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Dental Caries Prevalence in Patients with Type 2 Diabetes Mellitus in Tripoli, Libya: A Single-Center Study

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Abstract

***Background*:** Diabetes Mellitus (DM) presents significant public health issues, contributing to early mortality and complications. It encompasses Type 1, Type 2, gestational, and other specific forms, with Type 2 (T2DM) being associated with an increased risk of dental caries (DC). DC is an infection caused by bacteria such as Streptococcus mutans and lactobacilli, which feed on carbohydrates and produce acids that erode tooth minerals, leading to cavities. The level of glycated haemoglobin (HbA1c) reflects long-term glycemic control, with higher levels correlating with elevated risks of developing DC. ***Aim of the Work*:** The current study aimed to evaluate the prevalence of DC among Libyan patients with T2DM, including both those with controlled disease and those with uncontrolled disease**.** ***Material and Methods*:** This study was conducted on 440 Libyan patients with T2DM, collecting data on disease duration and complications from medical records. Dependent binary variables (DC) and independent variables such as age, gender, and glycemic control were analyzed using IBM SPSS version 21. ***Result*:** In a study of 440 Libyan individuals with T2DM, 56.8% presented with (DC), primarily affecting the 40-59 age group (46.2%). DC prevalence was higher among females (53.6%) than among males (46.4%). Among diabetic patients (DPs) with DC, 24.4% were classified as controlled, while 75.6% were uncontrolled. ***Conclusion*:** The findings indicate a higher prevalence of DC in Libyan DPs, particularly in those with uncontrolled T2DM, and this is more common in middle-aged populations and females.

Keywords: Libyan Patients, Prevalence, T2DM, DC, HbA1c, Controlled and Uncontrolled DPs.

INTRODUCTION

Dental diseases, such as carious lesions and periodontal disease, significantly affect systemic health, especially in conditions like DM and hypertension [1]. DM is a group of metabolic disorders affecting carbohydrate metabolism, causing underuse of glucose for energy and its excessive production, leading to hyperglycemia [2]. The International Diabetes Federation estimated 537 million people had diabetes in 2021, projected to grow to 643 million by 2030 and 783 million by 2045 [3]. DM poses a major public health challenge, with early death and numerous complications [4]. DM includes type 1 (T1DM), type 2 (T2DM), gestational, and other specific forms from various causes [5]. T2DM represents 90% to 95% of global diabetes cases, affecting an estimated 589 million to 828 million people worldwide [6]. The pathophysiology of T2DM involves two main defects: insulin resistance and inadequate insulin secretion [7]. Individuals with T2DM experience a higher incidence of DC and are at an elevated risk for caries development [8]. It remains a widespread disease globally, affecting 2.3 billion people with untreated caries in permanent teeth [9]. The term "dental caries," which was first recorded in 1634, originates from the Latin word "caries," meaning decay [10]. DC is an infection caused by dental plaque bacteria like Streptococcus mutans and Lactobacilli that colonize teeth, feed on carbohydrates, and produce acids. These acids dissolve tooth minerals, leading to DC if untreated [11]. Dental plaque comprises living and dead microorganisms, an extracellular polysaccharide matrix produced by these microorganisms, and components

derived from saliva and food debris [12]. DC remain a significant global health concern that affects individuals of all ages [13]. Women are more prone to DC than men, possibly due to differences in oral hygiene, hormones, or dental care access [14]. DC can occur on any surface of a tooth, including enamel, dentin, and cementum [15]. White spot lesions in the enamel, which manifest as tiny regions of underlying demineralization, are the initial signs of smooth surface caries [16]. DC can cause pain, infections, and poor aesthetics, adversely affecting oral health and quality of life [17]. Glycated haemoglobin (HbA1c) indicates long-term glycemic control by reflecting the past two to three months [18]. The American Diabetes Association and the International Diabetes Federation agree that HbA1c ≥ 6.5% diagnoses diabetes [19]. Elevated HbA1c levels and a prolonged DM duration are linked to a greater risk of developing DC [20]. While caries causes are well understood, further research is needed to identify high-risk patient groups and develop targeted preventive strategies based on these etiological factors [21].

Prevalence shows the number of people with a condition at a given time, helping estimate healthcare burden and interventions [22].

