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Public knowledge and awareness of the effect of diabetes mellitus on oral health

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RESEARCH

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ABSTRACT

Background
Diabetes mellitus (DM) is a common chronic disease with an increasing prevalence, affecting general and oral health, with several oral manifestations. A bidirectional effect of diabetes and periodontal diseases has been reported by many researchers.

Aim
This study aimed to evaluate public awareness and knowledge of the association between DM and oral health among public living in Saudi.

Methods
A cross-sectional survey was done in Saudi Arabia to determine knowledge, attitudes, and awareness to assess public regarding knowledge of DM-related oral health. Questionnaire was designed and distributed in local Language to a convenient sample group through social media outlets.

Results
One hundred-ninety completed questionnaires. Our study findings indicated a general awareness of the association between DM and oral health but demonstrated a lack of awareness concerning some oral diseases related with DM. 134 out 190 participants (70.5 per cent) of the respondents confirmed that DM had a negative effect on oral health, and 46.9 per cent considered periodontal disease to have a negative effect on glycemic control. There was a reasonable knowledge concerning DM-related oral manifestations. In contrast, one third of the respondents considered it possible to treat patients with DM and with a blood glucose below 3.9mmol/Which indicated that they think a low blood glucose level has good prognosis and 43.7 per cent agreed that patients with DM should take antibiotics after tooth extraction, while 33.7 per cent of respondents agreed that antibiotics should be administered prior to tooth extraction. These are important considerations for early diagnosis and onset management of oral disease.

Conclusion
These findings indicate the need for targeted and specific health information education. They also support a greater need for collaboration between physicians and dentists.

Key Words
Diabetes mellitus, oral health, knowledge, awareness

What this study adds:

1. What is known about this subject?
There is limited information in the literature on awareness in relation to DM and oral health.

2. What new information is offered in this study?
This study offers additional information on awareness of DM-related neuropathic oral manifestations and

appropriate antibiotic use.

3. What are the implications for research, policy, or practice?

With DM prevalence increasing, implementing routine dental screening to increase awareness of the relationship between oral health and DM, and address health issues is needed.

Background

Diabetes mellitus (DM) is a chronic disease with an increasing global prevalence. According to World Health Organization (WHO) statistics, the prevalence of DM has increased almost 4 times since 1980, with 422 million people diagnosed with DM reported in 2014.[1,2] Moreover, the prevalence of DM has doubled among adults aged >18 years old.[1,2] There are an estimated 174.8 million adults with undiagnosed DM, with most living in developing countries.[3] Given this high and increasing global prevalence, it is extremely likely that dentists will continue to encounter an increasing number of DM patients.

There are many major long-term DM-related complications that can develop, including diabetic nephropathy, retinopathy and the potential risk of blindness, and heart disease and stroke.[4] Similarly, people with DM are at greater risk of developing oral health-related complications. DM increases susceptibility to bacterial infection, decreases the ability to combat infection, and can result in a reduced blood supply to the gingiva, a dry mouth, and reduced saliva flow, causing tooth decay and plaque build-up and adversely affecting quality of life, particularly when poorly controlled.[5,6] Improving oral hygiene has been shown to aid in controlling blood glucose levels.[7-10]

Improving knowledge and understanding of DM, and enhancing awareness of the disease, is important to change patient attitudes towards oral health, to motivate patients to seek early treatment when needed, and to help control blood glucose levels.[8] Dissemination of information and increasing awareness are essential to prevent and control the disease. A lack of knowledge and motivation may lead to further deterioration and result in complications; however, few studies have addressed this issue. In 2015, Arunkumar et al.[8] measured patient knowledge and awareness concerning the effects of DM on oral health and found that only 10.8 per cent of the study participants were familiar with the effects of DM on oral health, and that only 13 per cent had been provided with information by their dentist concerning the risks of oral complications and the importance of regular dental care.[11] Other studies have also demonstrated limited awareness of oral health complications associated with DM.[9,12-14]

Early detection and treatment of oral diseases, such as dental caries and periodontal disease, is important in protecting patients with DM from harmful DM-associated oral complications.[8,15] Patient education and positive reinforcement may encourage patients to follow oral healthcare regimens as it has been reported that non-adherent patients to oral hygiene practices lack awareness concerning dental health. It has been reported that people who consider themselves susceptible to oral disease will undertake more preventative dental visits.[16] Therefore, it is essential to motivate people to seek preventive dental care for early detection and treatment of various periodontal diseases and caries. Consequently, this will limit oral complications and complex treatment.

