

## THE IMPACT OF THE DIABETES ON ORAL HEALTH – AN OBSERVATIONAL STUDY

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### ABSTRACT

**The aim:** To evaluate the impact of diabetes mellitus on the oral health.**Materials and methods:** This is an observational study. In the present research were taken into consideration 300 patients. The study sample consisted of 191 males, respectively (63.7%) of them and 109 females (36.3%) of the participants.**Results:** In the current study, we analyzed the oral health of diabetic patients within the age class of 11–80 years. We divided them into seven age groups: 11–20, 21–30, 31–40, 41–50, 51–60, 61–70, and 71–80 years. Based on the results of the current study it was observed that 83.7% of patients were affected by gingivitis. The results of our study show that dental caries prevalence was 68.7% and the prevalence of missing teeth among patients with diabetes mellitus was 78.7%. According to the ANOVA test, high blood sugar values had a direct impact on the manifestation of gingivitis and there it was a strong correlation between them  $P$ -value = .000. Males with diabetes mellitus were more affected by dental caries and this was indicated by the  $P$ -value = .02, in comparison to females who recorded a  $P$ -value = .03. The relation between gender males and missing teeth was highly significant  $P$ -value = .001.**Conclusions:** The present study proved that diabetes mellitus is risk factor for oral health. The authors studied this group of patients exposed to high blood glucose levels and found out that oral diseases were high in these patients.**KEY WORDS:** age range, blood glucose values, dental caries, gingivitis, missing teeth

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### INTRODUCTION

Diabetes mellitus is a metabolic disorder and its elevated global prevalence makes it the most problematic disease in the world [1].

According to the data conducted by Cho et al. the global prevalence of diabetes mellitus in 2017 was approximately 425 million (8.8%) and it is assumed to increase to 629 million by 2045 [2]. A scientific study showed that diabetes mellitus is a chronic disease accompanied by hyperglycemia and brings on to different complications, which includes the oral cavity [3].

More recently, study conducted by Nazir et al. found out that the oral complications associated with diabetes mellitus include the pathologies such as xerostomia, gingivitis, periodontal disease, missing teeth, dental caries, periapical lesions, taste and salivary gland dysfunction [4].

Daković D et al. in their study demonstrated that gingivitis and periodontitis among juveniles are chronic inflammatory diseases that have effect on the supporting tissues of the teeth in the type 1 diabetes mellitus patients [5].

In a recent study, conducted by Latti et al. is affirmed that with the increasing of the age, blood sugar levels, DMFT values and dental caries escalate in diabetics patients [6].

In a preliminary study, conducted by Wiener et al. proved that diabetes mellitus among adults was associated with having 6 or more teeth extracted [7]. Other clinicians reached at a conclusion that juveniles with T1DM have poor oral hygiene and are potentially at high risk of future oral diseases [8].

According the findings of recent study conducted by Rohani, it was showed that oral problems in diabetic patients are considered as utmost complications affecting on patients' quality of life [9]. According to Bissong et al. in their important research is stated that proper management of blood sugar levels might meliorate the oral health of patients who suffer from diabetes mellitus [10].

In a prior study conducted by Chen et al. it is declared that the persistent efforts to raise the diabetes awareness and educational programs need to take steps forward concerning juveniles in particular males [11]. In the study investigated by Newman et al. it was confirmed that type 2 diabetes mellitus is a significant risk factor for cardiovascular illness [12].

Another research conducted in the United States of America reported a 40% increment in the risk of type 2 diabetes mellitus among smokers [13].

In order to reach a significant conclusion in the present study were evaluated potential risk factors such as age, blood sugar values, number of cigarettes smoked per day and tooth brushing in diabetic patients in correlation with oral pathologies such as gingivitis, dental caries and missing teeth.

## THE AIM

The purpose of this study is to analyze the impact of diabetes mellitus on the oral health.

## MATERIALS AND METHODS

The current research was conducted in the period from February 2019 to November 2020 at the Department of Pathology in the Regional Hospital of Vlore, Albania. In the present research were taken into consideration 300 patients with an age range from 11 to 80 years old. The study sample was composed by 191 males, respectively 63.7% of them and 109 females or 36.3% of the participants.

