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Oral health and characteristics of saliva in diabetic and healthy children

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RESEARCH

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ABSTRACT

Background
Diabetes is the most common metabolic disorder. Idiopathic destruction of pancreatic beta cells will result in progressive loss of insulin, increase in ketone bodies, PH reduction and changes in bicarbonate neutralizing system in all body fluids including saliva and the oral cavity.

Aims
The aim of this study was to compare the quality and quantity of saliva and oral health in children and adolescents with diabetes compared to healthy children.

Methods
In this study, 27 diabetic patients (9 males, 18 females, with age range 7–18) were studied. A control group (27 people) were selected from healthy persons with similar age and sexual conditions. The amount of saliva was evaluated in 5 minutes, by non-stimulant collecting, in plastic vials. The PH and Total Antioxidant Capacity (TAC) were measured using paper strip and TAC kit. Oral and dental health was measured using DMFT and MGI indexes.

Results
Saliva in patients showed less secretion than control group (1.09±0.13, 5.28±0.23, $p<0.01$), PH (5.28±0.09, 7.11±0.10, $p<0.001$), and total antioxidant capacity was lower (0.36±0.04, 0.5±0.04, $p<0.001$) compared to controls group. DMF and MGI indicators were more in patients than in control group ($p<0.001$).

Conclusion
Patients with type 1 diabetes had less secretion, PH and antioxidant defence and as a result had more dental and oral problems compared to healthy children that with higher DMFT and MGI these patients require further training in this field and regularly examinations.

Key Words
Diabetes Mellitus Type 1, salvia, antioxidants, oral health

What this study adds:

1. What is known about this subject?
Idiopathic destruction of pancreatic beta cells will result in progressive loss of insulin, increase in ketone bodies, PH reduction and changes in bicarbonate neutralizing system in all body fluids including saliva and the oral cavity.

2. What new information is offered in this study?
Patients with type 1 diabetes had less secretion, PH and antioxidant defence and as a result had more dental and oral problems.

3. What are the implications for research, policy, or practice?
Patients with type 1 diabetes had more dental and oral problems and require further training in this field and regularly examinations.

Background

Diabetes is a group of metabolic disorders with a high level of blood glucose, which is caused by secretion problem or malfunction of insulin or a combination of both.[1] Type 1 diabetes usually begins before the age of 25 years, but may occur at any age. Glycated haemoglobin (HbA1c) is a standard benchmark that is often used to determine the level of blood glucose. A very good control of blood sugar holds the HbA1c in the range of 6.5–7.[2]

The importance of saliva is well known in oral and dental health. Saliva duty is to defend and preserve the oral mucosa by sliding and healing oral soft tissue. The amount of saliva and salivary compounds may increase due to tooth decay, periodontal disease and oral-mucosal lesions. In patients with diabetes, high prevalence of oral problems such as dry mouth, increased periodontal disease and etc. could be seen.[3] Poor control of blood sugar can cause progression of gingivitis, alveolar bone loss, salivary gland dysfunction and impaired sense of taste and mouth feel.[4] Acidity of saliva in patients with type 1 diabetes is a strong factor in reducing the buffering capacity of saliva and thus increasing the risk of tooth decay.[2] The risk of tooth decay in patients with diabetes is significantly greater than the controls that is because of reducing the ability of saliva in cleaning, neutralizing and antimicrobial activity.[2]

Moriera et al.[1] in a study showed that the rate of non-stimulated salivary secretion and salivary pH is lower in children with diabetes in comparison to healthy children.

Gingivitis is the inflammation of gum that happens due to the presence of bacterial plaque. The prevalence of gingivitis in patients with type 1 diabetes is higher than persons without diabetes who had similar levels of bacterial plaque[2] Oxidative stress can cause lipid oxidation and form free radicals. Most of the body's defence mechanisms against free radicals is by antioxidants. The balance between free radicals producing and antioxidant defence of the body is important for health. If too many free radicals produced and antioxidant defences of the body became too low, the oxidative stress increased and can lead to chronic or permanent damage. Several studies suggest that diabetes is associated with increased formation of free radicals and decreased antioxidant capacity.[5]

Abraham et al. compared salivary composition, serum and oxidative stress in patients with type 1 diabetes and healthy persons and concluded that there is a significant difference between diabetes mellitus and increased severity of antioxidants and a variety of saliva and blood parameters.[5]

Due to the limitations of international studies and the lack of similar studies in Iran this study designed to evaluate salivary factors including: amount of secretion, pH and total antioxidant capacity of saliva, as well as DMFT (Decayed, missed, filled teeth) and MGI (Modified Gingival Index) as indicators of oral health in patients with type 1 diabetes and to compare the mentioned factors with health group.

