Oral Health in Adults with Diabetes: Oral Health Conditions, Knowledge and Practice Following an Oral Health Educational Program

Marwa S. El-Ashkar [1], Zahira M. Gad [2], Mohamed D. El-Borgy [3], Nevein S. Abdalla [4], Nessrin A. El-Nimr [2] ¥

[1] Dentist, Ministry of Health and Population, El-Beheira Governorate, Egypt
[2] Department of Epidemiology, High Institute of Public Health, Alexandria University, Egypt
[3] Department of Health Administration and Behavioral Sciences, High Institute of Public Health, Alexandria University, Egypt
[4] Oral and Maxillofacial Surgery Department, Faculty of Dentistry, Alexandria University, Egypt

Abstract

Background: Diabetes mellitus is a risk factor for impaired oral health. Oral health knowledge is lacking among patients with diabetes.

Objective(s): The objectives of the study were to assess the oral health condition of patients with controlled and uncontrolled diabetes, to assess knowledge and practice of patients with diabetes concerning oral health and to construct, implement and evaluate the impact of an educational program for patients with diabetes on their oral health, their knowledge and self-reported practice regarding oral health.

Methods: A sample of 200 adult patients with diabetes mellitus attending two hospitals in Alexandria was included in the study. In phase 1, a cross sectional design was used and assessment of the patients' diabetes control, their oral health condition, knowledge and self-reported practice was carried out. In phase 2, an educational oral health intervention program was constructed and its effect on the patients' oral health condition, knowledge and self-reported practice was done.

Results: Most patients with diabetes had unsatisfactory glycemic control, 27.5% had good knowledge, while 75% had poor oral health practice. The oral health condition of patients with satisfactory diabetes control was relatively better than those with unsatisfactory control. The knowledge score, practice, gingivitis, plaque and calculus indices improved after the intervention

Conclusion: Better glycemic control is associated with better oral health conditions. Patients with diabetes had insufficient oral health knowledge and poor practice. The educational program improved their knowledge and practice, while some parameters of oral health improved.

Keywords: Diabetes; educational program; knowledge; oral health; practice

INTRODUCTION

Diabetes mellitus (DM) is a growing problem worldwide. It affects 5% of the world's population and the number of cases is doubling every generation. In 2014, the World Health Organization (WHO) estimated that the prevalence of DM in Egypt was 17.2% (15.3% among males and 19% among females).[1] The International Diabetes Federation (IDF) has identified Egypt as the ninth leading country in the world for the number of patients with type 2 DM. The prevalence of type 2 diabetes in Egypt was almost tripled over the last 2 decades.[2]

Patients with DM who do not carefully control their blood glucose levels are at high risk of systemic and oral complications.[3] The oral complications of DM are numerous and devastating including periodontal diseases (periodontitis and gingivitis); salivary dysfunction leading to a reduction in salivary flow, changes in saliva composition, taste dysfunction and xerostomia; increased susceptibility to bacterial, viral, and fungal infections; increased risk for dental caries; periapical abscesses and burning mouth syndrome. It also causes oral mucosal lesions in the form of stomatitis, geographic tongue, benign migratory glossitis, fissured tongue, traumatic ulcer, lichen planus, lichenoid reaction and angular chelitis.[4-7] In addition, delayed mucosal wound healing, mucosal neuro-sensory disorders, dental caries and tooth loss has been reported in patients with DM.[8] A meta-analysis of four studies with a total of 3,524 adults (>18 years old) showed

that those with diabetes have a two-fold higher risk of developing periodontal disease compared to those without diabetes.[9] Nationwide surveys in the USA have demonstrated that people with diabetes, especially poorly controlled diabetes, have a significantly higher prevalence of severe periodontitis.[10] In Michigan, USA (2011), the prevalence of moderate gingivitis was 44.8% among patients with diabetes.[11] In India, several studies investigated the oral complications of diabetes and reported that 85% of diabetic patients had periodontitis (2015),[12] while hospital based studies reported that the prevalence of dental caries among patients with diabetes ranged from 13.6% (2012)[13] to 73.33% (2016).[14]

Even though there is strong evidence that supports the relationship between oral health and DM, oral health knowledge is lacking among both patients with DM and health professionals.[15] Patients with DM have more knowledge about their increased risk for systemic complications associated with diabetes than they do for oral complications.[16] Maintaining proper oral hygiene through oral self-care is also lacking among patients with DM as reported by other studies.[16,17]

The objectives of the study were to assess the oral health condition of controlled and uncontrolled patients with DM, to assess knowledge and practice of patients with DM concerning oral health and to construct, implement and evaluate the impact of an educational program for patients with DM on their oral health, their knowledge and self-reported practice regarding oral health.

METHODS

The study was conducted during 2016 in the outpatient diabetes clinics in two hospitals in Alexandria: Alexandria Main University Hospital and one of the Ministry of Health and Population (MOHP) Hospitals; El-Ramad Hospital. This hospital was selected randomly from a list of the six hospitals belonging to the MOHP with diabetes and dental clinics. The target population were adults with DM, aged 35 years and above with clinically diagnosed type 1 or type 2 diabetes for at least one year earlier. Patients with gestational diabetes were excluded.

