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Original Research Article

Relationship between Unstimulated Salivary Flow Rate and DMFT Index with Glucose Regulation and Diabetes Duration among Patients with Type 2 Diabetes Mellitus in a Turkish Population

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Abstract

Type 2 Diabetes Mellitus (T2DM) is associated with many oral and dental problems. The objective of this study was to evaluate the Decayed, Missing, Filled index (DMFT index), unstimulated salivary flow rate and their relationships with glucose regulation in T2DM patients. The study included 60 patients with type 2 diabetes mellitus and 65 age- and gender-matched non-diabetic controls. Patients DMFT and unstimulated salivary flow rate were evaluated. T2DM patients were divided into two groups as good glycemic (HbA1C<7gr/dL) (30 patients) and poor glycemic control (HbA1C>7gr/dL) (30 patients). All statistical analysis was performed using SPSS version 21.0. Salivary flow rate was found as 0.14 ± 0.06 mL/min in T2DM group and 0.25 ± 0.09 mL/min in the control group and the difference was statistically significant (p=0.03). Salivary flow rate was found as 0.16 ± 0.07 mL/min in T2DM patients with good glycemic control and 0.12 ± 0.08 mL/min in T2DM patients with poor glycemic control, and the difference was statistically significant (p=0.03). DMFT index was 13.3 ± 3.7 in T2DM patients and 9.8 ± 1.7 in the control group, and the difference was statistically significant (p=0.02). DMTF index was 13.1 ± 3.3 in T2DM group with good glycemic control and 13.8 ± 4. In T2DM patients with poor glycemic control and the difference was statistically significant (p=0.04). The incidence of hyposalivation was higher in T2DM diabetic patients than control group. Salivary flow rate is low in T2DM patients, DMTF index is higher compared to non-diabetic patients, and hyposalivation is more frequently observed in these patients. Good glycemic control can prevent tooth decays and loss of teeth.

Keywords: Type 2 diabetes mellitus, unstimulated salivary flow rate, hyposalivation, DMFT index

INTRODUCTION

Diabetes Mellitus (DM) is a public health problem with an increasing incidence worldwide(Shaw et al, 2010). DM which is basically divided into two type, is a chronic and metabolic disease resulted from absolute lack/deficiency of insulin due to pancreatic beta cell damage (Type 1 DM) or impaired production of insulin/development of resistance in the peripheral tissue against insulin (Type 2 DM) and characterized by chronic hyperglycemia (American Diabetes Association, 2011). Chronic hyperglycemia and uncontrolled diabetes often causes microvascular (retinopathy, nephropathy, neuropathy) and macrovascular (coronary artery disease, peripheral

artery disease, cerebrovascular disease) complications and serious morbidity and mortality (American Diabetes Association, 2011). Besides these complications, diabetes lead to several other complications such as foot ulcers, charcot joint, autonomus neuropathy, neurogenic bladder, sexual dysfunction and hypertension (American Diabetes Association, 2011;World Health Organization, 2013).

Oral manifestations of the disease at the time of diagnosis include acetone odor in breath due to diabetic ketoacidosis in Type 1 DM and xerostomia in both Type 1 and Type 2 DM. Numerous oral signs and symptoms are seen in patients with impaired regulation of blood glucose due to decreased neutrophil functions such as fungal-viral infections, gingivitis, periodental diseases, lichen planus, decreased salivary flow rate (hyposalivation), increased incidence of decays, impaired wound healing and tendency to bleed after surgical operations, burning mouth syndrome, glossitis and stomatitis (Kathiresan et al., 2017).

The level of salivary glucose is well correlated with serum glucose level in T2DM patients (Carramolino-Cuellar et al., 2017). Salivary glucose concentration increases and chemical nature and pH of salivary changes as a result of uncontrolled blood glucose and hyperglycemia. In addition, fluid loss and dehidration due to polyuria and altered functions of inflammatory cells pave the way for development of oral complications. Microvascular and macrovascular complications may affect salivary gland functions in diabetic patients (Aral et al., 2016). The incidence of reduction in salivary flow rate was common in diabetic patients.

