

## **Oral health status among adults with type 2 diabetes compared to that of those without diabetes**

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### **Abstract:**

The prevalence of diabetes mellitus is steadily increasing in India, making it a growing public health problem. It is now one of the diseases that is found in the most people all around the world. The purpose of this study was to determine whether or not there was a correlation between oral health status, socioeconomic level (SES), and oral hygiene practises among adults who had Type 2 Diabetes and those who did not have Diabetes.

**Materials and the Methods:** A comparative research using a cross-sectional design was carried out between October 2021 and March 2022 on a total of 500 adult study volunteers, of which 250 had Type 2 diabetes and the remaining 250 did not have diabetes. Participants in the research were asked questions through interview that measured their socioeconomic status, body mass index, and demographic characteristics. Assessments were made of diabetic research subjects' knowledge of diabetes, its systemic and oral symptoms, and treatments, as well as their family histories of diabetes, the kind of diabetes they had, and how long they

had had diabetes. We utilised the WHO Oral Health Assessment Questionnaire 2013 for our research. In addition to this, the Oral Hygiene Index-Simplified and the Community Periodontal Index, both based on the WHO Oral Health 2013 Criteria, were utilised.

Results: Patients with diabetes had a mean age of 45.81 years, with a standard deviation of 5.05 years, whereas subjects without diabetes had a mean age of 40.85 years, with a standard deviation of 7.7 years. There is a statistically significant difference between the mean number of decaying, missing, and filled teeth among diabetics (10.23 4.73) and non-diabetics (5.34 3.316). Periodontal pocket was found in 67.2% of diabetes study participants, with a mean number of teeth impacted, with a pocket depth of around 4–5 mm in 4.68 2.94 and 6 mm or more in 3.76 2.83, which was somewhat greater than the nondiabetic study subjects who participated in the study. It was shown that diabetes study participants had a prevalence of connection loss that was 28.4%, whereas non-diabetic study subjects had a prevalence of attachment loss that was 18%.

Conclusion: The study came to the conclusion that there is a substantial link between diabetes and poor periodontal diseases, and that this association has an influence on the overall oral health status of diabetic study participants when compared to nondiabetic study subjects.

Dental caries, diabetes, and oral health are some of the terms

## Introduction

In India, diabetes mellitus (DM) is becoming an increasingly significant public health problem. It is a metabolic condition that is defined by persistent hyperglycemia as well as disordered carbohydrate, fat, and protein metabolism. This disorder is caused by either faulty insulin production or action, or both. [1] The International Diabetes Federation projects that by the year 2020, there will be 463 million individuals throughout the world living with diabetes. Of these 463 million people, 88 million will be residents of the Southeast Asia area. Surprisingly, India is home to 77 million diabetics out of these 88 million individuals who have the condition. [2] It is possible that the high levels of urbanisation and industrialization, as well as changes in lifestyle habits among the general population, are to blame for the alarmingly high rates of diabetes prevalence. [3] Diabetes is linked to a wide variety of medical difficulties in addition to the oral complications that it causes. Because of this, it is extremely important to make a correct diagnosis of this illness at an early stage, when it will be much simpler to adequately treat it. The possibility of preventing the onset of major issues as a result of it will be reduced even further as a result of this. [4] In addition to this, the financial burden that is currently associated with the management of this condition will be lessened.

Periodontitis is considered to be the sixth problem that might arise from having diabetes.[5] Periodontitis was identified as one of the pathological disorders that is frequently encountered in diabetics in a study that was compiled by an Expert Committee on Diagnosis and Classification of Diabetes Mellitus.[6] Numerous studies have, in point of fact, presented irrefutable proof that people with diabetes have a greatly higher risk of periodontal disease in all of its manifestations, including its prevalence, severity, and development.[7] If not treated, periodontitis can result in the loss of teeth, which makes it difficult for a patient to keep up with a healthy diet and can have a negative impact on the patient's overall quality of life.