In phase I, a cross sectional study design was used, while an intervention design (one group pretest post-test design) was used in phase II. The sample size was calculated using Epi-Info software version 7. Based on a percent of periodontal disease of 92%[18] among patients with DM, and confidence limit of 4%, the minimum required sample size at 95% confidence level was calculated to be 177. The sample was rounded to 200 patients (100 patients from each hospital). Patients attending diabetic clinics in the two hospitals were consecutively recruited until completion of the required sample size. A sub-sample was included for the intervention and was calculated based on an assumption of 0.05 α-error, 80% power, a prevalence of knowledgeable patients of 50% and an effect size of 0.33.[19] The minimum required sample size was calculated to be 100

patients with DM using G-power software. The subsample was selected at random from the initial sample of patients attending El-Ramed Hospital. This hospital was selected because it has a lecture room and the patients come regularly for follow up and treatment .

The authors collected data using an interviewing questionnaire, clinical oral examination, and laboratory investigation. The pre-designed structured interviewing questionnaire was used to collect data from patients with DM on the diabetes clinic day in each hospital. It consisted of three sections. Section I included socio-demographic characteristics, and family and medical history of DM. Section II consisted of 26 questions about knowledge of patients regarding teeth and their cleaning methods, dental caries, plaque, calculus, gingival bleeding, effect of sweets, the relation between diabetes and oral diseases and role of dentistry in diabetic oral health. Single and multiple response questions were used and the authors constructed a special scoring system to assess knowledge. The total knowledge score was calculated by summing the scores of all questions yielding a total knowledge score ranging from 0 to 27 and was classified as good (≥ 75% or 20.3 - 27 points), fair (50%-< 75% or 13.5 -< 20.3 points) and poor (<50% or 0- <13.5 points) levels of knowledge. Section III consisted of 15 questions about self-reported practice of patients with DM regarding oral health including teeth and their cleaning, eating sweets, managing dry mouth, dealing with removable dentures and frequency of dental visits. A special scoring system was constructed by the authors to assess the patients' self-reported practice. Summation of overall practice answers score was done yielding a total score ranging from 0 to 15. The total sum was classified as good (≥75% or 11.3-15 points), fair practice (50%-< 75% or 7.5 - < 11.3 points) and poor practice (< 50% or 0 - < 7.5 points).

The authors carried out an examination of the oral cavity and the following were assessed: the gingival and periodontal condition using periodontal disease index (PDI) with its three components; gingival and periodontal component, plaque component and calculus component[20], the condition of teeth using Decayed Missing Filled teeth (DMFT) index,[21] the condition of xerostomia using Fox's xerostomia index,[22], and the presence or absence of any oral mucosal lesion and gingival abscesses.

Patients were referred to the laboratory department in each selected hospital and a blood sample was taken to assess the level of glycosylated haemoglobin concentration (A1C). Guided by the American Diabetes Association (2014), diabetes control was considered to be satisfactory if the A1C was ≤ 7.5%, and unsatisfactory if it was > 7.5%.[23]

Based on the pre-identified educational needs of patients about oral health knowledge and practices after analysis of the findings from phase I, the authors developed an educational oral health intervention program to improve the oral health condition among patients with DM. Patients were divided into four groups (about 25 patients in each group). For each group, the content of the

oral health program was covered in four sessions. Each session lasted from 40-60 minutes (including lectures, group discussions, role play and demonstrations using dental models). At the end of the program, a booklet on the importance of oral health, which was developed by the authors, was given to all patients.

The authors assessed the impact of the intervention on the patients' knowledge, self-reported practice and oral health condition three months after its termination using the same data collection tools; namely the interviewing questionnaire and clinical oral examination .

Statistical analysis:
The collected data were revised, coded and fed to statistical software IBM SPSS version 20. Graphs were constructed using Microsoft excel software. All statistical analyses were done using two tailed tests and p value less than 0.05 was considered to be statistically significant. Mean with standard deviation and percent were used to describe the scale and categorical data, respectively. Pearson's chi square test (X^2), Pearson Correlation, paired t test, Mc-Nemar test, Marginal homogeneity test and Cochrane Q test were used. Linear regression was used to predict the dependent variable (knowledge and self-reported practice of patients with DM) on the basis of continuous and/or categorical independents (socio-demographic data and sample characteristics) and to determine the effect size of the independent variables on the dependent; to rank the relative importance of independent variable for predicting the outcome variable and to understand the impact of covariate control variables.

Ethical considerations:
The study protocol was reviewed and approved by the Ethics Committee of the High Institute of Public Health, Alexandria University. The International Guidelines for Research Ethics were followed. Informed verbal consent was obtained from all patients after explanation of the objectives and benefits of the research and confidentiality was ensured.

RESULTS

The patients' age ranged from 35 to 65 years with a mean age of 50 ± 9 years and a median of 50 years, 89.0 % were females, 74.5% were married, 57.5% were illiterate or read and write, 30.5% completed primary and preparatory education, while only 3.5% had university education or above. Most patients (83.5%) were housewives and only 1.5% were professionals, 77% were living in urban areas and 61% reported having insufficient income. The mean crowding index was 2.44± 0.76 with a range from 1 to 6 persons/room. About 82% reported having family history of DM. One third (33%) of patients had diabetes for 1- < 5 years, 27.5% had diabetes for 10- < 15 years, while 22.5% had diabetes for 15 years and above.

