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Original Article

Evaluation of Oral Complications, Oral Health, and Decayed, Missing, and Filled Teeth in Diabetic Patients: A Retrospective Cohort Study

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Abstract

Background: The aim of this study was to determine the presence of oral lesions and complications, caries, and oral hygiene status in patients with diabetes mellitus type 1 and 2, and gestational diabetes (GDM).

Methods: The plaque index of each patient was recorded using the Silness-Löe index. Dental health status was observed using the decayed, missing, and filled teeth (DMFT) index. The patient's mouth was examined clinically for oral lesions and complications.

Results: There were significant differences between the study groups with regard to age, duration of diabetes, DMFT index, oral lesions, and hygiene status.

Conclusion: According to the result of this study, the rate of dental caries, oral complications such as xerostomia, and burning mouth in patients with diabetes is higher than in healthy people.

Keywords: Diabetes mellitus, DMFT, Oral complications, Hygiene status

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Background

Diabetes mellitus (DM) is a clinical metabolic disease and a widespread heterogeneous group of disorders. Chronic hyperglycemia, defective insulin secretion and-/-or action, polyuria, polyphagia, and polydipsia are the characteristics of DM (1-3). The number of patients with this progressive disease is rising significantly, and the prevalence of all types of diabetes is estimated to be 592 million in 2035 (4). DM can affect various organs throughout the body, such as the oral cavity. Illness processes benefiting from chronic hyperglycemia use include hypertension, cardiovascular disease, autoimmune conditions, and the like (5). According to the American Diabetes Association, DM is classified into four groups, including type 1, type 2, gestational diabetes (GDM), and other specific types. Type 1 is characterized by the destruction of pancreatic beta cells and insulin deficiency (6). It is also an autoimmune idiopathic disease (7). Type 2 is the result of insulin resistance or relative insulin deficiency. In GDM, abnormal glucose tolerance is first identified during pregnancy. The other specific types include more than 56 pathological conditions associated with genetic defects or infections (6).

It seems that all types of diabetes have various possible long-term adverse effects and lesions (8). Oral cavity and associated anatomies consist of a somewhat under-researched area in patients with diabetes. The evidence suggests that a number of oral lesions have been associated with diabetes, and they can have a significant effect on oral health (3,9). Tooth loss, caries, gingivitis, periodontitis, and abscesses could occur in patients with DM, but some studies are controversial (2,10,11). All three types of diabetes have first been studied during this research (1,10-18).

This study aimed to determine the presence of oral lesions and complications of DM by the exactions of the oral mucosa. It was also sought to investigate the decayed, missing, and filled teeth (DMFT) index and oral hygiene

status using the Silness-Löe index.

Methods and Materials

This retrospective cohort research was approved by the local ethical committee (IR.UMSHA.REC.1394.63). Informed consent was obtained from all participants before saliva collection. The patient's mouth was clinically examined for oral lesions and complications, as well as gingival and oral health status, by a postgraduate oral medicine student. A total of 100 participants took part in this study in 2016 in Diabetes Research Center, Hamadan, Iran, including 20 patients with type 1 (DM1), 20 patients with type 2 (DM2), 20 patients with GDM, 20 normal people, and 20 healthy pregnant women. The samples of both genders were equal in each group.

The type and duration of diabetes, oral lesions, and complications, as well as the type and dose of hypoglycemic drugs, were recorded by reviewing medical records and interviewing individuals under the control of endocrinologists, along with the completion of the questionnaire by the patients. Patients with DM1, DM2, and GDM were confirmed by endocrinologists. GDM was chosen in any trimester. All normal people and healthy pregnant women were determined by the normal fasting blood sugar (FBS) test. Active inflammation, severe gingivitis, progressive periodontitis, systemic disease that affects the salivary glands, renal failure, rheumatology, using drugs during the past three months, except for blood glucose-lowering drugs, smoking, and use of alcohol were among the exclusion criteria for excluding the individuals from the study.

