Oral Health and Salivary Status in Children with Type 1 Diabetes Mellitus

Lulëjeta Ferizi[1], Fatmir Dragidella[2*], Lidvana Spahiu[3], Agim Begzati[1], Metush Disha[2], Teuta Pustina[4], Arben Murtezani[5], Rina Prokshi[1], Elvira Stanovci[1]

1. Department of Pediatric and Preventive Dentistry, School of Dentistry, Medical Faculty, University of Prishtina, Prishtina, Republic of Kosovo.
2. Department of Periodontology and Oral Medicine, School of Dentistry, Medical Faculty, University of Prishtina, Prishtina, Republic of Kosovo.
3. Department of Endocrinology, Pediatric Clinic, School of Medicine, Medical Faculty, University of Prishtina, Prishtina, Republic of Kosovo.
4. Department of Prosthodontics, School of Dentistry, Medical Faculty, University of Prishtina, Prishtina, Republic of Kosovo.
5. Department of Oral Surgery, School of Dentistry, Medical Faculty, University of Prishtina, Prishtina, Republic of Kosovo.

Abstract

Diabetes mellitus is a systemic disease which may be reflected in the oral cavity. The aim of the study is to evaluate the oral health and saliva in children with type 1 diabetes mellitus compared to control group.

The study was carried out on 160 children, 80 children with type 1 diabetes mellitus and 80 healthy children, age 10-15 years. The oral status was assessed using DMFT index for permanent teeth, oral hygiene index and gingival index. The stimulated salivary flow rate was estimated and counting the colonies of Streptococcus mutans was determined. Chi-square test, Fisher's exact test, Mann-Whitney U- test and odds ratio were used in the statistical analyses.

The prevalence of DMFT in children with type 1 diabetes was 96.25% compared to the healthy group (DMFT=95%). Moreover, plaque index and gingival index is significantly higher in diabetic children than control group, whereas stimulated salivary flow rate was significantly higher in control group (P<0.001). High counts and high risk of Streptococcus mutans were observed more often among the children with type 1 diabetes than in the controls (P<0.001 and P<0.01).

The findings we obtained showed that type 1 diabetes mellitus plays an important part in children's oral health.

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Introduction

Diabetes mellitus is a syndrome of metabolic disorders involving carbohydrate, fat and protein metabolism that results in acute and chronic complications due to the absolute or relative lack of insulin.[1,2] The most common types of diabetes are type 1 or insulin-dependent diabetes mellitus (IDDM) and type 2 or noninsulin-dependent diabetes mellitus (NIDDM).[3,4] Diabetes mellitus is a health problem, whose prevalence is growing rapidly in the world,[5] especially in low- and middle-income countries than in high-income countries.[6] The World Health Organization (WHO) has recently declared it to be a pandemic.[5]

The oral health of diabetic patients has been the subject of many studies in recent years. Several diseases have been reported to be associated with diabetes mellitus in the oral cavity. These complications include dental caries and tooth loss, periodontal diseases (periodontitis and gingivitis), salivary dysfunction leading to a reduction in salivary flow and changes in saliva composition.[7,8]

It has been reported that periodontal disease is the sixth most common complication of patients with diabetes mellitus.[9-11] Diabetes cannot be considered an etiologic factor for gingivitis or periodontitis, but is a predisposing factor for periodontal disease.[12] Those diseases are associated with poor metabolic control, and other diabetes complications.[13] Some studies have shown that patients with diabetes mellitus have a higher rate of caries,[14-17] periodontal diseases[14,15,18] and plaque indices[14,19-21] compared to non-diabetic individuals. Also, the quality and

*Corresponding author:
Prof. Fatmir Dragidella
Department of Periodontology and Oral Medicine,
School of Dentistry, Medical Faculty,
University of Prishtina,
Prishtina, Republic of Kosovo.
E-mail: fatmir.dragidella@uni-pr.edu

quantity of the saliva is very important for children with diabetes. There is evidence that diabetic patients have saliva secretion different from non-diabetic subjects. Diabetes is probably the most frequent metabolic disease with salivary implication, and diabetic patients complain because of dry mouth. Some studies reported that both unstimulated and stimulated salivary flow rates and buffer capacity are reduced in diabetic persons.[22,23]

On the other hand, many studies have evaluated the distribution of salivary Streptococcus mutans and Lactobacilli counts in diabetics and controls subjects, and reported higher counts of Streptococcus mutans and Lactobacillus in children with type 1 diabetes than in nondiabetics.[24,25]

The purpose of this study was to compare oral health between children with type 1 diabetes and control group related to the following variables: dental caries, oral hygiene index, gingival index, stimulated salivary flow rate, and quantitative distribution of Streptococcus mutans in saliva.

