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Impact of Oral Health Knowledge and Attitude on the Severity of Periodontitis among Patients with Type 2 Diabetes Mellitus: A Cross-Sectional Study

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ABSTRACT

OBJECTIVES: The aim of this study was to evaluate whether the level of oral health knowledge and attitudes of type 2 diabetes mellitus (T2DM) patients affected their periodontitis severity.

METHODS: Descriptive and statistical analysis of secondary data collected from follow-up 184 T2DM patients attending at Endocrinology Unit, Faculty of Medicine Vajira Hospital, was used.

RESULTS: All T2DM subjects were diagnosed as having periodontitis but with different degrees of severity: 64.7% and 70.0% of subjects with mild-to-moderate periodontitis had high knowledge and high attitude scores, respectively. A higher proportion of subjects (76.3%) with severe periodontitis had low attitude score. Of well-controlled diabetic subjects 20.6% had severe periodontitis, while of uncontrolled patients 40.8% suffered severe periodontitis. There was no significant difference between knowledge or attitude score and the level of periodontitis severity in T2DM. However, experiencing gingival problems was significantly related to periodontitis severity ($p = 0.024$).

CONCLUSION: General oral health knowledge does not have any impact on periodontitis severity while attitude seemingly does. Emphasize the knowledge on characteristic of gingival problems might affect periodontal health in people living with diabetes.

KEYWORDS: attitude, knowledge, periodontitis severity, T2DM

INTRODUCTION

Periodontitis is a persistent inflammatory condition that impacts the periodontium, which includes gingiva, alveolar bone, cementum and periodontal ligament. The accumulation of various periodontopathic bacteria in the dental biofilm due to inadequate oral hygiene care and lack of regular annual dental check-ups is the primary cause of the initiation and progression of periodontitis[1-3]. Several studies have indicated that patients with fair to poor oral hygiene had a 2-to 3- times higher risk of suffering from periodontitis comparing to those with good oral hygiene[4-6]. Epidemiologically, periodontitis is associated with various non-communicable chronic diseases (NCDs) including diabetes mellitus (DM), which is a two-way relationship. Evidence has shown that people living with diabetes have a 3- to 4-fold increase in the risk of periodontitis and, conversely, a significant increase in the severity of periodontitis presents in uncontrolled diabetic patients[7-11]. The European Federation of Periodontology (EFP) and the American Academy of Periodontology (AAP)

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have included DM as one of the risk factors contributing to the progression of periodontal disease[7]. Evidence has revealed links between the occurrence of microvascular complications and the severity of periodontitis[12], and several studies have demonstrated that uncontrolled diabetic patients were more prone to develop microvascular complications comparing to non-diabetic or controlled diabetic patients[13,14].

Though both DM and periodontitis are chronic inflammatory conditions that cannot be completely cured, adherence to effective measures could prevent an individual from being harmed by these conditions[4,7]. Adequate oral health care has been shown to help prevent and reduce the severity of periodontal disease, which might consequently improve diabetic condition[4]. It is widely accepted that human behaviors toward something are often influenced by their knowledge, which eventually affects their attitude[15,16]. Evidence also shows that lack of knowledge, attitude, and awareness regarding periodontitis in people living with diabetes may affect the severity of periodontitis and impact patients' quality of life (QoL)[17,18]. Nonetheless, a number of study have demonstrated inconclusive correlation between knowledge and attitude on the practice of oral health care among periodontitis in people living with diabetes[19-23].

This cross-sectional study aimed to investigate whether the level of knowledge and attitude related to the severity of periodontitis among patients with T2DM. The results might yield primary data for further comprehensive prevention programs for these groups of patients.

METHODS

This study was an observational study based on secondary data collected from subjects who were recruited for the previous study "Association between Periodontitis and Microvascular Complications among Patients with Type 2 Diabetes Mellitus"[24]. Prior to initiation of the study, approval was obtained from the Faculty of Dentistry/Faculty of Pharmacy, Mahidol University, Institutional Review Board (COE.No.MU-DT/PY-IRB 2023/031.1007). To maintain subject confidentiality, reporting of results will not include subjects' names.

The data collection was conducted between May 2018 to June 2018 from 184 T2DM patients attending a follow-up program at the Endocrinology Unit, Department of Medicine, Faculty of Medicine Vajira Hospital, Navamindradhiraj University.

The data collected from the patient chart record included the following: demographic data (i.e., gender, age, weight, height); duration of T2DM; laboratory investigation (i.e., fasting plasma glucose (FPG) level; glycosylated hemoglobin (HbA1c)).

