THE PREVALENCE OF DENTAL CARIES IN 5 – 18-YEAR-OLD INSULIN-DEPENDENT DIABETICS OF FARS PROVINCE, SOUTHERN IRAN

Ali-Asghar Alavi DMD MSD, Elham Amirhakimi DMD, Babak Karami DMD

Background: The association of dental caries and diabetes mellitus has not received enough attention, in spite of the fact that both diseases are associated with the ingestion of dietary carbohydrates. This study was undertaken in Fars Province, southern Iran, to determine the prevalence rates of dental caries in a group of metabolically well-controlled patients with type I diabetes mellitus and in a control group.

Methods: Fifty patients (22 boys and 28 girls) with type I diabetes mellitus under follow-up of the Endocrinology and Metabolism Research Center of Shiraz University of Medical Sciences, with a mean ± SD age of 11.72 ± 3.36 years and mean ± SD fasting blood sugar of 235.74 ± 103.61 mg/dL, entered this study. A similar study was conducted to determine the prevalence of dental caries in 12-year-old school children in Shiraz, Iran who served as the control group. After completing a questionnaire, the patients were examined separately by two dentists. Before the clinical examination, bitewing radiographies were performed. Student’s t- and Chi-square tests were used for statistical analysis in relation to sex, age of onset of diabetes mellitus, socioeconomic and nutritional status, family history of diabetes mellitus, and orohygiene status.

Results: The mean ± SD DMFT for diabetic children was 9.64 ± 4.64 (decayed = 8.12 ± 3.90, missing = 0.62 ± 1.34, and filling = 0.90 ± 2.10). The lower permanent first molars were the most frequency decayed and the incisors were the healthiest teeth. DMFT score and the frequency of decayed teeth were higher in boys than in girls. However, the rate of filling and missing teeth were higher in girls. DMFT and the number of decayed teeth were higher in patients with poor oral hygiene. The number of healthy first permanent molars was much higher in the mixed dentition groups than in those with permanent teeth. A direct correlation was found between the health status of the first permanent molar tooth and having type I diabetes mellitus.

Conclusion: Oral hygiene was somewhat poorer in diabetic patients than in the control group. Regular dental check-ups for preventive measures such as fluoride therapy, fissure sealant, regular medical follow-ups for proper control of metabolic abnormalities to decrease occurrence of xerostomia, omission of cariogenic substances from dietary regimen, fluoridation of drinking water, and individual and group education of diabetic patients regarding proper dental hygiene are recommended.

Keywords: Caries • correlation • diabetes • decay, missing, and filled teeth (DMFT) • Iran

Introduction

Diabetes mellitus is a disease, in which, the balance and metabolism of energy is disturbed for lack of secretory insulin or functional disorders, which would lead to an abnormal metabolism of carbohydrates, protein, and fat. Generally, diabetes mellitus is divided into type I disease, which is insulin-dependent (IDDM) and type II disease, which is not insulin-dependent (NIDDM). Type I is the most common metabolic endocrine disorder in children and young adults, which has important effects on the growth and development of patients. It often starts in childhood, but it could also occur at any age.1, 2

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Oral complications of diabetes mellitus include xerostomia, cheilosis, reduced salivary flow, and particularly, the increased risk of periodontal breakdown. Several studies have been carried out on the periodontal disorders in diabetic patients. However, in spite of a close relationship between diabetes mellitus and dental decay limited research has been undertaken on the prevalence of dental decay in diabetic patients. Despite remarkable industrial and scientific improvements, especially in the present century, no effective and comprehensive solution has already been suggested.\(^3,4\)

Precise statistics on the prevalence of oral and dental diseases and their relationship with nutrition, oral and dental health in different age groups and in patients with systemic disorders, such as diabetes type I, are available in developed countries. Nonetheless, no study has been conducted in Iran, especially in regard to the prevalence of dental decay in those suffering from systemic disorders. Evaluation of decay, missing, filled teeth (DMFT) score, as a health index, can determine the current status of a community from the viewpoint of dental health and disorders. WHO has reported the most appropriate rate of DMFT at the strategic age of 12 years, but it should be clarified for patients with type I diabetes mellitus.\(^5,6\)

Since no data was available on the prevalence of dental decay in patients with type I diabetes in Iran, this study was conducted according to the standard methods recommended by WHO to determine the DMFT score in 5 – 18-year-old diabetic patients residing in Fars Province, southern Iran.

