82.4)	3	(17.6)	
Morning and evening	51	(70.8)	21	(29.2)	
Morning, afternoon, and evening	20	(90.9)	2	(9.1)	
Use flossing	1	(100.0)	0	(0.0)	
Others/adjunct	0	(0.0)	1	(100.0)	
Symptoms from GQ					
Symptom 1					0.487[a]
No	61	(74.4)	21	(25.6)	
Yes	25	(80.6)	6	(19.4)	
Symptom 2					0.349[a]
No	78	(75.0)	26	(25.0)	
Yes	8	(88.9)	1	(11.1)	
Symptom 3					0.563[b]
No	84	(76.4)	26	(23.6)	
Yes	2	(66.7)	1	(33.3)	
Symptom 4					0.640[a]
No	77	(75.5)	25	(24.5)	
Yes	9	(81.8)	2	(18.2)	
Symptom 5					0.571[b]
No	82	(75.2)	27	(24.8)	
Yes	4	(100.0)	0	(0.0)	
Exercise status					0.047[b]
Never exercise	12	(70.6)	5	(29.4)	
Irregular exercise	14	(100.0)	0	(0.0)	
Regular exercise	60	(73.2)	22	(26.8)	
Diet status (frequency)					0.676[b]
2	9	(81.8)	2	(18.2)	
3	40	(80.0)	10	(20.0)	
4	32	(69.6)	14	(30.4)	
5	5	(83.3)	1	(16.7)	

Note: Symptom 1 = bleeding when brushing, flossing, or eating food
Symptom 2 = gums are swollen, red, or painful for no apparent reason
Symptom 3 = teeth look longer, and the smile appears more "toothy"
Symptom 4 = bad breath/halitosis/a foul odor mouth
Symptom 5 = loosening or shifting of teeth in the affected area
[a]Pearson's chi-squared test
[b]Fisher's exact test

Table 4: Relationship between gender, self-reported symptoms of PD, and knowledge on PD

Variables	Simple logistic regression			Multiple logistic regression		
	Crude OR	(95% CI)	*P*-value	Adj. OR	(95% CI)	*P*-value
Gender						
Male	1.00	(ref)		-	-	-
Female	0.73	(0.3, 1.73)	0.476	-	-	-
Symptoms from GQ						
Symptom 1						
No	1.00	(ref)		-	-	-
Yes	0.70	(0.23, 1.85)	0.488	-	-	-
Symptom 4						
No	1.00	(ref)		-	-	-
Yes	0.68	(0.1, 2.88)	0.642	-	-	-

Note: Symptom 1 = bleeding when brushing, flossing, or eating food

Symptom 4 = bad breath/halitosis/a foul odor mouth

Crude OR (95% CI) = crude odds ratio (95% confidence interval)

Adj. OR (95% CI) = adjusted odds ratio (95% confidence interval)

of flossing. This is in contrast to a study in Brazil, which stated that 30.9% of T1DM patients flossed at least once and brushed three times per day.[35] Therefore, the T1DM participants in this study were found to have unfavorable oral hygiene behavior.

We determined the knowledge of parents of T1DM was mostly poor (<75%). This aligns with a study by Sohn and Rowe[36] on parents of T1DM children aged 6–13, in which most parents chose "Don't know" for statements related to DM and oral health. In addition, worse health consequences in a child of parents with low health literacy have been observed.[37] Thus, it is essential to instill awareness among parents since their knowledge, beliefs, and attitudes directly influence their child's oral health maintenance, behaviors, and dietary habits.[38] A similar finding was discovered in the T1DM children's parents. All adolescents aged 16 and above also had poor knowledge of PD relation with T1DM. This agrees with a study from Colorado, USA, where a survey was conducted on children 12–19 years old, and it found that less than half of the adolescents were aware that PD is associated with DM. Only one-quarter knew that bleeding gums due to PD starts even in childhood.[15]

