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Awareness of Oral Complications and Oral Hygiene Habits of Subjects with Diagnosed Diabetes Mellitus

SUMMARY

Background/Aim: *The aim was to evaluate Diabetes Mellitus (DM) patients' awareness of their risk for oral and dental complications, to evaluate their oral health behaviors, assess their sources of related information, and to detect the influence of their awareness on oral health and dental management.* ***Material and Methods:*** *Total of 240 DM patients presenting to a university outpatient dental facility for routine care completed a self-administered questionnaire about demographic-socioeconomic characteristics, oral health care and awareness on oral complications of DM. Dental status of each patient was recorded. Data were analyzed with Chi- square test; p was set as 0.05.* ***Results:*** *The patients' mean age was 52.85 years; the majority had Type 2 DM (72.1%) and 61.7% were females. Two thirds of the patients had tooth loss; 65% brushed daily and used toothpick for interproximal cleaning (35%). Only 12.9% had regular dental visits and 37.5% reported their oral health as "poor". DM patients rarely received guidance from their health care professionals regarding their oral health (28.3%). Even though 62.5% were aware of oral complications of DM, only 46.3% knew that oral health may affect DM. The patients with Type 1 and Type 2 DM had similar perceptions about their oral health status (p=0.15>0.05). However, insulin users were more aware of the interaction between oral health and DM (p>0.05), and were more likely to consider their oral health as "poor" (p>0.05).* ***Conclusions:*** *DM patients' awareness of the effect of DM on oral health was higher than that of the effect of oral health on DM management. Medical health care providers were failing to provide the necessary information regarding these issues when compared to dentists.*

Key words: Community Care, Dental Care, Developing Countries, Health Care, Health Education

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Introduction

Diabetes Mellitus (DM) is a chronic, progressive, metabolic disease that is characterized by high levels of glucose in the blood. It results from the deficiency in insulin secretion from pancreatic beta cells or an increased cellular resistance to the actions of insulin[1]. Due to its high incidence and increasing prevalence, DM has been declared a pandemic disease by the World Health Organization [2,3]. According to the 2013 International Diabetes Federation Diabetes Atlas, 387 million people have diabetes and it is anticipated that this number will increase to 592 million worldwide by 2035[4].

The chronic complications of DM including microvascular abnormalities and neuropathy result in a high risk of developing oral health problems, such as xerostomia (dry mouth) which results with increased susceptibility to oral fungal infections (oral candidiasis) and dental caries, poor wound healing, taste impairment, burning mouth syndrome, and periodontal disease[5-7]. As a consequence of the impaired immunity and healing associated with DM, periodontitis may be more severe and aggressive in these

patients[8,9]. Additionally, periodontitis impairs glycaemic control as it has been shown that DM management is improved following treatment of periodontitis[8,9].Therefore, DM patients should be informed about this bidirectional interaction between oral health and DM for both the prevention and control of periodontal/oral disease and management of DM[3].

Among the health care professionals involved in DM management and patients care, the role of the nurses is of increasing importance because of the increasing global prevalence of DM[10]. Consequently, nurses are essential in the multidisciplinary team to provide appropriate care to DM patients and to manage DM, both in primary and secondary care settings[11]. Several papers have assessed the knowledge of dental students and dental care providers[12-16], internists and endocrinologists[3,17,18], diabetes educators [19] and diabetic patients[20-24] of the association between DM and oral health. Unfortunately, people with DM still lack important knowledge about the oral complications of the disease and may have poor levels of oral self-care [20-22,24-26].

The increased incidence of DM and the high level of poor oral health among diabetics indicate the continuing need for education of DM patients by the health care providers regarding the interaction between oral health and DM. However, establishing the actual awareness of DM patients on this interaction is vital in order to develop effective programs to enhance both the general and oral health of DM patients. In this study; we aimed to assess the knowledge and awareness of DM patients about their heightened risk for oral diseases, to evaluate their oral health habits, to evaluate their sources of related information, and also to assess the influence of DM patients' awareness about increased risk for oral diseases on their oral health and dental management.

