Statistical Significance Was Observed for The Responses Between the Participants About Knowledge, Attitude and Practice Toward the Effect of Diabetes on Oral Health in Makkah City

Raghad Alhajaji[1]*, Afaf J Alhajaji[2], Saba A Altaf[2] and Ahmad Alturkstani[3]

[1]*Family Medicine Specialist, Health Program Administration at Makkah Region Health Affairs, Ministry of Health, Saudi Arabia*
[2]*Dental Intern,Umm Al-Qura University, Saudi Arabia*
[3]*Registrar Preventive medicine and Public health,Director of Health Programs at Makkah Region Health Affairs, Ministry of Health, Saudi Arabia*

*Corresponding Author: Raghad Alhajaji, Family Medicine Specialist, Health Program Administration at Makkah Region Health Affairs, Ministry of Health, Saudi Arabia.

Abstract

Background: diabetes mellitus is one of the most common metabolic diseases. In addition to its several effects on general health, it also has a specific effect on oral health.

Methods: This comparative cross-sectional study design was conducted at governmental primary health care centers in Makkah, Kingdom of Saudi Arabia. The sample size was 222 of adults living with diabetes. The data was collected by a structured survey that included close-ended questions. The data was entered and analyzed by using multiple software programs.

Results: A total of 222 Diabetic patients 112 males (50.5%) of them and 110 females (49.5%), consisting of 176 (79.3%) Type 2 Diabetes and 30 (13.3%) Type 1 while there are 14 (6.3%) patients did not Know their diagnosis of type of diabetes. A response rate of 100% was observed, 79.7% reported that have knowledge about the effect of DM on general health while only 43.2% reported that have Knowledge about the effect of DM on oral health. 88.7% of total diabetic patients regularly Brush their teeth, on the other hand, only 33.3% reported that they do regular flossing. 84.2% of participants know the importance of routine dental visits. However, 14.9% of them go for a regular checkup while 82.2% visiting their dentist only when having dental problems

Conclusions: Diabetic patients need properly designed oral health education and screening programs to increase their knowledge and attitude toward oral health and prevent diabetic complications on oral health.

Keywords: Diabetes Mellitus; Oral Hygiene; Knowledge; Attitude, Practice; Saudi Arabia

Abbreviations

WHO: World Health Organization; DM: Diabetes Mellites; PHC: Primary Health Care

Introduction

Diabetes Mellitus (DM) is a critical issue confronting public health and according to the World Health Organization (WHO), Saudi Arabia ranks as the second highest in the Middle East and seventh in the world with regard to the prevalence of diabetes [1]. About 18.3%

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of the Saudi adult population has been diagnosed with diabetes and around 3 million are pre-diabetic [2]. Diabetes mellitus, a chronic metabolic disease [3], is characterized by high blood glucose levels that accumulates in the body and can gradually damage most organ systems, particularly the eyes, kidneys, nerves, heart, and blood vessels [4]. Additionally, it has been found to be linked to several oral complications [5] including periodontal and gingival disease [6]. Moreover, an increasing number of studies have documented a bi-directional link between diabetes and periodontitis where on one hand, uncontrolled hyperglycemia may increase the likelihood of periodontitis [7] and negatively impact periodontal treatment outcomes [8] while on the other hand, presence of periodontal inflammation impedes glycemic control [7] and may also contribute to the development of diabetes mellitus [9].

Thus, in view of this bilateral relationship and the fact that good oral hygiene and regular dental visits have an important role in the prevention and management of oral health problems [10], it is crucial to educate people with diabetes regarding proper oral hygiene habits and engage people in appropriate oral self-care practices that reduces their susceptibility to periodontal disease or hinder their diabetes management [11,12]. Conversely, people with lower health literacy levels tend to have a reduced understanding of the importance of prevention and maintenance, which in turn contributes to poor health outcomes [13].