Most (85%) patients had type 2 DM, while 15% had type 1 DM. Nearly 52% received insulin therapy and about 68% reported that they monitored their blood glucose

every month, while equal proportions (15% each) reported that they monitored their glucose every 3 months or irregularly. Based on the A1C concentration, 175 out of the 200 patients with diabetes (87.5%) had unsatisfactory blood glucose control and 25 patients (12.5%) had satisfactory blood glucose control (Figure 1).
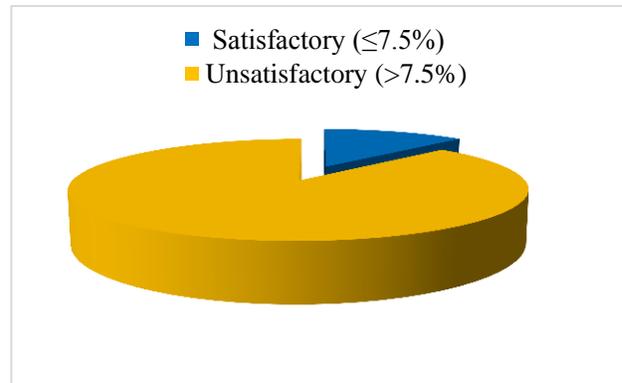
Figure 1: Distribution of patients with DM attending El-Ramad Hospital and Alexandria Main University Hospital diabetes clinics according to their diabetic control based on A1C level (Alexandria, 2016)

All patients with satisfactory diabetic control had at least one natural tooth, while 7.4% of patients with poor diabetic control were edentulous (table 1). Unexpectedly, the proportion of patients with gingivitis decreased with the decrease in the level of diabetic control, while the proportion of patients with periodontitis increased with the decrease in the diabetic control level. This difference was statistically significant (X^2= 17.2, p=0.00). The proportion of severe gingivitis increased with the decrease in the diabetic control (55.8% among unsatisfactory control and 35.3% among satisfactory control). Patients with unsatisfactory diabetic control had higher percent of severe periodontitis (19%) compared to 12.5% of patients with satisfactory diabetic control level.

The table also shows that almost all (97.9%) patients with DM had dental plaque regardless their diabetic control level, but patients with unsatisfactory control had higher percent of severe dental plaques (71.5%) compared to those with satisfactory control (56%). The association between the plaque index and diabetic control was statistically significant (X^2= 11.99, p=0.002). Patients with satisfactory diabetic control had higher percent of mild form of calculus (38.1%), while almost equal proportions of patients with satisfactory and unsatisfactory control had severe calculus with a statistically significant association X^2= 6.72, p=0.03). One fifth (20%) of patients with satisfactory diabetic control had more than five decayed teeth, compared to 23.5% of patients with unsatisfactory diabetic control. About 25% of patients with poor control had from one to five filled teeth, compared to 24% of patients with satisfactory control. Higher percent of patients with >12-< 32 missed teeth (19.1%) was noticed among patients with unsatisfactory control compared to 16% among those with satisfactory control.

Table 1: Distribution of patients with DM attending El-Ramad and Alexandria Main University Hospital diabetes clinics according to their oral health and their diabetic control based on A1C level (Alexandria, 2016)

