A Multicenter Cross-sectional Study to Assess the Knowledge of Oral Health Problems Among Diabetes Patients in Saudi Arabia

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Abstract

Objectives: The aims of this study were:1) to assess the awareness of diabetes and its systemic and oral complications among adults with diabetes in Saudi Arabia, 2) to evaluate their behaviors toward maintaining proper oral hygiene and factors associated with adequate oral health knowledge, and 3) to identify what recommendations and improvements are needed in diabetic clinics in KSA.

Methods: A validated questionnaire of six parts was distributed online to include all diabetes patients in Saudi Arabia. After applying the criteria, 400 diabetes responses were included. The data was analyzed using SPSS statistical software version 24. Descriptive statistics, univariate and multivariate analysis were used to report the results.

Results: Participants' responses showed that older aged patients with type 2 diabetes and the longer duration of diabetes had higher levels of awareness regarding oral health. However, their knowledge about being at high risk for oral diseases was low compared to their awareness regarding systemic complications. Relatively lower percentages of the participants (55.9%) were aware that diabetes can make teeth and gums worse and that gum disease makes it harder to control blood sugar (24.8%). Almost two thirds of the individuals believed that they should have regular visits to dental clinics, but many barriers were identified for their irregularity or no visits. With regards to the participants' source of information, 52% learned from health care providers, and 50% from the internet.

Conclusions: Our study revealed comparatively better results of awareness than previous studies reported in Saudi Arabia, however not to the desired standard. Therefore, both dentists and all healthcare providers should be encouraged to take the responsibility to promote proper oral hygiene practices among their diabetic patients in order to reduce the risk of having periodontal diseases. Further research is required to identify obstacles preventing those patients from having regular dentist visits.

Key words: Diabetes, oral health, periodontal disease, awareness, Saudi Arabia

Introduction

Diabetes mellitus (DM) is a chronic metabolic disease defined by hyperglycemia as a consequence of a deficiency in insulin's secretion, action or in both. It can be classified into two types. Type I diabetes is caused by a deficiency in the secretion of insulin as a result of autoimmune destruction of the pancreatic islet cells. The other classification is type II diabetes, which is caused by a combination of insulin action resistance and an inadequate insulin secretion as a compensatory response [1]. In 2019, approximately 9.3% of adults were living with DM in the world. It is predicted that 578 million people will have diabetes after 10 years in 2030 and the number will keep increasing in the coming 25 years until it reaches 51% in 2045 [2]. The prevalence of DM in adults is high in Saudi Arabia, which accounts for 18.5% [3].

DM is well known to have long term microvascular and macrovascular complications such as retinopathy, nephropathy, neuropathy, cardiovascular disease, cerebrovascular disease and sexual dysfunction [1]. One of these major complications of DM is oral diseases that can affect the patients' quality of life [4]. These oral manifestations include dry mouth, burning sensation, periodontal disease and altered taste [5].

There are some misconceptions about oral health that may truly lead to unhealthy behaviors. For instance, DM patients perhaps think that they have to stop brushing and flossing when their gingiva starts bleeding while brushing their teeth, instead of what they have to do, which is brushing and flossing frequently. Moreover, DM patients who have dry mouth might not know that improving oral health by rinsing their mouth with a rinse that has alcohol in it can actually lead to worsening dryness. These myths could act as considerable barriers to proper prevention and management of oral disease in DM patients who are at high risk of oral diseases [6].

Eight studies with similar aims were found internationally. Three studies done in Brazil, India, and Bangalore compared equal numbers of diabetic and non-diabetic patient's knowledge [7-9]. The Brazil and India studies found that the knowledge of diabetic patients to the association of oral health and diabetes was less than the non-diabetic groups [7,8]. The study in Bangalore, however, reported that the knowledge of the diabetic group was significantly better than their peers of the non-diabetic group [9]. Other international studies conducted in Mangalore, Melbourne, Pakistan, United Arab Emirates (UAE) and Egypt, only included diabetic patients in their sample [10-14]. Both studies done in Mangalore and Pakistan found that less than half of the patients interviewed knew about the relationship between diabetes and periodontal diseases with 22.5% in Mangalore and 35.4% answering 'Yes' in Pakistan [10,12]. In Melbourne and Egypt, most of the patients reported good knowledge with 78.2% in Melbourne, 60% in UAE and 72.5% in Egypt [11,14].