Few studies[11-14] have been conducted on the awareness of certain oral health aspects and the association of DM on oral health. Therefore, the aim of this investigation was to measure public knowledge and awareness concerning: (1) the bidirectional association between DM and oral health, and (2) the most common oral manifestation of DM in relation to demographic data, having a diagnosis of DM, and having a first-class relative with DM.

Method

A cross-sectional study was designed to assess public knowledge, awareness, and attitudes to knowledge of DM-related oral health. A structured questionnaire using multiple choice questions was developed in Arabic and consisted of two parts. The first part included socio-demographic questions concerning age, sex, occupation, educational level and whether the respondent had been diagnosed with DM or had a first-class relative diagnosed with DM. The second part was designed to measure knowledge and attitudes to DM-related oral health. The questionnaire employed a five-point Likert scale, with potential responses ranging from 'strongly agree' to 'strongly disagree'. The questionnaire was designed following a careful review of the relevant literature. First, a pilot study was undertaken, and we questioned 25 individuals with different characteristics to assess clarity and feasibility of the questionnaire. Results of the pilot study revealed that the questionnaire was easy to understand and took approximately between 5 and 10 minutes to complete. Therefore, no further adjustments were required. A questionnaire created using Google survey forms was distributed thereafter to a convenient sample group through social media outlets such as Twitter and the WhatsApp application. Data were collected over the period

from 18 August to 4 October 2017

Statistical analysis

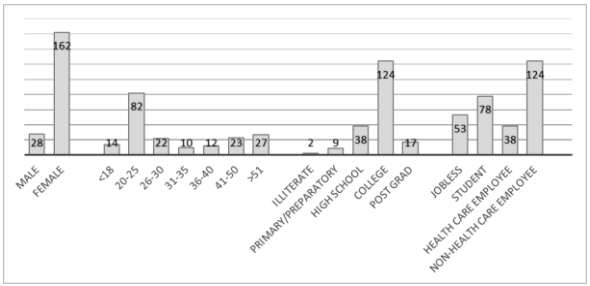
The data were collected, coded, and entered. All statistical analyses were performed using SPSS 2013 (IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp). The following descriptive statistics were performed: frequency distribution tables, one-way ANOVA, and P-values. A P-value of equal to or less than 0.05 was considered statistically significant.

Results

Sample characteristics

One hundred and ninety completed questionnaires were obtained. Most respondents were female (85.3 per cent), and 43.2 per cent of respondents were in the 20 to 25-year-old age group. More than half the respondents (65.3 per cent) had obtained a college-level education. Fifty-three respondents (27.9 per cent) were unemployed, 78 (41.1 per cent) were students, 38 (20 per cent) were healthcare workers, and 124 (65.3 per cent) were non-health care employers. The sample demographic characteristics are summarized in Figure 1.

Figure 1: Respondents' demographic data



From 190 respondents, 20 (10.5%) had a diagnosis of DM, while 132 (69.5%) reported having a first-class relative with DM. A total of 106 (55. 8%) respondents were using multiple sources to obtain information, followed by 18.7% of respondents obtaining information from their doctors. Data are presented in Table 1.

