

# Effect of diabetes index on periodontal disease in Korean adults

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## Abstract

**Background:** It is known that diabetes can cause complications in various organs and affect oral health. The purpose of this study was to investigate the relationship between oral health and diabetes mellitus among Korean adults.

**Materials and methods:** The study was conducted by the National Institute of Health and Nutrition Examination Survey (2015), produced by the Korea Centers for Disease Prevention and Control. A total of 4,780 patients took part in the survey of which 554 were diabetic patients. Descriptive statistics were used to identify the periodontal disease status of non-diabetics and people with diabetes mellitus, and multiple regression analysis was performed to analyze the effect of diabetes index on periodontal disease status.

**Results:** Normal people showed better periodontal disease and oral care status than diabetic patients. However, all three diabetic factors (glycated hemoglobin, fasting blood sugar, insulin) had no statistically significant influence on periodontal disease.

**Conclusions:** The increase in the diabetic index may have a negative effect on various periodontal diseases, which may ultimately lead to poor oral hygiene and cause disease. Therefore, diverse studies on diabetic index and periodontal disease are needed, and it is necessary to address the dental hygiene health of Korean adults through early education and campaigns to improve oral health. [Ethiop.J. Health Dev. 2020;34(Special issue-3):78-83]

**Key words:** Diabetes index, periodontal disease, oral health, Korean adults

## Introduction

Diabetes is a metabolic disorder in which chronic hyperglycemia occurs due to impaired insulin secretion or insulin action. The prevalence of diabetes is rising not only in Korea but globally, and it poses a great socioeconomic burden for many countries. Diabetes can also cause complications that affect quality of life and lifespan (1). The complications of diabetes mellitus are mainly long term in important organs and include retinopathy, nephropathy, neuropathy, and macrovascular disease. Diabetes also has an adverse effect on oral diseases such as gingivitis, candidiasis, and salivary gland dysfunction. Of these oral diseases, periodontal disease is considered as the sixth complication of diabetes (2-6).

Periodontal disease is caused by teeth, gingival recession, and periodontal disease. When periodontal disease worsens, the alveolar bone is gradually and widely destroyed, resulting in tooth loss. Therefore, periodontal disease has been reported to affect tooth loss in diabetic patients (7,8). As such, diabetes and periodontal disease are closely related, and diabetes patients with persistently high blood sugar may be at increased risk of periodontal disease (9). On the other hand, diabetes mellitus is a chronic disease judged by the level of glycated hemoglobin and fasting blood sugar (10). It is a dangerous disease that causes complications and causes death if the symptoms worsen.

Recent reviews of diabetes and periodontal disease (11-13) reveal that periodontal disease is widespread across the globe, and has a strong relationship with diabetes. It has been reported that periodontal disease in diabetic patients progresses twice as fast as in normal individuals (14). In healthy adults, the incidence of periodontitis is 10-15% (15). However, type 2 diabetic patients showed a 2.8-fold higher incidence of periodontal disease and a

4.2-fold higher alveolar bone loss than non-diabetic patients (16). It is periodontal disease is proven to inhibit blood glucose regulation and induce diabetes by complex mechanisms (17,18). It is known that diabetes mellitus affects periodontal disease(19,20). There are only a few studies on the effect of different diabetes indices on periodontal disease, and even fewer studies on the relationship between diabetes and periodontal disease among Korean adults. Therefore, in this study, we examine the dental and oral care status of diabetic patients and normal people to identify the level of the patients' awareness of periodontal disease. This study aims to raise awareness of dental treatment in diabetics and to utilize the relationship between diabetes and periodontal disease as education and prevention programs related to diabetes and periodontal disease.

## Materials and methods

The analysis is based on the 2015 Korea National Health and Nutrition Examination Survey (KNHANES), produced by the Korea Centers for Disease Prevention and Control (KCDC). From the survey, basic data, diabetes screening data and oral screening data were merged and used. We diagnosed 4,780 people over 19 years of age and 11.6% (554) were found to be diabetic.

**Definition of diabetic patients:** Diabetes mellitus was confirmed by examining the abductor for more than eight hours. A patient was defined as having diabetes mellitus if they had a fasting blood glucose level of 100mg/dL or more, were diagnosed as such by a doctor, were taking a hypoglycemic agent, or were receiving insulin injections.

**Measurement methods:** The method of testing for glycosylated hemoglobin (HbA1c) in blood was high-performance liquid chromatography. The equipment used was a Tosoh G8 (Tosoh, Japan).

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The reagent was HbA1c glycated hemoglobin (Tosoh, Japan). The fasting glucose test method was Hexokinase UV. The instrument used was a Hitachi Automatic Analyzer 7600 (Hitachi, Japan) and the reagent was Pureauto S GLU (Sekisui, Japan). The insulin test was performed by electrochemical luminescence immunoassay (ECLIA), the equipment used was a cobas 8000 modular analyzer (Roche, Germany), and the reagent was Elecys insulin

(Roche, Germany) (Table 1).