On a national level, five studies were done in Saudi Arabia. A study in Abha included 612 diabetic patients and found only 47.7% that agreed there is an association between diabetes and oral diseases [15]. A study in Riyadh found that out of 278 diabetic patients, 81% were aware of the increased risk of developing oral health diseases with diabetes [16]. Another study done in Riyadh interviewed 190 individuals, where 10.5% confirmed being diabetics, and where only 31.1% strongly agreed that there is a relationship between diabetes and oral diseases [17]. Two studies were conducted in Jeddah. One study found a positive correlation between the education level and awareness about the association between oral diseases and diabetes [18]. The other study, interviewed 500 individuals, with 15.2% diabetic patients among them, and concluded that 85% found an association between diabetes and oral tissue health [19].

The studies conducted at the national levels have several limitations. The Abha study had a completely self-administered questionnaire which could have had a percentage of no response to some items of the questionnaire as well as a high chance of responder bias [15]. With regards to the Jeddah studies, one of the studies distributed the questionnaire to mall goers, not necessarily to DM patients, and it did not correlate the level of awareness with the participants' characteristics [19]. The other Jeddah study used only one clinical site with a non-random convenience sampling and a self-administered questionnaire, therefore data collected may have high responder bias [18].

The current study was designed to investigate the levels of oral health knowledge and factors associated with adequate oral health knowledge in adults with diabetes in Saudi Arabia. This study addressed any limitations found in the national studies on the same topic. The knowledge gained from this study will indicate the magnitude of oral health knowledge among DM patients in Saudi Arabia. In addition, results from this multicenter study will help in identifying what recommendations/improvements are needed in DM clinics in KSA.

Methodology

A cross sectional study was carried out from October 2020-February 2021. A non-probability, convenience sampling technique was used with any person meeting the inclusion criteria included in the study. The inclusion criteria were applied to include any person living in Saudi Arabia with diabetes type 1 or 2 of any age group. Sample size calculations were based on the fact that there are 7 million diabetic patients in Saudi Arabia [20]. The Raosoft calculator was used with a 95% CI with a 5% margin of error resulting in a sample size of 385 diabetic patients. A validated questionnaire was distributed online and included the following categories: patient demographics, DM history, general DM awareness, oral hygiene practices, awareness of association between periodontal disease, and diabetes and patient's source of knowledge.

The data was analyzed using SPSS statistical software version 24. A P-value of <0.05 was considered significant. Descriptive statistics were applied with mean (standard deviation) or median (IQR) as appropriate. Univariate and multivariate analysis was applied to determine factors that influence the level of oral hygiene knowledge among diabetic patients.

Results

Overall 1,177 individuals filled out the questionnaire with 764 (64.9%) being non diabetic and 410 (34.8%) diabetic individuals. Out of the diabetic responses 10 responses were excluded due to not meeting the criteria of living in Saudi Arabia or due to duplicate responses. Therefore, only 400 diabetics' responses were included in the analysis. They were asked to fill out a predesigned valid questionnaire to assess the level of their awareness about association between periodontal disease and diabetes. The results' section was formed of three main compartments; the first one describes characteristics of the participants; the second one displays their awareness about the association between periodontal disease and diabetes and the third part shows factors potentially associated with variation in the level of awareness.

Characteristics of the participants:
There was a dominance of females (57.3%) over males (42.8%), and the overwhelming majority were Saudis (95%). The great majority of the participants (97.0%) were aged eighteen years or older. Most of them had either undergraduate education (40.5%) or university qualifications (49.0%), with only 7.5% who had postgraduate degrees. Less than one half of the participants (44.8%) were employed, with more than one third (35.5%) having a family income ranging between 5.000 to <10,000 SR and almost one quarter had monthly income ranging between 10.000 and <20,000 SR. Smokers formed 19.8% of them (Table 1).

Clinically, according to the participants, almost two thirds (61.5%) were type II diabetics, and 15% were type I, while one quarter (23.5%) did not know their type of diabetes. Most of the cases had diabetes for a relatively long duration ranging between five to less than ten years (22.3%) and ten years or more (43.8%). Family history of diabetes was positive in most of the cases (84.8%); that were mainly first-degree relatives (82.6%). Less than two thirds of the cases (61.3%) described themselves as being controlled diabetics; and one half (51.7%) claimed that they visited a physician for follow up in the past year (Table 1).