Other oral manifestations related to diabetes include mucosal ulceration, dry mouth, fungal infection, burning mouth syndrome, geographic tongue, oral lichen planus, fissured tongue, delayed wound healing, altered taste, impaired tooth eruption, benign parotid hypertrophy, tooth loss, xerostomia, dental caries, and periodontal disease.[8] It is believed that multifactorial behavioural issues, such as smoking cigarettes, being physically inactive, consuming foods high in saturated fatty acids, and drinking sugar-sweetened drinks, contribute to the development of diabetes.[9] Socioeconomic status (SES) is a complete measure of an individual's or family's economic and social standing.[10] There are certain socioeconomic characteristics that have been identified as risk factors that are associated with diabetes.[11] To be more specific, the socioeconomic determinants include gender, age, marital status, degree of education, income, employment, location, residential area, amount of current responsibility, and total remaining debt. According to the findings of a study that was carried out by Javed and colleagues, individuals who had type 2 diabetes that was under control were more likely to have a higher socioeconomic status, which may have enabled them to use conventional treatments for the disease and to keep their oral health in better condition. [12] Low SES is the key contributing factor in the advancement of periodontal problems in T2D. There is a correlation between a high incidence of type 2 diabetes and low levels of education and socioeconomic status. [13]

However, there is not yet a clear picture and only a limited amount of research has been done on the association between type 2 diabetes and dental health concerns among the general population. Second, because diabetes may go undetected for a significant amount of time, dentists may play an important role in the process of assisting the diagnosis of diabetes at an earlier stage. As a result, the purpose of this study was to evaluate and attempt to connect the oral health status, socioeconomic position, and oral hygiene practises of an adult population that was either Type 2 diabetic or did not have diabetes.

#### The Components and Procedures

In the Community Health Center (CHC) of the Muradnagar block in Ghaziabad, between the months of October 2021 and March 2022, a comparative cross-sectional research was carried out between 250 people with Type 2 diabetes and 250 study participants who did not have diabetes.

#### **The origin of the data**

The preconfirmed diabetics who were receiving treatment from a physician at the CHC of Muradnagar block in the Ghaziabad district were regarded to be diabetic study participants. On the other hand, the non-diabetic study subjects were those who accompanied diabetic patients to the centre. An immediate Glucometer was used to do further testing on the research volunteers who did not have diabetes in order to validate their blood glucose levels. They were not included in the research if their random plasma glucose level was discovered to be 200 mg/dL (11.1 mmol/L), which is regarded to be an indication of diabetes[14]. Instead, they were directed to physicians for additional confirmation of their illness.

Ethical approval as well as informed consent are both required.

Before beginning the study, permission on an ethical level was acquired from the Committee on Ethical Conduct. Before beginning the study, written informed agreement was gained

from the participants, and in the instance of participants who were illiterate, the technique was first described verbally, and then thumbprints were taken.

#### Pilot study

The purpose of the pilot study was to assess the sample size as well as to determine whether or not the study could be carried out successfully. The study had a total of 60 study volunteers, 30 of whom had diabetes and 30 of whom did not.

#### Sample size determination

The number of people who had experienced a loss of connection was used as a basis for the estimation of the sample size in the pilot research.  $Z = 1.960$ ,  $Z = 0.84$ ,  $P1 =$  Prevalence of loss of attachment among diabetic study subjects: 38%, and  $P2 =$  Prevalence of loss of attachment among nondiabetic study subjects: 26% Using the  $Z/2$  value for the 5% level of significance and the  $Z$  value for the 80% power of the study,  $Z = 1.960$ ,  $Z = 0.84$ ,  $P1 =$  Prevalence of loss of attachment among nondiabetic

This results in a number of  $n$  equal to 234 study subjects, which is then rounded up to 250 study subjects. As a result, there were a total of 500 people who participated in the study, with the sample size consisting of 250 diabetics and 250 people who did not have diabetes.

Inclusion criteria • Study subjects who were willing to participate • Diabetic study subjects who had been diagnosed with type 2 diabetes more than a year ago • No medication with antibiotics or steroidal and/or nonsteroidal anti-inflammatory agents over the past three weeks • At least 16 natural teeth still present • No immunosuppressive chemotherapy, no current acute illness, no professional periodontal treatment within the last six months, and no pregnancy or lactation.