Plaque indexes of each patient were recorded by the Silness-Löe index. The plaque index is in the range of 0–3 (no plaque = 0, plaques on the gingival margin after probing = 1, clearly visible plaques = 2, and an abundant layer of plaques on the tooth = 3) (19). Dental health status was observed using the DMFT index (D = Decayed, M = Missing, F = Filled, T = Tooth). Diagnostic criteria for determining DMFT are based on the methods suggested by the World Health Organization (10).

Quantitative variables were analyzed by a t-test, and the chi-square test (χ^2) was used to compare nominal parameters. All statistical analyses were conducted at the 95% confidence level using Stata software, version 11. In addition, they were supposed to be statistically significant at $P < 0.05$.

Results

There were significant differences between the study groups with regard to age, duration of diabetes, DMF index, familial history of diabetes, oral lesions, and hygiene status ($P < 0.05$). The findings of the study groups are presented in Tables 1 and 2.

Statistically significant differences were observed in the age, FBS, and DMF index between the patients with DM1, DM2, and GDM ($P < 0.05$). These findings of the study groups are provided in Tables 3, 4, and 5.

Table 1. Distribution of Continuous Variables Among the Study Population

Variables	Mean	SE	*P* value
Age (y)			
Diabetes type I	25.25	1.18	
Diabetes type II	54.35	2.44	
Gestational diabetes	34.80	1.31	0.001
Normal people	30.75	1.03	
Healthy pregnant	26.10	0.81	
Duration (day)			
Diabetes type I	1381.15	373.71	
Diabetes type II	2555.25	547.27	0.001
Gestational diabetes	120.75	3.68	
DMF index			
Diabetes type I	8.35	0.81	
Diabetes type II	10.75	0.69	
Gestational diabetes	6.80	0.45	0.001
Normal people	3.45	0.22	
Healthy pregnant	4.05	0.28	

Note. DMF: Decayed, missing, and filled teeth; SE: Standard error.

Significant differences were found between patients with DM1 with regard to hygiene status and those with DM2 ($P < 0.05$). No significant difference was found between GDM and hygiene ($P = 0.347$). All data are presented in Tables 6, 7, and 8.

Moreover, oral complications in DM1 and DM2 were analyzed according to gender, which was not statistically significant ($P > 0.05$, Table 9).

Oral complications in patients with DM1 included 7 (35%) cases with xerostomia, 2 (10%) cases with burning mouth, 2 (10%) cases with xerostomia and burning mouth, and 4 (20%) cases with xerostomia and increasing caries after developing diabetes.

Oral complications in patients with DM2 consisted of 10 (50%) cases with xerostomia, 1 (5%) case with burning mouth, 5 (25%) cases with xerostomia and burning mouth, and 1 (5%) case with xerostomia and increasing caries after developing diabetes.

Moreover, 7 (35%) cases with xerostomia and 2 (10%) cases with xerostomia and burning mouth were diagnosed in patients with GDM.

Discussion

DM is a growing chronic health disorder in the world. It is one of the diseases that can affect oral and dental health. Evidence showed that patients with DM suffered from some oral manifestations, such as gingivitis, periodontitis, dry mouth, and dental caries (20).

In our study, the mean DMF index in diabetic patients represents an increase in caries compared to the control group. On the other hand, these findings confirm that oral hygiene statues were influenced by DM. Patients with DM1 and DM2 demonstrated higher scores for the Silness-Löe index than control groups. However, no significant difference was found between GDM and hygiene. These

Table 2. Categorical of Continuous Variables Among the Study Population

Variables	Diabetes Type I		Diabetes Type II		Gestational Diabetes		Normal People		Healthy Pregnant		*P* value
	No.	%	No.	%	No.	%	No.	%	No.	%	
Gender											
Female	10	50.0	10	50.0	20	100.0	10	50.0	20	100.0	0.001
Male	10	50.0	10	50.0	-	-	10	50.0	-	-	
Family history											
No	14	70.0	2	10.0	20	100.0	20	100.0	20	100.0	0.001
Yes	6	30.0	18	90.0	-	-	-	-	-	-	
Oral complications											
No	5	25.0	3	15.0	11	55.0	-	-	-	-	0.01
Yes	15	75.0	17	85.0	9	45.0	-	-	-	-	
Hygiene status											
Score 0	2	10.0	0	0.0	2	10.0	11	55.0	0	0.0	0.001
Score 1	1	5.0	6	30.0	16	80.0	8	40.0	18	90.0	
Score 2	16	80.0	13	65.0	2	10.0	1	5.0	2	10.0	
Score 3	1	5.0	1	5.0	0	0.0	0	0.0	0	0.0	