Diabetes duration plays a role in oral signs and symptoms of blood glucose regulation level. Tooth decays, periodontal diseases (gingivitis) and other chronic infections in T2DM patients contribute to low degree chronic inflammation, causing tendency to atherosclerotic coronary artery disease which is the most important cause of mortality in diabetic patients. In this regard oral health status is assessed with some common indexes; one of them is the DMFT index.

The objective of this study was to evaluate DMFT index and unstimulated salivary flow rate in subjects with Type 2 DM, and the relationship of these parameters with diabetes duration and blood glucose regulation in a Turkish population.

MATERIAL AND METHODS

This study was designed with 125 subjects who presented to Akdeniz University Faculty of Dentistry, the department of oral and maxillofacial radiology for routine examination. Subjects were divided into two groups as T2DM (n=60)patients and non diabetic, healthy control group (n=65).

The subjects were informed about the study design and permission forms has been obtained from the patients in the related work. No any medication was used during the study by us and the patients were advised to continue their medical treatment in the clinics where they were followed-up. A detailed anamnestic evaluation was performed in all patients in terms of systemic diseases, diabetes duration and the drugs they have used. Demographic data included age, gender and diabetes duration were recorded. Height (cm) and weight (kg) of all patients were recorded. Body Mass Index (BMI) was calculated by body weight (kg) / height (m^2). Patients with a BMI of 25.0-29.9 were considered as over weight, 30-34,9 as obese and ≥ 35 as morbid obese. The study included T2DM patients who were regularly followed-up. Arithmetic mean of HbA1C measured within the last 6 months was taken. Patients were divided into two groups as good glycemic control (HbA1C<7gr/dL) (30 patients) and poor glycemic control (HbA1C>7gr/dL) (30 patients). The study excluded diabetic patients who were below 18 years old, smokers and alcohol abusers, patients with a history of radiotherapy applied on the head and neck region, salivary gland disease (tumor, stone), pregnants, patients who used psychotic drugs, those with active oral infection, a history of rheumatic diseases (Sjögren syndrome, Rheumatoid arthritis, Systemic lupus erythematous), chronic lung and kidney diseases, patients who rejected to participate and patients with unknown HbA1C values.

Oral examination of all patients was performed by a single oral and maxillofacial radiologist with a mouth mirror under light and DMFT indices were evaluated. In order to calculate unstimulated salivary flow rate; salivary samples were collected in morning hours (08:00-10:00), before taking any food or drink and brushing teeth and after the patients rested for 10 minutes, by making them rinse their mouth with distilled water and spitting into the tubes divided in milimeters for 5 minutes in sitting position. The results were recorded for each patient as milimeter/minute (mL/min). Unstimulated salivary flow rate values <0.1 mL/min were considered as hyposalivation.

In order to calculate DMFT index; all permanent teeth with oral decays, missing and filling teeth were identified by a single oral and maxillofacial radiologist through clinical and radiologic oral examination and DMFT indexes were determined. The abbrevation of DMFT included D: Decay, M: Missing, and F: Filling (filled teeth due to decays).

Statistical Analysis

Data obtained were evaluated using statistical SPSS 21.0 software. Normality of continuous and discrete numerical variables was evaluated with Kolmogorov Smirnov test. Correlation between the variables was evaluated using Spearman rank correlation coefficient. Nominal and

Table 1. Basic demographic characteristics, salivary flow rate, DMFT index and hyposalivation frequency of the subjects

Parameter	Type 2 DM	Control group	Allgroup	P+value
Age (year)	56.7 ± 18.8	53.2 ± 17.4	52.1 ± 16.2	**0.18**
Gender (M/F)	31/29	32/33	63/62	**0.21**
BMI (kg/m^2)	33.2 ± 13.4	27.6 ± 11.7	29.3 ± 14.2	**0.04**
Unstimulated SFR (ml/min)	0.14 ± 0.06	0.25 ± 0.09	0.19 ± 0.08	**0.03**
DMFT index	13.3 ± 3.7	9.8 ± 1.7	11.2 ± 2.4	**0.02**
Hyposalivation (n,%)	12, 40	4, 13.3	16, 26.6	**0.01**