**Patients and Methods**

A four-part questionnaire including demographic information, medical history, laboratory findings, and the dental health status, was administered to each patient. The questionnaire was completed by one of the researchers interviewing the diabetic patients and their parents. Two examination sheets were provided for each patient, in which the data of decayed, extracted, restored, and healthy teeth were registered separately by two researchers. The data were then compared. Fifty diabetic patients aged between 5 and 18 years who were admitted to the Department of Operative Dentistry, School of Dentistry, Shiraz University of Medical Sciences, during eight months, entered this study. Bitewing radiography was performed by another researcher in the radiology department and the data were recorded. The teeth of the diabetic patients were examined by each researcher, separately, to validate the results. If any inter-rater differences were found, the evaluation was repeated by the examiners and recorded again. According to their oral hygiene, patients were categorized as “good,” with no dental caries/debris; “fair,” with one or two caries but no debris; and “bad,” with both caries and debris. A similar study was performed on 12-year-old school children in Shiraz, Iran, who served as the control group. To determine the dental health status, using a mirror under sufficient light, a trained dentist examined the patients. Bitewing radiography was used to diagnose any proximal decay, which could not have been seen by clinical examination. The status of each tooth was registered in a form, as decayed (D), missing (M), filling (F) and healthy (H), as described earlier by WHO. Permanent and deciduous teeth were both examined. Student’s t- and Chi-square tests were used for statistical analyses.

**Results**

The 50 diabetic patients studied had a mean ± SD age of 11.72 ± 3.36 years and a mean ± SD fasting blood sugar of 235.74 ± 103.61 mg/dL. Tables 1 and 2 show the sex and geographic distribution of the participants.

Figure 1 shows the status of oral health in our patients. DMFT score and the frequency of decayed teeth were higher in patients with bad oral hygiene \((P < 0.003)\). Figure 2 presents the percentage of decayed, restored, extracted, and healthy tooth in 50 diabetic patients. The mean ± SD DMFT for diabetic patients was 9.64 ± 4.64. The mean ± SD for decayed was 8.12 ± 3.90, for missing 0.62 ± 1.34, and for filling was 0.90 ± 2.10. Figure 3 demonstrates the percentage of decayed, restored, extracted, and healthy first permanent molar tooth of both the upper and lower jaws. The lower permanent first molars were the most decayed and the incisors were the healthiest.

<table>
<thead>
<tr>
<th>Sex</th>
<th>n (%)</th>
<th>Mean ± SD age (yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>22 (44)</td>
<td>11.95 ± 2.85</td>
</tr>
<tr>
<td>Female</td>
<td>28 (56)</td>
<td>11.53 ± 3.75</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>50 (100)</td>
<td><strong>11.72 ± 3.36</strong></td>
</tr>
</tbody>
</table>

Table 1. Number, percentage, and mean ± SD age of diabetic patients in relation to sex.
teeth. DMFT score and the frequency of decayed teeth were higher in boys than girls. However, the frequency of filling and missing teeth were higher in girls. None of these differences however, were statistically significant. Comparison between DMFT and its components with the patients’ socioeconomic status, nutritional status, onset of diabetes, family history of diabetes, and tooth brushing habits, revealed no statistically significant difference between these groups. There was also no statistically significant difference in DMFT and its components, between patients with deciduous, mixed, or permanent dentition, although the mean number of filled teeth was lower in the mixed dentition group than the permanent dentition ($P < 0.02$). In comparing the first permanent molars of the mixed dentition and the permanent dentition groups, the number of healthy first permanent molars were more frequent in the mixed dentition than in the permanent group ($P < 0.007$). A direct correlation was found between the health status of the first permanent molar tooth and being affected by diabetes ($P < 0.05$). DMFT in diabetic patients was significantly ($P < 0.05$) higher than the control group (Figure 4).