#### Exclusion conditions

• Study patients with any other systemic disorders, such as hypertension and epilepsy, which might hinder the clinical examination. • Study subjects who were on antimicrobial medication or who had received any periodontal therapy during the previous six months.

#### Data collecting

A questionnaire based on interviews was sent out to be filled out, and its fundamental format was split into two parts. Using a modified version of the Kuppuswamy Scale 2019, the first portion of the study gathered fundamental demographic information on the study individuals, including their body mass index (BMI) and socioeconomic status. [15] The second part of the study evaluated the diabetic study subjects' fundamental knowledge of diabetes, as well as the history of diabetes in their families, the type of diabetes they had, how long they had had it, the various manifestations of diabetes (both systemic and oral), and the medications they had taken in the past as a result of their diabetes.

#### Clinical evaluation and observation

The WHO Oral Health Assessment Questionnaire 2013[16] was used to evaluate the individuals' current oral health status as well as their oral health behaviours. Both the Oral Hygiene Index-Simplified (OHI-S)[17] and the Community Periodontal Index[16] utilising the WHO Oral Health 2013 Criteria were utilised in order to ascertain the level of oral hygiene.

The IBM SPSS Statistics 20.0 for Windows programme was used to do the analysis on the data that was collected in Chicago, Illinois. The mean percentages and standard deviation

were used to illustrate the descriptive statistics of the people who participated in the study. The Chi-square statistic was utilised in the analysis of the association. Any P value that was less than 0.05 was judged to be significant. The Spearman rank correlation test was also evaluated to determine correlation. A t-test using an independent sample was utilised for usage in making comparisons within the group.

## Results

The participants in the study who had diabetes had a mean age of 45.81 years, whereas the participants in the study who did not have diabetes had a mean age of 40.85 years. The majority of study participants with diabetes (62.8%) were male, whereas the majority of research subjects without diabetes (64.8%) were male. There were 157 diabetic study subjects and 162 non-diabetic study subjects. When comparing diabetic and non-diabetic study subjects, a statistically significant difference was identified between the two groups in terms of their socioeconomic position, body mass index, and the prevalence of diabetes in their families (P 0.05).

Among the diabetic study subjects, the majority, 103 (41.2%), had diabetes for more than 8 years, 224 (89.6%) were taking medication for diabetes, either oral or injectable tablets, 168 (75%) diabetic study subjects used oral medications as a treatment modality to keep diabetes under control, and 122 (48.8%) diabetic study subjects surfed the Internet as a source of information for diabetes apart from their physician.

When looking at the replies to the knowledge test given to the study participants, a statistically significant difference was discovered between the diabetic and nondiabetic study subjects regarding their awareness of the influence diabetes has on an individual's overall as well as dental health (P 0.05).

When compared to those who do not have diabetes, the habits and practises of diabetics regarding oral hygiene were statistically significant (P 0.05). A comparison of the cleaning aids that diabetes and nondiabetic research subjects used to clean their teeth revealed a difference that did not reach the level of statistical significance (P = 0.06). [Table 1].

Table 1 presents a comparison of the replies of the people who participated in the study depending on the oral hygiene practises they followed.

	Diabetic, n (%)	Non Diabetic, n (%)	P value	Significance
Responses				
Never	3.7	2.1	0.001	Significant
Once a month	3.7	1.3		
2–3 times a month	3.1	1.3		
Once a week	1.3	4.1		
2–6 times a week	0	9.4		
Once a day	61	79.1		
Twice or more a day	28.5	3.3		
Oral hygiene aids				
Toothbrush and toothpaste	81	83.4	0.08	Nonsignificant
Wooden toothpicks	1.3	2.2		
Plastic toothpicks	1.7	2.1		
Charcoal	0.5	2.5		

