Original Article

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The Effect of Diabetes Mellitus Type I on Periodontal and Dental Status

Dentistry Section

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ABSTRACT

Introduction: Diabetes mellitus type I is a chronic metabolic disease with an autoimmune origin. The initial manifestations mainly appear during childhood and its prevalence is on the rise in many countries. Some of the complications of diabetes mellitus are problems related to oro-dental structures and periodontal diseases.

Aim: The present study was undertaken to evaluate the relationship between diabetes mellitus type I and dental and periodontal status in Tehran, Iran.

Materials and Methods: This cross-sectional study was carried out on 50 patients with diabetes mellitus type I who were under treatment in the Diabetic Patients' Center in Tehran and 50 healthy individuals who did not have diabetes, all recruited from schools. The subjects were divided into two age groups of 6-12 and 13-18 years. In test group, HbA1c (glycosylated haemoglobin) level of the patients was collected from the medical records of Association of Diabetic Patients. To make sure that the control subjects did not suffer from diabetes mellitus, their blood glucose was measured with the Glucocard 01 blood glucose monitoring kit (GT-1920, Japan). The periodontal and dental status were assessed using dmft/DMFT (Decayed, Missing, Filled Permanent Teeth), GI (Gingival Index), PPD (Periodontal Pocket Depth), PI (Plaque Index) and CI (Calculus Index). The data obtained from each group were compared statistically using the Mann-Whitney test and Kruskal Wallis Test.

Results: There was increase in PPD, GI and DMFT values with aging, with no significant differences between the diabetic and non-diabetic groups. PI and DMFT not only increased with aging but also were higher in both age groups in patients with diabetes compared to healthy subjects ($p<0.05$). GI was higher only in the 13-18 year age group in diabetic patients ($p<0.01$). There was no relation between the HbA1c (glycosylated haemoglobin) level, and periodontal indices ($p<0.09$).

Conclusion: It appears that patients with diabetes mellitus type I are more susceptible to periodontal diseases and tooth loss and such problems might be aggravated with aging.

Keywords: Children, Insulin-dependent diabetes mellitus, Periodontal status, Teeth

INTRODUCTION

Diabetes mellitus is a metabolic disease which is characterized by hyperglycemia due to the impaired synthesis or secretion of insulin [1]. According to WHO, there are three types of diabetes: insulin-dependent (type I), non-insulin dependent (type II) and diabetes related to other diseases and syndromes (type III). Diabetes mellitus type I is basically due to defects in or a total lack of insulin as a result of destruction of β Langerhans cells in the pancreas [2]. Children and adolescents are usually affected by diabetes mellitus type I. Approximately 3.8% of the American population suffer from diabetes mellitus [3], with the type I condition comprising 5%-10% of all the diabetes cases [4]. In Europe the highest annual incidence of diabetes mellitus type I has been reported in Finland (40 cases in 100,000 of the population), with the least incidence in the Balkan region (2.3 cases in 100,000 of the population) [1]. It has been reported that periodontal disease is the sixth most common complication of patients with diabetes mellitus [5-7]. However, some researchers believe there is no such increased risk [8]. Based on some recent studies diabetes is not a direct aetiologic factor but is a predisposing factor for periodontal disease [4]. Diabetes cannot be considered an aetiologic factor for gingivitis or periodontitis; rather, the metabolic disturbances resulting from diabetes can give rise to systemic problems, decreasing resistance to infections [9,10]. Therefore, the initiation, induction and progression of periodontal diseases are affected [5,9]. Several studies have evaluated the relationship between diabetes mellitus type I and oral and periodontal health and have reported conflicting results. Some studies have shown that patients with diabetes mellitus have a higher rate of caries [11-14] and periodontal diseases [11,12,15,16] and plaque indices [11,17-19] compared to non-diabetic individuals. In addition, diabetic children exhibit more severe gingivitis compared to non-diabetic children, despite similar plaque index [20]. Furthermore, it seems that poorly controlled diabetic patients are three times more likely to develop chronic periodontitis compared to healthy subjects, despite similar subgingival biofilm [21]. However, one study did not report such an increase [8]. In addition, there are controversial reports on the relationship between diabetes mellitus and dental caries; however, some dental caries risk factors have been detected in diabetic patients [1]. Given the importance of the issue and the contradictory reports on the relationship between diabetes mellitus and the dental and periodontal status in young diabetic patients and also a lack of a similar study in Iran, the present study was carried out to evaluate the relationship between diabetes mellitus type I and dental and periodontal status.