Table 1: Frequency of DM, having a first-class relative with DM, and the sources of information concerning the effects of DM

Variable	Response	Frequency	Per cent
Do you have DM?	Yes	20	10.5
	No	159	83.7
	I don't know	11	5.8
Do you have a first-class relative with DM?	Yes	132	69.5
	No	47	24.7
	I don't know	11	5.8
DM and oral health information sources	Multiple	106	55.8
	Friends	12	6.3
	E-Sources (any electronic info such as org…)	16	8.4
	Social Media (Facebook, Twitter…)	7	3.7
	Doctors	35	18.4
	Pharmacists	1	0.5
	Other healthcare professionals	3	1.6
	Media (Journals, TV... etc.)	7	3.7
	Others	3	1.6

Questionnaire data

The questionnaire results are summarized in Table 2. Approximately three-quarters (70.6 per cent) of the respondents agreed that there was a relationship between DM and oral health, and 73.2 per cent agreed DM had a negative effect. A substantial percentage of respondents (46.9 per cent) believed that periodontal diseases had a negative effect on glycaemic control. More than half (66.8 per cent) considered that DM had related oral manifestations, and 42 per cent confirmed that the dentist could initially identify undiagnosed DM. Almost three-quarters of the respondents (69.5 per cent) considered that DM may cause a dry mouth leading to oral infections, and 60.5 per cent considered that individuals with DM were more likely to have periodontal diseases. In contrast, one-third of respondents answered that treating DM patients with a blood glucose level <70mg/dl was possible, and 39 per cent considered DM may cause numbness and a burning sensation in the tongue. A considerable number of respondents (43.7 per cent) considered that individuals with DM should take antibiotics after tooth extraction, and 33.7 per cent considered that antibiotics were required prior to extraction. Regular dental visits, and informing the dentist concerning the level of DM control, comprised the areas of most agreement, accounting for 90.5 per cent and 90 per cent, respectively. On the other hand, whether to treat patients with DM and high blood glucose levels (>200mg/dl) was the area of least agreement.

The Tukey post-hoc test and ANOVA demonstrated a significant effect of age on the belief that patients with DM could be treated if the blood glucose level was <70mg/dl. Respondents aged between 26 and 30 years old were more likely to disagree. Respondents aged between 26 and 30 years old were also more likely to believe that DM may lead to dental caries, while those respondents aged >41 years were more likely to consider that antibiotics were required after tooth extraction. Concerning education, those with a college education or higher were more likely to agree on morning appointments, and that dentists could identify undiagnosed DM. Those with postgraduate education were less likely to consider that antibiotics were required after dental extraction and were subsequently less likely to agree on the success of implants for an individual with DM. Occupation was also found to have an influence. Those employed were more likely to acknowledge an association between DM and oral health, the negative effects of periodontitis on glycaemic control, and the advantages of morning appointments for individuals with DM, as well as those patients with DM could be treated even if they had been fasting. Healthcare workers were more aware of the negative effects of DM and the effects of DM on dental caries. They were also the least inclined to consider administering antibiotics prior to or after dental extraction.
Those with DM were more likely to acknowledge the effect of DM on periodontal health, and to disagree on whether morning appointments were needed for patients with DM, and whether treatment should occur after fasting more than two hours. Individuals with DM were also more aware of DM-related oral complications (Tables 3 and 4).

Having a first-class relative with DM had a significant effect on being aware of the oral manifestations of DM, including dry mouth, dental caries, and infections, but these respondents were less likely to know about the effects of DM on oral health and the likely success of dental implants.

Discussion

Measuring knowledge levels and knowledge gaps among the general population is essential. Health education is intended to improve both quality of life and cost effectiveness.[17,18] Studies that are not sufficiently robust or that lack evidence affect health education and, consequently, individual health, awareness, and prevention.[19]

In contrast to numerous studies[9,13,20-22] not showing an association between DM and oral health, but similar to other studies that did show an association,[12,20,23-25] our investigation revealed a reasonable awareness of the association between DM and oral health. Two studies have shown that patients with DM were more aware of potential medical complications than the association between DM and oral health[22,23] due to education provided by physicians. The moderate awareness of DM in relation to oral health in our study may be explained through the use of multiple sources to obtain information, as the results indicated that most of the respondents used multiple sources, including information provided by their doctors, when searching for information. It has been shown that patients who were educated by their dentist or physician had a better attitude and superior oral care.[13,22,23] In addition, those with DM who had searched for information were more likely to know about DM-related oral complications.[23]

Similar to a study by Fenwick et al.,[26] our study indicated that age, education level, and employment status affected knowledge and awareness. Employed respondents were more likely to know of the association between DM and oral health. Unemployed respondents and students were least likely to know of the effects of DM on oral health, the association of gum disease and glycaemic control, and glycaemic control and the importance of morning appointments. Targeted education should be considered when designing healthcare programs and should include both physicians and dentists.