Another positive finding was that children with regular exercise were highly associated with good parental knowledge of T1DM. This might be attributed to the use of a good attitude and knowledge and in actions that can support a positive and fruitful learning environment, as well as active engagement in all extracurricular and curricular activities.[39] Our study highlighted that a higher proportion of poor knowledge in T1DM was related to more inadequate glycaemic control. This is in line with a study in adult

diabetes patients emphasizing low knowledge of two-way relationships influencing the stability of glycaemic control.[40] Another recent meta-analysis supports this finding, highlighting that higher levels of health literacy were associated with lower levels of HbA1c.[41]

A higher good perception was observed in parents. Thus, this result may reflect the perception of children aged 16 and below as children, as children were reported to have similar good perceptions with their parents.[42] One study on adolescent perception supported this, where they credited reinforcing good oral self-care habits to their parents.[43] However, despite good perception, it was reported to be statistically significant with bleeding symptoms. This condition may explain why oral health was neglected, as the main focus is predominantly treating the systematic problem.[44]

Interestingly, our study found that T1DM with uncontrolled HbA1c are 6.68 times more likely to have a good perception. This highlighted the discordance between the perception of DM control and the HbA1c.[45] This may reflect a poor impact on their understanding of disease control over the years. Other than that, a study by Romano *et al.*[46] agreed with our research, reporting the presence of symptoms of bleeding. Patients are 0.34 times less likely to indicate a good perception.

In conclusion, less than half of parents of T1DM children and adolescent (27%) and none of the adolescent (16 years and above) was seen to have good knowledge of this bidirectional relationship between T1DM and PD, and those with good knowledge was associated significantly while regular exercise habits. Despite poor glycaemic control, excellent perception of parents of T1DM and adolescents (16 and above)

Variables	Poor perception (*n* = 46)		Good perception (*n* = 67)		*P*-value
	n	(%)	*n*	(%)	
Age group (years)					0.707[a]
<15	39	(84.8)	55	(82.1)	
≥16	7	(15.2)	12	(17.9)	
Gender					0.399[a]
Male	25	(54.3)	31	(46.3)	
Female	21	(45.7)	36	(53.7)	
Duration of T1DM (years)					0.585[a]
<5	25	(54.3)	41	(61.2)	
5–10	16	(34.8)	22	(32.8)	
>10	5	(10.9)	4	(6.0)	
Glycaemic control in HbA1c					0.018[a]
Controlled	7	(15.2)	2	(3.0)	
Uncontrolled	39	(84.8)	65	(97.0)	
BMI					0.711[b]
Underweight	6	(13.0)	5	(7.5)	
Healthy weight	28	(60.9)	40	(59.7)	
Overweight	10	(21.7)	17	(25.4)	
Obesity	2	(4.3)	5	(7.5)	
Oral hygiene practice					0.173[b]
Morning	10	(21.7)	7	(10.4)	
Morning and evening	25	(54.3)	47	(70.1)	
Morning, afternoon, and evening	10	(21.7)	12	(17.9)	
Use flossing	1	(2.2)	0	(0.0)	
Others/adjunct	0	(0.0)	1	(1.5)	
Symptoms from GQ					
Symptom 1					0.021[a]
No	28	(60.9)	54	(80.6)	
Yes	18	(39.1)	13	(19.4)	
Symptom 2					0.812[a]
No	42	(91.3)	62	(92.5)	
Yes	4	(8.7)	5	(7.5)	
Symptom 3					0.269[b]
No	46	(100.0)	64	(95.5)	
Yes	0	(0.0)	3	(4.5)	
Symptom 4					0.758[a]
No	42	(91.3)	60	(89.6)	
Yes	4	(8.7)	7	(10.4)	
Symptom 5					0.144[b]
No	46	(100.0)	63	(94.0)	
Yes	0	(0.0)	4	(6.0)	
Exercise status					0.069[a]
Never exercise	10	(21.7)	7	(10.4)	
Irregular exercise	8	(17.4)	6	(9.0)	
Regular exercise	28	(60.9)	54	(80.6)	
Diet status (frequency)					0.158[b]
2	7	(15.2)	4	(6.0)	
3	20	(43.5)	30	(44.8)	
4	15	(32.6)	31	(46.3)	
5	4	(8.7)	2	(3.0)	

