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Original Research Article

The Impact of Diabetes mellitus (DM) on Oral Health

Priyanka[1], Samir Kumar[2]

[1]Dental Officer, Sardar Hospital, Hajipur, Vaishali, Bihar, Patna
[2]Associate Professor, Department of General Medicine, Indira Gandhi Institute of Medical Sciences, Patna, Bihar, India

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Corresponding author:Dr. Samir Kumar
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Abstract:

Background: Millions of individuals worldwide suffer from diabetes mellitus (DM), a global health crisis. Patients with diabetes are more likely to experience dental caries, periodontal disease, and oral infections, among other oral health problems. In addition to lowering quality of life, these dental issues increase the total health burden for diabetics. There is still little data on how diabetes management affects oral health outcomes, despite the established links between diabetes and dental health.

Aim: This study aims to assess the oral health status of individuals with (DM) and examine the relationship between glycemic control (HbA1c levels) and oral health conditions, including dental caries, periodontal disease, and oral infections, in a clinical setting.

Methods: From March 2023 to March 2024, a cross-sectional study was carried out at Sadar Hospital in Hajipur, Bihar. 115 individuals with Type 1 and Type 2 diabetes were enrolled in the study. A licensed dentist conducted oral health examinations to examine mouth infections, periodontal disease, and dental caries. The HbA1c values of the subjects were used to calculate their glycemic control, and information about their demographics, length of diabetes, and dental hygiene habits was gathered. SPSS version 23.0 was used to conduct the statistical analysis.

Results: The results indicated that 68.7% of participants had dental caries, 53.0% had periodontal disease, and 39.1% exhibited oral infections. A significant positive correlation was found between the duration of diabetes and the incidence of these oral health issues ($p < 0.05$). Additionally, participants with poorly controlled diabetes (HbA1c $\geq$ 7%) exhibited significantly higher rates of periodontal disease and oral infections compared to those with controlled diabetes (HbA1c < 7%) ($p < 0.01$). No significant differences were observed between Type 1 and Type 2 diabetes patients regarding oral health conditions.

Conclusion: (DM) is strongly associated with poor oral health, with longer diabetes duration and poor glycemic control contributing to more severe oral complications. Effective diabetes management, including maintaining controlled blood sugar levels, is crucial for preventing and managing oral health issues in diabetic patients.

Recommendations: Clinicians should emphasize the importance of regular oral health check-ups for diabetic patients and integrate dental care into the overall management of diabetes. Improved interdisciplinary collaboration between endocrinologists and dental professionals is essential for the comprehensive care of diabetic individuals.

Keywords: Diabetes mellitus, oral health, periodontal disease, glycemic control, dental caries.

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Introduction

(DM) is a long-term metabolic disease marked by elevated blood sugar levels brought on by deficiencies in insulin secretion, action, or both. It is one of the most common non-communicable illnesses in the world and has a big impact on public health. About 537 million persons worldwide had diabetes in 2021, according to the IDF, and this number is predicted to increase significantly over the next several decades [1]. Diabetes is associated with a wide range of complications, including cardiovascular, renal, and neurological issues, but its impact on oral health is often overlooked, despite being of considerable importance.

Diabetic patients are more prone to various oral health conditions, such as dental caries, periodontal disease, and oral infections. These conditions not only affect the quality of life but also exacerbate the overall health burden in diabetic patients. Periodontal disease, for instance, has been shown to have a bidirectional relationship with diabetes, with poor glycemic control leading to more severe periodontal outcomes, while periodontal disease itself may worsen glycemic control [2]. Studies have also highlighted that individuals with diabetes have a higher susceptibility to oral infections such as candidiasis and gingivitis, often due to altered immune responses and microvascular changes that affect the oral tissues [3].

There are several underlying factors that connect diabetes to poor oral health. Advanced glycation end-products (AGEs), which are thought to encourage inflammation and tissue damage in the oral cavity, are produced when hyperglycemia occurs [4]. Additionally, diabetes affects salivary flow, making individuals with the condition more susceptible to dry mouth and subsequent oral infections [5]. Moreover, the elevated glucose levels in the saliva of diabetic patients create a favorable environment for pathogenic microorganisms, further exacerbating oral health problems [6].