**Discussion**

Incidence of diabetes mellitus is quite different among different countries and ethnic groups. As an example, the prevalence of IDDM in school age children in the USA is reported to be 1.9/1000. Each year, 30 new cases of diabetes per 100,000 are reported in Finland and only 0.8 per 100,000 in Japan. The prevalence of diabetes in Finland is 35 times more than that in Japan. The rate among Afro-Americans is $20 - 30\%$ of white Americans. The incidence of IDDM among 100,000 American children under 18 years old was 12 new cases annually. The prevalence of IDDM in countries such as Scotland and Finland is increasing, whereas, in the USA it is decreasing. In a study performed in Shiraz on the prevalence of type I diabetes from birth to the age of 17 years, the rate had two peaks at the ages of 6 – 8 and 12 – 14 years. The maximum frequency was observed in winter ($P < 0.01$); while the minimum was in summer. A positive family history of type I and II diabetes, was reported in 8% and 0.2% of patients, respectively. Tavares et al reported that the prevalence of root decay among adult diabetic population was remarkably lower than that of the control group, due to the restriction of pure carbohydrate consumption among diabetics. In a study by Wenger in Germany in 1968 – 1969 on two groups of diabetic patients aged 2 – 19 years old, the prevalence of tooth decay was surveyed and compared with DMFT in healthy people, which was about 4. They observed a higher prevalence of tooth decay among diabetic patients. Tonovuo et al studied 35 diabetic patients, with a mean age of 30.4 years. This group consisted of 24 men and 11 women. These patients were randomly selected from a university hospital in the Turku City of Finland, and all were suffering from type I diabetes, with a mean ± SD duration of illness of $14 ± 9.1$ years. The diagnosis of dental decay was made clinically, and by bitewing radiography. A DMFS index for each patient was evaluated. Their results showed that the prevalence of decay among diabetics was the same as the healthy people, and that among diabetics, those with a lower age (<7 years), had less decay and filling. In the Twetman et al’s study, 94 type I diabetic patients, aged 4 – 19 years, were compared with a control group. No difference was
observed between the rate of *Streptococci mutan* in saliva of both groups. No difference was also observed for tooth decay between diabetics and healthy people.\(^{12}\) In the study of Piattelli et al, 26 type I diabetics and 24 healthy individuals, as the control group, were studied.\(^{13}\) They showed that the rate of decay in diabetics was higher than the healthy persons, which was due to the high consumption of carbohydrates in their diet.\(^{13}\) Falk et al studied 94 diabetic patients over a long and 86 for a short period. They compared their findings with those of 86 nondiabetic patients.\(^{14}\) Age of these patients was between 20 and 70 years. There was no significant difference between these three groups in terms of tooth decay, but the rate of peripheral lesions among diabetics was more than

**Figure 2.** Percentage of decayed, missing, restored, and healthy teeth in 50 diabetic patients.

**Figure 3.** Percentage of decayed, missing, restored, and healthy first permanent molar teeth of both the upper and lower jaw.
The rate of decay in proximal aspects of teeth among long-term diabetics was more than nondiabetic group. In another study by Poppe et al two groups consisted of diabetic and nondiabetic patients were investigated. Sucrose consumption was restricted in both groups. The results showed that the rate of dental decay among diabetics was one-third of that in the control group. In a study by Albercht et al studied 1360 diabetic patients and showed that the DMFT score was higher; the rate of tooth decay was lower and the rate of restored and extracted teeth were more among diabetics. DMFT score had no correlation with onset of the disease, but increased with age. They observed that a sucrose-free diet among diabetics could not reduce tooth decay. The increase in DMFT index and earlier loss of teeth among diabetics was due to periodontitis. Goteiner et al conducted a study to compare the rate of decay and periodontal disease among type I diabetics and nondiabetics and found that the rate of decay among diabetics was higher. They showed that among the diabetic patients with a controlled diet, the rate of decay was not lower than the control group, which could be due to poor compliance of diabetic patients regarding their treatment and diet. They found a high prevalence of decay among diabetics at lower ages, for lack of cooperation during treatment. Albercht et al studied 1600 diabetic patients (815 with type I and 761 with type II diabetes). They showed a higher rate of dental decay among diabetics, based on DMFT index. However, the rate of unfilled decayed teeth in these patients was lower and the rate of tooth loss was higher among diabetics ($P < 0.01$). Jones et al conducted a study on oral health among diabetics and compared the results with the nation-wide oral health survey in England and showed that, although the diabetics paid more attention to oral hygiene, the rate of decay was higher among them due to their higher susceptibility to decay.