Oral health	Diabetic control level		Total (n=200)	X^2 (*p* value)
	Satisfactory control (n=25)	Unsatisfactory control (n=175)		
	No. (%)	No. (%)	No. (%)	
Presence or absence of teeth				
Edentulous	0 (0.0)	13 (7.4)	13 (6.2)	X^2 = 1.9
Patients with at least one tooth	25 (100.0)	162 (92.6)	187 (93.5)	(p=0.16)
Presence of gingivitis or periodontitis (n=187) [a]				
Gingivitis	17 (68.0)	43 (26.5)	60 (32.1)	X^2 = 17.2
Periodontitis	8 (32.0)	116 (71.6)	124 (66.3)	(p=0.00*)
Free from both	0 (0.0)	3 (1.9)	3 (1.6)	
Gingivitis score (n= 60) [b]				
Mild (score >0-1)	3 (17.6)	2 (4.7)	5 (8.3)	X^2 = 3.67
Moderate (score 1.1-2	8 (47.1)	17 (39.5)	25 (41.7)	(p=0.16)
Severe (score 2.1-3)	6 (35.3)	24 (55.8)	30 (50.0)	
Periodontitis score (Pocket score) (n=124) [c]				
Mild (score > 3-4)	0 (0.0)	2 (1.7)	2 (1.6)	X^2 = 0.37
Moderate (score 4.1- 5)	7 (87.5)	92 (79.3)	99 (79.9)	(p=0.83)
Severe (score 5.1 - >6)	1 (12.5)	22 (19.0)	23 (18.5)	
Presence of dental plaque (n=187) [a]				
Yes	25 (100.0)	158 (97.5)	183 (97.9)	X^2 = 0.63
No	0 (0.0)	4 (2.5)	4 (2.1)	(p=0.42)
Plaque index (n=183) [d]				
Mild (score >0-1)	4 (16.0)	3 (1.9)	7 (3.8)	X^2 = 11.99
Moderate (score 1.1-2)	7 (28.0)	42 (26.6)	49 (26.8)	(p=0.002*)
Severe (score 2.1-3)	14 (56.0)	113 (71.5)	127 (69.4)	
Presence of dental calculus (n=187) [a]				
Yes	21 (100.0)	156 (96.3)	177 (94.7)	X^2 = 0.8
No	0 (0.0)	6 (3.7)	10 (5.3)	(p=0.37)
Calculus Index (n=177) [e]				
Mild (score >0-1)	8 (38.1)	26 (16.7)	34 (19.2)	X^2 = 6.72
Moderate (score 1.1-2)	6 (28.6)	83 (53.2)	89 (50.3)	(p=0.03*)
Severe (score 2.1-3)	7 (33.3)	47 (30.1)	54 (30.5)	
Total number of decayed teeth (n=187) [a]				
No decayed teeth	1 (4.0)	25 (15.4)	26 (13.9)	X^2 = 2.9
1-5	19 (76.0)	99 (61.1)	118 (63.2)	(p=0.23)
>5	5 (20.0)	38 (23.5)	43 (22.9)	
Total number of filled teeth (n=187) [a]				
No filled teeth	17 (68.0)	118 (72.8)	135 (72.1)	X^2 = 2.14
1-5	6 (24.0)	40 (24.7)	46 (24.7)	(p=0.34)
5	2 (8.0)	4 (2.5)	6 (3.2)	
Total number of missed teeth (n=187) [a]				
No missed teeth	3 (12.0)	24 (14.8)	27 (14.4)	X^2 = 0.35
1-12 teeth	18 (72.0)	107 (66.0)	125 (66.9)	(p=0.84)
>12 - <32 teeth	4 (16.0)	31 (19.1)	35 (18.7)	

* Significant (p<0.05)

a % calculated among patients who had teeth

b % calculated among patients who had gingivitis

c % calculated among patients who had periodontal pocket

d % calculated among patients who had dental plaque (n=183)

e % calculated among patients who had dental calculus (n=177)

Table 2 reveals that patients with poor level of knowledge about oral health accounted to 27.5%, while 72.5% had fair and good level of knowledge [only one patient had good knowledge (0.5%) and 72% had fair knowledge]. On the other hand, three-quarters of patients had poor oral health practice, while none of patients had good practice. The correlation between the level of oral health knowledge and self-reported practice of patients with DM and the oral health indices (gingivitis score, periodontitis score, plaque index and calculus index) and their diabetic control level was tested. The correlation between knowledge score and all the oral health indices was negative, weak and significant, while the correlation between their self-reported practice and their oral health indices was positive, weak and significant, except for the periodontitis score which was negative, weak and not significant. The correlation between the level of oral health knowledge and the level of diabetic control was negative, weak and not significant, while a positive, weak and non-significant correlation was detected between level of self-reported practice and the level of diabetic control.

Table 2: Level of knowledge and self-reported practice of patients with DM attending El-Ramad Hospital and Alexandria Main University Hospital diabetes clinics regarding oral health (Alexandria, 2016)

Knowledge and self-reported practice	No. (%) n=200
Level of knowledge	
Fair/Good	145 (72.5)
Poor	55 (27.5)
Mean score ± SD	**16.83 ± 3.02**
Range	**7.00 - 25.00**
Level of self-reported practice	
Fair	50 (25.0)
Poor	150 (75.0)
Mean score ± SD	**2.79 ± 1.80**
Range	**0.00- 7.00**

SD: standard deviation

Linear regression analysis showed that higher levels of education and living in urban areas were the factors associated with better oral health knowledge, while being previously married was associated with poor oral health knowledge (table 3). About 24% of the variability which occurred in the patients' level of knowledge were attributed to these three factors (r2=0.239). On the other hand, one significant variable (monthly income) and two considerable variables (female sex and A1C level) affected the patients' oral health self-reported practice levels. Patients with insufficient monthly income had poor oral health self-reported practice, female patients with DM were more common to have fair self-reported practice than male patients and the level of oral health self-reported practice is becoming poor with the increase in the blood A1C level. About 33% of the change in the self-reported practice could be attributed to these variables (r2=0.334).

About 160 diabetic patients were called by phone and 115 patients came for the educational sessions (response rate= 71.9%). At the end of the study, 87 patients with DM completed the four educational sessions and completed the educational program questionnaire and oral clinical examination with a dropout rate of 24.3%.

The mean knowledge score increased from 16.7±3.1 points before the intervention to 24.5±3.4 points after the intervention (table 4). There was a significant improvement of patients' knowledge score regarding all aspects of oral health after the intervention. The total good knowledge has improved from 0% before the intervention to 69% after the intervention, while the total poor knowledge score was reduced from 27.6% to 3.4% with a percent decrease of 24.1%. This change was statistically significant.