Method

In this study 27 diabetic patients between 7–18 years old has been selected from patients referred to the clinic of Paediatric Endocrinology in Ahvaz, Iran. These patients should have no other severe or underlying disease except diabetes. Also 27 healthy children of the same age and sex without any underlying disease were selected from schools in different areas of Ahvaz, Iran, as control group. To begin the study parental consent was obtained from all of the participants in both patients and control group. The study was approved by the Ethics Committee of the Ahvaz Jundishapur University of Medical Sciences. In a questionnaire some information such as age, sex, occupation and education of parents were gathered to determine and estimate the economic and cultural situation of the participants.

Foods such as fruit, fruit juice, tea, coffee, and vitamin supplements may have the effect of antioxidant capacity and salivary pH,[6] so children were asked about having such foods in the past three hours. Also Information about the oral health status of patients, including toothbrush, floss and mouthwash were collected.

People who had mentioned foods during past three hours or patients with underlying disease other than diabetes and person with any oral habits such as smoking, bruxism and other destructive habits due to their effect on dental health were excluded from the study. Information about the dental health of individuals based on DMFT (Decayed Missed Filled teeth) were collected according to WHO criteria.[7]

Information related to pH, flow rate and total antioxidant capacity of saliva and also gingival inflammation (MGI, Modified Gingival Index)[8] in all patients were measured prior to evaluation of HbA1c.

The method of collecting saliva

To do this calibrated clear plastic vial with a capacity of 10ml was considered. Non-stimulated saliva of participants collected during five minutes while the person sitting on the chair and his head was bent slightly forward. Saliva were measured per ml in each five minutes.

The method of measuring pH

After collecting and measuring the amount of saliva, pH of saliva were recorded using paper strip manufactured by MERCK Germany, according to the manufacturer's instructions. The paper bars were placed inside a vial for 3–5 seconds in direct contact with saliva, then pH samples were recorded with the help of colour guide sheet provided by the manufacturer.

After the above steps, the samples were stored in the freezer -70°C until all samples were collected to measure simultaneously the total antioxidant capacity of saliva.

Check the oral and dental status of individuals

After collecting saliva, oral and dental examination was carried out on patients sitting on a chair in the room with spotlight using dental mirror and disposable probe. Detection of tooth decay carried out without x-rays in two ways: 1) See visual changes in the colour and consistency of the tooth surface 2) Touch scenes while examining the teeth by probe.

DMF index was used to record information about tooth health. The index is the number of teeth decayed, missing and restored according to the WHO instruction. To determine this index patients with structural defects such as amelogenesis imperfecta and dentinogenesis imperfecta were excluded. MGI indicators were used to evaluate the oral health of patients and since periodontal probe is not used in this method, it is a non-invasive method and increases children's co-operation. According to the Index, each state of gingival is allotted a number (8) as below:
1) Mild inflammation: Slight colour change, changing the consistency a part of gingival, margin involvement or gum papillae 2) Mild inflammation: same index above, only here the full involvement of marginalized or papilla could be seen. 3) Moderate inflammation: Shine, redness and swelling of the gums or hypertrophy of margin or papillae of the gingival. 4) Severe inflammation: Clear redness and swelling or hypertrophy of margin or papillae of gingival, spontaneous bleeding, congestion or sore.

After examination of the teeth and gums of participants, oral health education and the need to adhere to those described for them and in the case of need of treatment, guidance was given. After sample collection, according to age, gender, cultural and economic status of patients, some places of the city of Ahvaz with same economic conditions of residents has been selected using stratified sampling method. Then with cluster sampling method and based on age and gender of the patients, the schools in elementary, middle and high schools were identified in the selected areas of the city. Finally, the control group participants were selected from each class with the same age with the patients using systematic sampling method.

Finally, after collecting 54 samples sent to measure the total antioxidant capacity of saliva. It should be noted that samples were stored for 2 months in the freezer -70°C did not have any harmful effect on antioxidant capacity of samples.[9] Saliva samples were centrifuged, and total antioxidant capacity was measured using a TAC kit manufactured by RANDOX England with a spectrophotometric method. To verify the results all measurements were performed twice. After informing all the parents about the condition of the study, written consent was obtained. No extra examination or blood sampling imposed to patients or their families and patient information recorded confidential. The study was approved by the Ethics Committee of the Jundishapur University of Medical Sciences.