Nevertheless, numerous studies conducted globally have indicated that diabetic people lack sufficient knowledge pertaining to oral health [14]. For instance, Abu-Gharbieh., *et al.* (2019) reported that oral health knowledge among adults in UAE was sub-optimal particularly concerning the reasons for practicing healthy habits such as flossing and brushing teeth, and that they lacked knowledge regarding the implications of diabetes in relation to oral health [15]. With regard to attitude, there is evidence that people with diabetes tend to demonstrate lower priority when it comes to their oral health as indicated by lower perceived need and importance [16,17], and it has been reported that dental visits are less common among diabetic patients as compared to non-diabetics [18]. Accordingly, healthy practices relating to oral health have been shown to be inadequate, for instance, in a cross-sectional study by Basu., *et al.* (2020) among 339 diabetic patients in Delhi, India only 18.6% of the study participants reported to practice twice-daily brushing and 15.6% undertook a dental examination in the previous year [19].

Thus, the current study aims to examine the knowledge, attitude and practices related to oral health among diabetic adults living in Makkah City, Saudi Arabia.

Methodology

A cross-sectional study was carried out to assess the knowledge of oral health and determine the attitude of DM patients toward oral hygiene by using simple random technique. The sample size consisted of 222 adult diabetic patients attending the Chronic Disease Clinic and Family Medicine Clinic at governmental Primary Health Care Centers in Makkah City, Saudi Arabia. Adult diabetic patients (18 years old and above) from both genders were included in the study while excluding pregnant ladies with diabetes, and diabetic patients younger than 18 years of age. Data was collected by an interviewer-administered (face to face interview) questionnaire. The questionnaire was composed of close-ended questions that were derived from two relevant previous studies in the same area [20,21]. The study tool adopted a simplified and modified English version questionnaire to accommodate the aim of this study. The questionnaire was divided into four main parts: part one, contained questions related to the demographic data of the participants, part two included general questions to assess the medical and dental history, part three and four consisted of simple questions with dichotomous response format to assess knowledge and attitude of the participants toward oral health.

Before the data collection, an informed consent was obtained from all potential participants, The ethical approval was obtained from the institutional review board IRB of Ministry of Health (IRB number: H-02-K-076 - 0121 - 445).

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Reliability of the questionnaire

The Cronbach's alpha value of the questionnaires was 0.757 which reflect good reliability of the questionnaire.

Statistical analysis

Data were analyzed by using Statistical Package for Social Studies (SPSS 22; IBM Corp., New York, NY, USA). Continuous variables were expressed as mean ± standard deviation and categorical variables were expressed as percentages. Kruskal-Wallis test and Mann-Whitney test were used for continuous variables without normal distribution. Shapiro-Wilk test was used to assess normality distribution for the variables. The Cronbach's alpha was used to assess reliability and internal consistency of the items in the questionnaire. Univariate and Multivariate logistic regression were used to assess the associated factors with low level of Knowledge about Oral health among Diabetes Mellitus patients. A p-value < 0.05 was considered statistically significant.

Results

A total of 222 adult diabetic patients took part in the study and included almost an equal number of males (50.5%, n = 112) and females (49.5%, n = 110). A majority of them were 60 years old and above 133 (59.9%). Regarding their education level, 30.2% (n = 67) had a bachelor's degree while 28.4% (n = 63) had less than a high school education. More than a quarter of the participants (77.9%, n = 173) were married and more than half of the participants (57.7%, n = 128) had a monthly income of less than 5000 Saudi riyals. With regard to clinical characteristics, majority of the study participants (79.3%, n = 176) had Type 2 Diabetes Mellitus (Table 1).

		Number	%
Clinic	Family medicine clinic	95	42.8
	Chronic disease clinic	97	43.7
	Dental clinic	15	6.8
	General clinic	15	6.8
Age	18 - 25	5	2.3
	26 - 40	23	10.4
	41 - 59	61	27.5
	60 and above	133	59.9
Gender	Male	112	50.5
	Female	110	49.5
Level of Education	Primary school	37	16.7
	Elementary school	26	11.7
	High school	51	23.0
	Bachelors	67	30.2
	Postgraduate	10	4.5
	Illiterate	31	14.0
Marital Status	Married	173	77.9
	Divorce	9	4.1
	Widow	24	10.8
	Single	16	7.2