+:PearsonChi-squaredtests, Data aregiven as mean, standart deviation (SD)**M=**Male, **F=** Female, **BMI**= Body massindex, **SFR=**Salivaryflow rate, **DM=**Diabetesmellitus, **ml/min=** mililiter/minute

Table 2. Salivary flow rate, DMFT index and hyposalivation frequency according to blood glucose regulation

Parameter	HbA1c<7 gr/dL (n=30)	HbA1c>7 gr/dL (n=30)	P+ value
Age (year)	58.3 ± 19.8	55.1 ± 17.9	0.22
Gender (M/F)	16/14	15/15	0.34
BMI (kg/m^2)	32.5 ± 15.1	34.8 ± 16.7	0.18
Unstimulated SFR (ml/min)	0.16 ± 0.07	0.12 ± 0.08	0.03
DMFT index	13.1 ± 3.3	13.8 ± 4.1	0.06
Hyposalivation (n - %)	5 - 16.6	7 - 23.3	0.12

+:PearsonChi-squaredtests, **M=** Male, **F=** Female, **BMI**=Body massindex, **SFR=**Salivaryflow rate, **DM=** Diabetesmellitus, **ml/min=** mililiter/minute

ordinal data were analyzed with Chi-square test. In all comparisons, a P value ≤0.05 was considered statistically significant.

RESULTS

Subjects included in this study were divided into two groups as the subjects with and without T2DM. Out of 125 subject, 62 were female (49%) and 63 male (51%) with a mean age of 53.2±17.4 years. Out of 60 patients with T2DM, 29 were female and 31 male, while out of 65 subjects without T2DM 33 were female and 32 male. There was no significant difference between the groups in terms of age and gender distribution (Table 1).

BMI was found as 33.2±13.4 kg/m^2 in diabetic patients and 27.6±11.7 kg/m^2 in the control group, and the difference was statistically significant (p=0.04).

Unstimulated salivary flow rate was 0.14±0.06 mL/min in diabetic patients and 0.25±0.09 mL/min in the control group and the difference was statistically significant (p=0.03).

DMFT index was 13.3±3.7 in diabetic patients, and 9.8±1.7 in the control group, and the difference was statistically significant (p=0.02).

There was no significant difference between the diabetic patients with good glucose regulation (HbA1C<7 g/dL) and those with poor glucose regulation (HbA1C>7 g/dL) with regard to their mean age, gender distribution, BMI and diabetes duration (p>0.05).

Unstimulated salivary flow rate was 0.16±0.07 mL/min and 0.12±0.08 mL/min in diabetic patients with good and poor glucose control, respectively and the difference was statistically significant (p=0.03).

DMFT index was 13.1±3.3 in the good glycemic control group and 13.8±4.1 in the poor glycemic control group, and the difference was not statistically significant (p=0.06) (Table 2).

Regarding duration with diabetes patients who had DM for more than 10 years were 25, while those who had DM for less than 10 years were 35. Findings on unstimulated salivary flow rates in these two groups were 0.14±0.08 mL/min and 0.16±0.07 mL/min, respectively. The difference was not statistically significant (p=0.07). DMFT indexes in both groups were 14.2±4.8 and 12.7±3.5, respectively and the difference was statistically significant (p=0.02).

Hyposalivation was found in 40% of diabetic patients (n=12) and 13.3% of the control group (n=4), and the difference was statistically significant. There was no significant difference found between the good and bad glycemic control groups in terms of the incidence of hyposalivation (Table 2).

DISCUSSION

DM is a metabolic disease which causes chronic changes in all tissue and organs in the body including changes in oral cavity. Numerous pathological processes are observed in the oral cavity such as xerostomia, atrophic changes, increased incidence of decays, impaired dentition, gingivitis, periodontal diseases and burning mouth syndrome (Tozoglu and Bilge, 2009 ; Singh et al., 2016; Moore er al., 2007).

The mouth is a place where many microorganisms and toxic agent are encountered for the first time and salivary antimicrobial effects are the first defebse mechanism of the organism (Tozoglu and Bilge, 2009). In addition, salivary has important effects on digestive system, taste and physiologic functions such as chewing, swallowing and speech (Tozoglu and Bilge, 2009).Decreased salivary flow rate, difficulty in speech, chewing and swallowing, halitosis, decreased taste sensation, increased opportunist infections due to impaired oral flora (oral candidiasis) pave the way for emergence of periodontal problems, decays (Hoseini et al., 2017). Enzymes contained by salivary and its bacteriostatic and bactericide effects have been shown to protect mucosal integrity and accelerate epithelization in wound healing (Emekli et al., 2008).