Table 5 shows that the mean self-reported practice score increased from 3±1.6 before the intervention to 3.4±2.1 after the intervention. The level of self-reported practice regarding all aspects of oral health have significantly increased after the intervention. The total poor self-reported practice was reduced from 75.9% before the intervention to 57.5% after the intervention with a percent decrease of 18.4% with a statistically significant difference.

The percent of patients who had gingivitis, plaque and calculus before the intervention (95.7%, 85.4% and 90.2%, respectively) was reduced to 86.9%, 24.4% and 36.6%, respectively three months after the intervention (table 6). On the other hand, 4.3%, 14.6% and 9.8% of patients were free of gingivitis plaque and calculus before the intervention compared to 13.1%, 75.6% and 63.4% after intervention, respectively. These differences were statistically significant. The gingivitis score was 1.89±0.70 before and 1.31±0.91 after the intervention with a statistically significant difference, while the difference in the mean periodontitis score before and after the educational intervention was not statistically significant. The table also shows that the differences between the missed, decayed and filled teeth before and after the intervention was not statistically significant.

Table 3: Linear regression analysis of the factors affecting knowledge (model a) and self-reported practice (model b) of patients with DM attending El-Ramad Hospital and Alexandria Main University Hospital diabetes clinics regarding oral health (Alexandria, 2016)

Independent variables	Coefficient B	Standard error	p value
Model a: Knowledge regarding oral health			
Education (higher levels)	1.449	0.281	0.000*
Previously married	- 0.655	0.287	0.024*
Urban residence	1.126	0.518	0.031*
Non-significant variables			
Age (years)	0.033	0.028	0.242
Sex	0.698	0.708	0.326
Occupation	-0.032	0.766	0.967
Monthly income	0.067	0.480	0.889
Crowding index	0.112	0.285	0.695
Family history of DM	-0.140	0.507	0.782
Duration of DM	0.122	0.202	0.546
Type of DM	0.382	0.667	0.567
Constant	9.722	2.619	0.000*
$r^2= 0.239$ F= 5.373 p<0.0001			
Model b: Self-reported practice			
Monthly income	-1.613	0.414	0.000*
Considerable variables:			
Female gender	1.762	1.040	0.094
A1C level	0.168	0.099	0.095
Non-significant variables			
Age (years)	0.018	0.024	0.458
Family History of DM	-0.696	0.451	0.127
Crowding Index (CI)	-0.014	0.271	0.959
Level of education	-0.115	0.251	0.650
Type of DM	0.372	0.574	0.519
Previously married	-0.003	0.243	0.989
Rural residence	0.055	0.427	0.899
Duration of DM	-0.244	0.192	0.208
Total knowledge score	0.087	0.059	0.140
Constant	0.719	3.233	0.825
$r^2=0.334$ F= 3.093 p= 0.001*			

* Significant (p<0.05)

Table 4: Oral health knowledge of patients with DM attending El-Ramad Hospital and Alexandria Main University Hospital diabetes clinics before and after the intervention (Alexandria, 2016)

Oral health knowledge (n=87)	Before intervention No. (%)	After interention No. (%)	% change	Test of significance X^2_{mc} (p)
Knowledge regarding teeth and their cleaning methods				
Poor	69 (79.3)	12 (13.8)	-65.5	
Fair	18 (20.7)	61 (70.1)	49.4	15.9 (0.001*)
Good	0 (0.0)	14 (16.1)	16.1	
Knowledge regarding dental caries, plaque, calculus, gingival bleeding and effect of sweets				
Poor	17 (19.5)	1 (1.1)	-18.4	
Fair	67 (77.0)	42 (48.3)	-28.7	11.6 (0.001*)
Good	3 (3.4)	44 (50.6)	47.1	
Knowledge regarding the relation between diabetes and oral diseases				
Poor	4 (4.6)	2 (2.3)	-2.3	
Fair	24 (27.6)	2 (2.3)	-25.3	9.6 (0.001*)
Good	59 (67.8)	83 (95.4)	27.6	
Knowledge regarding role of dentistry in diabetic oral health				
Poor	52 (59.8)	8 (9.2)	-50.6	
Fair	35 (40.2)	13 (14.9)	-25.3	20.9 (0.001*)
Good	0 (0.0)	66 (75.9)	75.9	
Total knowledge				
Poor	24 (27.6)	3 (3.4)	-24.1	
Fair	63 (72.4)	24 (27.6)	-44.8	21.8 (0.001*)
Good	0 (0.0)	60 (69.0)	69.0	
Mean score ± SD	**16.7 ± 3.1**	**24.5 ± 3.4**		

* Significant (p<0.05); X2mc, Mc-Nemar Test; SD, standard deviation

Table 5: Oral health self-reported practice of patients with DM attending El-Ramad Hospital and Alexandria Main University Hospital diabetes clinics before and after the intervention (Alexandria, 2016)