Full mouth periodontal examination consisted of measuring gingival sulcus depth, clinical attachment level and bleeding on probing. Six locations on each tooth were probed with a manual periodontal probe (North Carolina periodontal probe UNC-15 Hu Friedy Manufacturing Inc, Chicago, IL) using an artificial dental unit light to obtain the measurements which were then recorded as mesiobuccal, midbuccal, distobuccal, distolingual, midlingual and mesiolingual. All the dental examinations were conducted by Assoc.Prof. Pirasut Rodanant. Periodontitis was classified into 3 severity levels[1]: mild periodontitis was defined as having at least one tooth but < 30% of the teeth with lost gingival attachment of ≥ 1 mm but ≥ 3 mm; moderate periodontitis was defined as 30-60% of the teeth with lost gingival attachment ≥ 3 mm or < 30% of the teeth with lost gingival attachment ≥ 5 mm; severe periodontitis was defined as ≥ 60% of the teeth with lost gingival attachment of ≥ 3 mm or ≥ 30% of the teeth having lost gingival attachment of ≥ 5 mm.

The questionnaire comprised 14 questions developed under the consensus of the members of the research team. A small-scale pre-test was conducted (n = 20). Cronbach alpha was calculated and found to be 0.502. A correct answer will be rewarded 1 point whereas 0 points for the

incorrect answer. An in-person interview was conducted whereby subjects were asked to answer the following questions: question numbers 1-8 measured oral health knowledge level. Subjects were divided into 2 groups (high and low knowledge level) according to the points they received from their answers; question numbers 9-12 measured oral health attitude level. Subjects were divided into 2 groups (high and low attitude level) according to the points they received from their answer; question numbers 13-14 evaluated subjects' perception of their oral health. The knowledge and attitude scores were initially evaluated using their means in order to approximate the central tendency of the sample and provide a balanced division for analysis[25], thus, the cut-off points for knowledge score and attitude score were as follow: patients who got ≥ 6 points were categorized as having high knowledge level, and patients who got < 6 points were categorized as having low knowledge level; patients who got ≥ 2 points were categorized as having high attitude level, and patients who got < 2 points were categorized as having low attitude level. Subjects were excluded from the study if they had incomplete details of the data (Figure 1). The SPSS Statistics 28.0.1.1 (IBM Corp. Released 2021. IBM SPSS Statistics for Macintosh, Version 28.0. Armonk, NY: IBM Corp.) was used to analyze data. Descriptive statistics is applied for elucidating general characteristics, DM status, periodontal status and oral health knowledge and attitude level. Analytical statistics is applied for assessing associations between clinical/laboratory characteristics and periodontal status via using independent sample *t*-test, association between DM status/knowledge level/attitude level and periodontal status via using Chi-square. Then the variables potentially associated with periodontal status are assessed via univariable and multivariable analysis.