Among the oral care factors, alcohol consumption was assessed by the Alcohol Use Disorder Identification Test (AUDIT) score, and the amount of smoking was measured by the average daily amount of smoking in the past and present.

**Table 1: Specific items for measurement variables**

Division	Variable	Explanation
Dependent variable		
	Periodontal disease status	Periodontal disease status score: Periodontal disease of six periodontal surfaces (maxillary right anterior posterior part, maxillary anterior part, maxillary left posterior part, mandible right posterior part, mandibular anterior part, mandibular left posterior part). 1. healthy periodontal tissue, 2. hemorrhagic periodontal tissue, 3. gingival periodontal tissue, 4. gingival periodontal tissue, gingiva-forming periodontal tissue. The higher the value, the more significant the periodontal disease. The higher the combined score, the more severe the periodontal disease.
Independent variable		
	Diabetes index	
	Glycated hemoglobin	%
	Fasting blood sugar	mg/dL
	Insulin	uIU/mL
Control variable		
Personal characteristics		
	Gender	1. male, 2. Female
	Age	Age
	Personal income	1. low, 2. low-intermediate, 3. upper-intermediate, 4. high
	Low-income households	National basic livelihood 1. nonexistence, 2. existence
	Level of education	1. Below graduate, 2. Primary school graduate, 3. High school graduate, 4. College or higher
Oral care factor		
	Frequency of brushing	times/1 day
	Supplies	1. nonexistence, 2. existence (dental floss, toothbrush, toothpaste solution, electric toothbrush, etc.) use one or more oral hygiene products)
	Subjective health status	1. very bad, 2. bad, 3. moderate, 4. good, 5. very good
	Drinking	AUDIT score
	Amount of smoking	Average smoking per day {(past+present)/2}

**Data analysis:** Descriptive statistics were used to identify the periodontal disease status of normal and diabetic individuals, followed by a t-test to compare the periodontal disease status of the two groups. In addition, multiple regression analysis was performed to analyze the effect of diabetes index (glycated hemoglobin, fasting blood sugar, insulin) on periodontal disease status.

## Results

**Periodontal disease and oral care status of normal and diabetic subjects:** Periodontal disease status was found to be better in normal subjects than in diabetics (Table

2), and there was a significant difference between them ( $P < .001$ ).

The levels of glycated hemoglobin, fasting blood glucose and insulin were significantly higher in diabetic subjects than in normal subjects ( $P < .001$ ).

In addition, in terms of oral care factors, non-diabetics were perceived to carry out more frequent brushing of their teeth than diabetics. The amount of smoking was significantly higher in normal people than in diabetics ( $P < .001$ ), but there was no difference in the amount of alcohol consumption between the two groups.

**Table 2: Periodontal disease and oral care factors of normal and diabetic subjects**

Variable	Group	N	SD	Min	Max	t
Periodontal disease status score						
	normal	3,753	4.803	.000	24.000	
	diabetes	470	5.419	.000	24.000	565.150***
Diabetes index						
	Glycated hemoglobin					
	normal	4,205	.369	4.100	8.000	
	diabetes	554	1.316	4.400	13.100	-30.719***
	Fasting blood sugar					
	normal	4,226	9.663	59.000	125.000	
	diabetes	554	41.365	77.000	364.000	-28.431***
	Insulin					
	normal	4,224	5.731	.300	99.400	
	diabetes	554	11.892	.200	141.300	-6.552***
Oral care factor						
	Frequency of brushing					
	normal	4,094	.975	1.000	8.000	
	diabetes	517	.965	.000	8.000	6.860***
	Subjective oral health status					
	normal	3,840	.858	.000	4.000	
	diabetes	507	.898	.000	4.000	4.421***
	Drinking					
	normal	3,440	6.901	.000	37.000	
	diabetes	413	7.392	.000	32.000	-1.506
	Amount of smoking					
	normal	4,226	178.458	.500	499.500	
	diabetes	554	198.914	.500	499.500	3.611***

\*\*\*P&lt; .001

**Effect of diabetes index on periodontal disease:** To examine the effect of diabetes index on periodontal disease, multiple regression analysis was performed (Table 3). The independent variables were glycated hemoglobin, fasting glucose and insulin. Control variables included individual factors and oral care factors. This model explained 12.5% of periodontal disease, and the model fit was good ( $F=39.874, p=.001$ )

Only normal glycated hemoglobin was found to affect periodontal disease. On the other hand, all three diabetic

factors (glycated hemoglobin, fasting blood sugar, insulin) have no relationship on the diabetic patients.