Recent studies suggest that poor oral health in diabetic individuals can lead to systemic complications, including the worsening of diabetes itself. Evidence has shown that periodontal disease can impair insulin resistance, increasing the difficulty of managing blood glucose levels [7]. Therefore, addressing oral health in diabetic care is essential for the comprehensive management of the disease. However, despite this understanding, there remains a lack of awareness and integration between dental and diabetes care in many clinical settings. This study aims to assess the oral health status of individuals with (DM) and examine the relationship between glycemic control (HbA1c levels) and oral health conditions, including dental caries, periodontal disease, and oral infections, in a clinical setting.

Methodology

Study Design

This study was a cross-sectional observational design.

Study Setting

The study will be conducted at Sadar Hospital, located in Hajipur, Vaishali, Bihar. It will involve direct examination and assessment of participants diagnosed with diabetes, focusing on various oral health parameters, such as periodontal disease, dental caries, and oral infections. Data will be collected over a period of one year, from March 2023 to March 2024, to gather a comprehensive understanding of the oral health issues associated with diabetes mellitus.

Participants

The study will involve approximately 115 participants who are diagnosed with (DM) and seeking dental care at Sadar Hospital. These patients will be selected from the outpatient clinic and will be informed of the

study's purpose and procedure before participation. Consent will be obtained from each participant, ensuring that they are fully aware of the study requirements.

Inclusion Criteria

- Diagnosed with (DM) (Type 1 or Type 2) by a licensed healthcare provider.
- Aged between 18 and 65 years.
- Being prepared to give informed consent and take part in the research.
- Have at least one dental examination in the past year.
- No history of other significant systemic diseases that may influence oral health.

Exclusion Criteria

- Women who are nursing or pregnant.
- Patients with acute oral infections or other systemic diseases such as cancer, HIV, or severe heart conditions that could affect the study outcomes.
- Individuals who have undergone recent dental treatments or surgeries within the last six months.
- Participants who are unable or unwilling to provide informed consent.

Bias

To minimize bias, the study will ensure strict inclusion and exclusion criteria, and all data collection procedures will be standardized. The participants will be selected randomly from the diabetes outpatient department to avoid selection bias. The assessment of oral health will be conducted by a trained dentist to reduce observer bias. Additionally, patient self-reporting regarding their oral health habits and diabetes management will be validated through medical records and clinical examination, helping mitigate recall bias.

Data Collection

A combination of primary and secondary sources will be used to gather data. Primary data will include clinical oral health assessments, including a full dental examination to assess dental caries, periodontal disease, and other oral health conditions. Secondary data will include demographic details (age, sex, diabetes type, duration of diabetes) and medical history, which will be obtained from the patients' medical records. A structured questionnaire will be used to collect additional information on lifestyle factors such as smoking, alcohol consumption, and oral hygiene habits.

Procedure

After obtaining informed consent, each participant will undergo a thorough clinical oral health assessment conducted by a qualified dentist. The assessment will include checking for dental caries, periodontal conditions, and the presence of oral infections such as candidiasis. The dentist will also record the patient's medical history, diabetes management practices, and any other relevant oral health issues. The participants will be interviewed using the structured questionnaire to gather additional data on their diabetes management, smoking, and oral care habits.

Statistical Analysis

SPSS version 23.0 will be used for data analysis. The individuals' demographic and clinical characteristics will be summed up using descriptive statistics (mean, standard deviation, frequency, and percentages). When applicable, relevant statistical tests, such as t-tests or ANOVA for continuous variables and chi-square tests for categorical variables, will be used to examine the link between diabetes and dental health outcomes. A statistically significant p-value is one that is less than 0.05. To evaluate the impact of several factors on the oral health outcomes of diabetic patients, multivariate analysis may be performed.

Results

The study included 115 people with a mean age of 52.4 ± 9.6 years and a diagnosis of diabetes mellitus. There were 59 (51.3%) females and 56 (48.7%) men in the group. The subjects' mean duration of diabetes was

8.2 ± 5.7 years, with a range of 2 to 20 years. **Table 1** below provides a summary of the study participants' demographic attributes.