Material and Methods

This cross sectional study was performed on 240 DM patients (both Type 1 and 2) among the patients who were referred to the Outpatient Dental Clinic for treatment of their dental needs in a routine, nonemergency basis. The inclusion criteria were DM diagnosis for at least 1 year, cognitive skills to understand the questions, and to accept enrollment in the study. The patients with history of cerebrovascular disease, uncontrolled systemic diseases, major psychiatric conditions, using medications that alter the cognitive function, diabetic medical personnel, and patients who had diabetes only during pregnancy were excluded from the study. The patients entered the investigation voluntarily following an explanation of the study purpose and written informed consents were obtained. All study protocols were approved by the Institutional Review Board at Ege University (29.04.2016, #16-4/1) and were completed in accordance with the Declaration of Helsinki.

A self-administered questionnaire which included 38 questions was prepared after careful selection of relevant published reports in the literature[26-29]. DM patients completed this patient-reported questionnaire as they waited for their appointment at the outpatient clinic. For illiterate patients, a researcher (HÇ) read and explained the queries and recorded patients' responses. The first part of the questionnaire was related to the patients' demographic and socioeconomic characteristics such as age, gender, literacy and annual household income-which was determined according to the minimum wage provided by the government (https://www.csgb.gov.tr). The type and duration of DM and DM management (diet, oral antidiabetic agents, and insulin) were recorded. The second part of the questionnaire assessed participants' oral health behaviors, such as frequency of dental visits, tooth brushing, flossing and mouth rinse use. The third part of the questionnaire was related to participant's awareness about oral complications associated with diabetes.

All participants underwent standard oral examination related to their complaint by experienced clinicians under standard clinical conditions and were referred to dental clinics for treatment of their routine dental complaints.

Missing data were also presented in the tables, since these were considered important to show the actual patient profile. Data were entered on an Excel spreadsheet and statistical analyses were performed with SPSS version 12 (SPSS Inc., Chicago, IL, USA). Following assessment of descriptive features, Chi- square test was used to analyze the categorical data. In all tests, P was set as 0.05.

Results

The patients' demographic and socioeconomic characteristics and dental findings are presented in Table 1.

Two hundred and forty DM patients who were consisted of 61.7% females and 38.3% males and whose ages were ranging between 13 to 82 years (mean=52.85 years) participated in this survey. Half of the patients (51.53%) were either illiterate or had literacy level of elementary school, and their monthly income were low (73.3%). The majority of patients (72.1%) had Type 2 DM and the duration of the disease ranged between 1-40 years. Most of the patients were using oral antidiabetic agents (62.5%) and insulin (20.8%), and 95% of patients were regularly controlling their blood glucose level at home (85%) (Table 1).

Table 1. Sociodemographic characteristics and diabetes related information of DM patients

		n
Gender	Male	92
	Female	148
Age (years)	<20	3
	20-29	5
	30-39	15
	40-49	57
	50-59	93
	>60	66
Education	Illiterate	21
	Elementary school	102
	Secondary school	33
	High school	45
	University	39
Income	Low	176
	High	64
Type of diabetes	Type I	67
	Type 2	173
Length of diagnosis	<5 years	92
	5-9 years	60
	10-14 years	47
	15-19 years	25
	20-24 years	9
	>25 years	6
Treatment	Diet	11
	Oral antidiabetics	150
	Insulin	50
	Combined	25

Seventy-five percent of respondents were completely or partially edentulous. Of the participants, 7.1% did not brush their teeth on a daily basis, whereas 65% brushed once a day. Approximately 2/3 (63.3%) reported interproximal cleaning, mostly using a toothpick as an adjunct tool (35%) to clean the problematic sites rather than dental floss (12.9%), and 56 patients (23.3%) used oral rinses regularly.