Chewstick/Miswak	11.8	7.9		
Others, specify	1.7	4.1		

When compared to non-diabetics, diabetics had a statistically significant difference in the mean number of sound teeth, which was 21.62, the mean number of carious teeth, which was 2.68, the mean number of filled teeth with caries, which was 0.98, the mean number of filled teeth with no caries, which was 1.09, the mean number of missing teeth due to any other reason, which was 3.16, and the mean number of fixed dental prosthesis/abutment, which was 3.16. The percentage of diabetes patients who had decaying, missing, or filled teeth (DMFT) was statistically and substantially greater than that of non-diabetic patients (10.23). The average number of teeth found to have a periodontal pocket depth of 4–5 millimetres was 4.68, and sextants affected with loss of attachment score 0–3 millimetres (2.39), 4–5 millimetres (1.72), 6–8 millimetres (1.37), 9–11 millimetres (0.20), and 12 millimetres or more (0.16) were statistically significant and higher among diabetic study subjects ( $P = 0.815$ ).

In the current study, the prevalence of gingival bleeding and periodontal pocket development among diabetic study individuals was found to be 33.4% and 33.6%, respectively. Both of these conditions are associated with periodontal disease. In the diabetes study subjects, periodontal pockets were found in a majority of the research subjects (168, 67.2%), whereas in the non-diabetic study subjects, periodontal pockets were seen in a majority of the study subjects (109, 43.6%). It was shown that diabetes study participants had a prevalence of connection loss that was 28.4%, but non-diabetic study subjects only had a prevalence of attachment loss that was 18%. When the mean OHI-S scores of both study groups were compared, it was discovered that the diabetic study subjects had significantly higher mean Oral Hygiene-Simplified Index scores than the non-diabetic study subjects did. These diabetic study subjects' scores were 3.77, which is statistically significant and higher than the non-diabetic study subjects' scores. When comparing diabetes and nondiabetic research subjects for gingival bleeding, periodontal pocket development, and loss of attachment, a statistically significant difference was discovered between the two groups ( $P < 0.05$ ; see Table 2 for details).

Table 2 presents a comparison of periodontal diseases and an interpretation of the Oral Hygiene Index score among research patients who either had or did not have diabetes. in percentage

Gingival bleeding				
Present	65.7	47.2	0.001	Significant
Absent	32.7	51.9		
Periodontal pocket				
Present	66.9	43.2	0.001	Significant
Absent	33.1	55.7		
Loss of attachment				
Present	57.2	35.9	0.002	Significant
Absent	41.7	63.88		
OHI-S Index interpretation				
Good	5.8	6.2	0.001	Significant
Fair	78.1	57.1		
Poor	16.1	37.1		

According to the findings of multinomial logistic regression, nondiabetic study subjects are 1.72 times (odds ratio [OR]: 1.72, 95% confidence interval [CI]: 1.064–2.783), 1.27 times (OR: 1.27, 95% confidence interval [CI]: 0.77–2.09), and 1.4 times (OR: 1.407, 95% confidence interval [CI]: 0.881–2.248) more likely to not have gingival bleeding, periodontitis

## Discussion

It is possible that having a systemic illness would raise the likelihood of various health problems in an individual, particularly those that are connected to the individual's body. Diabetes is often cited as an excellent illustration of this concept. Oral implications have been a prominent complication of diabetes for as long as anyone can remember, and they are one of the complications that need treatment at an early and urgent phase.

Both the diabetes group (62.8% of research subjects) and the non-diabetic group (64.8% of study subjects) were predominantly comprised of men. This finding is comparable to that of a study carried out by Bharateesh et al., in which females made up 39% of the study population while males made up 61%.

[18] A total of 64.4% of diabetic research respondents had a positive history of diabetes in their family, which is comparable to the results of a study that Geetha and her colleagues carried out in Tamil Nadu. [19] Diabetes is a disease that is known to strongly cluster in families and has been shown to have a hereditary component. This is likely the reason why this is the case. If either one or both of a person's parents have diabetes type 2, their chances of having the condition themselves are around two to four times higher. [19], [20] Therefore, a history of diabetes in the family may be an effective tool for identifying individuals who are at a higher risk of acquiring the illness and for targeting behaviour adjustments that may potentially postpone the onset of disease and improve health outcomes.