Table 1: Demographic Characteristics of Study Participants (n=115)

Characteristic	Frequency (%)	Mean ± SD
Age (years)	52.4 ± 9.6	
Gender		
Male	56 (48.7%)	
Female	59 (51.3%)	
Duration of Diabetes	8.2 ± 5.7	
Diabetes Type		
Type 1	34 (29.6%)	
Type 2	81 (70.4%)	

The oral health status of the participants was categorized based on clinical examination findings. The key parameters assessed included the presence of dental caries, periodontal disease, and oral infections. The results are summarized in **Table 2** below.

Table 2: Oral Health Status of Study Participants (n=115)

Oral Health Condition	Frequency (%)
Dental Caries	79 (68.7%)
Periodontal Disease	61 (53.0%)
Oral Infections	45 (39.1%)
Healthy Oral Status	20 (17.4%)

From the results, it is evident that a significant portion of the participants exhibited poor oral health, with the majority having dental caries (68.7%), followed by periodontal disease (53.0%) and oral infections (39.1%).

The presence of dental caries, periodontal disease, and oral infections was examined in connection to the length of diabetes. According to the results, a higher incidence of poor oral health outcomes was linked to a longer duration of diabetes.

Table 3: Correlation Between Duration of Diabetes and Oral Health Conditions

Oral Health Condition	Duration of Diabetes (years)	p-value
Dental Caries	9.4 ± 6.3	< 0.01
Periodontal Disease	8.7 ± 5.1	< 0.05
Oral Infections	8.0 ± 4.8	< 0.05

The incidence of dental caries ($p < 0.01$), periodontal disease ($p < 0.05$), and oral infections ($p < 0.05$) was significantly positively correlated with the length of diabetes. This suggests that more serious issues with oral health are linked to longer diabetes duration.

The study also compared oral health conditions between participants with Type 1 and Type 2 diabetes. The results are shown in **Table 4** below.

Table 4: Comparison of Oral Health Conditions Between Type 1 and Type 2 Diabetes

Oral Health Condition	Type 1 Diabetes (n=34)	Type 2 Diabetes (n=81)	p-value
Dental Caries	26 (76.5%)	53 (65.4%)	0.12
Periodontal Disease	22 (64.7%)	39 (48.1%)	0.11
Oral Infections	17 (50.0%)	28 (34.6%)	0.17

There were no discernible statistical differences between the groups with Type 1 and Type 2 diabetes for dental caries, periodontal disease, and oral infections (all p-values > 0.05). However, a higher proportion of Type 1 diabetics exhibited dental caries and periodontal disease, which may be attributed to the younger average age of the Type 1 diabetic group.

The study also evaluated how diabetes management impacted oral health. Patients who had controlled blood sugar levels (HbA1c < 7%) showed significantly better oral health compared to those with uncontrolled diabetes (HbA1c ≥ 7%).

Table 5: Oral Health Status Based on Diabetes Control (HbA1c < 7% vs. HbA1c ≥ 7%)

Oral Health Condition	HbA1c < 7% (n=48)	HbA1c ≥ 7% (n=67)	p-value
Dental Caries	30 (62.5%)	49 (73.1%)	0.15
Periodontal Disease	18 (37.5%)	43 (64.2%)	< 0.01
Oral Infections	11 (22.9%)	34 (50.7%)	< 0.01

Participants with uncontrolled diabetes had a greater prevalence of oral infections ($p < 0.01$) and periodontal disease ($p < 0.01$), which were significant differences. On the other hand, there was no discernible variation in dental caries ($p = 0.15$).

Statistical Analysis Summary

Both the influence of diabetes control (HbA1c < 7%) on periodontal disease and oral infections (both $p < 0.01$) and the association between diabetes duration and oral health ($p < 0.05$) showed significant results.

