http://www.cjmb.org

Open Access Original Article

Crescent Journal of Medical and Biological Sciences
Vol. x, No. x, xx 2022, x–x
eISSN 2148-9696

Oral Health Indices in Patients with Type 2 Diabetes Receiving Insulin Treatment Compared With Metformin: A Cross-sectional Study

Katayoun Katebi[1], Zahra Aghazadeh[1], Vahideh Sadra[2], Marziyeh Aghazadeh[1], Mohammad Lak[3], Ehsan Habibivand[4]

Abstract

Objectives: Due to the important influence of glycemic control on oral health, this study aimed to compare the gingival index and decayed, missing, filled teeth (DMFT) in participants with type 2 diabetes mellitus receiving insulin and metformin.

Materials and Methods: In this cross-sectional study, 130 participants with type 2 diabetes mellitus treated with insulin and metformin were studied in two groups based on the type of treatment. The information for DMFT and gingival indices were obtained using the oral examination. In the insulin group, participants received insulin Lantus 0.2 unit/kg once daily, and in the metformin group, participants received metformin tablets 500 mg every 12 hours. Glycosylated hemoglobin A1c was measured by lab test in all participants. Finally, hemoglobin A1c, the information of DMFT, and gingival indices were compared between the two groups.

Results: The results showed that there were no statistically significant differences in decayed, missed, and restored teeth, as well as the overall DMFT index between the two groups. The gingival index was significantly higher in insulin group ($P=0.046$).

Conclusions: Gingival health of insulin users is poorer than metformin users, but it seems that type of diabetes treatment does not affect the DMFT index.

Keywords: Metformin, Diabetes Mellitus, Type 2, DMFT Index, Periodontal Index, Insulin

Introduction

Type 2 diabetes mellitus can increase oral and dental disorders, especially gingival diseases and dental caries. People with diabetes mellitus are prone to higher dental caries and oral infections. Lack of blood sugar control compromises the body's ability to fight gingival bacterial pathogens; xerostomia (dry mouth) is another condition seen frequently in diabetic people, thereby precipitating dental caries (1). On the other hand, a chronic infection in the body, such as gingival inflammation, increases blood sugar rendering glycemic control more complicated (2).

Salivary glucose rises following increased blood sugar. Therefore, the sugar rate in the saliva and gingival crevicular fluid of diabetic people is higher than healthy individuals; this alters the microbial flora of the mouth, accelerating the caries process (3,4). Salivary flow in type 2 diabetics undergoing treatment with a non-insulin diet is lower than healthy individuals and type 2 diabetic people receiving insulin (5,6). Salivary pH in diabetic people is lower than that of healthy individuals; this increased salivary acidity is considered a predisposing factor for caries in diabetes mellitus. The manner of control and treatment of diabetes mellitus impacts dental caries. The rate of dental caries and decayed, missing, filled teeth (DMFT) index is higher in poorly-controlled diabetic people than healthy individuals (7).

On the other hand, in well-controlled diabetic people, oral manifestations of the disease (dry mouth, angular cheilitis) are absent or minimum, and the salivary flow and rate of dental caries are similar to those of healthy individuals (8). It has been reported that the rate of dental caries is lower in people with diabetes mellitus than healthy individuals and it was due to restricted carbohydrate consumption, and the DMFT index was similar in healthy individuals and diabetic people (9). It is also demonstrated that the glucose level in saliva, the quantity of salivary candida colonies, and complaint of dry mouth in diabetic people taking oral blood sugar-lowering medications and insulin users differ from one another (10).

All studies in this field have compared the oral health of diabetic patients with healthy and no research regarding the effects of diabetes mellitus II medications on dental and gingival indices. Since the micro-vascular condition in type 2 diabetic people receiving insulin differs from patients taking metformin, this study aimed to evaluate dental and gingival indices in type 2 diabetic patients treated with insulin compared to metformin.