Oral health self-reported practice (n=87)	Before intervention No. (%)	After interention No. (%)	% change	Test of significance X^2_{mc} (p)
Self-reported practice regarding teeth and their cleaning				
Poor	68 (78.2)	38 (43.7)	-34.5	
Fair	19 (21.8)	38 (43.7)	21.8	12.8 (0.00*1)
Good	0 (0.0)	11 (12.6)	12.6	
Self-reported practice regarding dental visit				
Poor	54 (62.1)	35 (40.2)	-21.9	20.4 (0.001*)
Fair	33 (37.9)	52 (59.8)	21.9	
Self-reported practice regarding eating sweets, managing dry mouth and dealing with removable dentures				
Poor	19 (21.8)	4 (4.6)	-17.2	7.3 (0.001*)
Fair	68 (78.2)	83 (95.4)	17.2	
Total self-reported practice				
Poor	66 (75.9)	50 (57.5)	-18.4	6.6 (0.010*)
Fair	21 (24.1)	37 (42.5)	18.4	
Mean ± SD	**3.0 ±1.6**	**3.4 ± 2.1**		

* Significant (p<0.05); X2mc, Mc-Nemar Test; SD, standard deviation

Table 6: Oral health indices of patients with DM attending both El-Ramad Hospital and Alexandria Main University Hospital diabetes clinics before and after the intervention (Alexandria, 2016)

Oral health indices	Before intervention No. (%)	After intervention No. (%)	MH (p)
Gingivitis (n=23)			
Yes	22 (95.7)	20 (86.9)	
No	1 (4.3)	3 (13.1)	-
Gingivitis score [a]			
Mild	2 (9.1)	4 (20.0)	0.028*
Moderate	9 (40.9)	12 (60.0)	
Severe	11 (50.0)	4 (20.0)	
Mean ± SD	1.89 ± 0.70	1.31 ± 0.91	t_p (p) =2.5 (0.014*)
Periodontitis score (n=59) [b]			
Mild (score > 3-4)	2 (3.4)	3 (5.1)	0.235
Moderate (score 4.1- 5)	44 (74.6)	45 (76.3)	
Severe (score 5.1 - >6)	13 (22.0)	11 (18.6)	
Mean ± SD	3.43 ± 0.97	3.10 ± 1.34	t_p (p) = 1.5 (0.121)
Presence of plaque (n=82) [c]			
Yes	70 (85.4)	20 (24.4)	0.001*
No	12 (14.6)	62 (75.6)	
Mean ± SD	2.12 ± 0.82	1.59 ± 0.94	t_p (p) =3.9 (0.001*)
Presence of calculus (n=82) [c]			
Yes	74 (90.2)	30 (36.6)	0.001*
No	8 (9.8)	52 (63.4)	
Mean ± SD	1.56 ± 0.80	1.19 ± 0.77	t_p (p) = 3.0 (0.003*)
Total number of decayed teeth (n=82) [c]			
No decayed teeth	11 (13.4)	10 (12.2)	
1-5 teeth	55 (67.1)	54 (65.9)	0.859
>5 teeth	16 (19.5)	18 (21.9)	
Mean ± SD	3.19 ± 2.49	3.24 ± 2.55	t_p (p) = 0.14 (0.888)
Total number of filled teeth (n=82) [c]			
No filled teeth	60 (73.2)	58 (70.8)	
1-5 teeth	20 (24.4)	22 (26.8)	0.745
>5 teeth	2 (2.4)	2 (2.4)	
Mean ± SD	0.65 ± 1.42	0.76 ± 1.46	t_p (p) = 0.50 (0.615)
Total number of missed teeth (n=82) [c]			
No missed teeth	10 (12.2)	10 (12.2)	
1-12 missed teeth	63 (76.9)	56 (68.3)	0.806
>12 - <32 missed teeth	9 (10.9)	16 (19.5)	
Mean ± SD	7.03 ± 6.96	8.43 ± 7.96	tp (p) = 1.2 (0.222)
DMFT [c]			
Very low caries prevalence	80 (97.6)	82 (100.0)	Q = 0.155
Low caries prevalence	2 (2.4)	0 (0.0)	

* Significant (p<0.05); MH, Marginal Homogeneity test; tp, Paired t-test; Q, Cochrane Q test
a % calculated among patients who had gingivitis
b % calculated among patients who had periodontitis
c % calculated among patients who had teeth (n=82)

DISCUSSION

Oral diseases among patients with DM are increasingly regarded as behavioral illnesses.24 Patients with DM generally develop complications due to lack of awareness of the disease. Patient education programs and programs intended to change behavior are a particular need and could play a role in lessening the complications related to diabetes.[25]

In the present study, female patients overcome males with a female to male ratio of 8.5:1, possibly because females have more time than males to come for follow up regarding their DM condition. Besides, they tend to attend the MOHP Hospitals due to its lower cost compared to Private Health Sectors. The majority of patients were with lower educational levels because most patients were housewives.

Type 2 diabetes accounts for the vast majority of people with diabetes around the world.[25] The results of the present study was in agreement with this fact (85% had type 2 DM). The current study demonstrated that most patients had unsatisfactory blood glucose control. Similar percentage was reported from a study in Brazil,[26] but was in contrast with the results of the study conducted in India in 2012.23 The majority of the patients in the present study were with low level of education and they had poor knowledge on the importance of controlling blood glucose level, which may explain the high percentage of poor glycemic control.