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Monthly income	Less than 5000	128	57.7
	5000 - 10000	54	24.3
	More than 10000	40	18.0
Type of diabetes	Type 1 diabetes	30	13.5
	Type 2 diabetes	176	79.3
	Don't Know	16	7.2
Duration of diabetes, years	Less than 5 years	87	39.2
	5 - 10 years	53	23.9
	11 - 20 years	48	21.6
	More than 20 years	34	15.3
Most recent A1C level	Less than 7	42	18.9
	7 - 8	49	22.1
	8.1 - 9	38	17.1
	9.1 - 10	20	9.0
	More than 10	17	7.7
	I don't know	56	25.2
Management Plan	Medication	53	23.9
	Lifestyle modification	98	44.1
	Both	66	29.7
	No treatment	5	2.3
Presence of complication	Yes	88	39.6
	No	134	60.4
Type of complication	Neuropathy	27	31.8
	Retinopathy	39	45.9
	Nephropathy	3	3.5
	CVD	8	9.4
	CVA	5	5.9
	Oral	3	3.5
Patient Received oral health education	Yes	48	21.6
	No	174	78.4
Source of oral health education	General practitioner	9	18.4
	Family medicine doctor	14	28.6
	Health educator	4	8.2
	Dentist	19	38.8
	Other	3	6.1
Have you ever visited a dentist?	Yes	190	85.6
	No	23	10.4
	Not remember	9	4.1
Cause of dental visit?	Feel pain	157	82.2
	Routine checkup	18	9.4
	Other	16	8.4

Table 1: *Demographic and clinical characteristics for the participants.*

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An assessment regarding the knowledge of oral health among the participants revealed that 84.2% (n = 187) of them were aware of the necessity of regular oral health examination while more than a quarter of the participants (79.7%, n = 177) were aware of the effect of diabetes on general health. However, only less than half of the participants (43.2%, n = 96) knew about the effect of diabetes on oral health (Table 2). Regarding the assessment of the participants' attitude towards oral hygiene, 14.9% (n = 33) reported to undergo regular check-up (Table 3). With regard to practice, 88.7% (n = 197) reported to brush their teeth out of which 58.4% (n = 115) brushed twice a day. With regard to flossing, only 33.3% (n = 74) reported practicing it (Table 4).

	Correct answers	
	Number	**%**
Do you Know the effect of diabetes on general health?	177	79.7
Do you Know the effect of diabetes on oral health?	96	43.2
Does diabetes cause dental caries?	147	66.5
Does diabetes affect gingiva?	124	55.9
Do you think that the bacteria can cause gingivitis?	119	53.6
Do you think that the bacteria can cause dental caries?	124	55.9
Do you think that the brushing can prevent gum bleeding?	102	45.9
Do you think the regular oral health examination is necessary?	187	84.2

Table 2: Assessment the knowledge of oral health among adults' diabetic patients.

		Number	%
Do you do the regular oral checkup?	Yes	33	14.9
	No	189	85.1

Table 3: Assessment of participants' attitude to oral hygiene.

		Number	%
Do you brush your teeth?	yes	197	88.7
	No	25	11.3
If previous question yes, what's the frequency of tooth brushing?	Once a day	64	32.5
	Twice a day	115	58.4
	Once a week	5	2.5
	2-3 times per a week	13	6.6
Do you have bleeding during brushing?	Yes	65	34.2
	No	125	65.8
Do you floss your teeth?	Yes	74	33.3
	No	148	66.7
If previous question yes, what's the frequency of flossing?	Daily	23	31.5
	Every 2-3 days	22	30.1
	Once a week	28	38.4

Table 4: Assessment of participants' practice of oral hygiene.

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Regarding the mean of knowledge score in relation to demographic characteristics, education level was significantly related to knowledge score with higher scores among those with a post-graduate degree and least scores among the illiterate participants (p < 0.001). Monthly income is also significantly associated with knowledge scores, with higher score among the participants with the highest monthly income and lower score among those with the lowest monthly income category (p < 0.001). In relation to clinical characteristics, duration of diabetes was related to the knowledge score with the least score seen among those diagnosed less than 5 years ago (p = 0.008). Recent HbA1C levels were also significantly associated with mean knowledge score, with the highest score seen the participants having an HbA1C level than 7 (p < 0.001). Presence of complications was also significantly related to knowledge score (p = 0.031) (Table 5).