Received 17 March 2021, **Accepted** 30 June 2021, **Available online** 12 January 2022

[1]Department of Oral Medicine, Tabriz University of Medical Sciences, Tabriz, Iran. [2]Endocrine Research Center, Tabriz University of Medical Sciences, Tabriz, Iran. [3]Faculty of Dentistry, Tabriz University of Medical Sciences, Tabriz, Iran. [4]Faculty of Dentistry, Tabriz Branch, Islamic Azad University of Medical Sciences, Tabriz, Iran.
*Corresponding Author: Katayoun Katebi, Tel: +989144351552, Email: katebik@tbzmed.ac.ir, k_katebi@yahoo.co.uk

Key Messages

- Gingival health of people using insulin was significantly weaker than the gingival health of metformin users.
- Diabetic people, especially those who use insulin, should pay close attention to their oral health because it can affect glycemic control.

Materials and Methods

Setting and Participants

In this cross-sectional study, 130 participants with type 2 diabetes mellitus treated with insulin or metformin referred to Oral Medicine Department, Faculty of Dentistry, Tabriz University of Medical Sciences, Tabriz, Iran from September 2020 to January 2021, were evaluated in two groups based on the type of treatment (n=65/each).

Our inclusion criteria were having at least one-year history of type 2 diabetes mellitus, undergoing insulin (Lantus 0.2 unit/kg, Sanofi, France) or metformin (500 mg/12 h) treatment, glycosylated hemoglobin A1c (HbA1c) test between 7-8%, having at least 20 teeth, age>18 years, and brushing at least once a day. All participants with a history of systemic diseases, such as heart and kidney disorders, HIV, hepatitis, and pregnant women, were excluded from the study.

Because the most frequently used insulin in the population was Lantus and the most frequently used oral agent was metformin, these medications were selected. HbA1c level was measured using Direct Enzymatic HbA1c assay (Diazyme, CA, USA) with LOT number HB003200-07-01 in all participants.

Sample Size

According to the Suzuki et al study (11) and considering α=0.05 and β=90, we calculated the sample size of 54 in each group. The sample size was increased by 20% to improve the study's reliability, which eventually yielded 65 participants in each group (Total sample size=130).

Data Sources/Measurement

The data was recorded from participants' medical records, including the treatment modality and demographic variables. Clinical dental examination was performed to assess the DMFT and gingival indices. All participants of both groups were examined using a tongue depressor, oral mirror no. 22, and dental explorer no. 23; the DMFT index was calculated by adding the numbers of decayed teeth, missing teeth due to caries, and restored teeth together. Third molars were excluded, therefore, the maximum of DMFT was 28. The Löe-Silness definition was used to calculate the gingival index (12). DMFT and gingival indices were compared between the two groups.

Data Analysis

Mean ± standard deviation (SD) of DMFT were calculated for each group. The normality of data was assessed by Kolmogorov Smirnov test. Gingival index, age, duration of disease, and HbA1c had normal distribution therefore Independent Samples *t* test was used to compare them between two groups. DMFT had non normal distribution therefore Mann-Whitney U test was used to analyze it. Gender was compared between two groups by Chi square test. Data was analyzed by SPSS version 17 (IBM Corp., New York, USA). *P* value of less than 0.05 was considered statistically significant.

Results

The participants of two groups were matched in terms of age, sex, history of diabetes mellitus, and HbA1c level (Table 1).

Our results showed that there were no statistically significant differences in decayed, missed, and restored teeth, as well as the overall DMFT index between the two groups (Table 2). Figure 1 shows the comparison of the gingival index between the two study groups. The mean gingival index was significantly higher in the insulin group compared with that of the metformin group ($P=0.046$) .