The present study established that patients with DM had more advanced periodontal diseases and that higher percentage of patients with unsatisfactory controlled blood glucose level had severe periodontitis compared to patients with satisfactory controlled level. This confirmed the strong and old interrelationship between DM and the occurrence of periodontitis which is the most common oral complication of DM disease worldwide.[27] It also indicated that patients with diabetes in the current study did not ask for early treatment of their periodontal conditions.

High percentages of decayed teeth and filled teeth among both patients with satisfactory and unsatisfactory controlled blood glucose levels were noticed in the current study compared to the figures reported in other studies.[28, 29] Different DMF index figures between the different studies may be attributed to different types of consumed food that predispose to dental diseases in different countries. There is, however, a problem in comparing diabetic control level between studies in other countries as different methods of A1C analysis have been used, which might explain such wide discrepancy between countries. Another factor could be the personnel differences in dealing with decayed teeth in different communities.

The present study showed that more than quarter of patients had poor knowledge regarding oral health and three quarters had poor oral health self-reported practice. This may indicate lack of oral health counseling on the part of physicians and dentists and the lower educational levels

of participants. The results were consistent with studies conducted in Saudi Arabia and Pakistan [30, 31] while better findings were reported from Iran, 2013.[15] The lower levels of self-reported practice could be explained by several factors. The poor self-reported practice about teeth and their cleaning methods could be due to financial difficulties or lack of knowledge of the availability of these various aids. Poor practice concerning dental visits might be because of their lack of knowledge regarding importance of visiting the dentist regularly, phobia from the dental visits, long waiting time in the dental clinics and the cost of dental visits.

The linear regression analysis showed that level of education, was among the factors affecting patients' knowledge which was reported in another study.[15] Another factor was being from an urban area. An explanation could be the different sources of information about oral health between urban and rural populations. High monthly income was a significant predictor for patients' self-reported practice, which could be due to better affordability of the dental cleaning aids. Female gender was one of the considerable variables affecting patients' self-reported practice, which disagreed with the finding reported from Iran.[15]

The present study showed an improvement in the oral health knowledge following the oral health program, which was in accordance with several studies,[32,33] Improvement in the oral health self-reported practice regarding teeth and their cleaning methods and regarding dental visits was observed in the present study. This was supported by another Iranian study.[34] It was noticed that the self-reported practice has improved after the intervention despite the total knowledge score not being a significant predictor of the self-reported practice. A possible explanation was depending on the patients' own report for assessment of their oral health practice rather than direct observation .

The current study also suggested that the mean periodontitis score and the mean plaque index improved after the oral program intervention, which was supported by the findings of other studies.[33, 34]

Limitations of the study
The study did not include patients with DM in other health settings such as health insurance hospitals and private hospitals. Self-reporting of practice has its limitation in terms of over-reporting, while daily self-monitoring would be a better method in assessing practice.

In conclusion, patients with DM had unsatisfactory blood glucose control level, fair/poor oral health knowledge and poor self-reported practice. Patients with satisfactory controlled diabetes had a relatively better oral health condition than patients with unsatisfactory controlled diabetes. High level of education and urban residence were associated with better oral health knowledge, while being previously married was associated with poor oral health knowledge. The monthly income, the

female gender and the A1C concentration were among the considered variables affecting self-reported oral health practice. The educational intervention program was effective in improving the oral health knowledge, self-reported practice, the mean gingivitis score, dental plaque and dental calculus indices of patients with DM .

Oral health should be promoted in people with diabetes as an integral component of their overall diabetes management. Close collaboration between medical and dental clinical teams is necessary for the joint management of people with diabetes and periodontitis, and contact with dentists is important after the diagnosis of diabetes. Training and advising healthcare professionals particularly dentists concerning importance of good oral health in patients with DM. Dental professionals are required to raise the awareness among patients of their increased risk for oral diseases and the impact of oral health on their general health.

Conflict of Interest: None to declare.