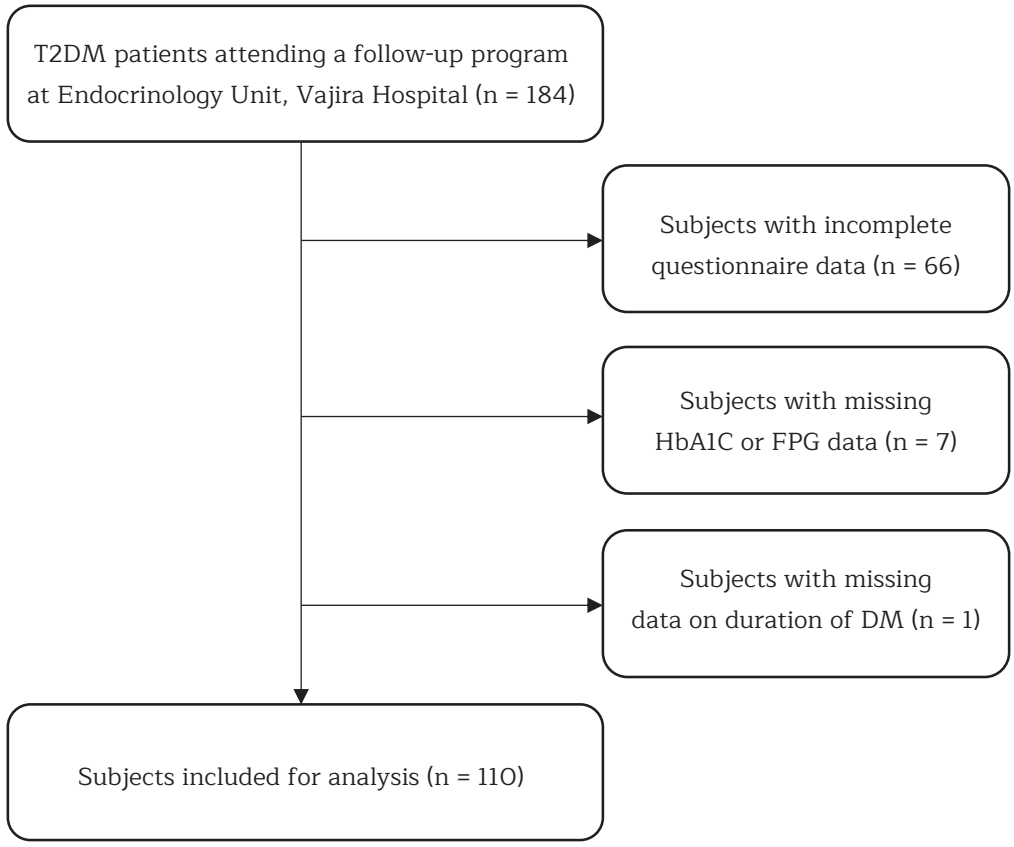

Figure 1 Number of participants recruited, excluded and included in the final analysis

RESULTS

Data of 110 subjects were collected for analysis. Thirty-eight subjects (34.5%) were diagnosed as having severe periodontitis. Sixty-five subjects (59.1%) suffered from moderate periodontitis. While seven subjects (6.4%) exhibited mild periodontitis. Demographic data of subjects are shown in Table 1.

The average knowledge score in these subjects was high (6.25 ± 1.17 points), while the average attitude score was low (0.99 ± 0.80 point). The details of the responses to each question are shown in Table 2.

Univariable analysis of factors potentially associated with periodontitis severity is demonstrated in Table 3. Regardless of the level of periodontitis severity, the majority of subjects had high knowledge scores (6-8 points) but low attitude score (0-1 points). Knowledge and attitude scores did not show any significant association with the level of periodontitis severity (p = 0.761 and p = 0.540, respectively). No matter the level of knowledge or attitude, about one-third of the subjects had severe periodontitis. Uncontrolled T2DM subjects (HbA1c > 7) were more likely to have severe periodontitis, which is statistically significant (p = 0.044, odds ratio 2.66, 95% confidence interval [1.03, 6.86]). An average body mass index (BMI) in subjects who were diagnosed with severe periodontitis (28.43 ± 5.13 kg/m^2) was higher than that of mild-to-moderate periodontitis subjects (26.48 ± 4.37 kg/m^2). There was a statistically significant association between BMI and the level of periodontitis severity (p = 0.044). FPG and HbA1c levels were notably higher in severe periodontitis subjects (179.0 ± 75.6 mg/dl and 8.6 ± 2.0%, respectively) than in mild-to-moderate periodontitis subjects (148.7 ± 36.5 mg/dl and 7.5 ± 1.3%, respectively). Statistically significant association was found between FPG and HbA1c and the level of periodontitis severity (p = 0.008 and p = 0.002, respectively). Nevertheless, using multivariable analysis, there was no statistically significant association between other potential factors and periodontitis severity (Table 4).

Table 1 Baseline characteristics of diabetic patients

1. Age (years)	
Mean ± SD	58.50 ± 10.44
2. Sex	
Male	43 (39.1%)
Female	67 (60.9%)
3. Duration	
Mean ± SD (years)	13.06 ± 7.02
≤ 10 years	40 (36.4%)
> 10 years	70 (63.6%)
4. BMI (kg/m^2)	
Mean ± SD	27.15 ± 4.72
5. FPG (mg/dl)	
Mean ± SD	159.13 ± 54.48
6. HbA1c (mg%)	
Mean ± SD	7.89 ± 1.62
≤ 7 (controlled DM)	38 (34.5%)
> 7 (uncontrolled DM)	72 (64.5%)
7. Periodontal status	
Mild	7 (6.4%)
Moderate	65 (59.1%)
Severe	38 (34.5%)

Abbreviations: BMI, body mass index; DM, diabetes mellitus; FPG, fasting plasma glucose; HbA1c, glycosylated hemoglobin; kg/m^2, kilogram per square metre; mg, milligrams; mg/dl, milligrams per deciliter; SD, standard deviation