MATERIALS AND METHODS

This cross-sectional study was conducted on 440 diabetic patients at the Diabetes and Endocrine Gland Diseases Hospital in Tripoli, Libya, from October 2024 to September 2025. Ethics approval and consent were obtained before the study. Researchers documented patient demographics and medical histories, examining the oral cavity for the presence of DC according to World Health Organization guidelines. Data were analyzed using Microsoft Excel and SPSS® 21, with quantitative data summarized using mean and standard deviation, and qualitative data depicted through cross-tabulation tables, bar charts, and pie charts. A chi-square test assessed relationships between DC and variables such as age, gender, and glycemic control in patients with controlled (HbA1c ≤ 7%) and non-controlled (HbA1c > 7%) T2DM, considering a P value of less than 0.05 as statistically significant.

RESULT

Among 440 Libyans with T2DM, 250 (56.8%) had DC, and 190 (43.2%) did not (Fig. 1).

The participants in this study had an average age of 58.63 years (SD 10.62 years). Their ages ranged from 23 to 95 years. Four age groups were established: 20-39, 40-59, 60-79 and ≥ 80 years old (Fig.2). DC was most common in the 40-59 age group with 115 cases (46.2%, P=0.000), and least in the ≥80 group with 8 cases (3.2%). (Table 1).

This research involved 440 participants: 215 females (48.9%) and 225 males (51.1%) (Fig. 4). DC prevalence was 134 cases: 53.6% females and 46.4% males, mainly affecting females, p = 0.282 (Fig. 5). The male-to-female ratio was roughly 1:1.2.

The glycaemic state of the DPs in the full sample, based on HbA1c, was 105 cases (23.9%) controlled and 335 cases (76.1%) uncontrolled (Fig.6).

Among DPs with DC, 24.4% (61 cases) were controlled, while 75.6% (189 cases) were uncontrolled, showing no significant correlation (p = 0.762). (Table 2).

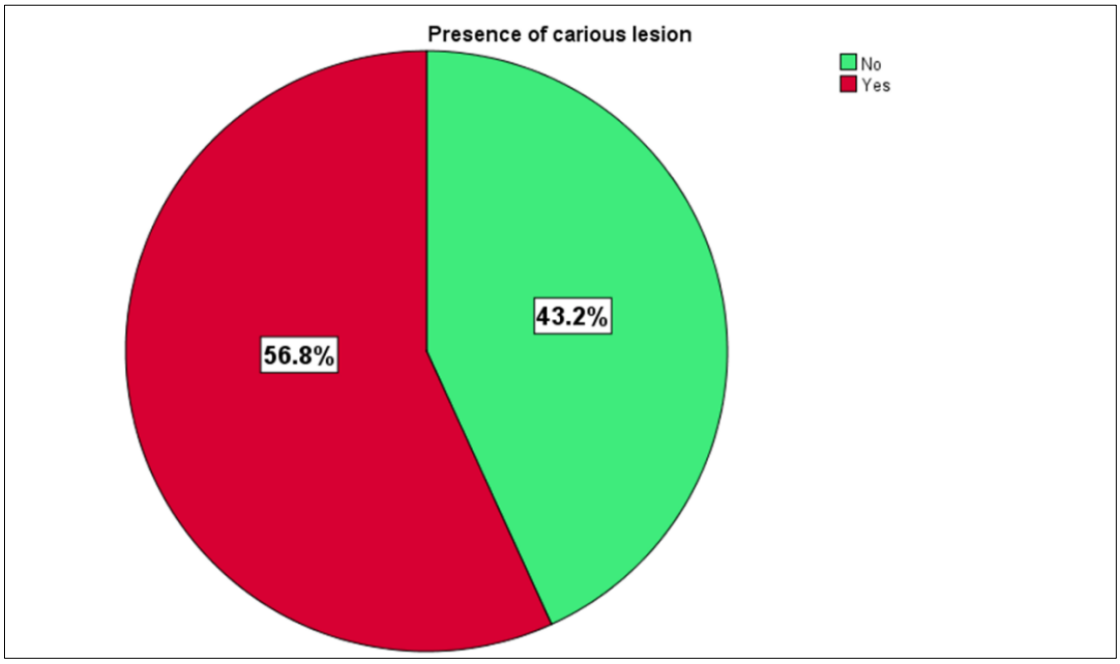

Figure 1: A pie chart that shows the dental caries prevalence in the entire study sample.