Materials and methods

Ethical considerations

For this study, the ethical approval was obtained from Ethic Committee-Medical Faculty, University of Prishtina, Kosovo (Ref. Nr. 4000) and conducted during June 2016 -December 2017. All patients volunteered for the study after receiving information and consent from their parents.

Subjects

This prospective study was carried out on 160 subjects, 80 patients with type 1 diabetes mellitus, aged 10-15 years from urban and rural areas, who were attending in the Department of Pediatric Clinic, University Clinical Centre of Kosovo (UCCK). At the same time, the control group subjects were matched with the case group subjects in relation to number, age and gender. Children with type 1 diabetes suggested doing a dental visit, whereas the control subjects were mainly attending for routine dental checkups, and all children for both groups were examined in Department of Pediatric and Preventive Dentistry, University Dentistry Clinical Centre of Kosovo (UDCCK). Inclusion criteria for the diabetic group were: an established diagnosis of type 1 diabetes for at least 1 year, a minimum age of 10 years and the ability to undergo a dental examination. The exclusion criteria for group with type 1 diabetes were the presence of other systemic disorders unrelated to the complications of diabetes, no antibiotic received in the previous month or the use of other medication in addition to insulin. The control group was required to present no systemic diseases, or drug use. Dental examination was carried out in the dental chair with dental instruments and artificial lighting, in both groups of subjects.

Clinical oral health assessment methodology

Clinical oral examinations were performed at the Department of Pediatric and Preventive Dentistry, University Dentistry Clinical Centre of Kosovo (UDCCK), by a single dentist, using a straight dental mirror and dental probe. The clinical oral health status was measured using the Decayed, Missing and Filled teeth index for permanent teeth (DMFT) according to the World Health Organization (WHO) guidelines.[26] The percentages of caries free subjects in the permanent dentition were also calculated. The Silness-Löe plaque index[27] and Löe-Silness gingival index[28] were assessed on 4 sites per tooth (mesiobuccal, distobuccal, mesiolingual and distolingual). The plaque index was scored on a scale of 0-3 as follows: 0 = no plaque; 1 = subgingival plaque only detectable with probe; 2 = visible plaque; 3 = abundant plaque covering the tooth. The gingival index was used to detect signs of inflammation and was also scored on a scale of 0-3 as follows: 0 = normal gingiva; 1 = mild inflammation/slight color change or edema; 2 = moderate inflammation/redness and edema; 3 = severe inflammation with marked redness and edema and/or tendency for spontaneous bleeding.

Saliva sample

Stimulated saliva collection from the diabetic and the control groups was performed in the morning, and stress situations of the children prior to and during saliva collection were avoided. Each subject was given a piece of paraffin pellet, and asked to chew the paraffin and to

expectorate the stimulated saliva into the container**.** Also, stimulated saliva samples (5 min production) were collected from children for bacterial assessment. The presence of S. mutans was determined using the CRT bacteria caries risk test (Ivoclar Vivadent, Liechtenstein). Bacterial counts were recorded as colony-forming units per milliliter (CFU/mL) of saliva. The number of bacterial colonies was graded as follows: Class 0 (none detected), Class 1 ($(10^2$-10^3 CFU/mL), Class 2 (10^4-10^5 CFU/mL), and Class 3 (CFU ≥ 10^5/mL), according to the manufacturers' scoring-card. Findings lower than 10^5 CFU/mL indicate low risk for caries (Class 0 and Class 1), whereas higher than 10^5 CFU/mL of S. mutans indicate a high risk for caries disease (Class 3 and Class 4). The CRT test is sensitive enough to provide a low, medium or high level of cariogenic bacterial challenge.

Statistical analysis

The statistical tests were performed with SPSS 17 (SPSS Inc., Chicago, Illinois, USA) and Excel 2007 (Microsoft Corporation, Redmond, WA, USA). Percentages were compared by using the Chi-Square test. The difference in the values of plaque index, gingival index and stimulated salivary flow rate, between type 1 diabetes mellitus and control group, was tested using the Mann-Whitney U Test. For estimate caries risk factors associated S. mutans, Odds Ratio (OR) were summarized with 95% confidence interval (95% CI). Differences were set to be statistically significant at *P*<0.05.

Results

From all 160 children, 80 children were with type 1 diabetes mellitus and 80 consisted in healthy control. Based on residence from 80 children with type 1 diabetes, 38 (47.5%) of children live in urban areas and 42 (52.5%) of children live in rural areas. Out of 80 children of control group, 47 (58.8%) of children live in urban areas and 33 (41.3) of children live in rural areas. There was no significant difference regarding residence among subjects (Chi=0.37; *P*>0.05) (Table 1).

