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Prevalence and Risk Factors of Dental Caries in Patients with Type 2 Diabetes Mellitus: A Cross-Sectional Study

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ABSTRACT:

Background: Dental caries is a widespread oral health problem that can be exacerbated by systemic conditions such as type 2 diabetes mellitus (T2DM). Individuals with T2DM are often at increased risk of oral infections due to impaired immune responses, altered salivary composition, and higher glucose levels in oral fluids. Understanding the prevalence and contributing risk factors of dental caries in this population is essential for targeted preventive and therapeutic strategies.

Aim: This study aimed to assess the prevalence of dental caries and identify associated risk factors in patients diagnosed with type 2 diabetes mellitus.

Methods: This cross-sectional study was conducted at PIMS Hospital, Islamabad, from June 2024 to May 2025. A total of 130 patients with confirmed diagnoses of type 2 diabetes mellitus were enrolled using a consecutive sampling technique. Data were collected through clinical oral examinations to determine the presence and severity of dental caries using the DMFT (Decayed, Missing, and Filled Teeth) index. A structured questionnaire was used to gather information on demographic details, glycemic control, oral hygiene practices, duration of diabetes, and dietary habits. Statistical analysis was performed using SPSS version 25.0 to identify significant associations between risk factors and dental caries prevalence.

Results: Out of 130 patients, 98 (75.4%) exhibited at least one form of dental caries. The mean DMFT score was 6.3 ± 2.4. Poor glycemic control (HbA1c > 7%) was significantly associated with higher caries prevalence ($p < 0.01$). Additional factors contributing to increased risk included poor oral hygiene practices, longer duration of diabetes (≥10 years), and frequent consumption of sugary foods. Age, gender, and educational level did not show a statistically significant association with caries prevalence.

Conclusion: The prevalence of dental caries was notably high among patients with type 2 diabetes mellitus. Poor glycemic control, inadequate oral hygiene, and prolonged disease duration emerged as key risk factors. These findings underscore the importance of integrating dental care into routine diabetes management to reduce oral health complications in this vulnerable population.

Keywords: Dental caries, Type 2 diabetes mellitus, Prevalence, Risk factors, Oral health, Glycemic control, Cross-sectional study.

INTRODUCTION:

Dental caries had long been recognized as a prevalent oral health concern globally, affecting individuals across all age groups. Characterized by the demineralization of tooth enamel and subsequent decay, dental caries developed due to a combination of microbial activity, dietary habits, and inadequate oral hygiene. Among populations at increased risk of dental caries, patients with Type 2 Diabetes Mellitus (T2DM) had

shown a significantly higher susceptibility [1]. T2DM, a chronic metabolic disorder marked by insulin resistance and impaired glucose metabolism, had been linked with multiple systemic complications, including those involving oral health. The intricate association between hyperglycemia and reduced salivary flow, coupled with altered immune responses and changes in oral microbiota, contributed to the increased incidence of dental caries in diabetic individuals.

The growing global burden of T2DM, especially in developing countries such as Pakistan, had raised public health concerns regarding its wide-ranging complications [2]. With Pakistan being among the top countries with the highest number of diabetic individuals, understanding the interplay between diabetes and oral health had gained significant importance. Despite mounting evidence highlighting the bidirectional relationship between diabetes and periodontal disease, relatively fewer studies had focused on the prevalence and associated risk factors of dental caries in this population [3]. Dental caries not only impaired chewing and nutrition but also negatively impacted the quality of life and glycemic control, thereby complicating diabetes management.

Several factors were believed to influence the development of dental caries in diabetic individuals. Poor glycemic control had been associated with increased levels of glucose in saliva, promoting bacterial growth and acid production, which in turn facilitated the demineralization of tooth surfaces. Additionally, reduced salivary flow rate, a common condition in diabetic patients, diminished the natural cleansing mechanism of the oral cavity, increasing the retention of food particles and plaque [4]. Moreover, compromised immune function in T2DM patients heightened their vulnerability to oral infections. Dietary patterns, particularly frequent consumption of refined carbohydrates, and poor oral hygiene practices further aggravated the risk. Socioeconomic status, lack of awareness regarding oral health, and limited access to dental care also played contributory roles.

Previous research had demonstrated variable prevalence rates of dental caries among diabetic populations, influenced by geographic location, healthcare accessibility, cultural practices, and patient awareness [5]. However, in the Pakistani context, limited data existed that specifically examined the burden of dental caries among T2DM patients and the contributory risk factors. This knowledge gap hindered the development of effective preventive and management strategies aimed at reducing oral health complications in diabetic individuals.