Table 1: Demonstrates a correlation between the prevalence of DC in various age groups

Age groups	Count & percentage	Presence of a DC		Total
		No	Yes	
20-39	Count	6	19	25
	Expected Count	10.8	14.2	25.0
	% within Age groups	24.0%	76.0%	100.0%
40-59	Count	82	115	197
	Expected Count	85.3	111.7	197.0
	% within Age groups	41.6%	58.4%	100.0%
60-79	Count	101	107	208
	Expected Count	90.0	118.0	208.0
	% within Age groups	48.6%	51.4%	100.0%
≥80	Count	1	8	9
	Expected Count	3.9	5.1	9.0
	% within Age groups	11.1%	88.9%	100.0%
Total	Count	190	249	439
	Expected Count	190.0	249.0	439.0
	% within Age groups	43.3%	56.7%	100.0%

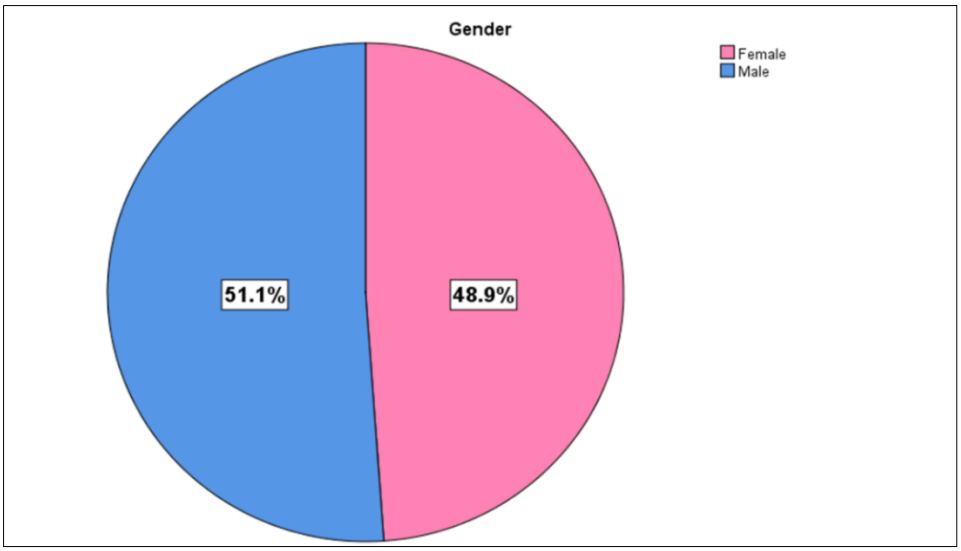

Figure 2: A bar graph shows the percentage distribution of the gender in the entire study sample.

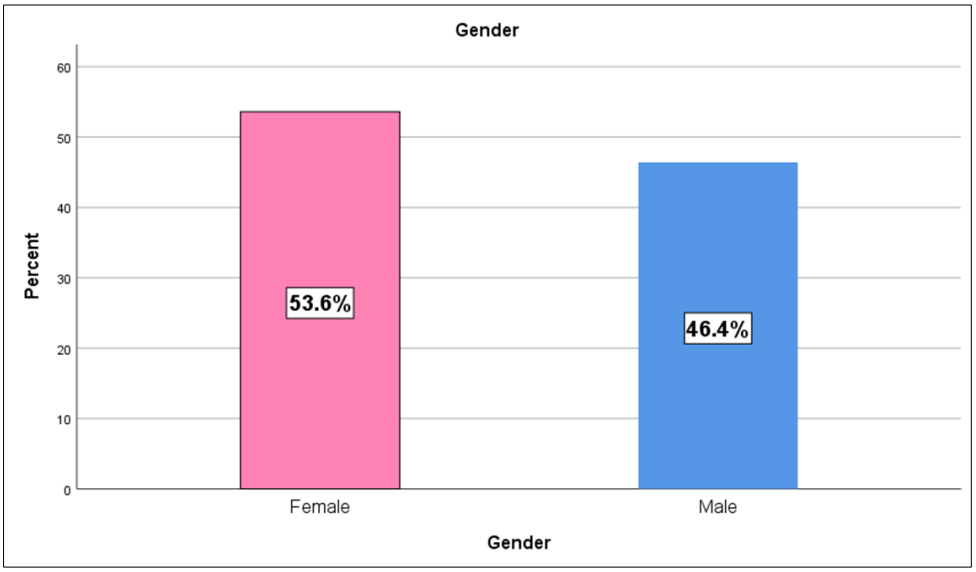

Figure 3: A bar graph illustrates an association between the percentage of DC in various age groups