Only 12.9% reported that they had visits for regular dental check-ups, and two-thirds of the patients visited the dentist when they perceived there was a need (74.2%). More than half of the patients (55.4%) reported oral bleeding during tooth brushing; 21.7% of those kept on brushing whereas 14.6% did not have concerns about bleeding. In our study, 37.5% of patients reported that their oral health was poor and almost half of the patients rated their oral health as “moderate”.

Approximately two-thirds (62.5%) of the participants had some knowledge of oral complications of DM, mostly received from their dentists (34.6%) (Table 2).

The patients were mostly aware of mouth dryness as an oral complication of DM (46.7%), and this was followed by tooth decay (25%), malodor (23.3%) and bleeding gums during tooth brushing (22.9%) (Table 3). Patients were less aware of diabetes related mouth ulcers and taste impairment (11.7%) and fungal infection (4.6%) (Table 2).

Table 2. Awareness of DM patients and the source of their information regarding the effect of diabetes on oral health

Aware of the effect of diabetes on oral health		Yes n(%)	150 (62.5)
		No n(%)	74 (30.8)
		Missing data	16 (6.7)
If yes:	the source of this information	Nurse/physician	13 (5.4)
		Internet	12 (5.0)
		TV	36 (15.0)
		Dentist	83 (34.6)
		Combined	4 (1.85)
		Missing data	24 (10.0)

Regarding information about the effect of oral health on DM, 46.3% of the patients had some knowledge with 22.5% receiving this information from their dentists (Table 3). 40.8% of the patients were not aware that oral health may influence DM management.

Table 3. Awareness of DM patients regarding oral problems linked to diabetes

Does DM cause the following oral complications?	Yes n(%)	No n(%)
Mouth dryness	112 (46.7)	128 (53.3)
Delayed healing	52 (21.7)	188 (78.3)
Gingival bleeding during brushing	55 (22.9)	185 (77.1)
Mouth ulcers	28 (11.7)	212 (88.3)
Malodor	56 (23.3)	184 (76.7)
Tooth decay	60 (25.0)	180 (75.0)
Tooth loss	51 (21.3)	189 (78.8)
Oral fungal infections	11 (4.6)	229 (95.4)
Swollen or tender gingiva	44 (18.3)	196 (81.7)
Taste impairment	28 (11.7)	212 (88.3)

As presented in Table 5, DM patients rarely received guidance from their health care professionals regarding their oral health (28.3%). Additionally, over 60% of the patients reported that clinicians failed to provide information about the importance of oral examination and oral care, tooth brushing, maintenance of optimal oral health and interdental cleaning (Table 4).

Almost all DM patients informed their dentists about their diabetes. Most of the patients stated that their dentist should inform them about the importance of good oral health on the management of DM. Also, the patients agreed on the necessity of regular dental appointments and stated that they would prefer to visit their dentist at the same time as medical follow-up (Table 5).

Table 4. Awareness of DM patients and the source of their information regarding the effect of oral health on diabetes

Aware of a negative effect of oral health on diabetes		Yes n(%)	111 (46.3)
		No n(%)	98 (40.8)
		Missing data	31 (12.9)
If yes:	the source of this information	Nurse/physician	8 (3.3)
		Internet	8 (3.3)
		TV	26 (10.8)
		Dentist	54 (22.5)
		Combined	6 (5.9)
		Missing data	47 (19.6)

Table 5. The oral health care advices received by DM patients and the patients attitutes towards dentists involvement in DM care