The results shown in Table 2 refer to the prevalence of DMFT index for permanent teeth in 80 children with type 1 diabetes mellitus and 80 children from control group. There was a difference about DMFT between groups, especially the prevalence of component D in the diabetic group was higher than in the control group (D=91.25% / 66.25). On the other hand, the component F was higher in control group than in type 1 diabetes children (F=77.5% / 46.25%). Total DMFT-free for type 1 diabetic children and control group was found to be 3.75% and 5.00%, respectively (Table 2).

			Area		Total	Test
			Urban	Rural		
Group	Type 1 DM	Count	38	42	80	
		%	47.5%	52.5%	100.0%	
	Control group	Count	47	33	80	Chi=0.37
		%	58.8%	41.3%	100.0%	*P*>0.05
Total		Count	85	75	160	
		%	53.1%	46.9%	100.0%	

Table 1. Distribution of Children by Residence.

			D	M	F	DMFT	DMFT free
Group	Type 1 DM	Count	73	26	37	77	3
		%	91.25	32.50	46.25	96.25	3.75
	Control group	Count	53	34	62	76	4
		%	66.25	42.50	77.50	95.00	5.00
	Total	Count	126	60	99	153	7
		%	78.80	37.50	61.90	95.60	4.40

Table 2. Distribution of DMFT Values based on Groups.

There was a statistically significant difference related to plaque index, gingival index and stimulated salivary flow rate in type 1 diabetes children and control group. Plaque index and gingival index in type 1 diabetes children is significantly higher compared to the control group (Z=6.98 and Z=6.99; *P*<0.001). The value of stimulated salivary flow rate at children in the control group is significantly higher compared to the value in children with type 1 diabetes mellitus (Z= -8.18; *P*<0.001) (Table 3).
Table 4 shows results related to the number of colonies of Streptococcus mutans in both groups of children. Our results show that only a small number of children (0% for diabetic group and 3.8% for control group) exhibited the absence of S mutans (Class 0). In other words, S mutans

prevalence in both groups of children was 11.3%, respectively 27.5% (Class 1). Classes that represent higher risk for caries (Classes 2 and 3) were present in 33.8% and 55.0% in diabetic group, respectively 56.3% and 12.5% for control group. There is a significant difference of both groups and the number of colonies of Streptococcus mutans (divided into classes) (F=35.17; *P*<0.001). About caries risk for S. mutans there is a significant difference between groups (Chi=10.57; *P*<0.01). Low risk for caries were found in 11.2% for children with type 1 diabetes and 32.5% for control group, whereas high risk for caries was found in children with type 1 diabetes (88.8%) than in control group (67.5%) (Table 4).

The odds ratio was performed between groups, where the children with type 1 diabetes mellitus have a 0.26 times significantly lower probability of caries risk of S. mutans compared with children in the control group [OR = 0.26 (95% CI: 0.11-0.61]. However, for cohort-Low caries risk of S. mutans, children with type 1 diabetes mellitus have a 0.35 times significantly lower probability OR= 0.35 (95%CI: 0.17-0.69)] than control group, and 1.32 times significantly higher probability for cohort-High caries risk of S. mutans compared to the control group [OR= 1.32 (95% CI: 1.11-1.56)] (Table 5).

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Group (Type 1 DM / Control group)	0.26	0.11	0.61
For cohort - Low caries risk-S mutans	0.35	0.17	0.69
For cohort - High caries risk-S mutans	1.32	1.11	1.56
N of Valid Cases	160		

Table 5. Risk Estimate. Odds Ratio = 0.26 (95% CI: 0.11-0.61).

Discussion

Oral child health in Kosovo is a serious public health problem due to the high prevalence of caries in general, especially children with type 1 diabetes mellitus. According to the World Oral Health Report from 2003, dental caries is still a serious public health problem of population worldwide.[29,30] Dental caries and periodontal diseases are among the most frequent oral pathologies with multifactorial etiology associated with poor oral hygiene that affects the overall health.[31] The present study throws light on oral health and salivary factors among type 1 diabetes children and controls group. According to the results, it has been shown that the DMFT score, particularly D-component of the children with type 1 diabetes mellitus was very high in comparison with the control group. Oral health has been previously explored in Kosovo and caries values have always been high.[32,33] Several other authors have reported similar findings,[34-37] while some authors have reported low prevalence of dental caries among diabetics.[38]