MATERIALS AND METHODS

The study was an institution-based observational study, carried out in the Iranian Diabetes Society in Tehran, Iran, for one year from September 2015 to August 2016.

This cross-sectional study was carried out on 100 subjects, recruited using purposive sampling technique. 50 patients with diabetic mellitus type I, aged 6-18 years, with the definitive diagnosis of the condition, who were under treatment in the Diabetic Patients' Center in Tehran, Iran, were selected. At the same time, the control group subjects were matched with the case group subjects in relation to age, gender and the city district they lived in. Their family size and

father's educational level were also recorded. In both groups, there were 36 subjects in the 6-12 year age group (elementary school) and 14 subjects in 12-18 year age group (high school). The exclusion criteria consisted of the following: smokers; affliction with systemic conditions other than diabetes mellitus, especially autoimmune diseases, hematologic diseases and infectious diseases; the presence of restorations or caries near the gingival sulcus of the teeth in question; subjects who had undergone therapy for periodontal problems in the past; those on any medication that affected dental and periodontal status, such as anticonvulsants, calcium channel blockers and immunosuppressive agents; and users of orthodontic appliances. After obtaining consent from all the patients and their parents, clinical examinations were carried out with Willams periodontal probe, a dental mirror, an explorer and an electric light in the upright position. Age, gender, socioeconomic status based on the city district they lived in, family size, father's educational level and the duration of affliction with the condition were recorded. In test group, HbA1c (glycosylated haemoglobin) level [2,20] of the patients were collected from the medical records of Association of Diabetic Patients. Blood glucose of the control group subjects was measured with the GLUCOCARD 01 blood glucose monitoring kit (GT-1920, Japan) so as to ensure the absence of study disease. Periodontal status was evaluated using PI (Sillness and Löe) [22], PPD, GI (Löe and Sillness) [23] and CI (Greene and Vermilion) [24] and the health of the teeth was evaluated with the dmft/DMFT indices [25].

STATISTICAL ANALYSIS

Data was recorded in special forms for both healthy and diabetic subjects and analyzed withMann-Whitney U non-parametric test for differences between the two groups and Kruskal Wallis Test.

RESULTS

The present study was carried out on 100 subjects; 50 subjects with insulin-dependent diabetes mellitus and 50 non-diabetic subjects. [Table/Fig-1] presents demographic information of the case and control groups [Table/Fig-1].

The mean duration of affliction with diabetes mellitus type 1 was 4.1±3.7 years, with a mean HbA1c of 7.6±0.8%. Nine subjects (18%) had good metabolic control (HbA1c≤7%), 21 subject (42%) had moderate metabolic control (7% <HbA1c ≤8%) and 20 subjects (40%) had poor metabolic control (HbA1c>8%).

The DMFT index indicated that it was 0.48 higher in the case group compared to the control group, with no statistically significant differences (p<0.2). The dmft/DMFT index in the 6-12-year age groups in the control and case groups were 1.04±0.9 and 2.1±1.9, respectively, indicating 1.06 higher rate in the case group, which was statistically significant (p<0.08). The DMFT indices in the 12-18 year age groups in the control and case groups were 2.4±1.9 and 4±2.8, respectively, indicating a higher rate of 1.6 in the case group, which was statistically significant (p<0.05) [Table/Fig-2].

The periodontal index indicating that PI was 0.39 higher in the 6-12 years age group in the case group and 0.33 higher in the 12-18 year age group, which was statistically significant based on the results of Mann-Whitney U test (p<0.01). Furthermore, the GI was 0.09 and 0.53 higher in the 6-12 year and 12-18 year age groups, respectively, in the diabetic subjects compared to the healthy subjects, with only a significant difference in the 12-18 year age group based on the results of Mann-Whitney U test (p<0.01). The CI indicating a 0.08 higher value in the 6-12 year age group and a 0.13 higher value in the 12-18 year age group compared to the healthy controls, with no significant differences (p<0.06). The PPD indicating 0.13 and 0.22 higher values in the 6-12 year and 12-18 year age groups in the case group compared to the healthy controls, with no statistically significant differences (p<0.6) [Table/Fig-3].