This study, therefore, aimed to assess the prevalence of dental caries in patients with T2DM and identify the associated risk factors in a tertiary care setting [6]. By exploring these aspects, the research sought to provide a clearer understanding of the oral health challenges faced by diabetic patients and promote integrated healthcare approaches. The findings of this study were intended to assist healthcare providers and policymakers in formulating targeted interventions and educational programs to improve oral hygiene practices and glycemic control among diabetic patients. In light of the rising burden of T2DM in Pakistan, this research held crucial implications for both clinical practice and public health planning [7].

MATERIALS AND METHODS:

This cross-sectional study was conducted at the Pakistan Institute of Medical Sciences (PIMS) Hospital, Islamabad, from June 2024 to May 2025. The primary objective was to determine the prevalence and associated risk factors of dental caries in patients diagnosed with Type 2 Diabetes Mellitus (T2DM). A total of 130 participants were included in the study, all of whom were adult patients previously diagnosed with T2DM and attending the diabetic outpatient department at PIMS Hospital during the study period.

A non-probability convenience sampling technique was employed to recruit the participants. Inclusion criteria comprised individuals aged 30 to 70 years with a confirmed diagnosis of T2DM for at least one year. Patients with type 1 diabetes, gestational diabetes, known immunodeficiencies, those undergoing chemotherapy or radiotherapy, and individuals with recent dental surgeries were excluded to avoid confounding variables.

All participants were informed about the nature of the study, and written informed consent was obtained before enrollment. Ethical approval for the study was granted by the institutional review board of PIMS Hospital.

Data collection involved two components: clinical oral examination and a structured questionnaire. The oral examinations were carried out by trained dental professionals using standardized procedures and equipment under proper lighting. Dental caries were diagnosed based on the World Health Organization (WHO) criteria, utilizing the Decayed, Missing, and Filled Teeth (DMFT) index. Each patient's DMFT score was recorded, and a DMFT score greater than zero was considered indicative of the presence of dental caries.

The structured questionnaire was administered through face-to-face interviews and covered demographic details (age, gender, education), diabetic history (duration of disease, HbA1c levels, frequency of glucose monitoring), lifestyle habits (oral hygiene practices, dietary habits, smoking), and dental history (frequency of dental visits, use of fluoridated toothpaste). HbA1c levels were obtained from recent laboratory results available in the patients' medical records to evaluate glycemic control.

Data were entered and analyzed using SPSS version 26. Descriptive statistics such as means, standard deviations, frequencies, and percentages were calculated for demographic and clinical variables. The prevalence of dental caries was expressed as a percentage of patients with a DMFT score >0. Chi-square tests and independent t-tests were used to compare categorical and continuous variables, respectively, between patients with and without dental caries. Logistic regression analysis was employed to identify independent risk factors associated with dental caries, with odds ratios and 95% confidence intervals calculated. A p-value of less than 0.05 was considered statistically significant.

Efforts were made to minimize biases by using calibrated examiners for the dental assessment and by verifying self-reported diabetic information through hospital records. Data confidentiality and anonymity were maintained throughout the study. Participants were also provided with feedback on their oral health and advised on preventive dental care where necessary.

This methodological framework allowed for a comprehensive evaluation of the prevalence and contributing factors to dental caries in patients with T2DM, thereby providing valuable insights for targeted prevention and intervention strategies.

RESULTS:

The study enrolled a total of 130 patients diagnosed with Type 2 Diabetes Mellitus (T2DM), aiming to assess the prevalence of dental caries and evaluate associated risk factors. The demographic and clinical data were collected using structured interviews and clinical dental examinations.

Table 1: Prevalence of Dental Caries Among T2DM Patients (n=130):

Caries Status	Frequency (n)	Percentage (%)
Present	88	67.7%
Absent	42	32.3%
Total	130	100%

Table 1 presented the prevalence of dental caries among the 130 patients diagnosed with T2DM. A total of 88 participants (67.7%) exhibited one or more dental caries lesions upon clinical examination, indicating a notably high burden of dental disease in this population. The remaining 42 patients (32.3%) were found to be free of caries. These results clearly suggested that individuals with T2DM were at increased risk of developing dental caries. The prevalence rate of 67.7% was consistent with findings from previous studies conducted in similar populations, highlighting the chronic impact of hyperglycemia and altered salivary composition in promoting dental decay.

Table 2: Association of Risk Factors with Dental Caries in T2DM Patients (n=130):

Risk Factor	Caries Present (n=88)	Caries Absent (n=42)	p-value
Poor Oral Hygiene	63 (71.6%)	13 (30.9%)	<0.001
Duration of Diabetes > 5 yrs	56 (63.6%)	12 (28.6%)	0.002
HbA1c > 7%	72 (81.8%)	18 (42.9%)	<0.001
Irregular Dental Visits	69 (78.4%)	21 (50.0%)	0.004
Xerostomia	60 (68.2%)	14 (33.3%)	0.001

Table 2 illustrated the relationship between various risk factors and the presence of dental caries in patients with Type 2 Diabetes Mellitus. A significant association was observed between poor oral hygiene and caries occurrence; 71.6% of patients with caries reported poor hygiene compared to only 30.9% in the caries-free group ($p<0.001$). This emphasized the importance of oral care practices in preventing caries.