In our study, the DMFT index among 50 type I diabetic patients was 9.64, which is much higher than the DMFT recommended by WHO ($\leq 3$) for nondiabetic children. The rate of decay was 8.12 and the rate for filled teeth was 0.9, showing a high rate of tooth decay among these patients, which could be due to the diabetes, as well as receiving minimal dental care. Oral hygiene was significantly ($P < 0.003$) correlated with DMFT. All other factors studied including sex, socioeconomic status, brushing frequency, and diabetes duration had no significant correlation with DMFT. A statistically significant ($P < 0.05$) difference was also observed in the level of oral hygiene as well as the extent of the caries of the first permanent mandibular molar teeth between diabetic and nondiabetic people studied. Diabetic patients with mixed dentition, had healthier permanent first molar teeth than those with permanent dentition ($P < 0.007$). When each tooth of diabetic patients was evaluated separately, the first permanent molar tooth of the lower jaw had the most percentage of decay; probably, due to its unique anatomic condition, it collects more microbial plaque. Early growth of these teeth leading to a greater exposure against local factors, the anatomical difference between the lower and upper first molar teeth, the saliva cleansing effects, and more blockade of food on the first lower molars, all cause greater decay on these teeth as compared with the first upper molars. Our results, similar to those reported by Piattelli et al, indicated that the decay rate in the diabetic patients is higher than healthy individuals, probably due to a greater carbohydrate consumption. In a study conducted by Stadtler et al similar results were obtained with a high percentage of decay in diabetic patients, due to poor compliance. Jones et al conducted a comprehensive study on oral and dental health of diabetic patients. Their results, which were in keeping with ours, indicated that although diabetic patients imported greater oral health as compared to nondiabetics, the rate of decay among them was higher. Wegner, in his studies, showed that the
prevalence of tooth decay in diabetic patients was higher than nondiabetics and that the rate of decay in first permanent molar teeth in diabetics was higher (95.3%) than the nondiabetic group (73.5%). The same results were obtained in our study. Tooth decay among diabetic and healthy people was 63.3% and 48.9%, respectively. Nonetheless, the rate of decay in Wegner’s study was higher than our study. 23, 24 Albercht et al reported the same results as ours. 20 DMFT score was higher among diabetic patients than nondiabetics. The rate of decay, however, was lower. Similar to our study, the frequency of the restored and extracted teeth were higher among diabetics as compared to the control group. The rate of decay in our study among diabetics was also higher than the control group. Albercht et al stated that the reason for a higher DMFT score in diabetic patients is periodontitis, which leads to losing their teeth earlier, hence, having a higher DMFT score. 20 Some studies have reported different results, showing no difference between DMFT score of diabetic patients and nondiabetics. 4, 11, 14, 25 On the other hand, other researchers have shown that the DMFT score of diabetic patients was lower than nondiabetics. 4, 15, 19, 26 Our results showed that the DMFT score of diabetic patients was higher than nondiabetic people, which may be due to xerostomia and reduction of saliva secretion in diabetic patients, poor compliance while on treatment and diet, and lack of dental and oral hygiene (44% of the patients in this study did not brush their teeth). To reduce dental decay in diabetic patients, basic measures should be implemented. These include a better control of diabetic patients in relation to dental condition from childhood by regular visits for preventive measures such as fluoride therapy, use of fissure sealants, better glycemic control and prevention of xerostomia, omission of desserts from the patients’ diet, fluorination of the patients’ drinking water, and training of patients to comply with the oral and dental health effectively and continuously.

We concluded that oral hygienic condition is somewhat poorer in diabetic patients than the control group. This aspect, along with an elevated risk for low salivary flow, xerostomia, and an increased tendency for the prevalence of caries, should alert the dental professionals to emphasize on the prevention of dental diseases in diabetic patients. Regular dental check-ups for preventive measures such as fluoride therapy, fissure sealant, regular medical follow-ups for proper control of metabolic abnormalities to decrease the occurrence of xerostomia, omission of cariogenic substances form the dietary regimen, fluorination of the drinking water, and individual and group education of diabetic patients regarding proper dental hygiene are recommended.

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