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

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**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 (HbA1c) was measured by lab test in all participants. Finally, HbA1c, 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 the 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, DMF index, Periodontal index, Insulin

## Introduction

Type 2 diabetes mellitus can increase oral and dental disorders, especially gingival diseases and dental caries. The individuals 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 individuals, thereby precipitating dental caries (1). Meanwhile, 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 individuals is higher than in 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 in healthy individuals and in type 2 diabetic ones receiving insulin (5,6). Salivary pH in diabetic individuals is lower than that of healthy ones. 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 in healthy individuals (7). Meanwhile, 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). Reportedly, the rate of dental caries is lower in people with diabetes mellitus than in 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 number of salivary candida colonies, and complaints 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

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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.

dental and gingival indices in type 2 diabetic patients treated with insulin compared to metformin.

## 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 the 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 Suzuki et al [11] and considering $\alpha = 0.05$ and $\beta = 90$, we calculated the sample size of 54 in each group. The sample size was increased by 20% to improve the reliability of the study, which eventually yielded 65 participants in each group (Total sample size=130).

### Data Sources/Measurement

The data were recorded from participants' medical records, including the treatment modality and demographic variables. A 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 (1963) 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 was 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 for comparing them between the 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 analysis was done by SPSS version 17 (IBM Corp., New York, USA). $P$ value < 0.05 was considered statistically significant.

## Results

The participants of both groups were matched in terms of age, gender, 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

This study aimed 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 the 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

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[xxx] |
| 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 samples $t$ 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) | 8.80±7.24 | 9.52±8.52 | 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 Samples *t* test).

diabetes. Numerous studies have shown an association 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 better glycemic control (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 was 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 the 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 research 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 study on 500 participants with type 2 diabetes mellitus and 500 healthy individuals, demonstrated a significant relationship between diabetes mellitus and periodontal disease. Periodontal disease was more severe in diabetic participants than in non-diabetic individuals (19).

It has been shown that the mean DMFT index in subjects 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 subjects 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 found regarding the comparison between the gingival index in diabetic participants using insulin and participants taking oral blood sugar-lowering medications. Still, participants' blood glucose l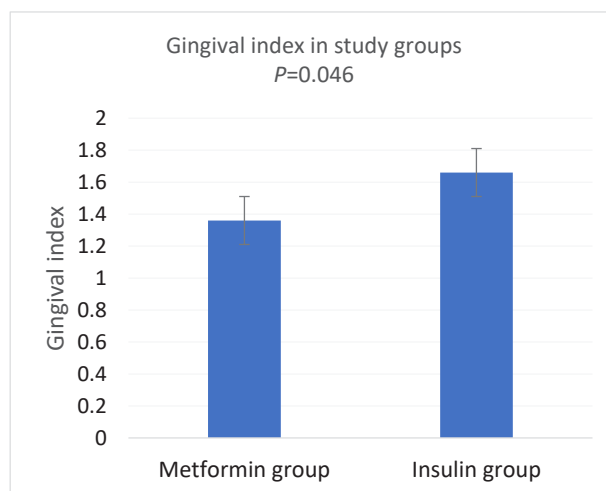evel is one of the factors influencing the gingival index because studies have revealed that the gingival index in diabetic participants is higher than that of healthy individuals. In the present study, the insulin-using participants had been probably affected by diabetes mellitus for a longer duration 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
Because of the limitations of resources, this study 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 once a day by 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 the 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**
**Conceptualization:** Katayoun Katebi, Zahra Aghazadeh.
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## 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.

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