Regarding basic knowledge of the individuals about diabetes, Table 2 shows that 53.8% of the individuals knew that diabetes is caused by an increase in blood sugar level, and 55.8% attributed it to being overweight. The great majority (95.5%) agreed that patients should eat a healthy diet and perform daily physical exercise (91.5%). Most of the participants knew that complications of diabetes include eye complications (98.3%), diabetic foot (80.3%), nervous complications (77.0%) and kidney complications (77.0%). The oral hygiene practice is presented in Table 2 which demonstrates that almost two thirds of the individuals believe that there should be regular visits to dental clinics; reasons for irregularity or no visits included high costs (4.5%), difficulty in scheduling (3.3%) and fear or anxiety (2.0%). Although the great majority (91.5%) reported that they should brush their teeth once daily, a much lesser percentage (47.5%) reported that they should floss their teeth at least once daily.

Awareness of the participants about association between periodontal disease and diabetes:
Almost two thirds of the participants (61.0%) were aware that diabetic patients are more likely to have mouth infection; and 57.5% were aware that smokers have more serious gum disease than non-smokers; and relatively lower percentages were aware that diabetes can make teeth and gums worse (55.9%) and that gum disease can lead to loss of teeth (53.8%). The lowest percentages of awareness were observed for the items that dry mouths are more likely to have tooth decay (39.3%) and gum disease makes it harder to control blood sugar (24.8%).

To facilitate comparisons of the level of awareness within the diabetic patients, the overall awareness score was calculated, with one score for each correct answer, and the summed-up outcome was transferred to percentages. The ultimate mean score percentage was 48.5%±30.3%. Notably, a borderline significance was found in the difference in awareness according to age, where older diabetic patients aged 18+ years had better levels of awareness (49.0%±30.4%) than younger patients (34.3%±23.4%) p=0.055. Otherwise, no statistically significant difference was found regarding gender, education level, employment or family income p>0.05 (Table 1). Moreover, the table shows that there is no statistically significant difference in the level of awareness of the participants according to their residence, region or health institute.

In addition, Table 1 demonstrates that type II diabetic patients recorded the highest level of awareness (51.2%±30.3%) when compared to type I diabetic patients (39.6%±27.7%). Also, it was noted that the longer the duration of diabetes corresponded to a higher level of awareness; the mean score percentage ranged between (39.1%±29.9%) in patients with duration of diabetes <1 year and up to (55.7%±31.4%) in those with duration from 5-<10 years p<0.05. On the other hand, no statistically significant difference was observed in the level of their awareness according to family history of diabetes p>0.05.

Sources of the participants' knowledge regarding diabetes:
All 400 participants answered the question of where they learned about their information regarding diabetes and oral health. As shown in Figure 1, more than half (52%) had learned from health care providers, and the internet was considered a source in 50% of participants. In addition 46% noted that family and friends were considered a source of health information, while 33% were from health awareness campaigns, 21% from books and journals and only 6% from school.

Table 1: Description of the study group (n=400).

Characteristics	No.	Percentage	Mean±SD	p
Gender:				
Male	171	42.8	51.7%±31.8%	
Female	229	57.3	46.2%±29.0%	0.079
Nationality:				
Saudi	380	95.0	49.1%±30.7%	
Non Saudi	20	5.0	38.3%±20.9%	0.039
Region				
Makkah	346	86.5	49.7%±30.1%	
Riyadh	31	7.75	37.6%±30.9%	0.126
Eastern	8	2	51.4%±29.1%	
Northern Borders	8	2	30.6%±28.3%	
Almadinah	3	0.75	66.7%±38.5%	
Albaha	2	0.5	72.2%±23.6%	
Age categories:				
<18 years	12	3.0	34.3%±23.4%	0.055
±18 years	388	97.0	49.0%±30.4%	
Education level:				
Illiterate	12	3.0	42.2%±30.1%	
Undergraduate	162	40.5	50.0%±30.5%	0.097
University	196	49.0	47.1%±29.4%	
Postgraduate	30	7.5	69.4%±8.9%	
Employment:				
Employed	179	44.8	48.2%±29.1%	0.832
Unemployed	221	55.3	48.8%±29.1%	
Family income:				
<5,000 SR	75	18.7	54.7%±32.1%	0.215
5,000-<10,000 SR	142	35.5	45.6%±29.0%	
10,000-<20,000 SR	102	25.5	47.7%±30.5%	
±20,000 SR	81	20.3	49.0%±30.3%	
Smoking status:				
Smoker	79	19.8		
Non smoker	321	80.3		
Type of diabetes:				
Type I	60	15.0	39.6%±27.7%	0.026
Type II	246	61.5	51.2%±30.3%	
Do not know	94	23.5	47.2%±31.2%	
Medications				
Insulin	74.4	18.6		
Oral Hypoglycemic drugs	244	61		
Both	75.6	18.9		