Discussion

The aim of the present study was to compare the DMFT and gingival indices of diabetic participants based on their type of treatment. It was shown that DMFT was similar in both study groups but the gingival index was significantly higher in insulin group. Diabetes Mellitus is a common chronic disease that is related to numerous complications (13), such as periodontal diseases, missing teeth, and xerostomia which are common findings in people with diabetes. Numerous studies have shown an association

Table 1. Demographic Characteristics of Participants in Two Study Groups (n=65/Each)

Variables	Insulin Group	Metformin Group	*P* Value
Age (y)	56.78±11.79	57.18±11.30	0.491[a]
Gender			
Male	31 (23.8)	35 (23.9)	0.599[b]
Female	34 (26.2)	30 (23.1)	0.581[b]
Diabetes mellitus duration (y)	7.64±1.56	7.38±2.28	0.624[a]
HbA1c	6.68±0.96	6.17±0.87	0.216[a]

HbA1c, hemoglobin A1c.
[a] Independent sample *t* test; [b] Chi-square test.

Table 2. Comparison of DMFT Index in Two Study Groups (n=65/Each)

Variables	Insulin Group	Metformin Group	*P* Value[a]
Decayed tooth (D)	2.73 ± 2.15	3.06 ± 2.78	0.834
Missing tooth (M)	7.24 ± 8.80	8.52 ± 9.52	0.471
Filled tooth (F)	4.84 ± 3.80	4.40 ± 3.61	0.523
DMFT	14.83 ± 7.69	15.98 ± 7.89	0.241

DMFT: decayed, missing, filled tooth.
[a] Mann-Whitney U test.

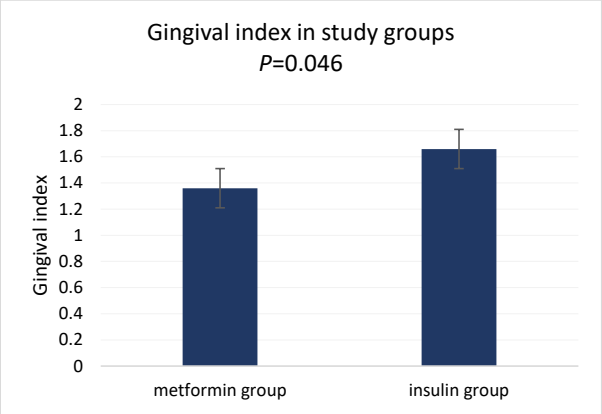

Figure 1. Comparison of the Gingival Index in Study Groups. *P* value based on independent sample *t* test.

of diabetes mellitus with the aforementioned diseases (14,15). Periodontal disease is linked with the involvement of the microvascular system in diabetes mellitus rendering the periodontal system more susceptible to infection and inflammation. Diabetes mellitus and periodontal diseases have a reciprocal connection. Treatment of periodontal diseases helps to achieve a better glycemic (16,17).

In the present study, the mean DMFT index in diabetic participants receiving insulin and participants using metformin was 14.83 ± 7.69 and 15.98 ± 7.89, respectively; this high value is mainly due to the higher number of missing teeth (M index), and this can be explained by rapid caries process and severity of periodontal disease in these individuals, leading to rapid dental loss. In a study which evaluated the DMFT in diabetic patients, it was shown that DMFT index of diabetic participants was 13.52, but the type of treatment was not specified, and the results were compared with non-diabetics (10).

In a meta-analysis study, four researches with a total of 3524 adults revealed that the risk of acquiring periodontal diseases is two times greater in diabetic participants than in non-diabetic individuals (18). A research on 500 participants with type 2 diabetes mellitus and 500 healthy individuals, demonstrated that there is a significant relationship between diabetes mellitus and periodontal disease. Periodontal disease was more severe in diabetic participants than non-diabetic individuals (19).

It has been shown that mean DMFT index in people with diabetes is significantly higher than that of healthy individuals in such a way that the incidence of dental caries is three times greater in type-2 diabetic participants compared to healthy individuals. DMFT index in participants with uncontrolled diabetes mellitus is significantly higher than the DMFT index of diabetic participants with controlled blood sugar (20). A study about the prevalence of periodontal disease in diabetic people and showed that patients with diabetes of longer duration tend to have more severe periodontal disease (21). In the current study, the gingival index in the group of insulin users was significantly higher compared to the gingival index of metformin literature were found regarding the comparison between gingival index in diabetic participants using insulin and participants taking oral blood sugar lowering medications. Still, it can be said that participants' blood glucose level is one of the factors influencing the gingival index because studies have revealed that the gingival index in diabetic participants is higher than that of healthy individuals. In the present study, the insulin-using participants had been probably affected by diabetes mellitus for a longer duration and had past episodes of uncontrolled blood sugar influencing the gingival index. That is why the gingival index in this group surpassed that of metformin users. The etiology of periodontitis and gingivitis is multifactorial with microbial, environmental, and genetic factors and systemic diseases (15, 22). Conducting this study with other oral blood sugar-lowering medications from different drug classes could result in different findings.