After evaluation with Kruskal Wallis test, it was concluded that in diabetic patients with good and moderate metabolic control, with HbA1c ≤8%, PI was better than those with poor metabolic control; however, the difference was not statistically significant (p<0.6). In addition, there was no relations between the quality of metabolic control and other indices (p<0.9) [Table/Fig-4]. [Table/Fig-5] presents the relationship between the metabolic control and dental indices.

Groups	Age		Sex		Father's Education			Family Size	Birth Order	Total
	6-12	12-18	Female	Male	University Graduates	High School Graduates	Some High School Education			
Control	36	14	34	16	17	22	11	4.2±0.5	2	50
Case	36	14	34	16	17	22	11	4.5±1.1	2.1±0.9	50

[Table/Fig-1]: Demographic information of the case and control groups.

Dental Index	Age	Case	Control	Mean difference	p*
dmft	6-12	2.5±2	2.02±1.7	0.48	0.2
	12-18	-	-	-	-
DMFT	6-12	2.1±1.9	1.04±0.9	1.06	0.08**
	12-18	4±2.8	2.4±1.9	1.6	0.05***

[Table/Fig-2]: Mean±sd, mean difference and comparison test of Dental index in two groups.
* p-value based on Mann-Whitney U test
** Significant at level 0.1, *** significant at level 0.05

Periodontal Index	Age	Case	Control	Mean Difference	p*
PI	6-12	1.05±0.6	0.66±0.5	0.39	0.01***
	12-18	1.12±0.4	0.79±0.2	0.33	0.01***
GI	6-12	0.92±0.3	0.83±0.4	0.09	0.5
	12-18	1.74±0.5	1.21±0.2	0.53	0.01***
CI	6-12	0.62±0.3	0.54±0.5	0.08	0.6
	12-18	0.88±0.5	0.75±0.7	0.13	0.6
PPD	6-12	0.89±0.4	0.76±0.5	0.13	0.6
	12-18	1.03±0.3	0.81±0.2	0.22	0.7

[Table/Fig-3]: Mean±sd , mean difference and comparison test of periodontal index in two groups.
* p-value based on Mann-Whitney U test
** Significant at level 0.1, *** significant at level 0.05

HbA1c level	Periodontal Indexes			
	PI	GI	CI	PPD
HbA1c≤7% n=9	0.99±0.5	1.38±0.4	0.68±0.2	1.02±0.7
7%<HbA1c≤8% n=21	1.08± 0.3	1.27±0.2	0.82±0.6	0.91±0.5
8%<HbA1c n=20	1.17±0.7	1.34±0.5	0.75±0.3	0.95±0.3
Statistical test (p-value)	0.6	0.9	0.9	0.9

[Table/Fig-4]: Periodontal indexes of diabetic patients according to the HbA1c level.
*p-value based on Kruskal Wallis test

HbA1c level	Dental Indexes	
	DMFT	dmft
HbA1c≤7% n=9	3.1±0.9	2.3±0.7
7%<HbA1c≤8% n=21	2.7±0.4	2.5±0.5
8%<HbA1c n=20	3.2±0.5	2.5±0.3
Statistical test (p-value)	0.8	0.9

[Table/Fig-5]: Dental indexes of diabetic patients according to the HbA1c level.
*p-value based on Kruskal Wallis test

It was concluded no statistically significant differences between the metabolic control and dmft (p<0.8). In addition, it was concluded no statistically significant differences between the metabolic control and DMFT (p<0.9) [Table/Fig-5].