Table 1: Description of the study group (n=400).(continued)

Duration of diabetes:				
<1 year	27	6.8	39.1%±29.9%	0.035
1-<5 years	109	27.3	48.7%±30.0%	
5-<10 years	89	22.3	55.7%±31.4%	
10+ years	175	43.8	46.2%±29.6%	
Family history:				
Yes	339	84.8	48.7%±30.4%	0.784
No	61	15.3	47.5%±30.4%	
Degree of consanguinity (n=339):				
First degree	280	82.6		
Second degree	19	5.6		
Both first and second degree	23	6.8		
Distant consanguinity	5	1.5		
All	12	3.5		
Control of diabetes:				
Controlled	245	61.3		
Uncontrolled	155	38.8		
Visited physician in the past year for follow up:				
Yes	30	51.7		
No	28	48.3		
Follow up Center				
NGH	91	22.7	55.7%±30.6%	
MOH	86	21.5	45.6%±28.8%	0.064
Private	103	25.7	46.4%±29.5%	
Other	48	12	44.9%±30.1%	

Table 2: Response of the participants to the questionnaire items.

Items	No.	Percentage
Awareness about diabetes		
Causes of diabetes:		
Increase blood sugar level (right)	215	53.8
Overweight (right)	223	55.8
Body unable to make sugar (wrong)	81	20.3
Eating too much (right)	206	51.5
Recommended dietary habits:		
Patient must eat healthy diet (right)	382	95.5
Patient must eat high protein diet (wrong)	139	34.8
Patient must eat carbohydrate diet (wrong)	16	4.0
Recommended frequent exercise:		
Daily (right)	366	91.5
Complications of diabetes:		
Eye complications (right)	393	98.3
Nervous complications (right)	308	77.0
Kidney complications (right)	308	77.0
Heart complications (right)	253	63.3
Diabetic foot (right)	321	80.3
Oral hygiene practice		
Frequent visits to dental clinics:		
Regular	240	60.0
No need for regular visits	149	37.3
No visits	11	2.8
Reasons for irregular or no visits:		
High costs	18	4.5
Difficulty in scheduling	13	3.3
Fear or anxiety	8	2.0
Do not like dentists	7	1.8
Cannot miss work	8	2.0
Transportation problems	2	0.5
Frequent brushing:		
Once	366	91.5
Twice	229	57.3
>Twice	112	28.0
Never	2	0.5
Frequent flossing:		
At least once	190	47.5
Occasional	136	34.0
Never	74	18.5