Patients with a longer duration of diabetes (>5 years) were significantly more likely to have caries (63.6%) than those with a shorter duration (28.6%) ($p=0.002$), indicating the progressive nature of diabetic complications. Furthermore, poorly controlled diabetes, as reflected by HbA1c levels >7%, showed a strong correlation with dental caries. Among patients with caries, 81.8% had elevated HbA1c levels compared to 42.9% in those without caries ($p<0.001$), confirming the role of glycemic control in oral health.

Irregular dental visits also contributed to higher caries prevalence, with 78.4% of caries-positive patients reporting infrequent checkups versus 50% in the caries-free group ($p=0.004$). Finally, xerostomia (dry mouth), a common symptom among diabetics, was reported by 68.2% of the caries group, compared to 33.3% of the non-caries group ($p=0.001$), highlighting its contribution to caries development by reducing salivary protective functions.

DISCUSSION:

This cross-sectional study explored the prevalence and associated risk factors of dental caries among patients diagnosed with Type 2 Diabetes Mellitus (T2DM). The findings indicated a notably high prevalence of dental caries in this population, supporting previous literature that suggested a strong relationship between poor glycemic control and increased risk of oral health deterioration [8]. The results underscored the importance of integrating oral health assessments within the standard diabetes management protocol.

It was observed that a significant proportion of the study participants exhibited multiple carious lesions, particularly those with poor glycemic control, long-standing diabetes, and inadequate oral hygiene practices. The high caries prevalence among these patients might have been attributed to xerostomia, or dry mouth, commonly reported in diabetic individuals due to reduced salivary flow and altered salivary composition [9]. Saliva plays a crucial role in buffering oral pH and in the mechanical clearance of food particles and bacteria; hence, its reduction created a favorable environment for cariogenic bacterial growth.

Furthermore, a strong association was noted between dental caries and the duration of diabetes. Patients who had been living with T2DM for more than ten years showed a higher caries burden compared to those with a shorter duration of disease [10]. This trend may have reflected the cumulative effect of prolonged hyperglycemia on the oral cavity and its impact on host immune response and oral microbial balance. Additionally, the study revealed that patients with poorly controlled HbA1c levels were more susceptible to caries, highlighting the influence of metabolic dysregulation on oral health.

Dietary habits also played a significant role in caries development. Many patients with T2DM reported frequent snacking on carbohydrate-rich foods and sugary beverages, often as a part of mismanaged dietary plans or in response to hypoglycemic episodes [11]. This practice increased the frequency of acid attacks

on tooth enamel, leading to demineralization and carious lesions. The relationship between dietary behavior and dental caries suggested the need for interdisciplinary dietary counseling for diabetic patients.

Poor oral hygiene practices were another key factor contributing to caries prevalence [12]. A considerable number of participants admitted to brushing less than twice a day and rarely visiting dental clinics for preventive care. These behavioral patterns further exacerbated their vulnerability to caries and emphasized the importance of continuous oral hygiene education among diabetic patients.

Interestingly, a higher prevalence of dental caries was recorded among female participants, which might have been linked to hormonal fluctuations influencing salivary flow and oral microbial composition, although further research would be required to confirm this association [13]. Socioeconomic status also appeared to impact oral health, as patients from lower-income backgrounds reported limited access to dental services and health education.

In summary, this study reaffirmed that patients with Type 2 Diabetes Mellitus were at a heightened risk for dental caries due to a multifactorial interplay of systemic, behavioral, and lifestyle-related factors [14]. The findings emphasized the need for routine oral examinations and comprehensive dental care in diabetic management programs. Effective glycemic control, dietary regulation, improved oral hygiene, and timely dental interventions were recommended to mitigate the risk of dental caries in this vulnerable population [15].

CONCLUSION:

This cross-sectional study concluded that the prevalence of dental caries was significantly high among patients with Type 2 Diabetes Mellitus (T2DM). The findings highlighted that poor glycemic control, reduced salivary flow, longer duration of diabetes, and inadequate oral hygiene practices were major contributing risk factors. A notable association between increased HbA1c levels and the severity of dental caries was also observed, emphasizing the role of metabolic control in oral health outcomes. Furthermore, lifestyle habits such as infrequent dental visits and high carbohydrate intake further exacerbated the risk. These results underscored the importance of integrating oral health education and preventive strategies into the routine management of diabetic patients. The study emphasized that early identification and management of dental caries in T2DM patients could lead to improved quality of life and reduced complications. Regular dental assessments and interdisciplinary care approaches were recommended to mitigate the burden of oral diseases in this population.

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