Data collection was done using clinical documentations as well as questionnaires which were completed by the hospital nurses. There is a specialized documentation in which are registered all patients with diabetes mellitus who have been hospitalized. This documentation provides information about patients' age, gender and blood sugar values. The questionnaire included the characteristics of the sample such as gingivitis, dental caries and missing teeth.

The questionnaire was designed based on the resolution of the Albanian National Committee no. 9, date 11.11.2011. The duration of the questionnaire lasted 20 minutes and the anonymity of the participants was preserved. The original research was conducted according to the guidelines of the Helsinki statement [14]. Based on the Helsinki Declaration approved by the World Medical Association the current research, in which participants were diabetics patients, was obviously formulated based on protocols. All data were anonymous and the confidentiality of patients' medical records was respected. The participants had the right to withdraw at any time. There was no withdrawal of the patients from the research.

Inclusion criteria in the current study were the age of patients, who should be over 11 years old and all the patients who suffered from diabetes mellitus. The exclusion criteria of the study were pregnant women and non-diabetic patients who were not observed.

For each patient the following parameters were recorded such as dental caries, missing teeth and the presence of gingivitis. Depending on the gender of the patients and their age, the present study is an attempt to demonstrate the impact of diabetes on oral health, assessing the association of diabetes mellitus with gingivitis, dental caries and missing teeth.

All patients in this study suffer from diabetes mellitus and we chose this group of patients because they were the most difficult people in adhering to dietary therapy. The diabetic patients had tendency to replace energy expen-

diture with foods high in fats and carbohydrates. They accepted that even though had diabetes mellitus, they again consumed meat, bread, pasta, fried foods, candy, chocolate and biscuits. The patients stated that restricting these food products encourages them to eat more of those foods from which they are deprived. Furthermore, for these patients abstain from smoking resulted to be enormously difficult.

Most of these patients don't assess the risk and serious consequences of diabetes mellitus even when have repercussion for their relatives. The patients in this study except diabetes mellitus had also concomitant cardiovascular disease. It should be noted that Albania lack of medical knowledge culture and tradition.

Drug therapy in patients was 500 mg metformin hydrochloride 2 times daily, novonorm 2mg tablet 2 times daily, torvast 10 mg once a day, hyzaar 50-12.5 once daily, lobivon tablet 5 milligrams once a day.

## STUDY DESIGN

This is an observational study. Descriptive analysis was performed using percentages for qualitative variables such as gender, age, blood sugar values, cardiovascular disease, number of cigarettes smoked per day, tooth brushing, gingivitis, dental caries and missing teeth. The current study was approved by the University of Vlore, Albania.

## ETHICAL APPROVAL AND PERMISSIONS

Permission to collect data from the patients was obtained in the Department of Pathology at the Regional Hospital of Vlore, Albania.

## STATISTICAL ANALYSIS

Statistical analysis was performed using IBM SPSS 23.0 statistics, Microsoft Windows Linux, Chicago, IL, USA. Data were analyzed by Post Hoc LSD test in variance analysis (ANOVA).  $P \leq 0.05$  values were considered significant.

## RESULTS

The sample is composed by 300 participants of which 191(63.7%) are males and 109 (36.3%) are females. The majority of patients participating in the study belonged to the age range from 41 to 50 years old, precisely 62 (20.7%) of them, while 81 (27%) of the patients were from 51 to 60 years old.

Based on the present research it resulted that 24.4% of the participants had high blood sugar values 250-300 mg/dl, whereas 19 % of the patients had very high blood sugar values 300-350 mg/dl. The results of our study showed that the most affected by cardiovascular disease were male with 188 patients or 62.7 % (Table I).

In the current study, the significant finding is that the percentage of the patients with diabetes mellitus who reported smoking 6 to 10 cigarettes per day was 48.3 % of the participants. In the present survey 52.4% of the