Table 2 Response to questionnaire regarding knowledge and attitude in oral health according to periodontal status

Questions	Periodontal status	
	Mild-to-moderate N* (%)	Severe N* (%)
1. You should have a dental check-up at least twice a year.	43 (65.3)	27 (71.1)
2. Soft-bristled toothbrushes should be used.	59 (81.9)	30 (78.9)
3. Dental floss should be used after tooth brushing.	25 (34.7)	11 (28.9)
4. Mouthwash can be used to replace tooth brushing.	22 (30.6)	17 (44.7)
5. You should brush your teeth at least twice a day.	71 (98.6)	37 (97.4)
6. The type of food you consume affects your teeth and oral health.	55 (76.4)	29 (76.3)
7. People with diabetes are at a higher risk of periodontitis.	52 (72.2)	32 (83.2)
8. Improper brushing techniques can cause tooth wear.	67 (93.1)	36 (94.7)
9. You have a dental check-up regularly, at least twice a year.	27 (37.5)	12 (31.6)
10. Having been older could lead to tooth loss.	71 (98.6)	37 (97.4)
11. Experiencing toothache, swollen gingiva, or needing a tooth extraction is embarrassing.	11 (15.3)	10 (26.3)
12. Visiting a dentist makes you feel worry.	41 (56.9)	22 (57.9)
13. You do know how to well-maintain your oral hygiene.	48 (66.7)	22 (57.9)
14. You are currently experiencing negative issues with your gingiva.	33 (45.8)	26 (68.4)

Abbreviation: N, number
* Number of subjects who respond 'YES' to each question.

Table 3 Univariable analysis of factors associated with periodontitis severity

	Periodontal status		Crude OR (95%CI)	P-value
	Mild/Moderate	Severe		
Knowledge score				
Low	17	8	0.86 (0.33, 2.23)	0.761
High	55	30	1	
Attitude score				
Low	51	29	1.33 (0.54, 3.28)	0.540
High	21	9	1	
DM status				
Uncontrolled	45	31	2.66 (1.03, 6.86)	0.044
Controlled	27	7	1	
DM indicators				
BMI	26.48 ± 4.37	28.43 ± 5.13	1.09 (1.00, 1.20)	0.044
FPG	148.67 ± 36.46	178.95 ± 75.59	1.01 (1.00, 1.19)	0.008
HbA1C	7.52 ± 1.29	8.57 ± 1.95	1.59 (1.16, 1.97)	0.002

Abbreviations: BMI, body mass index; CI, confidence interval; DM, diabetes mellitus; FPG, fasting plasma glucose; HbA1c, glycosylated hemoglobin; OR, odds ratio

Table 4 Multivariable analysis of factors associated with periodontitis severity

	Adjusted or (95%CI)	P-value
Knowledge score: low	0.86 (0.32, 2.34)	0.766
Attitude score: low	1.35 (0.54, 3.55)	0.506
DM status: Uncontrolled (HbA1C > 7)	2.28 (0.86, 6.06)	0.098
BMI	1.08 (0.99, 1.18)	0.097

Abbreviations: BMI, body mass index; CI, confidence interval; DM, diabetes mellitus; HbA1c, glycosylated hemoglobin.

DISCUSSION

This study found that people living with diabetes have satisfactory knowledge but low attitude toward oral health. Interestingly, among people living with diabetes categorized as having severe periodontitis, a high proportion of subjects had low attitude score. Nevertheless, statistical significance could not be demonstrated. This finding is consistent with the study of Penmetsa et al., which stated that a positive attitude plays a key role in achieving better periodontal status[26].

This study showed that the level of oral health knowledge and attitude did not correlate with the level of the severity of periodontitis in patients with T2DM. The multivariable analysis demonstrated that knowledge and attitude towards periodontal health are not strong dependent factors in predicting periodontal disease severity. Our results suggested that knowledge and attitude would have less significant impact on the progression of periodontitis than other variables in these subjects. Several epidemiological studies have identified many risk factors to be implicated in the manifestation and progression of periodontal diseases such as age, gender, oral hygiene habits, frequency of dental visits, income level, education attainment, residence place, cigarette smoking, DM, ethnicity, microbiological factors, genetic factors, immunity, social and behavioral factors, and psychological factors[27-29]. Our study indicated a statistically significant association between uncontrolled DM (HbA1c > 7) and severe periodontitis. This result is consistent with a study by Tsai et al. who found that adults with diabetes exhibited a higher prevalence of severe periodontitis than those without diabetes, and highest prevalence was observed in individuals with poorly controlled diabetes[30]. The analysis demonstrated a potential trend indicating that systemic factors such as uncontrolled diabetes and higher BMI may have a more considerable independent effect on periodontal health. Results from this study align with the findings of Saito et al. who reported that the greater the BMI, the greater the risk of having periodontitis[31]. Our findings also align with other studies which revealed the interrelationship between oral health and systemic diseases (including DM)[7,11,14,30,32,33].