Most of the previous studies in children with systemic diseases especially diabetes mellitus, demonstrated higher periodontal problems because periodontal problems are not limited to adults. Our results showed that there was more plaque and gingival index scores in diabetics than in the control groups. Diabetic subjects exhibited a higher plaque index and gingival index compared to the control subjects, consistent with the results of studies by Aren G[39] and Orbak R.[40] However, Siudikiene J reported a lower plaque index and higher gingival index in diabetic children compared to non-diabetic patients.[41] Several mechanisms have been proposed to explain the greater incidence and severity of periodontal disease in diabetic subjects,[42] knowing than periodontitis is a slowly progressing disease but the tissue destruction that occurs is largely irreversible.[43] According the studies, periodontal disease in children with diabetes seems to follow puberty and progress with age due to changes in metabolic control.[13] Periodontitis can exacerbate glycemic control, and increase the risk of diabetic complication and the severity of gingivitis and periodontitis.[44]

Saliva plays an important role for the integrity and maintenance of the oral mucosa and the teeth, and is a very useful alternative instead of blood that is used for the diagnosis of various systemic diseases.[45] Following our analysis, significantly low levels of stimulated saliva has been seen among diabetic children. This finding is in agreement with results from previous studies.[35,46,47] The causes of reduced salivary secretion in diabetic patients may be multiple. The prevalence of glycosuria caused by

hyperglycemia results in fluid loss and dehydration of the body, or occur pathologies with regard to salivary glands, which leads to disorders in the production of saliva.[48,49]

The present study results showed significantly increased levels of S. mutans especially classes with high risk for caries in diabetics. This significant correlation with high S. mutans counts has been demonstrated in other studies.[16,21,50] No differences in the distribution or number of Streptococcus mutans between type 1 diabetic and non-diabetic children were also recorded.[51] The reasoning behind this high prevalence of S. mutans is that salivary glucose level among the diabetic patients is very high that favors the accumulation of microorganisms on tooth surface and thus increases the risk of tooth decay among children with diabetes. Also, the decreasing in salivary flow can cause oral alterations such as an increase in the concentration of mucin and glucose and proliferation of pathogenic microorganisms.[52]

The present study has a few limitations, as a small sample size which prevented us from arriving conclusions on alteration in salivary parameters in diabetic subjects. Also, it would be an added value if the glycemic control status of subjects was analyzed using HbA1c values.

Conclusions

Within the limitations of this study, this is the first study that demonstrated oral health of children with type 1 diabetes mellitus in Kosovo. Children with type 1 diabetes mellitus are more likely to experience dental caries, periodontal disease and changes in the amount of saliva and its bacterial flora. The pediatrician's role is to make diabetic patients aware of a diet that suits their unique nutritional needs and the dentist's obligation is to evaluate and help maintain oral hygiene in children with type 1 diabetes mellitus.

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Declaration of Interest

The authors report no conflict of interest and the article is not funded or supported by any research grant.

Variable	Rank Sum Type 1 DM	Rank Sum Control group	U	Z adjusted	*P*-level	Valid N Type 1 DM	Valid N Control group
Plaque index	8485.00	4395.00	1155.00	6.98	**0.000**	80	80
Gingival index	8462.50	4417.50	1177.50	6.99	**0.000**	80	80
Stimulated salivary flow rate	4081.00	8799.00	841.00	-8.18	**0.000**	80	80

Table 3. Difference of Plaque Index, Gingival Index and Stimulated Salivary Flow Rate between Groups. *P*<0.001; *significant difference between groups.

S mutans	Type 1 DM		Control group		Total		Test
	N	%	N	%	N	%	
Class 0 (none detected)	0	0%	3	3.8%	3	1.9%	F=35.17, p<0.001
Class 1 (10^2–10^3 CFU/mL)	9	11.3%	22	27.5%	31	19.4%	
Class 2 (10^4-10^5 CFU/mL)	27	33.8%	45	56.3%	72	45.0%	
Class 3 (≥10^5 CFU/mL)	44	55.0%	10	12.5%	54	33.8%	
S mutans values in CFU/mL saliva (Caries risk test of S mutans)							Test
Low risk[CFU< 10^5 (Class 0 and 1)]	9	11.2%	26	32.5%	35	21.9%	Chi=10.57, p<0.01
High risk[CFU≥ 10^5 (Class2 and 3)]	71	88.8%	54	67.5%	125	78.1%	

Table 4. General and Specific Distribution of Streptococcus Mutans between Groups. SM=Streptococcus mutans; CFU=colony forming units; F=Fisher's exact test was used for class of S. mutans; Chi - Square test was used for caries risk of S. mutans.

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