Salivary flow rate can be evaluated as stimulated and unstimulated. Unstimulated salivary flow is provided at a rate of 0.25-0.35 mL/min (mean 0.3 mL/min)at resting depending on persons and time. Unstimulated salivary flow is the more dominant condition in salivary production, and is more important in terms of the protection of oral cavity (Hoseini et al., 2017). There are different studies reporting that unstimulated salivary flow rate is decreased and xerostomia is more common (Hoseini et al., 2017), or do not change in diabetic patients (Collin et al.,2006; Aydin, 2015).

In this study, it was found that unstimulated salivary flow rate was significantly decreased in diabetic patients compared to the non-diabetic group. Hyposalivation is mentioned when unstimulated salivary flow rate drops under 0.1 mL/min (Singh et al., 2016). Changes in the production and rate of salivary in diabetic patients can develop depending on acute and chronic processes.

Glucose regulation is the most important factor which causes changes in salivary production acutely and chronically (Hoseini et al., 2017). In this study, the effect of blood glucose regulation on unstimulated salivary flow rate was further evaluated and salivary rate was significantly decreased in poor glycemic control group (HbA1C>7 g/dL) compared to good glycemic control group (HbA1C<7 g/dL). Similar results were obtained in a study by Chavez et al. 2000 with parotis salivary flow rate was found to be lower in poor glycemic control group (HbA1C>9 g/dL) compared to good glycemic control group and non-diabetic patients (Chavez et al., 2000). In this study, no significant difference was found between unstimulated salivary flow rates of the patients with a diabetes duration longer and shorter than 10 years. In another study by Chavez et al. 2001, age, gender and diabetes duration were reported to not affect salivary flow rate (Chavez et al., 2001).

Various indexes have been proposed to evaluate oral and dental health in different age groups. DMF index which is the most commonly used among these indices was developed for the first time in 1930s, and it can dedect the amount and incidence of tooth decay in patients for a long time (Koser and Nalçaci, 2011). It enables collection of epidemiological data as a simple and practical method. Primary teeth and permanent teeth can be evaluated.

In this study, DMF index was applied by evaluation of permanent teeth (DMFT index). In this study DMFT index was evaluated by a singer researcher. Since DMF index is obtained from the evaluation of all decay, missing and filling teeth, it enables to mathematically determine incidence of decays. Evaluation of not only decay teeth, but also missing and filling teeth provides evaluation of the effects of diseases affecting oral and dental health for a long time. DMFT index varies between 0-28 and 0-32 depending on whether the third molar teeth are assessed. Despite its positive aspect, there may be big differences between researchers in DMFT calculations (World Health Organization, 2013). In this study, DMFT index was evaluated by a single researcher. According to DMFT index by the World Health Organization, severity of decay was determined between 35-44 years of age. A value of <5 was specified as very low, 5.0-8.9 as low, 9.0-13.9 moderate, and >13.9 as high decay (World Health Organization, 2013). In this study, moderate decay values were found in diabetic patients and the control groups. DMFT value was the highest in patients with a diabetes duration longer than 10 years.

It has been demonstrated that diabetes predisposes to decays and decreased salivary flow rate contributes to occurrence of decays. Again, decreased salivary flow rate in diabetic patients has been shown in many studies. However, there are also studies reporting different results in this issue.

In this study, DMFT index was higher in diabetic patients than in the control group, but no correlation of DMFT with glucose regulation was found. In addition, DMTF index was higher in patients with a long duration of diabetes (>10 years). This may be a result of the chronic effects of diabetes on chronic hyperglycemia and oral mucosa.

CONCLUSION

According to the results of this study, unstimulated salivary flow rate was decreased, and DMFT index was increased in diabetic patients. Salivary flow rate was

found to be correlated with glucose regulation level and DMFT index with the disease duration.

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Conflicts of Interest

All authors declare that there is no conflict of interest

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