DISCUSSION

In the present study, the relationship between diabetes mellitus type I and periodontal and dental health was evaluated using dental and periodontal indices. A number of cross-sectional studies have shown lower prevalence of dental caries in patients with diabetes mellitus type I and have attributed it to a diet with limited sugar content [25]. Some studies have shown no significant differences in caries experience [26,27], some other studies have shown that due to an increase in some salivary components such as glucose and albumin [28] and calcium [29], a decrease in salivary pH [30] and flow [31] and peroxidase, lysozyme and lactoferrin [32] result in an increase in caries rate in such patients. On the other hand, good metabolic control can prevent such changes [33,34]. In the present study, DMFT/dmft indices were used to evaluate the status of permanent and deciduous teeth, respectively. Although dmft did not exhibit any significant differences between the diabetic and non-diabetic subjects in the 6-12 year age groups, DMFT was significantly higher in the diabetic subjects compared to nondiabetic subjects. The reason for higher DMFT in diabetic subjects in our study might be a higher PI which indicates poorer oral hygiene in these patients. In the present study the periodontal status was evaluated with plaque, gingival and calculus indices and the pocket depths; diabetic subjects exhibited a higher plaque index compared to the control subjects, consistent with the results of studies by Aren G [35] and Orbak R [36]. However, Siudikiene J reported a lower plaque index in diabetic children compared to non-diabetic patients [37]. Akpata ES et al., reported that 65% of the diabetic subjects had poor cooperation in relation to dental care and 44% did not refer for dental visits. They also exhibited higher Bleeding on Probing (BOP), PI and GI compared to non-diabetic subjects and the incidence of periodontitis exhibited a significant relationship with the duration of affliction with diabetes [38]. Gingival bleeding a sign of gingival inflammation is a frequent complaint of diabetic patients and is due to the problem of diabetic microvascular lesions in patients. Capillaroscopy of marginal gingiva in diabetic patients has shown irregular distribution of capillary loops, diversities in the length and diameter of blood capillaries and degenerative changes in the connective tissue around capillaries that making the periodontium susceptible to injuries [37,39,40]. The results of the present study might confirm this in patients with diabetes, who exhibited a higher gingival index compared to healthy controls and this increase was significant in the 12-18 year age group. However, Barnett ML et al., did not report a significant relationship between gingival index and affliction with diabetes mellitus type I in 45 patients 10-18 years of age [8].

In the present study, despite the higher calculus index in diabetic patients, this difference was not significant, consistent with Patino MN's study in 2007 [41], some studies reported a significant difference in calculus index between diabetic and non-diabetic subjects [36,37]. There is an increase in salivary calcium and magnesium in patients with diabetes mellitus type I, which might result in an increase in the formation of calculus in such patients [29]. A lack of difference in the formation of calculus between the diabetic and non-diabetic subjects might be attributed to inherent differences between individuals in deposition of calculus [41].

In the present research, PPD was higher in the diabetic subjects compared to the healthy controls; however, the difference was not significant, consistent with the results of Luczaj Cepowicz E [42]. However, in a study by Aren G, it was concluded that the mean pocket depths in children with diabetes were significantly higher [35]. As to the relationship between the metabolic control of diabetes and the oral cavity complications, studies have shown that the incidence and severity of gingivitis might have a relationship with poor metabolic control of diabetes. It appears an increase in glucose levels in the gingival crevicular fluid and blood of diabetic patient's results in qualitative changes in bacteria due to a change in their living environment, increasing the severity of periodontal disease in diabetic patients with poor metabolic control [37]. Poplowska-Kita A reported that 15% of systemically healthy individuals and 57.9% of patients with diabetes mellitus type I had periodontitis, 40% of which had controlled diabetes and 59.5% had uncontrolled diabetes. In addition, there was a positive relationship between the number of areas affected by periodontitis and FBS. They pointed out that patient with poor metabolic control exhibited significantly greater loss of attachment and alveolar bone loss [43]. Seppala B et al., concluded in a prospective study that patients with uncontrolled insulin-dependent diabetes had more severe gingivitis and more BOP compared with those with controlled diabetes [44].

However, there are some limitations in this study including purposive sampling technique due to lack of access to appropriate sample. However, this study provides information about the periodontal and dental status of patients with type I diabetes, which might be used in preparing preventive and therapeutic programs of the educational system of the country.

CONCLUSION

The results of the present study showed that patients with diabetes mellitus type I are more susceptible to periodontal diseases and may present increased prevalence of dental caries and tooth loss, and the risk increases with aging.

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