**Table I.** Shows the data of the participants' with diabetes and cardiovascular disease

Variables	Age group (years old)						
Age group	11-20	21-30	31-40	41-50	51-60	61-70	71-80
Male	10(3.3%)	18(6%)	11(3.7%)	40(13.3%)	56(18.7%)	36(12%)	20(6.7%)
Female	8(2.7%)	10(3.3%)	12(4%)	22(7.3%)	25(8.3%)	21(7%)	11(3.7%)
Blood glucose values							
150-200 mg/dL	8(2.7%)	7(2.4%)	7(2.4%)	37(12.4%)	7(2.4%)	17(5.7%)	20(6.7%)
200-250 mg/dL	8(2.7%)	3(1%)	3(1%)	20(6.7%)	2(0.7%)	13(4.4%)	14(4.7%)
250-300 mg/dL	1(0.3%)	4(1.3%)	3(1%)	16(5.4%)	4(1.4%)	22(7.3%)	23(7.7%)
300-350 mg/dL	1(0.3%)	3(1%)	2(0.7%)	8(2.7%)	3(1%)	19(6.4%)	21(7%)
Cardiovascular disease							
Yes	14(4.7%)	16(5.4%)	12(4%)	37(12.3%)	51(17%)	31(10.4%)	20(6.7%)
No	5(1.6%)	9(3%)	14(4.7%)	21(7%)	21(7%)	28(9.3%)	21(7%)

**Table II.** Shows the frequency of cigarettes smoked per day, tooth brushing and oral health complications

Variables	Age group (years old)						
Age group	11-20	21-30	31-40	41-50	51-60	61-70	71-80
Number of cigarettes smoked per day							
Never smoked	10(3.3%)	7(2.4%)	5(1.7%)	6(2%)	6(2%)	7(2.4%)	4(1.3%)
1-5 cigarettes per day	6(2%)	3(1%)	14(4.7%)	16(5.4%)	18(6%)	25(8.4%)	28(9.3%)
6-10 cigarettes per day	8(2.7%)	7(2.4%)	17(5.7%)	24(8%)	26(8.6%)	34(11.3%)	29(9.6%)
Tooth brushing							
Once a day	13(4.4%)	11(3.7%)	20(6.7%)	21(7%)	22(7.3%)	28(9.3%)	42(14%)
2 times a day	8(2.7%)	7(2.4%)	13(4.4%)	14(4.7%)	14(4.7%)	24(8%)	25(8.4%)
3 times a day	8(2.7%)	2(0.7%)	5(1.7%)	6(2%)	6(2%)	7(2.4%)	4(1.4%)
Gingivitis							
Yes	2(0.7%)	1(0.3%)	22(7.4%)	38(12.7%)	48(16%)	56(18.7%)	70(23.4%)
No	16(5.4%)	1(0.3%)	10(3.3%)	8(2.7%)	9(3%)	11(3.7%)	8(2.7%)
Dental caries							
Yes	5(1.7%)	7(2.4%)	46(15.4%)	48(16%)	44(14.7%)	31(10.4%)	25(8.4%)
No	25(8.4%)	13(4.4%)	14(4.7%)	17(5.7%)	11(3.7%)	9(3%)	5(1.7%)
Missing teeth							
Yes	12(4%)	4(1.3%)	33(11%)	45(15%)	54(18%)	55(18.4%)	33(11%)
No	2(0.7%)	5(1.7%)	7(2.4%)	10(3.3%)	13(4.4%)	15(5%)	6(2%)

participants declared, that they brushed their teeth only once a day. Based on the results of the current study it was observed that 83.7% of patients were affected by gingivitis.

The results of our study show that dental caries prevalence was 68.7 % and the prevalence of missing teeth among patients with diabetes mellitus in Albania was 78.7% (Table II).

In the current study, the significant finding is that 22% of patients had more than 7 teeth with dental caries and 21% of them had 5-7 teeth with dental caries, whereas 13.7% of the patients had 4-5 dental caries and the remaining 12% of them had 1-3 dental caries.

The present study showed that most of the patients 27% of them had lost more than 7 teeth and 22% of the participants had lost 5-7 teeth, whereas 17.7% of the patients

had lost 4-5 teeth and only 12 % of them had lost 1-3 teeth (Table III).

This study proved that high blood sugar values had a direct impact on the manifestation of gingivitis and there it was a strong correlation between them with P-value = .000.

Gender influenced gingivitis manifestation in which males were significantly affected more by gingivitis in comparison to females. The data analysis proved that there was a stronger correlation in males in comparison to females with P- value = .000.

Higher values of dental caries in 68.7% of the patients were also influenced by high blood sugar values. Males with diabetes mellitus were more affected by dental caries and this was indicated by the P-value= .02, in comparison to females who recorded a P-value= .03.