REFERENCES

1. WHO. Global status report on non-communicable diseases, 2014. Geneva: WHO; 2014. 279p.
2. Hegazi R, El-Gamal M, Abdel-Hady N, Hamdy O. Epidemiology of and Risk Factors for Type 2 Diabetes in Egypt. Ann Glob Health. 2015;81(6):814-20.
3. Skamagas M, Breen TL, Leroith D. Update on diabetes mellitus: prevention, treatment, and association with oral diseases. Oral Dis. 2008;14:105-14.
4. Stegeman CA. Oral manifestations of diabetes. Home Health Nurse. 2005;23(4):233-42.
5. Moin M, Malik A. Frequency of Dental Caries and level of risk among type 2 diabetics. Dentistry. 2015;5(10).
6. Siudikiene J, Machiulskiene V, Nyvad B, Tenovuo J, Nedzelskiene I. Dental caries increments and related factors in children with type 1 diabetes mellitus. Caries Res. 2008;42(5):354-62.
7. Vasconcelos BC, Novaes M, Sandrini FA, Maranhão Filho AW, Coimbra LS. Prevalence of oral mucosa lesions in diabetic patients: a preliminary study. Rev Bras Otorrinolaringol. 2008;74 (3):423-8.
8. Guariguata L, Whiting DR, Hambleton I, Beagley J, Linnenkamp U, Shaw JE. Global estimates of diabetes prevalence for 2013 and projections for 2035. Diabetes Res Clin Pract 2014; 103 (2):137-49.
9. Papapanou PN. Periodontal diseases: epidemiology. Ann Periodontol. 1996;1(1):1–36.
10. Sai C, Hayes C, Taylor GW. Glycemic control of type 2 diabetes and severe periodontal disease in the US adult population. Community Dent Oral Epidemiol. 2002;30:182–92.
11. Kanjirath PP, Kim SE, Inglehart MR. Diabetes and oral health: The importance of oral health–related behavior. J Dent Hyg. 2011;85(4):264-72.
12. Ravindran R, Deepa M, Sruthi A, Kuruvila C, Priya S, Sunil S et al. Evaluation of oral health in type II diabetes mellitus patients. Oral Maxfacl Pathol J. 2015;6 (1):525-31.
13. Bharateesh JV, Ahmed M, Kokila G. Diabetes and Oral Health: A case-control study. Int J Prev Med. 2012;3(11):806–9.
14. Malvania EA, Sheth SA, Sharma AS, Mansuri S, Shaikh F, Sahani S. Dental caries prevalence among type II diabetic and nondiabetic adults attending a hospital. J Int Soc Prev Community Dent. 2016;6(Suppl 3):S232–6.
15. Moghadam FA, Haerian A, Salami MS, Karbasi MH, Fakhr-tabatabayi R, Vaziri F. Evaluation of knowledge, Attitude and Practice between Periodontal Disease and Diabetes. J Community Health Res. 2013;2(2):124-30.
16. Bowyer V, Sutcliffe P, Ireland R, Lindenmeyer A, Gadsby R, Graveney M, et al. Oral health awareness in adult patients with diabetes: a questionnaire study. Br Dent J. 2011;23:211-7.
17. Bakhshandeh S, Murtomaa H, Vehkalahti MM, Mofid R, Suomalainen K. Oral self-care and use of dental services among adults with diabetes mellitus. Oral Health Prev Dent. 2008;6(4):279-86.
18. Bharateesh JV, Ahmed M, Kokila G. Diabetes and oral health: a case-control study. Int J Prev Med. 2012;3(11):806-9.
19. Smith RM, Fleming LE, Arheart Kl, Wilkinson JD. Periodontal disease and diabetes: knowledge and attitudes assessment project. Fla Pub Health Rev. 2007;4:12-7.
20. Poulsen S. Epidemiology and indices of gingival and periodontal disease. Pediatr Dent. 1981;3e:82-8.
21. WHO. Oral health surveys: basic methods. Geneva: WHO; 2013. 125p.
22. Fox PC, Van PF, Baum BJ, Mandel ID. Pilocarpine for the treatment of xerostomia associated with salivary gland hypofunction. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1986;61:243-8.
23. American Diabetes Association. Standards of medical care in diabetes – 2014. Diabetes care 2014; 37(Supplement 1): S14-S80.
24. Petersen PE, Bourgeois D, Bratthall D, Ogawa H. Oral health information systems – towards measuring progress in oral health promotion and disease prevention. Bull W Health Organ. 2005;83:686-93.
25. WHO. Global report on diabetes. Geneva: WHO; 2016. 86p.
26. Busato IM, Bittencourt MS, Machado MA, Grégio AM, Azevedo-Alanis LR, Busato S. Association between metabolic control and oral health in adolescents with type 1 diabetes mellitus. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2010;109 (3):e51-6.
27. Hegab A. Dental Infection and Diabetes: The Cycle. Oral Hyg Health. 2015;3(2).
28. Jawed M, Shahid SM, Shah A. Qader SA, Azhar A. Dental caries in diabetes mellitus: role of salivary flow rate and minerals. J Diab Compl. 2011;25:183–6 .
29. Yonekura S, Usui M, Murano S. Association between numbers of decayed teeth and HbA1c in Japanese patients with type 2 diabetes mellitus. Ups J Med Sci. 2017;17:108-13.
30. Ismaeil FM, Ali N. Diabetic patients knowledge, attitude and practice toward oral Health. J Edu Pract. 2013;4(20):19-25.
31. Mirza KM, Khan AA, Ali MM, Chaudhry S. Oral health knowledge, attitude, and practices and sources of information for diabetic patients in Lahore, Pakistan. Diab Care. 2007;30(12):3046-7.
32. MacDonald LL, Aylward N, Sellers E, Sloshower S, Dean HJ. Development of an Inter professional Diabetes and Oral Hygiene Education Program for Youth with Type 2 Diabetes Mellitus. Can J Diab. 2012;36:327-31.
33. Lee HK, Choi SH, Won KC, Merchant AT, Song KB, Jeong SH, et al. The effect of intensive oral hygiene care on gingivitis and periodontal destruction in type 2 diabetic patients. Yonsei Med J 2009;31;50(4):529-36.
34. Bakhshandeh S, Murtomaa H, Vehkalahti MM, Mofid R, Suomalainen K. Oral health behaviour and periodontal treatment needs in a group of Iranian adults with diabetes one year after an oral health intervention. OHDMBSC. 2010;9(2):122-30.