		Mean*	SD	p value
Clinic	Family medicine clinic	5.06	1.69	0.418
	Chronic disease clinic	4.63	1.80	
	Dental clinic	5.00	1.56	
	General clinic	4.73	1.44	
Age	18-25	4.60	1.34	0.062
	26-40	5.65	1.56	
	41-59	4.90	1.73	
	60 and above	4.69	1.72	
Gender	Male	4.88	1.64	0.850
	Female	4.82	1.80	
level of education	Primary school	4.46	1.73	<0.001*
	Elementary school	4.62	1.42	
	High school	4.69	1.68	
	Bachelor	5.48	1.42	
	Postgraduate	6.90	0.88	
	Illiterate	3.74	1.81	
Marital Status	Married	4.95	1.69	0.090
	Divorce	3.78	1.56	
	Widow	4.29	1.97	
	Single	5.19	1.38	
Monthly income	Less than 5000	4.47	1.74	<0.001*
	5000-10000	5.19	1.68	
	More than 10000	5.60	1.34	
Type of diabetes	Type 1 diabetes	5.50	1.46	0.087
	Type 2 diabetes	4.77	1.74	
	Don't Know	4.50	1.67	
Duration of diabetes, years	Less than 5 years	4.56	1.69	0.008*
	5-10 years	4.60	1.59	
	11-20 years	5.46	1.87	
	More than 20 years	5.09	1.56	

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Most recent A1C level	Less than 7	5.57	1.61	<0.001*
	7-8	4.63	1.72	
	8.1-9	5.45	1.37	
	9.1-10	5.00	1.78	
	More than 10	4.76	1.48	
	I don't know	4.05	1.73	
Management Plan	Medication	4.49	1.81	0.001*
	Lifestyle modification	4.73	1.66	
	Both	5.44	1.54	
	No treatment	3.00	1.58	
Present of complication	Yes	4.77	1.73	0.031*
	No	4.90	1.71	
Type of complication	Neuropathy	5.22	2.01	0.131
	Retinopathy	4.36	1.48	
	Nephropathy	5.33	1.15	
	CVD	4.13	2.10	
	CVA	5.40	0.89	
	Oral	6.00	1.73	
Patient received oral health education	Yes	5.58	1.44	0.001*
	No	4.64	1.73	
Source of oral health education	General practitioner	5.56	1.74	
	Family medicine doctor	5.43	1.60	
	Health educator	5.50	1.00	0.987
	Dentist	5.63	1.38	
	Other	6.00	1.00	
Have you ever visit a dentist?	Yes	4.98	1.70	0.004*
	No	3.87	1.69	
	Not remember	4.44	1.24	
The cause of dental visit?	Feel pain	4.94	1.72	0.357
	Routine checkup	5.50	1.65	
	Other	5.00	1.37	
Overall (out of 8)		4.85	1.72	

Table 5: Mean of knowledge score by demographic and clinical characteristics for the participants.
*Out of 8
Likert scale was used with 2 points (Wrong = 0, Correct = 1) for the 8 questions of knowledge,
The maximum score= 8 and the minimum score = 0.
High score indicates to high level of knowledge and low score indicates to low level of knowledge.

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Table 6 demonstrates the univariate logistic regression for the factors associated with low level of knowledge regarding oral health among diabetic patients. It is clear that age 60 years and above is a significant factor associated with low knowledge OR (95%CI) of 3.15 (1.26 - 7.83). Level of education including illiterate or primary school, elementary school, high school and bachelors are significant associated factors for low knowledge with OR (95%CI) of 31.80 (3.73 - 271.37), 24.43 (2.60 - 229.55), 13.95 (1.64 - 118.70) and 8.74 (1.05 - 72.73) respectively. A monthly income of less than 5000 SR is a significant associated factor for low knowledge with OR (95%CI) of 2.28 (1.19-4.38). Duration of diabetes less than 5 years, and 5-10 years are significant associated factors for low knowledge with OR (95%CI) of 3.11 (1.50 - 6.47), 3.55 (1.55 - 8.12) respectively. Patients who did not know their most recent A1C level is a significant associated factors for low knowledge with OR (95%CI) of 4.95 (2.02 - 12.14). Diabetes management plan of medication or lifestyle modification are significant associated factors for low knowledge with OR (95%CI) of 2.95 (1.38 - 6.32), 2.63 (1.38 - 5.01) respectively, Patients with the complication retinopathy are significantly associated with low knowledge OR (95%CI) of 3.59 (1.24 - 10.37).