Are you informed by the health care provider that in diabetic patients:	No n(%)	Yes n(%)	Missing data n(%)
Oral examination by a dental professional is vital	165 (68.8)	68 (28.3)	7 (2.9)
Oral care and tooth brushing is important	146 (60.8)	85 (35.4)	9 (3.8)
Regular visit to dentist is a requirement	163 (67.9)	68 (28.3)	9 (3.8)
Gingival health status shall be controlled	162 (67.5)	68 (28.3)	10 (4.2)
Use of dental floss is essential	189 (78.7)	40 (16.7)	11 (4.6)
Did you tell your dentist that you have diabetes	14 (5.8)	222 (92.5)	4 (1.7)
Should your dentist inform you about the importance of oral health on diabetes management?	22 (9.2)	210 (87.5)	8 (3.3)
Should you have a dental appointment during your diabetes control?	28 (11.7)	205 (85.4)	7 (2.9)
If yes, would you regulary attend to dental appointments	19 (7.9)	203 (84.6)	18 (7.5)

The patients' knowledge regarding the interaction between DM and oral health was not associated with tooth brushing habits (p=0.81), gender (p=0.58), monthly income (p=0.34) and education (p=0.22). Dental flossing and interproximal cleaning was more common among females than males (p=0.01, p=0.01, respectively).

The patients with Type 1 and Type 2 DM provided similar results with respect to their perception of their oral health status (p=0.15). Additionally, the awareness of the patients regarding the effect of DM on oral health (p=0.13) and the effect of oral health on DM management (p=0.052) were not significantly different.

DM management had significant influence on some of patient responses. Most of the antidiabetic using DM patients (53.38%) considered their oral health as "moderate", but among insulin using DM patients, 35.42% considered their oral health as "moderate", and the difference between the groups was significant (p=0.01). On the other hand, most of the insulin users (56.25%) described their oral health as "poor" whereas this was observed in only 31.08% of oral antidiabetic agent users (p=0.01), which could reflect severity of disease and diabetic control and impact upon oral health. Similarly, there were significant differences between the oral antidiabetic and insulin users with respect to their awareness about the effect of DM on oral health. Most of the insulin users were aware of this influence (78%), but this incidence was lower among oral antidiabetic agent users (57%), (p=0.03). Of insulin users, 64% were aware of the potential impact of oral health on DM management, whereas this was observed in 41.33% of oral antidiabetic agent users (p=0.02).

The highest portion of the missing replies were observed in the questions regarding the management of gingival bleeding during brushing (35%) and the information about the effect of oral health on DM (19.6%).

Discussion

In the literature, previous studies have examined the interaction between DM and oral health[3,30,31]. However, in order to develop appropriate health care recommendations, patient education and health care delivery to diabetic patients, assessment of patient awareness level about the oral manifestations of DM and related effects on oral health are needed. Unfortunately, despite the development of numerous questionnaires to assess the patients' knowledge on DM and related medical problems[32,33] to the authors' knowledge, there is no standard and validated questionnaire to establish the patients' awareness about the interaction between DM patients' oral health and their disease. Thus, as done in previous research[26-29] a questionnaire was developed by the authors after thorough search of relevant published reports in the literature and the knowledge/ awareness of diabetic patients about their increased risk for oral diseases were established in this study. Additionally, the sources of information and oral hygiene habits of DM patients were examined so that the general physicians, DM specialists, nurses, patient educators and others may be aware of the general practices of DM patients in their oral care.

Even though higher male predominance is reported in the literature, the disease appears to be increasing in females[34], as observed in the present study. Our patients were mostly middle-aged individuals, which parallels with other reports[1,35-37]. Although several studies have reported the prevalence of Type 2 DM as high as 90% of diabetic

patients[38,39] in the present study, 72% of the patients had Type 2 DM, and this was within the range provided for the global prevalence[20,23,24,37,40]. This wide variation among the incidence of Type 2 DM has been attributed to the ethnicity, lifestyle, demographic differences, obesity and genetics of the patients and the socioeconomic status of population studied[3,37,38].

The same variability was observed within the oral hygiene habits of DM patients in the literature. Oral brushing frequency of our patients were comparable to the other studies: most of the patients in this study brushed once a day (65%); this frequency was within the range of the literature, reported between 24.2% and 95.3% [22,23,25,26,41-44]. Less DM patients brushed their teeth twice a day (22.5%), and this was similar to others with frequency ranging between 17%-38% [22,23,40,42,45].