**Table III.** Shows dental caries and missing teeth related blood glucose values

Blood glucose values	150-200 mg/dL	200-250 mg/dL	250-300 mg/dL	300-350 mg/dL
Number of teeth with dental caries				
Age group	1-3	4-5	5-7	>7
11-20	1(0.3%)	1(0.3%)	1(0.3%)	2(0.6%)
21-30	1(0.3%)	1(0.3%)	3(1%)	2(0.6%)
31-40	6(2%)	10(3.4%)	14(4.7%)	16(5.4%)
41-50	8(2.7%)	9(3%)	17(5.7%)	14(4.7%)
51-60	12(4%)	9(3%)	11(3.7%)	12(4%)
61-70	5(1.7%)	6(2%)	9(3%)	11(3.7%)
71-80	3(1%)	5(1.7%)	8(2.7%)	9(3%)
Blood glucose values	150-200 mg/dL	200-250 mg/dL	250-300 mg/dL	300-350 mg/dL
Missing teeth				
Age group	1-3	4-5	5-7	>7
11-20	2(0.6%)	3(1%)	3(1%)	4(1.4%)
21-30	1(0.3%)	1(0.3%)	1(0.3%)	1(0.3%)
31-40	4(1.4%)	7(2.4%)	10(3.4%)	12(4%)
41-50	6(2%)	11(3.7%)	13(4.4%)	15(5%)
51-60	10(3.4%)	13(4.4%)	14(4.7%)	17(5.7%)
61-70	10(3.4%)	12(4%)	15(5%)	18(6%)
71-80	3(1%)	6(2%)	10(3.4%)	14(4.7%)

**Table IV.** Correlation between blood glucose values with gingivitis, dental caries and missing teeth

Variables	Blood glucose values		Gender	
	Confidence intervals ( 95%) and P-values		Female	Male
Diseases	Confidence level 95%		P-value	
Gingivitis	.08	.14	.000	.000
Dental caries	.27	.34	.03	.02
Missing teeth	.31	.38	.004	.001

The impact of high blood sugar values affects missing teeth and the correlation between them was statistically significant with P- value = .000. The relation between gender males and missing teeth was highly significant with the P -value = .001 (Table IV).

## DISCUSSION

The goal of this observational study was to report what oral diseases patients with diabetes mellitus have and to highlight whether they have high presence of diseases such as dental caries, gingivitis and missing teeth.

According the data of recent survey conducted by Henning, it was demonstrated that the worldwide prevalence of diabetes mellitus was 8.5% in 2014 [15].

In a preliminary research, it was observed that the prevalence of oral pathologies is higher in patients with Diabetes Mellitus and that is the reason why it should be monitored since in its earlier stages [16].

Based on data collected by the Institute of Public Health in Albania, experts claim that diabetes mellitus affects 7-10% of

the Albanian population, while the study conducted in 2018 by Schmidt showed that in the United States it is evaluated that 86.1 million adults have prediabetes, in addition to those who are diagnosed with diabetes mellitus [17].

Today in Albania, most people who are diagnosed with diabetes mellitus do not have a family history of diabetes. In recent decades, public health institutions have raised awareness about diabetes and screening campaigns are being held throughout Albania.

Most patients belonged to the age group 65+, but this age range changed from 51 to 65+. This is why it is important for the population to have routine checkups and understand that measuring blood sugar levels may remove the suspicion of whether or not they have diabetes.

The results of an experimental study carried out by Akcali et al. demonstrated that diabetes mellitus was associated with the disease of gingivitis [18]. Similar data were found in the present study, 83.7% of the participants with diabetes mellitus were affected by gingivitis.

In the present survey, gingivitis in patients with diabetes mellitus is significantly higher in patients aged from 71 to

80 years, respectively 23.4% of them in comparison with patients aged from 61 to 70 years, respectively 18.7% of participants. Thus, this study shows that gingivitis disease increases with age.

The number of cigarettes smoked per day and tooth brushing were factors associated with increased gingivitis prevalence. In the present study 52.4% of the patients reported that brushes their teeth only once a day. On the basis of our data, 48.3 % of the participants smoking 6 to 10 cigarettes per day, while 36.8% of them smoked 1-5 cigarettes per day.