Results

People with diabetes consisted of 27 patients (9 male, 18 female) aged 7–18 years with an average of 10±5 years. In all patients HbA1c was lower than 6.5 per cent. Control group was consisted of 27 same participants (9 male, 18 female) with an age range of 10±6. Participants in two groups were at a same level in age, gender and economic condition. The mean age of participants was almost 10 years old with the male female ratio of 1:2. Data normality assumption was rejected after statistical calculations so in order to compare continuous abnormal data Man Whitney test was used which the results are shown in Table 1.

According to the above data, average flow rate, pH and total antioxidant capacity of saliva in the patient were lower than control group (p<0.01) and DMF index was higher in patients (p<0.01). Since MGI index is a discrete index, Fisher's exact test was used to assess independent or dependent variables to diabetes. The data 28.32 and p<0.001 showed that markers of gingivitis is related to the disease. To assess the correlation between salivary factors and oral-dental health of participants, Spearman correlation coefficient was used and results are shown in Tables 2 and 3.

In patients group there is a negative correlation between DMF and pH (pH reduction associated with increased injuries and dental caries) and there is a positive correlation between the flow and TAC of salvia (increasing the saliva flow will result increasing antioxidant capacity).

Discussion

This study showed that in diabetic patients flow and pH of salvia is lower, and the DMF index is higher than healthy people. These results are consistent with Moiera[1] and Ben Arieh[2] studies. In contrast Siudikien,[10] Lopez,[11] and Swanljung,[12] studies concluded that there is no significant differences in salvia flow rate among diabetic patients and healthy volunteers.

A decrease in saliva causes the sympathetic and parasympathetic nervous system dysfunction in patients with diabetes that is a form of peripheral neuropathy that decreases the function of salivary glands and resulting in dry mouth.[1,13] In this study same as Moreira study,[1] pH of saliva in diabetic patients was less than healthy individuals and had acidic nature.

Total antioxidant capacity of unstimulated saliva in our patients was lower than the healthy group, which is consistent with the results of the studies by Rahimi[14] and Abdollahi.[15,16] In contrast Astanei et al.[5] in their study reached the conclusion that the antioxidant power is increased in people with diabetes.

On the other hand Wilms[16] and Philth[17] observed no difference in antioxidant defence between patients and healthy subjects. DMF in our patients was higher than control group, in other word the average number of decayed, missing or restored teeth are more than healthy people. These findings are compatible with studies of Moriera,[13] Ben Arieh,[1] Soel,[2] and Abdolsamadi.[3]

MGI index in patients was greater than control group. According to Fisher's exact test, gingivitis was a dependent to disease variable, in other word the presence or absence of inflammation depends on the presence or absence of disease. These finding are consistent with Soel[2] findings. During statistical analysis we achieved the correlation between salivary parameters and DMF and MGI. In the patients group there was a negative correlation between salivary pH DMF and a positive correlation between the TAC and saliva flow rate. Thus, in patients with reduced pH and acidotic saliva of dental damage and caries increases. Also in this group greater saliva flow will result in increased antioxidant capacity of saliva that means more antioxidant defence against free radicals.

Conclusion

In conclusion children with diabetes are potential of the mouth and teeth diseases due to reduced pH and acidification of saliva and decreased antioxidant defence. More serious oral health education and regular periodic examinations should be included in the schedule care of the patients.

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PEER REVIEW

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CONFLICTS OF INTEREST

The authors declare that they have no competing interests.

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ETHICS COMMITTEE APPROVAL

The study was approved by the Ethics Committee of the Jundishapur University of Medical Sciences.

Table 1: Comparison of oral hygiene and dental health varies between diabetes and healthy groups

	Flow rate	pH	Total Antioxidant Capacity	Decay Missing Filling
Patient Cases a	1.09±0.13384	5.821±0.089	0.362±0.039	5.678±1.128
Health Cases a	5.2885±0.230	7.115±0.101	0.506±0.037	0.884±0.160
Man Whitney test	2	31.5	202.5	37
P Value	0	0	0.008	0

a Data are presented as Mean±SD

Table 2: The correlation coefficient between the measured parameters in diabetic children

	Total Antioxidant Capacity	pH	Decay Missing Filling	Flow rate
DMF	1.000	-0.319	-0.082	0.038
pH	-0.319	1	0.105	0.252
TAC	-0.082	0.105	1.000	0.405
Flow rate	0.038	0.252	0.405	1.000

Table 3: The correlation coefficient between the parameters measured in control group

	pH	Total Antioxidant Capacity	Flow Rate	
DMF	1.000	-0.054	0.139	0.202
pH	-0.054	1.000	0.256	0.202
TAC	0.139	0.256	1.000	0.101
Flow rate	0.202	0.202	0.101	1.000