Several respondents considered individuals with DM should take antibiotics after dental extraction. This was particularly significant among students. Healthcare employers were less likely to agree on whether to take antibiotics after dental extraction. This indicates the importance of education concerning antibiotic use for individuals with DM.

In contrast to several studies[8,27,28] our investigation demonstrated that individuals with DM and those with first-class relatives with DM were more likely to acknowledge a susceptibly to gum disease, dryness of the mouth, and a diminished wound healing capacity. This finding has also been supported in previously reported literature among individuals with DM.[9,13,23]

Despite the respondents' knowledge of some of the oral manifestations of DM, approximately half the respondents answered that a dentist could not initially diagnose DM.[29] This may reflect a limited awareness of the role of dentists. The British Society of Periodontology and the Diabetes.co.uk campaign (2017) highlighted the role of the dentist concerning glycaemic control, and introduced the three A's: Ask, Assess, Act.[30] Bartold and Phillips (2008) emphasized the dentist's role in the management of DM

through a "Team Care Arrangement".[31]

Knowledge of the relationship between oral numbness, dental caries, and DM was limited. Most of the respondents did not know whether there was a relationship. The shortage in community programs plays important role in lack of awareness. Reducing this knowledge gap may decrease morbidity. Awareness of such complications may also enhance DM prevention and cost effectiveness. So the dentist and the physician should increase the efforts in advising and supporting patients.

While our results showed a reasonable awareness of the relationship between DM and oral health, areas of knowledge deficiency remain. Some studies have reported a higher knowledge concerning systemic complications than oral complications among patients with DM.[8,20] It is possible that individuals with DM view the disease as more serious than periodontal diseases.[28] Another reason may be due to a lack of physician awareness, with fewer dental referrals and education consequently.[29] Targeted education using different routes to disseminate essential information is required. Long-term programs are also recommended as they have been shown to increase information retention.[19]

Dentists and physicians have an important role to play in improving patient knowledge regarding oral complications and their effect on quality of life. Moreover, it is recommended that referral to a dentist form part of the overall DM treatment protocol.[23]

Conclusion

A knowledge gap was highlighted in this study. Targeted health education is recommended, as demographic data showed knowledge and awareness deficiencies in the relationship between DM and oral health. Greater attention and education is required. A DM-specific health education program should involve both dentists and physicians. Health education should be performed by both physicians and dentists during follow-up appointments. These findings may have important implications on prevention, morbidity and financial burden of treatment.

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PEER REVIEW

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CONFLICTS OF INTEREST

The authors declare that they have no competing interests.

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ETHICS COMMITTEE APPROVAL

Approved by the ethics review committee of the Center of Research, College of Dentistry, King Saud University, Riyadh, Saudi Arabia (FR0406).