The large impact of diabetes mellitus as a risk factor for oral diseases is evident in both genders, but in the current study it was demonstrated that diabetes mellitus has a greater impact on the manifestation of gingivitis in men with a P-value = .000, in comparison to women with the P-value= .003.

The current study aims to highlight that 5.4% of diabetic children aged 11-20 suffer from gingivitis raising the alarm that children are at high risk of developing serious diseases in the oral cavity and this will be associated with a large number of missing teeth. The results achieved in the current study point out that type 1 diabetes affects the oral health of children. Moreover, in a scientific study conducted by Xavier et al., it was reported that 21% of the Brazilian children with DM1 and a mean age of  $13 \pm 3.5$  years suffered from gingivitis [19].

An epidemiological study conducted in Albania by Canga et al. showed that the prevalence of dental caries was 46.62% [20]. Similarly, the study conducted by Laganà et al. revealed that 47.19% of the participants had dental caries [21].

We consider that the strong point of this study is that gives us data on a significant number of diabetes mellitus patients who has dental caries, 68.7% of them.

On the basis of our data, blood sugar values have a significant influence on the manifestation of dental caries with the P-value = .000.

Our results are supported by the study carried out from Siudikiene et al. that clearly indicated that exists a significant correlation between dental caries and high blood sugar levels [22].

Again, similar results to the present study, which report an increase in the incidence of dental caries among patients with diabetes mellitus, are also reinforced by Akpata et al., and Singh et al., in their studies [23,24].

A study conducted in Albania by Dharmo et al. showed that 15.2% of the patients had at least one missing permanent tooth [25]. The situation is worse, if we talk about people with diabetes mellitus. The current study confirmed that 78.7% of the participants had missing teeth. Based on the results of in this study, it was found out that men who have diabetes mellitus are more likely to be affected by missing teeth with P-value = .001 in comparison to diabetic women with P-value = .004.

According to Delgado-Pérez et al., diabetes mellitus is associated with higher experience of missing teeth in an open adult population in Mexico [26]. Furthermore, another survey conducted by López-Gómez et al., reached to

the conclusion that the mean number of missing teeth is higher in people with diabetes mellitus [27]. Dar-Odeh et al. claimed that missing teeth were significantly associated with diabetes mellitus with the P-value = .009 [28].

Diabetes mellitus is a serious risk factor for the development of cardiovascular diseases [29]. The data of the current research confirmed that 62.7% of the diabetic patients had cardiovascular disease.

In the present survey it was found out that there is a strong correlation between Diabetes Mellitus and oral health. We aimed to investigate effects of the impact of diabetes mellitus on oral health based on the fact that the diabetes mellitus is one of the most serious health problems in the world. The current study proved that Diabetes Mellitus increases the risk of being affected by diseases such as dental caries, gingivitis and missing teeth.

As proved by Leite et al. glycemia adversely effects on oral health, which can be devastating for the patient [30].

On the basis of the fact that blood sugar levels leads to long-term complications in the diabetic patients this research recommends the application of low-carbohydrate diets so as not to favor the growth of cariogenic bacteria and the development of carious lesions in diabetic patients.

Regarding the results of the present study it can be stated that in order to reduce acute or chronic complications from diabetes it is important that the prevention and management of diabetes must be public health priority.

Finally, we think that to give dentists the opportunity to suggest the patients to check their blood sugar levels when they have oral diseases. Consequently, the oral cavity is an excellent indicator and rapid detector of the dentists to identify other diseases in the human body.

There are some limitations that should be declared in this study, first was the small sample size that was taken under consideration. Another limitation of this study has to do with the fact that this research was limited only in the people with diabetes mellitus.

Also, the age range can be seen as a limitation because patients older than 80 years were excluded from the study.

## CONCLUSIONS

The present study proved that diabetes mellitus is risk factor for oral health. The authors studied this group of patients exposed to high blood glucose levels and found out that oral diseases were high in these patients. Gingivitis was the most common disease which affected 83.7% of the participants, followed by 78.7% of them who had missing teeth and 68.7% of the patients who had dental caries.

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#### Conflict of interest:

*The Authors declare no conflict of interest.*

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**A** – Work concept and design, **B** – Data collection and analysis, **C** – Responsibility for statistical analysis,

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