In some other reports, over 60% of diabetics brushed their teeth twice a day[25,26,43]. Over one third of our patients never performed interproximal cleaning as a routine dental practice, comparable with other studies of DM populations [23,26,40,43]. Our patients mostly preferred a tooth pick as an adjunct tool to clean the problematic sites rather than for regular interdental cleaning. Although using a tooth pick is not advised by some dental practitioners, many diabetic patients continued on using it as a cleaning tool[22,42]. Overall, reported dental floss and interdental cleaning habits and oral rinse usage of our patients were comparable to the literature[23-26,40,42].

The frequency of DM patients who have regular dental visits ranges widely[20,22,23,25,29,40,45,46]. In our study, only 12.9% of DM patients attended to dental controls yearly, whereas 9.6% visited their dentists in every 6 months. The main reason for poor attendance to dental clinics was the socioeconomic status of the patients, i.e., the level of education and financial sources[1,26,46-48]. The rates of our patients with regular dental visits were comparable to that reported by others, ranging between 12.6% and 14% [23,24,40]. On the other hand, higher rates of regular dental visits (up to 79.8%) are reported in other countries[1,20,26,41,42,45]. In the USA, the national health objective aimed to increase the ratio of diabetic patients who have annual dental check-ups up to 71% [40]. Since regular dental appointments of DM patients are essential not only to provide early detection of diabetes related oral complications, but also to eliminate any oro-dental foci of pain and infection that may lead to difficulties in metabolic control, the health authorities in developing countries have included guidelines to comprise this issue in their future health programs[1].

Approximately 38% of our patients rated their oral health as poor less than patient self-report (60%) in other reports[1,22]. Patients' attitudes regarding frequency of brushing when they have observed bleeding after brushing should also be investigated[25]. In our study, DM patients did not know how to manage bleeding gums and even though more than half reported bleeding during tooth brushing, only 5% preferred to go to a dentist for this problem and 15% did not care about bleeding at all. In a similar study, more patients (33.2%) visited their dentists for bleeding during brushing[22]. It's suggested that the lack of awareness of the interaction between oral health and DM may be a potential reason for patients not taking action when this symptom is present.

Our patients' knowledge regarding the interaction between diabetes and oral health was not influenced by the parameters assessed including age, tooth brushing habits, gender, monthly income and education. On the other hand, others report a positive impact of education on their knowledge and awareness[21,40]. Considering that people may answer the questions to receive social approval[42], this could have led to higher positive responses from the undereducated patients in the present study. Diabetics were more aware of their increased risk for systemic complications associated with DM than they were for oral and dental complications[20,24,26,35,46]. As reported in the literature[1,20,21,24-26,35,41,49], our study also revealed a lack of information about oral complications of DM in one-third of diabetic patients. The most reported oral complication was mouth dryness, as seen in other studies[25,26,29]. Our patients were less aware that mouth ulcers, taste impairment and fungal infection were additional oral complications of DM. Bowyer *et al.* stated that fewer patients knew that delayed healing in the mouth, swollen or tender gums and loose teeth may be associated with diabetes[26].Limited awareness of the signs and impact of periodontal disease were recognized in other DM populations[17,23,25,35,40,50]. Our patients' awareness about DM related oral complications was higher than awareness of oral health on the management of DM (63% and 46%, respectively).

In the literature, DM patients have considered medical practitioners, nurses and other health care providers inefficient to provide information regarding the oral complications of DM[17,35, 51]. Even though the numbers varied among the studies, oral complications of DM were explained by less than half of the medical health care providers[17,23,35] and about half informed the patients about tooth brushing[1,35]. Only up to 1/3 of DM patients were guided to visit a dentist by a medical practitioner[40]. In our study, nearly 90% of the patients thought that providing the information about the impact of poor oral health on DM management should be one of the tasks of a dental professional, but only 34.6% of DM patients reported their dentists as the source of their knowledge and dental visits of our patients were infrequent, similar to other studies[23,24,26]. Television programs were the second source of information in the present study. Other sources such as the Internet, magazines (10%-52%)[22,23,40] and family/friends (55.3%)[40] were also noted as sources of information. Even though our results were in accordance with the literature, many patients did not respond to this query.