Limitations of the Study

In the present study, because of the limitations of resources, we included only subjects using metformin and Lantus insulin in the comparison. We did not study other types of insulins and oral agents. Also, the oral hygiene habits of the two groups were only matched by once a day brushing the teeth, but the use of mouthwashes and dental floss might be influential as well.

Conclusions

It can be concluded from the current study that gingival health of insulin users is poorer than metformin users, but it seems that type of diabetes treatment (metformin or Lantus insulin) does not affect the DMFT index.

Authors' Contribution

K.K and Z.A designed the study. V.S examined the participants for inclusion and exclusion criteria. M.L and E.H conducted the oral examinations. K.K and M.A monitored, evaluated, and analysed the result of the study. Further, M.A, K.K, Z.A, and V.S drafted the manuscript. All authors approved the final manuscript and took responsibility for the integrity of the data. The manuscript has been read and approved by all the authors. The requirements for authorship have been met for all the authors based on the criteria stated by ICMJE. All the authors agree in the order of authorship. Each author confirms that the manuscript represents honest work.

Conflict of Interests

All authors declare that there is no conflict of interest.

Ethical Issues

This study was approved by the Ethics Committee of Tabriz University of Medical Sciences, Tabriz, Iran (Code: IR.TBZMED.REC.1399.622). All participants signed informed written consent before the study. Participants were also assured that their information would remain confidential.

Financial Support

This study was financially supported by Tabriz University of Medical Sciences, Tabriz, Iran.

Acknowledgments

The researchers are grateful to the personnel of Ayin Pathobiology Laboratory for conducting the laboratory analysis.