Figure 1: Sources of the participants' knowledge regarding diabetes

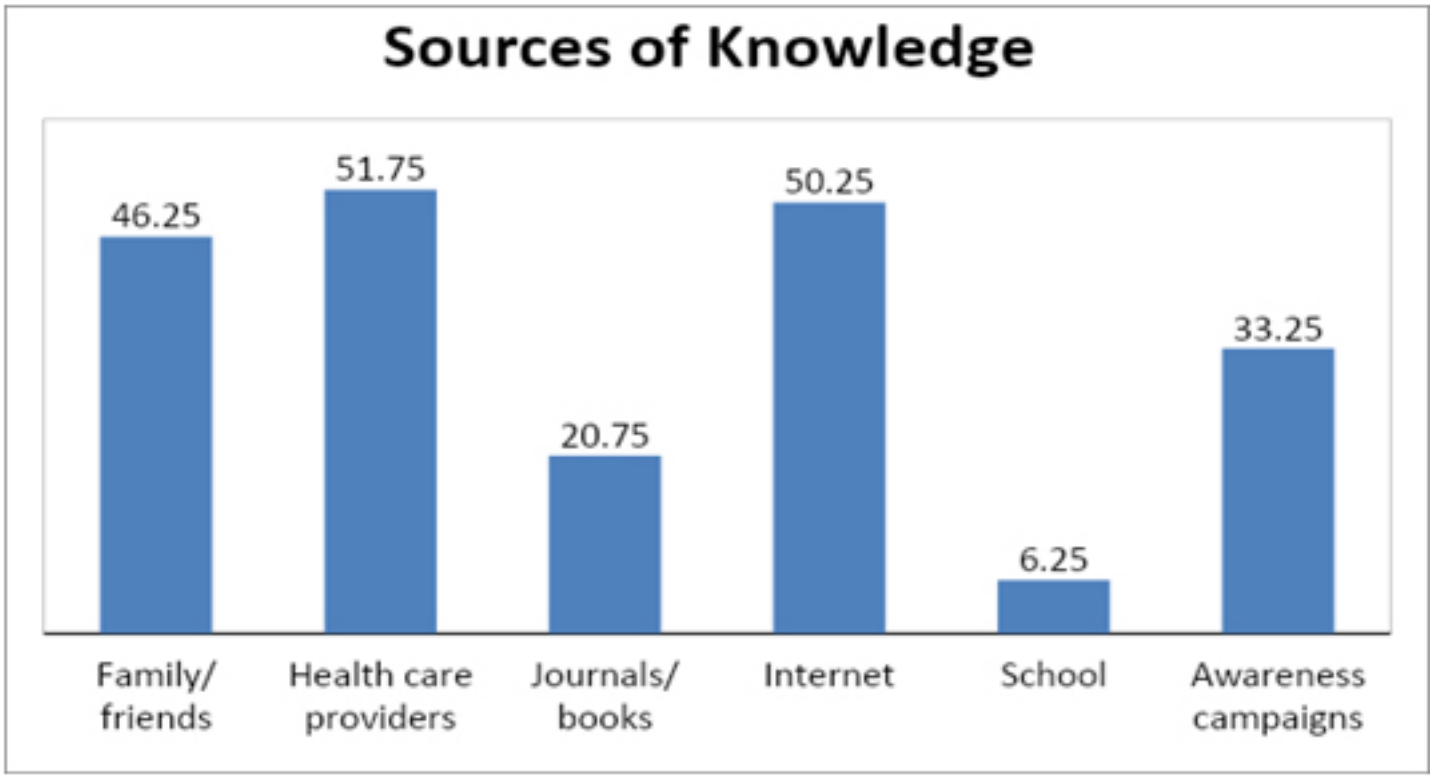

Table 3: Response of the participants to the items reflecting awareness about association of periodontal disease and diabetes.

Items*	Correct	Percentage
People with diabetes are more likely to have infection in their mouth.	244	61.0
People with diabetes are more likely to have gum disease.	221	55.3
Diabetes can make ones' teeth and gums worse.	223	55.8
People with dry mouths are more likely to have tooth decay.	157	39.3
People with dry mouths are more likely to have sore in their mouth.	171	42.8
If your gums bleed every time you brush your teeth, it's an early sign of gum disease.	198	49.5
Gum disease can lead to loss of teeth.	215	53.8
Gum disease makes it harder to control blood sugar in diabetes.	99	24.8
Diabetic smokers have more serious gum disease than nonsmokers.	230	57.5

*"Yes" is the right answer for all items.

Discussion

The prevalence of diabetes has been increasing worldwide, and WHO estimated that 366 million people will suffer from diabetes by 2030 [13]. Type 2 diabetes accounts for the majority of diabetic people around the world. This current study is in agreement with this fact as almost two thirds (61.5%) of our participants were type II diabetics. The study also showed that 61.3% of our participants described themselves as being controlled diabetics. Furthermore, results suggested that the study population had considerably more knowledge about general diabetic items and its systemic complications than they do for oral or dental complications. Most of them knew that complications of diabetes include eye complications (98.3%), diabetic foot (80.3%), nervous complications (77.0%) and kidney complications (77.0%). However, two thirds of the participants (61.0%) were aware that diabetic patients are more likely to have mouth infection; and relatively lower percentages were aware that diabetes can make teeth and gums worse (55.9%) and that gum disease makes it harder to control blood sugar levels (24.8%). Several investigators have reported similar low percentages regarding knowledge of diabetic patients. A study found that their patients were aware of the increased risk for eye diseases (98%), heart diseases (84%), kidney diseases (94%), but only 33% considered periodontal diseases as complications of diabetes [21]. Another study in the UAE also investigated similar issues and they reported closer results [13].

Diabetic patients are known to be at high risk of developing several oral health diseases such as gingivitis, periodontitis, thrush, and dry mouth [22], salivary gland dysfunction, halitosis, burning mouth sensation, candidiasis, and taste disturbance [23]. It has been established previously that DM can increase the risk of developing inflammatory periodontal diseases. On the other hand, periodontal diseases can also affect DM, by means of affecting blood glucose level [24]. Thus, prevention and management of oral health diseases are significantly important as well as increasing awareness about oral hygiene, the effect of diabetes on oral health and regular dental checkups [25].