Interestingly, while a majority of subjects had a high knowledge score regarding oral health care, their attitude scores were low. This finding suggested that while subjects had knowledge regarding good oral hygiene practices, this knowledge does not raise their awareness towards a positive attitude on oral health care. This observation seemed to conform with the characteristics of our subjects. They were elderly individuals who had an experience of having poor oral hygiene status for a long time and were familiar with negative attitude in oral health, such as the perception that tooth loss is a natural process of their lifetime. It indicates a gap between knowledge and practice that needs to be addressed through behavioral interventions[33]. This observation might point out the need for public health initiatives not only to educate generally about oral health concerns but also to provide declarative and procedural knowledge to T2DM patients in order to emphasize that individuals engage with health behavior that positively impacts their QoL[34,35]. Moreover, repetition making concrete examples that impact their QoL concerning their gingival problems might elevate the possibility of raising their awareness practice adequate oral hygiene care[36,37].

Our results showed that people with severe periodontal status are more likely to report having gingival problems than those with mild/moderate periodontal status. Gingival problems provoked difficulty in food mastication which might impact QoL and eventually raise health issue concerns[38,39]. This result aligns with what one would expect intuitively, as more severe periodontal conditions would likely lead to more noticeable gingival issues. The statistical significance implies that this is not likely due to random chance, but rather there is a true association between

the severity of periodontal disease and the experience of gingival issues. This finding might indicate a crucial need to align knowledge with their QoL to improve attitudes and foster better oral health behavior[40].

Another explanation on the lack of correlation between knowledge and periodontitis severity was the appropriateness of the knowledge content. Evidence has shown that lack of knowledge and awareness about the etiology of periodontal diseases and the effect of proper treatment in maintaining and preventing further destruction of periodontal tissues led to the further destruction of periodontal tissues[40]. Our results demonstrated good knowledge on periodontal health issues, which generally emphasize disease prevention. However, the lack of correlation between knowledge and periodontal status presenting in our study might imply that these subjects did have knowledge in preventing disease occurrence but not enough to stop the disease progression[41].

Although our study did not find any correlation between attitude and the periodontitis severity, it suggested the importance of positive attitude toward having better oral health status. Subjects with positive attitude could perform better oral hygiene practice than those without.

As the characteristic of cross sectional study, relatively small sample size from one specific institution, and the use of secondary data set which might limit the ability to detect some potentially relevant psychosocial and behavioral variables (eg. smoking habit), the results of our study might not be a strong inferrence for the general diabetic population in the country. The use of secondary data which did not contain oral radiographic examination also limited us to use the old version of periodontal disease classification which categorize periodontitis severity into 3 levels rather than the use of a recent 2018 AAP/EFP classification of periodontal diseases which categorize periodontal severity into 4 satges. Another flaw of this study included the reliability of the questionnaires (ie. the process of validation and the ambiguous phrases of question items wording) which might affect the interpretation of the results. Larger sample sizes from multi-center institutions, a design of case-control study, the construction of clear and understandable question items, or the thoroughness of data collection concerning the initiation and progression of periodontitis might be necessary to fully elucidate the relationships between knowledge, attitudes, and the severity of periodontal disease and to validate the associations observed in this study.

CONCLUSION

With certain limitations, this study has highlighted a crucial link between diabetes and periodontitis, showcasing the impact of knowledge and attitudes on oral health outcomes in diabetic patients. General oral health knowledge does not have strong effect on periodontitis severity while attitude seemingly affects periodontitis severity. Providing appropriate knowledge concerning patients' QoL is necessary. The present findings emphasized the need for integrated care approaches by including oral health promotion intervention into the components of T2DM management. Addressing this issue requires a multifaceted approach that includes providing targeted oral health education, improving oral health attitude, and fostering collaboration between dental and medical healthcare providers.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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DATA AVAILABILITY STATEMENT

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

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