An interesting finding is that glycated hemoglobin affects periodontal disease in normal subjects, but no diabetic index has any effect on periodontal disease. The diabetic patient had a severe periodontal disease. As normal people increase glycated hemoglobin, which indicates blood glucose control status, periodontal disease worsens. It means that periodontal disease is deepened due to diabetes.

**Table 3: Effect of diabetes index on periodontal disease status**

Model	Normal			Diabetes		
	B	beta	T	B	beta	T
<b>Independent variable</b>						
Diabetes index						
Glycated hemoglobin	.613	.046	2.199*	.159	.038	.485
Fasting blood sugar	-.006	-.012	-.557	.013	.095	1.225
Insulin	.024	.028	1.516	.035	.077	1.447
<b>Control variable</b>						
Individual factor						
Gender	1.084	.113	5.406***	.675	.060	.901
Age	.061	.201	9.974***	-.036	-.075	-1.313
Personal income	-.451	-.103	-5.950***	-.335	-.070	-1.290
Oral care factor						
Frequency of brushing	-.090	-.018	-1.025	-.361	-.063	-1.185
Supplies	-.639	-.067	-3.744***	-1.513	-.136	-2.483*
Subjective oral health status	-.978	-.171	-9.930***	-.463	-.076	-1.418
Drinking	.048	.068	3.549***	.034	.042	.689
Smoking	.001	.052	2.680***	-.002	-.068	-1.099
Constant					7.601	*
R^2					.090	
adj. R^2					.060	
F			39.874***		3.031***	

\*P< .05, \*\*\*P< .001

## Discussion

Diabetes mellitus, characterized by hyperglycemia and impaired carbohydrate, fat and protein metabolism, is classified as type 1 and type 2. Type 1 diabetes is present in children and adolescents, and type 2 diabetes in adults. Type 2 diabetes is associated with lifestyle, such as high fat and sugar intake and obesity, resulting in insulin deficiency due to a decrease in insulin production, which accounts for about 90 to 95% of diabetic patients. Such diabetes is associated with increased susceptibility to oral infection, including periodontal disease. In particular, it is important to understand the mechanism of diabetes and periodontal disease, since diabetes has a bi-directional relationship with periodontal disease (21). In the present study, the periodontal disease status of non-diabetics subjects was statistically different from that of diabetic patients as in Table 3. In the oral health state, normal people had more frequent brushing than diabetic patients. As a result, diabetic patients had lower oral care ability than normal people.

The results of this study showed that periodontal disease index was higher in diabetic patients than in normal subjects and that normal people had better periodontal status. However, in the form of oral health consciousness, there was a difference between the two groups in terms of the frequency of brushing and subjective oral health evaluation (22). This is not consistent with our study.

However, tooth surface bacteria index and periodontal health index (gingival index, stiffness), which have a negative correlation with oral administration ability, were higher in non-diabetics than in diabetic patients. So, the results showed that the oral care ability of diabetic patients was lower than that of normal people, suggesting the necessity of professional oral health education for diabetic patients (23).

In this study, we analyzed the effect of diabetes index on periodontal disease, using glycated hemoglobin, fasting blood glucose and insulin parameters. Periodontal disease was exacerbated as HbA1c increased in normal subjects, whereas diabetic patients did not have any diabetic index on periodontal disease. Considering that periodontal disease condition is severe compared to the normal person with diabetes, it can be concluded that the deterioration of periodontal disease has presented at the time of diabetes mellitus, because periodontal disease is worsened by diabetes. In the previous study in (24), non-surgical periodontal treatment of type 2 diabetic patients with periodontal disease showed that glycated hemoglobin (HbA1c) decreased from  $7.7806 \pm 1.5636$  to  $8.0290 \pm 1.5539$  after non-surgical periodontal therapy. This improved blood glucose control supports the results of this study. Glycated hemoglobin concentration is an indispensable part of routine diabetes management as a long-term blood glucose control index and risk predictor. Glycated hemoglobin concentration is increasingly used for the diagnosis of diabetes (25). Therefore, glycated hemoglobin has a significant effect as the only diabetic index closely related to periodontal disease. In diabetic patients, hyperglycemia not only had bad periodontal status due to deteriorated periodontal disease, but also low oral care. Therefore, it is necessary to develop diverse programs for more specialized oral health care. What does this mean? Due to the high quality of the test? for diabetic patients, and detailed studies should be conducted of the impact of age and sex on the relationship between glycated hemoglobin and periodontal disease (26).

It is necessary to know the cause of various diseases affecting oral health and develop the oral health management program. In addition, comprehensive national policies should be developed to provide education, and to prevent and treat oral health. 26).

Recently, there have been some reports of periodontal disease in relation to other diseases, especially obesity (27), but further research is needed. As mentioned above, periodontal disease is organically related to various diseases, so it is urgent to develop various programs for periodontal management from childhood in order to prevent and treat dental hygiene.

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