Data in this study revealed that the majority of the participants believed they should have regular dental visits, but various reasons have been reported explaining their irregularity or no dental visits. The survey clearly showed that more than one third (35.5%) had a family income ranging between 5.000 to <10,000 SR, hence, high costs of dental clinics was the main cause (4.5%) followed by difficulty in appointment scheduling (3.3%) and fear or anxiety (2.0%). These reasons were also documented in a study done in Egypt when they assessed their patients for irregular dental visits [14]. Therefore, our results emphasize the necessity for carrying out more research in Saudi Arabia in order to identify the barriers behind the noncompliance of diabetic patients with regular dental checkups. Further research might also motivate the government, private health sectors as well as insurance companies to create a system that facilitates the annual dental visits for all diabetic patients to meet the objective of the United States National Institutes of Healthy People set in 2010 which aims to increase the proportion of diabetic patients who have annual dental visits to 71% [26].

Regarding oral hygiene practices, findings demonstrated that participants had moderate knowledge about oral hygiene measures in which 91.5% of the study population believed that brushing teeth should be at least once a day, while 47.5% believed in using dental floss to clean between their teeth. Numerous national and international previous studies supported our findings [8,14,18]. Furthermore, in accordance with national studies [16,18], our data illustrated that the greatest percentage of diabetic participants received limited advice from their healthcare providers as 6.5% of them were only advised about the importance of regular dentist checkups and 59.5% have never been advised about either brushing their teeth or regular dental visits. The awareness of oral health in relation to diabetes is a mutual responsibility between healthcare professionals and dentists, but only 45.25% of our study population had been advised by dentists to control their blood sugar. Thus, physicians, dentists and other healthcare providers play an important role in raising the awareness of oral health priority among diabetic patients and to encourage them to seek oral examinations regularly. This will help in early identification of periodontal diseases associated with diabetes and thereby lead to early prevention and better quality of life.

Results of this study revealed that older diabetic patients aged 18+ years had better levels of awareness of oral disease compared to younger patients. Similar results have been seen in a study conducted in Riyadh, Saudi Arabia [17]. In addition, type II diabetic patients recorded the highest level of awareness when compared to type I diabetic patients. This may be attributed to the fact that type I diabetes affects younger populations than type II diabetes. Also, it was noted that the longer the duration of diabetes corresponded to a higher level of awareness. Respondents who have diabetes from 5 to less than 10 years were more likely to know of the association between DM and oral health.

Other factors such as gender, education level, employment status, family income or residence region showed no statistically significant difference in the level of awareness which disagreed with the findings of the previous studies conducted in Saudi Arabia and Egypt [14,17,18]. Moreover, there is no statistically significant difference observed in the level of awareness of the participants according to the health institute they follow up at or family history of diabetes.

Different populations have different sources of information especially when it comes to health problems and complications. In this study, it was reported that Health care workers (HCW), internet, family and friends are the most used sources of information in almost 50% of the cases, while a lower percentage (33%) was from health awareness campaigns, and the least of 6% was from school. This is comparable with the results obtained from

a previous study conducted in Saudi Arabia [18]. Although HCW was one of the top three sources, other informal sources like the internet, family and friends with limited scientific background have to be taken into account. Promoting more health education programs would deliver accurate and updated information for diabetic patients. In addition, the study suggested that the role of schools in health education has to be improved especially when considering young patients with type 1 diabetes.

Conclusion and Recommendations

Patients of older age, type 2 diabetes and the longer duration of diabetes have been shown to have higher levels of awareness regarding DM and oral health. Although the level of awareness in this study is slightly better than previous studies reported in Saudi Arabia, it is still limited, indicating the need for further efforts and cooperation between physicians, diabetic educators, dentists and policy makers.

Limitations

This study was supposed to be conducted as an interview aiming for more understanding and accurate results. However, due to the Coronavirus Disease 2019 pandemic, some patients were contacted by phone while others were asked to fill out the questionnaire. Also due to this pandemic, it is reported that almost 50% of the cases confirmed non-compliance to follow up appointments during the past year leading to missed or inaccurate data regarding some factors that may considered as significant when considering oral health awareness such as compliance, controlled diabetes (recent A1C level) and regular dental visits.

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