Table 3. Distribution of Continuous Variables Among Diabetes Type 1 and Normal People

Variables	Normal People		Diabetes Type 1		Difference		*P* value[a]
	Mean	SD	Mean	SD	Mean	SE	
Age (y)	30.75	4.64	25.25	5.32	-5.5	1.57	0.001
DMF index	3.45	0.99	8.35	3.63	4.9	0.84	0.001
FBS	86.05	8.34	215.20	62.93	129.15	14.19	0.001

Note. SD: Standard deviation; DMF: Decayed, missing and filled teeth; FBS: Fasting blood sugar; SE: Standard error.
[a] *t* test.

Table 4. Distribution of the Continuous Variables Among Diabetes Type 2 and Normal People

Variables	Normal People		Diabetes Type 2		Difference		*P* value[a]
	Mean	SD	Mean	SD	Mean	SE	
Age (years)	30.75	4.64	54.35	10.92	23.60	2.65	0.001
DMF index	3.45	0.99	10.75	3.12	7.3	0.73	0.001
FBS	86.05	8.34	190.25	70.60	104.2	15.89	0.001

Note. SD: Standard deviation; DMF: Decayed, missing and filled teeth; FBS: Fasting blood sugar; SE: Standard error.
[a] *t* test.

Table 5. Distribution of the Continuous Variables Among Gestational Diabetes and Healthy Pregnant

Variables	Healthy Pregnant		Gestational Diabetes		Difference		*P* value[a]
	Mean	SD	Mean	SD	Mean	SE	
Age (years)	26.1	3.62	34.8	5.86	8.7	1.54	0.001
DMF index	4.05	1.27	6.80	2.01	2.75	0.53	0.001
FBS	89.6	5.80	129.05	33.54	39.45	7.61	0.001

Note. SD: Standard deviation; DMF: Decayed, missing and filled teeth; FBS: Fasting blood sugar.
[a] *t* test.

results in GDM can be attributed to the short duration of developing this type of diabetes in the participants of this study.

The results of Singh-Hüsgen et al (14), in agreement with our study findings, on diabetic patients revealed a higher caries experience and higher values for the Silness-Löe index. The DMF index in children with DM1 was higher than in healthy individuals in the study of Arheiam and Omar (21). The plaque index in diabetic patients was higher than that in healthy controls, and the difference was significant in the study of Orbak et al (22). Stojanović et al (23) concluded that the DMF index was higher in DM2 patients with poorly controlled conditions compared to other patients, and the plaque index was positively associated only with age. Siudikiene et al (13) established higher increments in diabetic children and suggested that it was associated with higher increments in salivary glucose concentrations, dental plaques, and saliva albumin

Table 6. Categorical of the Continuous Variables (Sex and Hygiene) Among Diabetes Type 1 and Normal People

Variables	Normal People		Diabetes Type 1		*P* value[a]
	No.	%	No.	%	
Gender					
Female	10	50.0	10	50.0	1.00
Male	10	50.0	10	50.0	
Hygiene					
Score 0	11	55.0	2	10.0	0.001
Score 1	8	40.0	1	5.0	
Score 2	1	5.0	16	80.0	
Score 3	0	0.0	1	5.0	

[a] Chi-square.

Table 7. Categorical of the Continuous Variables (Sex and Hygiene) Among Diabetes Type 2 and Normal People

Variables	Normal People		Diabetes Type 2		*P* value[a]
	No.	%	No.	%	
Gender					
Female	10	50.0	10	50.0	1.00
Male	10	50.0	10	50.0	
Hygiene					
Score 0	11	55.0	0	0.0	0.001
Score 1	8	40.0	6	30.0	
Score 2	1	5.0	13	65.0	
Score 3	0	0.0	1	5.0	

[a] Chi-square.