References

1. Llambés F, Arias-Herrera S, Caffesse R. Relationship between diabetes and periodontal infection. World J Diabetes. 2015;6(7):927-935. doi:10.4239/wjd.v6.i7.927
2. Ju OJ, Lee HK, Jung JA. Comparison of oral health status according to glycated hemoglobin A1c. J Dent Hyg Sci. 2017;17(4):290-297. doi:10.17135/jdhs.2017.17.4.290
3. Almusawi MA, Gosadi I, Abidia R, Almasawi M, Khan HA. Potential risk factors for dental caries in type 2 diabetic patients. Int J Dent Hyg. 2018;16(4):467-475. doi:10.1111/idh.12346
4. Latti BR, Kalburge JV, Birajdar SB, Latti RG. Evaluation of relationship between dental caries, diabetes mellitus and oral microbiota in diabetics. J Oral Maxillofac Pathol. 2018;22(2):282. doi:10.4103/jomfp.JOMFP_163_16
5. Khalifa N, Rahman B, Gaintantzopoulou MD, Al-Amad S, Awad MM. Oral health status and oral health-related quality of life among patients with type 2 diabetes mellitus in the United Arab Emirates: a matched case-control study. Health Qual Life Outcomes. 2020;18(1):182. doi:10.1186/s12955-020-01418-9
6. Mascarenhas P, Fatela B, Barahona I. Effect of diabetes mellitus type 2 on salivary glucose--a systematic review and meta-analysis of observational studies. PLoS One. 2014;9(7):e101706. doi:10.1371/journal.pone.0101706
7. Majbauddin A, Tanimura C, Aoto H, et al. Association between dental caries indicators and serum glycated hemoglobin-levels among patients with type 2 diabetes mellitus. J Oral Sci. 2019;61(2):335-342. doi:10.2334/josnusd.18-0156
8. Verhulst MJL, Loos BG, Gerdes VEA, Teeuw WJ. Evaluating all potential oral complications of diabetes mellitus. Front Endocrinol (Lausanne). 2019;10:56. doi:10.3389/fendo.2019.00056
9. Gupta VK, Malhotra S, Sharma V, Hiremath SS. The influence of insulin dependent diabetes mellitus on dental caries and salivary flow. Int J Chronic Dis. 2014;2014:790898. doi:10.1155/2014/790898
10. Yonekura S, Usui M, Murano S. Association between numbers of decayed teeth and HbA1c in Japanese patients with type 2 diabetes mellitus. Ups J Med Sci. 2017;122(2):108-113. doi:10.1080/03009734.2017.1285838
11. Suzuki S, Noda T, Nishioka Y, Imamura T, Kamijo H, Sugihara N. Evaluation of tooth loss among patients with diabetes mellitus using the National Database of Health Insurance Claims and Specific Health Checkups of Japan. Int Dent J. 2020;70(4):308-315. doi:10.1111/idj.12561
12. Babu KLG, Subramaniam P, Kaje K. Assessment of dental caries and gingival status among a group of type 1 diabetes mellitus and healthy children of South India - a comparative study. J Pediatr Endocrinol Metab. 2018;31(12):1305-1310. doi:10.1515/jpem-2018-0335
13. Visaria J, Iyer NN, Raval AD, et al. Healthcare costs of diabetes and microvascular and macrovascular disease in individuals with incident type 2 diabetes mellitus: a ten-year longitudinal study. Clinicoecon Outcomes Res. 2020;12:423-434. doi:10.2147/ceor.s247498
14. Rohani B. Oral manifestations in patients with diabetes mellitus. World J Diabetes. 2019;10(9):485-489. doi:10.4239/wjd.v10.i9.485
15. Madianos PN, Koromantzos PA. An update of the evidence on the potential impact of periodontal therapy on diabetes outcomes. J Clin Periodontol. 2018;45(2):188-195. doi:10.1111/jcpe.12836
16. Singh N, Agrawal G, Subhash A, Suneela S, Barabde AS, Kumar GA. A comparative evaluation of shear bond strength of different pits and fissure sealants: an in vitro study. J Contemp Dent Pract. 2013;14(5):917-923. doi:10.5005/jp-journals-10024-1426
17. Stöhr J, Barbaresko J, Neuenschwander M, Schlesinger S. Bidirectional association between periodontal disease and diabetes mellitus: a systematic review and meta-analysis of cohort studies. Sci Rep. 2021;11(1):13686. doi:10.1038/s41598-021-93062-6
18. Leite RS, Marlow NM, Fernandes JK, Hermayer K. Oral health and type 2 diabetes. Am J Med Sci. 2013;345(4):271-273. doi:10.1097/MAJ.0b013e31828bdedf
19. Kesavan R, Chaly P, Reddy V, Mary A. Periodontal status among type II diabetic and nondiabetic individuals in Chennai, India: a comparative study. J Indian Assoc Public Health Dent. 2015;13(4):393-398. doi:10.4103/2319-5932.171167
20. de Lima AKA, Amorim Dos Santos J, Stefani CM, de Almeida de Lima A, Damé-Teixeira N. Diabetes mellitus and poor glycemic control increase the occurrence of coronal and root caries: a systematic review and meta-analysis. Clin Oral Investig. 2020;24(11):3801-3812. doi:10.1007/s00784-020-03531-x
21. Susanto A, Manurung AS, Miranda A, Sopiatin S. Periodontal disease and treatment needs among patients with diabetes mellitus type 2 attending Talaga Bodas Community Health Center in Bandung city. Sci Dent J. 2020;4(1):1-5. doi:10.4103/sdj.sdj_27_19
22. Daniel R, Gokulanathan S, Shanmugasundaram N, Lakshmigandhan M, Kavin T. Diabetes and periodontal disease. J Pharm Bioallied Sci. 2012;4(Suppl 2):S280-282. doi:10.4103/0975-7406.100251