Although the type of DM was not associated with the level of knowledge of our DM patients, the type of DM management influenced the results. Insulin users were more aware of the consequences of DM and oral health interactions than those on oral antidiabetic medications. Additionally, the same group was more likely to consider their oral health as "poor" than the others. Previously, diabetic subjects have estimated their overall oral health to be poorer than nondiabetic controls[1] . We found that insulin users were more pessimistic about their oral health among DM patients, likely reflecting the severity of DM.

Most of our DM patients agreed on the requirement of dental appointments and suggested regular dental evaluation at the time of medical visits. Unfortunately, only 13% had regular dental visits. This suggests a lack of appropriate oral health care knowledge and behavior among diabetic patients in our sample.

Longitudinal studies have demonstrated a bidirectional relationship between glycaemic levels and periodontitis, indicating that chronic periodontal infection can complicate glycaemic control in DM patients, which, in turn, could lead to more severe periodontal tissue destruction[8,31,52-58] . Recently, Simpson *et al.* concluded in their meta-analysis that there is no strong evidence to state that periodontal disease treatment by scaling and root planning improves DM management, suggesting periodontal status may more closely reflect daily oral hygiene and systemic status[31]. However, they also stressed that larger, well conducted and clearly reported studies are required to assess the effect of periodontal treatment on glycaemic control[31].

The main limitation of the study is that DM patients who participated in this study were admitted for routine dental control and were not referred by their DM doctor. This study therefore represents a selected population and is not representative of all DM patients. Nevertheless, this study does emphasize the need to develop the knowledge and awareness in a high risk DM population. Additionally, since the aim was to determine only the awareness of the patients in this study, the clinical and radiographic findings of these patients were not assessed. For this reason, we were unable to comment on the effect of the oral health status on the assessment of the treatment type of DM.

The limited knowledge of patients particularly in oral hygiene on DM control indicates the need for improved patient education. There are many reports in the literature revealing the impact of nurses on the improvement of DM care[59-61]. In addition to giving advice on dietary intake and physical activity, weighing patients, and testing or discussing blood glucose levels[10] , nurses may advise the patients to maintain proper oral health care habits to control their disease. Provided that involvement of the nurses in case management could improve rates of control for hypertension, hyperglycemia, and hyperlipidemia[62], a similar approach is proposed to improve the awareness of DM patients regarding the interaction of the oral care and DM, following appropriate education programs of the nurses on this issue.

Within the limitations of the study, the results revealed that DM patients were aware of oral complications associated with DM; however they were unaware of the effect of oral health on DM management. According to the patients, medical health care providers were not efficiently providing the necessary information regarding these issues when compared to dentists. Following dentists, television programs were the second source of information.

A standard and validated questionnaire for patient reported outcomes is required to assess the oral hygiene habits and awareness of DM patients, regarding their oral health and related consequences, especially on the glycemic control. Training and advice about the interaction between oral health and DM should be planned by governmental organizations for medical and dental health care professionals, DM patients, but particularly for nurses who are willing to take more responsibility in DM management[59]. Subsequently, health care providers in primary and secondary settings may communicate with DM patients about the oral manifestations of DM, and provide information related to oral care (brushing teeth at least two times daily, flossing at least once a day, visiting a dentist twice a year). Additionally, they may also remind the physicians about the annual dental control of DM patients and notify about the urgency of a dental referral when required.

Conclusions

DM patients' awareness of the effect of DM on oral health was higher than that of the effect of oral health on DM management. Medical health care providers were failing to provide the necessary information regarding these issues when compared to dentists.

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