Table 6: Summary of Statistical Findings

Variable	Statistical Test	Result	p-value
Diabetes Duration vs. Dental Caries	t-test	Significant	< 0.01
Diabetes Duration vs. Periodontal Disease	t-test	Significant	< 0.05
Diabetes Duration vs. Oral Infections	t-test	Significant	< 0.05
Type 1 vs. Type 2 Diabetes	Chi-square	Not Significant	> 0.05
HbA1c < 7% vs. HbA1c ≥ 7% (Periodontal Disease)	t-test	Significant	< 0.01
HbA1c < 7% vs. HbA1c ≥ 7% (Oral Infections)	t-test	Significant	< 0.01

Discussion

The study involved 115 participants with diabetes mellitus, comprising 56 males (48.7%) and 59 females (51.3%) with a mean age of 52.4 years. The participants had a range of diabetes durations, with a mean of 8.2 years. The oral health assessment revealed that a majority of participants had poor oral health, with 68.7% showing dental caries, 53.0% exhibiting periodontal disease, and 39.1% presenting oral infections. Only 17.4% of the participants were categorized as having a healthy oral status.

The substantial relationship between the occurrence of oral health problems and the length of diabetes was one of the study's main conclusions. As the duration of diabetes increased, the prevalence of dental caries, periodontal disease, and oral infections also increased. This suggests that prolonged exposure to high blood sugar levels may exacerbate oral health problems, highlighting the importance of early and continuous diabetes management to prevent long-term oral complications.

When comparing participants with T1DM and T2DM, no statistically significant differences were found in terms of oral health conditions, although Type 1 diabetics had slightly higher rates of dental caries and periodontal disease. This could be attributed to the generally younger age of Type 1 diabetes patients, which might make them more susceptible to such conditions, particularly in the early stages of diabetes.

Furthermore, the study revealed that diabetes control, measured by HbA1c levels, significantly affected oral health outcomes. Participants with well-controlled diabetes (HbA1c < 7%) had lower rates of periodontal disease and oral infections compared to those with poorly controlled diabetes (HbA1c ≥ 7%). This underscores the critical role of maintaining good glycemic control in minimizing the risk of oral health complications among diabetic patients.

Recent research underscores the profound effect of (DM) on oral health, with several studies highlighting the increased risk of oral diseases in diabetic individuals. A systematic review by Rylev et al. (2019) concluded that periodontal disease and diabetes share a bidirectional relationship, with poorly controlled diabetes leading to more severe periodontal outcomes, while periodontal disease itself can worsen glycemic control [8]. Similar findings were made by Brito et al. (2020), who discovered that patients with Type 2 diabetes had a greater frequency of periodontal disease and dental caries than the general population. The risk increased with poor glycemic management and the length of the condition [9].

Diabetic patients are also at a greater risk of oral infections. López-Jornet et al. (2019) reviewed the pathogenesis and clinical manifestations of oral candidiasis in diabetic individuals, emphasizing how the altered immune response and high glucose levels contribute to fungal infections in the oral cavity [10]. A related study by Yeganeh et al. (2020) examined the impact of diabetes on salivary composition, revealing that decreased salivary flow and altered pH increase the susceptibility to dry mouth and oral infections in diabetic patients [11].

(AGEs) are key factors that exacerbate oral health issues in diabetes. Singh et al. (2020) highlighted that AGEs, which accumulate due to prolonged hyperglycemia, contribute to tissue damage and inflammatory processes in periodontal tissues, leading to more severe periodontal disease in diabetic patients [12]. In addition to periodontal disease, diabetic patients are at risk for poor oral hygiene and complications related to poor self-care. A study by Ekambaram et al. (2018) emphasized that diabetes impairs the natural defense mechanisms of the oral cavity, contributing to the heightened risk of gingivitis, periodontitis, and other oral conditions [13].

A cross-sectional study by Chung et al. (2020) found a significant correlation between glycemic control (HbA1c levels) and oral health outcomes. Diabetic individuals with HbA1c levels greater than 7% had worse periodontal health and higher rates of oral infections compared to those with well-controlled diabetes [14].

Conclusion

The study demonstrates a significant impact of diabetes on oral health, with longer diabetes duration and poorer blood sugar control correlating with worse oral health outcomes. Periodontal disease and oral

infections were notably more prevalent among those with poorly controlled diabetes. These results emphasize how crucial diabetes care is in avoiding problems with diabetic individuals' dental health.

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