Diabetes was present in a majority (41.2%) of the people who participated in the research for more than three years. According to the findings of a study that was carried out in Nigeria by Ojehanon and colleagues, around 30.6% of the participants had been afflicted with diabetes for more than ten years. [21] This suggests that diabetes is a lifetime problem that may not manifest any symptoms and be untreated or unrecognised for a considerable amount of time. Therefore, the phrase "silent killer" is the most appropriate descriptor for this illness. A total of 32% of diabetic research subjects were considered obese, which is identical to a study carried out in Nepal by Shah et al., which found that obesity was more prevalent among diabetics than non-diabetics due to diabetics having a higher body mass index (BMI). [22] Therefore, it is possible that obesity is an etiologic factor in the progression of diabetes. Dietary changes, the degree of physical activity that one gets from leading a sedentary lifestyle, and genetic predisposition are the elements that are most closely connected with diabetes.

A large majority of people with diabetes (56.8%) and people without diabetes (70.8%) were unaware of the implications that diabetes can have on dental health. This study is comparable to one that was conducted by Arunkumar et al., in which patient knowledge and awareness regarding the effects of diabetes on oral health were measured. The researchers found that

only 10.8% of the people who participated in the study were aware of the effects of diabetes on oral health. [23], [24] The results of the study showed that diabetics and non-diabetic study subjects did not significantly vary from one another in their oral hygiene routines. The usage of toothbrushes and toothpaste came in first place for the participants in the survey when it came to cleaning their teeth, followed by the use of chewsticks and neem sticks. Similar findings were discovered by Attas and Oda, who found that 80 percent of the people in their research group cleaned their teeth with toothbrushes and paste. [25] This may be the result of the fact that the current research was carried out in a semiurban area, where the vast majority of people use toothpaste and toothbrushes, as well as a growing awareness about the use of the appropriate oral hygiene aid as a result of various oral health programmes carried out at health centres as well as through the media. Only 28.4% of diabetics washed their teeth twice per day, whereas the majority of diabetic study participants (60%) and nondiabetic research subjects (79.2%) in the current study only brushed their teeth once per day. In a study that was carried out in Finland by Karikoski et al., the researchers found that only 38% of the participants brushed their teeth twice per day. On the other hand, in a study that was carried out in Jeddah, the researchers found that 46% of the study subjects brushed their teeth more than once per day. [25],[26] In light of the findings of the current research, it is of utmost significance to place an emphasis on the appropriate techniques for brushing one's teeth as well as the frequency of doing so among the adults living in Muradnagar.

Controlling glycemia is one of the principal etiologic mechanisms associated with periodontal breakdown. The duration of diabetes is considered to be the most important factor when addressing the susceptibility to periodontal disease and other systemic complications; however, this does not negate the fact that duration of diabetes is the primary factor.

[27],[28] As a result, the research examines a significant connection between the length of time a person has diabetes and periodontal disease as well as loss of attachment. According to the findings of one of these investigations, which was carried out by Cerda and colleagues, the length of time a person has had diabetes is a major influence in the severity of periodontal disease. [29]

When compared with the non-diabetic group, the number of carious lesions seen in the mouths of research participants who had diabetes was significantly greater. Patients with diabetes may eat more often than normal people, and repeated consumption of any amount of carbs, no matter how tiny, may increase the risk of developing cancer. Similar findings were found in a study that was carried out by Lalla and colleagues. The researchers found that while the mean number of carious lesions was the same in both groups, the non-diabetic control group had a considerably higher number of teeth that had been restored. [30]

When compared to non-diabetic study participants, diabetes study subjects had a larger mean number of teeth that had been filled, which indicates that diabetic study subjects had higher oral treatment demands and more disabling oral problems. In a study carried out by Puranik and Hiremath, the average number of filled teeth was found to be greater in the non-diabetic population compared to the diabetes population. These findings contradict the findings of a previous study carried out by the same researchers. [31]

In the current study, the nondiabetic participants had a little lower mean number of missing teeth owing to various causes than the diabetic participants did. Due to periodontal problems,

the "other cause" that was taken into consideration for this investigation was not present. Even while the average number of missing teeth does not provide a clear picture of the periodontal health, it is still an essential component in the process of determining the state of oral health.