		Odds Ratio	95% CI Lower	95% CI Upper	p value
Age	26 - 40**	1.00			
	18 - 25	2.33	0.32	16.82	0.401
	41 - 59	2.24	0.84	5.97	0.107
	60 and above	3.15	1.26	7.83	0.014*
Gender	Male	0.85	0.49	1.46	0.559
	Female**	1.00			
level of education	Illiterate or primary school	31.80	3.73	271.37	0.001*
	Elementary school	24.43	2.60	229.55	0.005*
	High school	13.95	1.64	118.70	0.016*
	Bachelors	8.74	1.05	72.83	0.045*
	Postgraduate**	1.00			
Marital Status	Married	0.84	0.29	2.42	0.749
	Divorce	4.80	0.48	48.46	0.184
	Widow	1.80	0.46	7.09	0.401
	Single**	1.00			
Monthly income	5000 - 10000**	1.00			
	Less than 5000	2.28	1.19	4.38	0.013*
	More than 10000	1.11	0.49	2.51	0.811
Type of diabetes	Type 1 diabetes**	1.00			
	Type 2 diabetes	1.95	0.89	4.26	0.093
	Don't Know	3.43	0.90	13.09	0.071
Duration of diabetes, years	Less than 5 years	3.11	1.50	6.47	0.002
	5 - 10 years	3.55	1.55	8.12	0.003
	11 - 20 years**	1.00			
	More than 20 years	1.77	0.73	4.31	0.206
Most recent A1C level	Less than 7**	1.00			
	7 - 8	2.08	0.90	4.83	0.087
	8.1 - 9	1.35	0.56	3.24	0.509
	9.1 - 10	1.48	0.51	4.31	0.473
	More than 10	2.22	0.69	7.12	0.180
	I don't know	4.95	2.02	12.14	0.000
Management Plan	Medication	2.95	1.38	6.32	0.005
	Lifestyle Modification	2.63	1.38	5.01	0.003
	Both**	1.00			

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Present of complication	Yes	1.24	0.71	2.17	0.447
	No**	1.00			
Type of complication	Neuropathy**	1.00			
	Retinopathy	3.59	1.24	10.37	0.018*
	Nephropathy	0.54	0.04	6.67	0.630
	CVD	3.23	0.55	18.96	0.194
	CVA	4.31	0.42	43.73	0.217
	Oral	0.54	0.04	6.67	0.630
Patient Received oral health education	Yes**	1.00			
	No	1.85	0.97	3.53	0.061
Source of oral health education	General practitioner	2.50	0.16	38.60	0.512
	Family medicine doctor	1.50	0.11	20.68	0.762
	Health educator	6.00	0.22	162.53	0.287
	Dentist	2.22	0.17	28.86	0.542
	Other**	1.00			

Table 6: Univariate logistic regression for the associated factors with low level of Knowledge about Oral health among Diabetes Mellitus patients.

* Significant p value

** Used as a reference.

		Odds Ratio	95% CI		p value
			Lower	Upper	
Age	26 - 40**	1.00			
	18 - 25	2.60	0.30	22.13	0.383
	41 - 59	3.13	0.92	10.74	0.069
	60 and above	3.88	1.23	12.28	0.021
Level of education	Illiterate or primary school	22.65	2.32	221.07	0.007
	Elementary school	25.36	2.39	268.91	0.007
	High school	20.75	2.16	199.56	0.009
	Bachelors	18.10	1.93	170.08	0.011
	Postgraduate**	1.00			
Monthly income	5000 - 10000**	1.00			
	Less than 5000	2.96	1.31	6.69	0.009
	More than 10000	2.62	0.97	7.12	0.058
Most recent A1C level	Less than 7**	1.00			
	7 - 8	1.37	0.51	3.69	0.533
	8.1 - 9	1.39	0.50	3.88	0.524
	9.1 - 10	0.93	0.28	3.15	0.914
	More than 10	1.70	0.45	6.49	0.436
	I don't know	3.43	1.21	9.71	0.021
Management Plan	Medication	2.59	1.08	6.24	0.034
	Lifestyle modification	3.37	1.51	7.52	0.003
	Both**	1.00			

Table 7: Multivariate logistic regression for the associated factors with low level of Knowledge about Oral health among Diabetes Mellitus patients.