Table 5: Distribution of T1DM patients' and/or parents' perception of PD by percentage

Note: Symptom 1 = bleeding when brushing, flossing, or eating food
Symptom 2 = gums are swollen, red, or painful for no apparent reason
Symptom 3 = teeth look longer, and the smile appears more "toothy"
Symptom 4 = bad breath/halitosis/a foul odor mouth
Symptom 5 = loosening or shifting of teeth in the affected area
[a]Pearson's chi-squared test
[b]Fisher's exact test

Table 6: Relationship between T1DM parameters, self-perception on PD symptoms, diet, and exercise status and T1DM patients' and parents' perception of PD

Variables	Simple logistic regression			Multiple logistic regression		
	Crude OR	(95% CI)	*P*-value	Adj. OR	(95% CI)	*P*-value
Age group (years)						
<15	1.00	(ref)		-	-	-
≥16	1.22	(0.45, 3.53)	0.707	-	-	-
Gender						
Male	1.00	(ref)		-	-	-
Female	1.38	(0.65, 2.96)	0.399	-	-	-
Duration of T1DM (years)						
<5	1.00	(ref)		-	-	-
5–10	0.84	(0.37, 1.9)	0.671	-	-	-
> 10	0.49	(0.11, 2.01)	0.317	-	-	-
Glycaemic control in HbA1c						
Controlled	1.00	(ref)		1.00	(ref)	
Uncontrolled	5.83	(1.33, 40.49)	0.033	6.68	(1.48, 47.28)	0.024
BMI						
Underweight	1.00	(ref)		-	-	-
Normal	1.71	(0.47, 6.48)	0.410	-	-	-
Overweight	2.04	(0.49, 8.84)	0.325	-	-	-
Obese	3.00	(0.43, 28.16)	0.287	-	-	-
Symptoms from GQ						
Symptom 1						
No	1.00	(ref)		1.00	(ref)	
Yes	0.37	(0.16, 0.87)	0.023	0.34	(0.14, 0.81)	0.016
Symptom 2						
No	1.00	(ref)		-	-	-
Yes	0.85	(0.21, 3.59)	0.812	-	-	-
Symptom 4						
No	1.00	(ref)		-	-	-
Yes	1.22	(0.35, 4.92)	0.758	-	-	-

Note: Symptom 1 = bleeding when brushing, flossing, or eating food

Symptom 2 = gums are swollen, red, or painful for no apparent reason

Symptom 4 = bad breath/halitosis/a foul odor mouth

Crude OR (95% CI) = crude odds ratio (95% confidence interval)

Adj. OR (95% CI) = adjusted odds ratio (95% confidence interval)

was observed for the bidirectional relationship (82.1%). This reflects a poor understanding of disease control. However, less concern for the periodontal health condition was observed among those with bleeding symptoms. This study suggested the importance of raising the knowledge about PD with T1DM. Self-perception of periodontal symptoms may encourage everyone to inquire about care early during the disease.

CONFLICT OF INTEREST

The authors declare that they have no competing interests.

AUTHOR CONTRIBUTION

ZZA, RAH, EN, NSMN (Noor Shafina), NSMN (Nor Shafina), AAZ, and NZA—study conception and data collection; ZZA, RAH, and SAS—data acquisition and analysis and data interpretation: ZZA and RAH—manuscript writing, RAH, EN, NSMN (Noor Shafina), NSMN (Nor Shafina), AAZ, NZA, and SAS—revision; ZZA, RAH, EN, NSMN (Noor

Shafina), NSMN (Nor Shafina), AAZ, NZA, and SAS—review on final approval.

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