Table 2: Knowledge, attitudes, and awareness concerning DM and oral health

Variable	Strongly agree	Agree	I don't know	Disagree	Strongly Disagree
	N (%)	N (%)	N (%)	N (%)	N (%)
Do you think that there is a relationship between DM and oral health?	59(31.1)	75(39.5)	49(25.8)	7(3.7)	0(0)
Do you think having DM negatively affects oral health?	57(30.0)	82(43.2)	48(25.3)	3(1.6)	0(0)
Do you think periodontitis can have a negative effect on glycemic control in patients with DM?	33(17.4)	56(29.5)	94(49.5)	7(3.7)	0(0)
Are morning appointments better for patients with DM?	35(18.4)	66(34.7)	82(43.2)	6(3.2)	1(5)
Are fungal infections, dry mouth, and periodontitis oral manifestations related to DM?	53(27.9)	74(38.9)	59(31.1)	4(2.1)	0(0)
Do you think a dentist can initially diagnose DM?	26(13.7)	56(29.2)	99(52.1)	7(3.7)	2(1.1)
Do you know if DM causes delayed wound healing and abscesses at extraction sites?	99(52.1)	72(37.9)	18(9.5)	1(5)	0(0)
Is it possible to treat a patient with DM if the blood glucose level is <70mg/dl?	17(8.9)	45(23.7)	108(56.8)	13(6.8)	7(3.7)
Is it possible to treat a patient with DM if the blood glucose level is >200mg/dl?	10(5.3)	20(10.5)	119(62.6)	24(12.6)	17(8.9)
Are patients with DM more likely to have periodontal and oral infections?	43(22.6)	72(37.9)	70(36.8)	5(2.6)	0(0)
Does DM cause a dry mouth, leading to oral infections, such as fungal infections?	49(25.8)	83(43.7)	56(29.5)	2(1.1)	0(0)
Do you think that DM may cause pain, numbness, and/or a burning sensation to the tongue?	25(13.2)	49(25.8)	114(60)	2(1.1)	0(0)
Do you think that having DM may lead to dental caries?	30(15.8)	61(32.1)	89(46.8)	10(5.3)	0(0)
Do you think it is always necessary for a patient with DM to take antibiotics prior to a tooth extraction?	19(10)	45(23.7)	119(62.6)	5(2.6)	2(1.1)

Do you think it is always necessary for a patient with DM to take antibiotics following a tooth extraction?	29(15.3)	54(28.4)	100(52.6)	5(2.6)	2(1.1)
Should regular dental visits be maintained to improve oral and periodontal health?	98(51.6)	74(38.9)	17(8.9)	0(0)	1(0.5)
Do you think being in a hypoglycemic state is an indication to stop dental treatment?	46(24.2)	60(31.6)	80(42.1)	4(2.1)	0(0)
Is it necessary for patients with DM to inform their dentists of their medical history even when their DM is deemed to be well-controlled?	114(60)	57(30.0)	19(10)	0(0)	0(0)
Can patients with DM be treated after having fasted for more than 2 hours prior to an appointment?	17(8.9)	31(16.3)	125(65.8)	10(5.3)	7(3.7)
Can dental implants be used successfully in patients with DM?	24(12.6)	69(36.3)	95(50)	1(0.5)	1(0.5)

Table 3: ANOVA summary results between and within groups, in relation to demographic data, on knowledge and awareness of DM on oral health

Variable		Sum of Squares	df	Mean Square	F	Sig.
Age						
Do you think that treating a patient with DM is possible with a blood glucose level < 70mg/ml?	Between groups	11.296	6	1.883	2.682	0.016
	Within groups	128.472	183	0.702		
	Total	139.768	189			
Do you think that having DM may lead to dental caries?	Between groups	10.172	6	1.695	2.675	0.016
	Within groups	115.980	183	0.634		
	Total	126.153	189			
Do you think it is always necessary for a patient with DM to take antibiotics after a dental extraction?	Between groups	12.895	6	2.149	3.442	0.003
	Within groups	114.269	183	0.624		
	Total	127.163	189			
Education						
Do you think that morning appointments are better for patients with DM?	Between groups	11.993	4	2.998	4.710	0.001
	Within groups	117.776	185	0.637		
	Total	129.768	189			
Do you think a dentist can initially diagnose DM?	Between groups	9.100	4	2.275	3.616	0.007
	Within groups	116.379	185	0.629		
	Total	125.479	189			
Do you think it is always necessary for a patient with DM to take antibiotics after dental	Between groups	10.307	4	2.577	4.079	0.003
	Within groups	116.856	185	0.632		