* Significant p value

** Used as a reference.

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Table 7 demonstrates the multivariate logistic regression for the associated factors with low knowledge levels about oral health among the diabetic patients. Age of 60 years and above was found to be a significantly associated factor for low knowledge with OR (95%CI) of 3.88 (1.23 - 12.28). Level of education including illiterate or primary school, elementary school, high school and bachelors are significantly associated factors for low knowledge with OR (95%CI) of 22.65 (2.32 - 221.07), 25.36 (2.39 - 268.91), 20.75 (2.16 - 199.56) and 18.10 (1.93-170.08) respectively. Monthly income of less than 5000 SR is a significantly associated factor for low knowledge OR (95%CI) of 2.96 (1.31- 6.69). Not knowing recent A1C level is significantly associated with low knowledge OR (95%CI) of 43.43 (1.21 - 9.71). Medication or lifestyle modification are significant associated factors for low knowledge OR (95%CI) of 2.59 (1.08 -6.24), 3.37 (1.51-7.52) respectively.

Discussion and Conclusion

This cross-sectional study assessed the knowledge, attitude and practices related to oral health among adults living with diabetes in Makkah city. With regard to knowledge, we report an overall lack of adequate knowledge pertaining to oral health, particularly less than half (43.2%) of the study participants were aware of the effect of diabetes on oral health. This is consistent with several previous studies that have concluded insufficient awareness regarding the association of diabetes and oral health [22-25].

In the current study it was revealed that more than a quarter (78.4%) of the participants had received no oral health education and for those who had, dentists were the most common source for oral health education (38.8%) while general practitioners and educators (18.4%, 8.2% respectively) were among the least common. While some earlier studies have suggested that oral health education was not usually received through general physicians or diabetes care providers [22,26,27], other studies have cited media [26] and physicians [28] to be the most common sources of oral health awareness. Thus, this study underlines the need for a greater role of physicians, educators and media in educating patients regarding the impact of diabetes on oral health and vice versa. Moreover, since the current study has reported that the majority of the participants (82.2%) visit the dentist only when they feel pain, the role of knowledge sources of oral health and hygiene besides the dentist becomes all the more important especially in relation to diabetes prevention and management education.

In the present study, significantly higher knowledge scores were found among the participants with higher education while lower scores were found among the participants who were illiterate or had a lower education level. This finding is similar to a previous study [24] and underscores the need to implement tailored oral health education among patient groups with lower education levels.

Majority of the participants (85.1%) did not undertake regular oral checkup indicating a poor attitude. Previous studies have cited numerous reasons for irregular dental checkups including costs, lack of need for oral health care, absence of dental related problems, unpleasant experience and effort required to schedule an appointment [14]. Although the Saudi Arabian government offers free dental treatment, and only a small portion of the population takes advantage of these services [29], it is worth exploring the factors responsible for low levels of regular checkups among the local population.

The level of healthy oral practices was found to be sub-optimal with only 58.4 participants brushing their teeth twice a day and 33.3% flossing their teeth. A systematic review revealed that the less than half of the diabetic study participants (mean 49.3%, 95% CI 35.70 - 62.90) brushed twice a day while regular flossing (≥1/day) was undertaken by a mere quarter of the participants (mean 25.1%, 95% CI 10.36 - 39.88) [14].

Our findings highlight the gaps related to knowledge, attitude and provides crucial information related to the factors associated with low knowledge levels practice among diabetic adults in Makkah city which will be useful for program managers and policy makers in implementing interventional programs to increase the awareness among adults with or without diabetes and motivate them to practice healthy behaviors related to oral health.

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We recognize limitations in our study related to short duration and strong regional focus of the study. We recommend future studies to explore national studies to assess oral health in this type of population.

In conclusion, there is inadequate knowledge related to oral health among adults living with diabetes and poor oral health practices. It is crucial to improve them especially in view of the high diabetes prevalence in Saudi Arabia.

Ethics Approval and Consent to Participate

- All necessary official permissions was secured by the higher authorities and IRB was taken from ministry of health, reference number (H-02-K-076 - 0121 - 445)

- Before the data collection, an informed consent was obtained from all potential participants, then all participants have the right to not participate in the study.

- Confidentiality and privacy were guarantee for all participants.

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