This is quite similar to a research that was carried out by Sukminigram N et al., in which they found that the mean DMFT in the diabetic group was 13.52, which was considerably greater ( $P < 0.05$ ) than 9.73 in the group that did not have diabetes.

[32] In contrast, Pohjamo and colleagues found that persons with diabetes had just slightly fewer teeth with decay when compared to controls. [33] These findings could be explained, at least in part, by the fact that diabetics' saliva lacks the defensive mechanisms that healthy people possess. In addition to this, the saliva's cleaning and buffering abilities are compromised. A low salivary pH encourages the proliferation of aciduric bacteria, which in turn enables acidogenic bacteria to thrive and creates an environment that is hostile to the protective oral bacteria that normally prevent dental caries from occurring.

When compared to the non-diabetic study participants, the proportion of diabetic study subjects who reported having periodontal pockets was significantly higher (67.2%), as opposed to the non-diabetic study subjects (43.6%). Comparable findings were reported by Botero et al., who found that the prevalence of periodontitis was significantly greater in diabetics (75.3%), compared to non-diabetics (64.1%). [34] In addition to this, the effect of diabetes on periodontal tissues has also been carefully explored in a variety of observational studies in the past, which have shown that diabetes is related with an accelerated degradation of periodontal tissue. A research with a follow-up duration of 5 years found that periodontal tissue deterioration is linked with poor glycemic control (HbA1c 6.5%) (48 mmol/mol) with an OR of 2.9. This association was found in the study. [35]

When compared to non-diabetic research participants, diabetes study subjects had a greater mean number of 4.68 teeth with pockets 4–5 mm and 11 teeth with pockets 6 mm or more, which is consistent to the findings of a study carried out by Kesavan R et al.

[3] There was a loss of connection seen in 36% of the diabetes research subjects and 56.8% of the non-diabetic study subjects. Studies including various populations and carried out by Lalla et al., Hintao et al., and Khader et al. all came to the same conclusions as this one. [30] [36] [37] However, a study that was carried out by Collin and colleagues found that there was no significant difference in the loss of attachment ratings of study individuals who had diabetes and those who did not have diabetes. [38] Diabetic individuals who also had periodontitis had a greater degree of periodontal attachment loss as compared to those who did not have diabetes. Nevertheless, the examination of periodontal disease and attachment loss, which indicates the destruction of periodontal tissues in the past, is what leads to the diagnosis of periodontal disease. Periodontal disease is one of the primary reasons why people lose their teeth.

The state of diabetics' oral hygiene was somewhat worse when compared to that of non-diabetics, which is consistent with the findings of a study carried out by Hintao et al., which found that non-diabetics had a better oral health status. [36] It is possible that this is the result of inadequate clearance of dental plaque and debris, both of which attach to the surface of the tooth and the gingiva, so causing caries and gingival irritation.

Therefore, the study reveals a strong relationship between diabetes and deteriorating bad periodontal diseases. Additionally, the study leaves an influence on the total oral health status of the diabetic study participants when compared to the study subjects who did not have diabetes. In addition to this, the current study identified a number of risk factors, including socioeconomic status, body mass index, and duration of diabetes, all of which contributed to poor oral health outcomes among the people who participated in the research. The majority of people in India believe that dental care is prohibitively expensive, which, on the one hand, keeps them away from registered professionals and, on the other hand, makes them hostages to the services of unregistered lay practitioners who are sitting on the streets. The lack of awareness among people regarding the importance of oral hygiene and health is the primary cause of this. [39]

### **Conclusion**

The current study came to the conclusion that diabetic study subjects had a lower level of oral health status compared to non-diabetic study subjects. In addition, there is a lack of awareness regarding diabetes and the effects that it has on oral health. The relationship between diabetes and the condition of one's teeth and gums is only just beginning to be investigated. When it comes to this topic, additional research is absolutely necessary if we are going to have any hope of comprehending the implications of common systemic manifestations that occur in an individual's oral cavity.

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