extraction?	Total	127.163	189			
Are dental implants successful for patients with DM?	Between groups	5.351	4	1.338	2.571	0.039
	Within groups	96.249	185	0.520		
	Total	101.600	189			
Occupation						
Do you think that there is a relationship between DM and oral health?	Between groups	9.699	3	3.233	4.764	0.003
	Within groups	126.217	186	0.679		
	Total	135.916	189			
Do you think DM negatively affects oral health?	Between groups	7.575	3	2.525	4.294	0.006
	Within groups	109.378	186	0.588		
	Total	116.953	189			
Does periodontitis have a negative effect on glycemic control in patients with DM?	Between groups	5.893	3	1.964	3.057	0.030
	Within groups	119.502	186	0.642		
	Total	125.395	189			
Do you consider morning appointments are better for patients with DM?	Between groups	8.263	3	2.754	4.216	0.007
	Within groups	121.505	186	0.653		
	Total	129.768	189			
Are oral diseases such as periodontitis, dry mouth and fungal infections DM-related?	Between groups	8.328	3	2.776	4.352	0.005
	Within groups	118.640	186	0.638		
	Total	126.968	189			
Do you think that patients with DM are more likely to have periodontal and oral infections?	Between groups	7.517	3	2.506	3.940	0.009
	Within groups	118.278	186	0.636		
	Total	125.795	189			
Do you think that DM may lead to dental caries?	Between groups	13.769	3	4.590	7.596	0.000
	Within groups	112.384	186	0.604		
	Total	126.153	189			
Do you think it is always necessary for a patient with DM to take antibiotics before dental extraction?	Between groups	6.112	3	2.037	3.825	0.011
	Within groups	99.067	186	0.533		
	Total	105.179	189			
Is it always necessary for a patient with DM to take antibiotics after dental extraction?	Between groups	13.254	3	4.418	7.214	0.000
	Within groups	113.910	186	0.612		
	Total	127.163	189			
Are patients with DM able to be treated after a 2-hour fast prior to an appointment?	Between groups	8.241	3	2.747	4.261	0.006
	Within groups	119.912	186	0.645		
	Total	128.153	189			

Table 4: One-way ANOVA results for respondents with DM, or having a first-class relative with DM, and attitudes and knowledge towards infection control

Variable		Sum of Squares	df	Mean Square	F	Sig.
Do you have DM?						
Do you think that periodontitis could have a negative effect on glycemic control in patients with DM?	Between groups	4.503	2	2.252	3.483	0.033
	Within groups	120.892	187	0.646		
	Total	125.395	189			
Do you think that morning appointments are better for patients with DM?	Between groups	6.754	2	3.377	5.134	0.007
	Within groups	123.014	187	0.658		
	Total	129.768	189			
Are periodontitis, dry mouth, or fungal infections oral manifestations of DM?	Between groups	6.345	2	3.173	4.919	0.008
	Within groups	120.623	187	0.645		
	Total	126.968	189			
Is treating a patient with DM possible if the blood glucose level is <70mg/dl?	Between groups	6.463	2	3.232	4.533	0.012
	Within groups	133.305	187	0.713		
	Total	139.768	189			
Do you have a first-class relative with DM?						
Do you think DM negatively affects oral health?	Between groups	8.918	2	4.459	7.718	0.001
	Within groups	108.034	187	0.578		
	Total	116.953	189			
Are periodontitis, dry mouth, or fungal infections oral manifestations of DM?	Between groups	4.574	2	2.287	3.494	0.032
	Within groups	122.394	187	0.655		
	Total	126.968	189			
Does DM cause a dry mouth and lead to oral infections, such as fungal infections?	Between groups	4.431	2	2.215	3.838	0.023
	Within groups	107.932	187	0.577		
	Total	112.363	189			
Does DM lead to dental caries?	Between groups	8.058	2	4.029	6.380	0.002
	Within groups	118.095	187	0.632		
	Total	126.153	189			
Are dental implants successful for patients with DM?	Between groups	7.043	2	3.521	6.964	0.001
	Within groups	94.557	187	0.506		
Information Sources						
Do you know if DM causes pain, numbness, or a burning sensation in the tongue?	Between groups	15.833	8	1.979	4.183	0.000
	Within groups	85.646	181	0.473		
	Total	101.479	189			