Table 8. Categorical of the Continuous Variable (Hygiene) Among Gestational Diabetes and Healthy Pregnant

Variable	Healthy Pregnant		Gestational Diabetes		*P* value[a]
	No.	%	No.	%	
Hygiene					0.347
Score 0	0	0.0	2	10.0	
Score 1	18	90.0	16	80.0	
Score 2	2	10.0	2	10.0	
Score 3	0	0.0	0	0.0	

[a] Chi-square.

Table 9. Oral Complications in Diabetes Patients According to Sex

Variables	Diabetes Type 1					Diabetes Type 2					Gestational Diabetes	
	F		M		*P* value	F		M		*P* value	F	
	No.	%	No.	%		No.	%	No.	%		No.	%
Oral complications					0.606					0.060		
No	3	30	2	20		3	30	0	0		11	55
Yes	7	70	8	80		7	70	10	10		9	45

in diabetics. The reduced flow of saliva, poor oral hygiene, and poor control of blood sugar are strongly associated with an increased incidence of caries in diabetic patients. These changes can lead to the growth of cariogenic bacteria and a reduction in the mechanical cleansing action of saliva, causing dental plaque accumulation in diabetic patients (21). The results of other studies differed in this regard. The findings of Sukminingrum et al (12) revealed that there was no significant difference between the two groups regarding oral health status; however, the number of examined diabetic patients was higher than that of the control group. Hintao et al (18) reported that diabetic patients had a higher oral hygiene status compared with non-diabetic subjects. Leung et al (17) evaluated DMFT in diabetic patients and healthy populations and exhibited that oral health conditions were poor in both groups. Saes Busato et al (16) assessed the association between metabolic control and the oral health status of patients with DM, and the results showed that the oral health status of diabetic adolescents was poor regardless of metabolic control. The results of these studies may be due to a different number of samples or a different grouping of oral and dental health statuses.

The objective of this research was to describe significant differences between the study groups with regard to oral complications and lesions, apart from higher scores on the Silness-Löe and DMF index. Saini et al (15) concluded that the prevalence of oral mucosal lesions was higher in patients with diabetes than in healthy people. Silva et al demonstrated a higher frequency of oral lesions among diabetic patients with DM2 compared to DM1 (24). Xerostomia, or the complaint of dry mouth, is one of the things that should be differentiated from the reduction of the salivary flow rate in diabetic patients, and it was a common oral complaint in our patients (25). Malicka et al (26) found a higher prevalence of xerostomia in patients with DM1 than in the control group. However, this result was not significant in patients with DM2. Moore et al (27) observed the occurrence of xerostomia symptoms in patients with DM1. Chavez et al (28) noted decreased saliva and xerostomia in patients with poor diabetic control. It seems that multiple factors could lead to reduced salivary

secretion, such as glycosuria and hyperglycemia (26).

Based on the findings of this study, patients with diabetes have poor hygiene compared with healthy people and need more attention and monitoring for oral health. In addition, they should carefully control their blood glucose because it is a major risk factor for oral complications in both genders. Furthermore, the results of the present research give special importance to the necessity of physicians monitoring the oral health status of diabetic patients.

Conclusion

According to the results of this study, the rate of dental caries, oral complications such as xerostomia, and burning mouth in patients with diabetes is higher than in healthy individuals. Inappropriate blood glucose control may be one of the main causes. Therefore, monitoring blood glucose control and oral hygiene, along with periodic oral examinations, should be recommended for diabetic people more than healthy people. Additionally, diabetic patients need to be justified in believing that the presence of any of the mentioned symptoms could be a red flag for the blood sugar level that needs to be monitored. Healthcare providers and parents should pay more attention to the oral health status of diabetic patients.

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Authors' Contribution

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Competing Interests

All authors declare that they have no conflict of interest.

Ethical Approval

This study was approved by Hamadan University of Medical Scieneces (Code: IR.UMSHA.REC.1394.63).

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