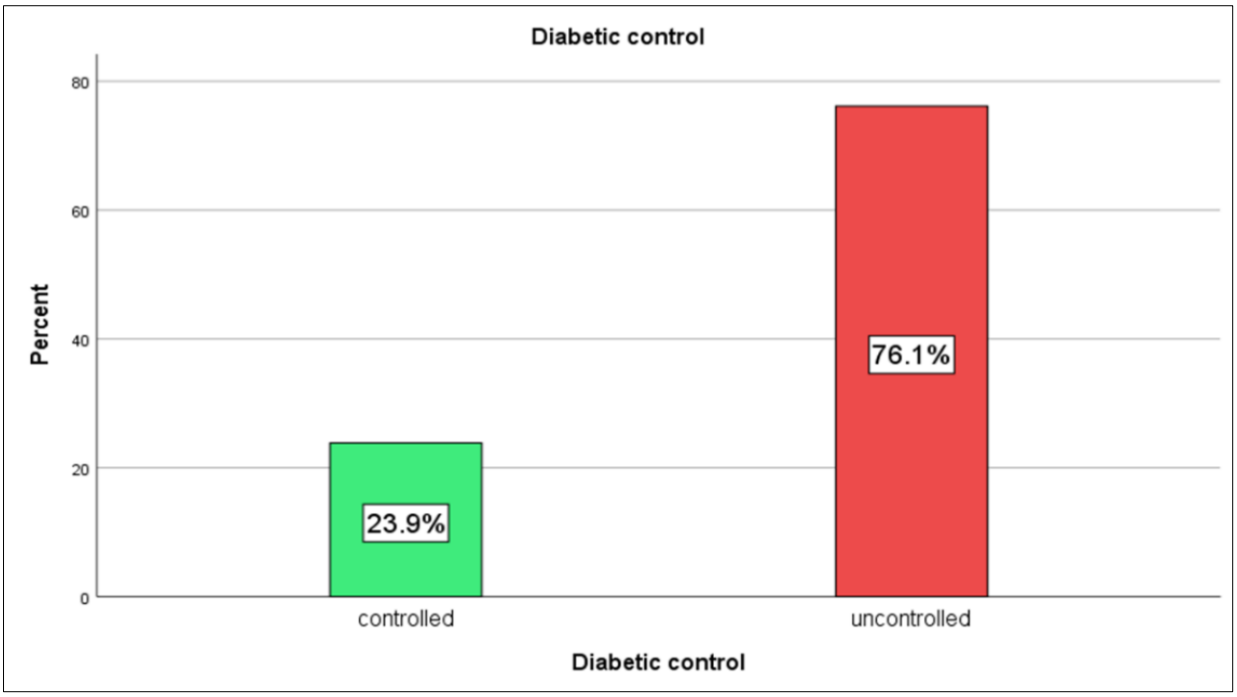

Figure 4: A bar graph displays the percentage distribution of controlled and uncontrolled DPs in the overall study sample.

Table 2: shows the frequency and percentage of glycemic states of the DPs associated with DC

Glycemic states		Presence of a DC		Total
		No	Yes	
controlled	Count	44	61	105
	Expected Count	45.3	59.7	105.0
	% within Diabetic control	41.9%	58.1%	100.0%
uncontrolled	Count	146	189	335
	Expected Count	144.7	190.3	335.0
	% within Diabetic control	43.6%	56.4%	100.0%
Total	Count	190	250	440
	Expected Count	190.0	250.0	440.0
	% within Diabetic control	43.2%	56.8%	100.0%

DISCUSSION

The current study aimed to assess the prevalence of DC among Libyan patients with T2DM, including both those with controlled and uncontrolled disease, who attended the Diabetes and Endocrinology Hospitals.

DC occurs more frequently and tends to be more severe in individuals with DM [23].

In the current study, the prevalence of DC was 56.8% in patients with T2DM. This finding is consistent with many previous studies that showed a higher prevalence of DC in T2DM patients compared to non-diabetic individuals [24]. The prevalence rate in this study was lower than the 70.1% reported by Thearawiboon and Rojanaworarit (2024) [25] among 438 individuals with T2DM, and also less than the rates reported in Africa: 86.63% in Egypt, 83.7% in Uganda, and 67.9% in Eritrea, showing a growing occurrence of DC across the continent. This higher prevalence could be attributable to the high incidence of xerostomia among DPs. Our findings are inconsistent with those of Moosa *et al*., (2020) [26], who observed that non-diabetics have a higher prevalence of DC than diabetics.

DC is the most common oral infectious lesion that affects people from early childhood to old age [27]. Our study found the 40-59 age group most affected by DC at 46.2%, aligning with Arubaku *et al*., (2023) [28], who reported middle-aged individuals [35-60], most affected. This contrasts with Mageshwari [29], who stated that T2DM and DC prevalence increase with age. In this study, participants aged ≥ 80 years with DC represented only 3.2% of the total. This low percentage likely occurs because many in this age group have lost most teeth, though DC can affect any age.

The available evidence is insufficient to establish differences in dental caries between males and females [36].

In the current study, the prevalence of DC was found to be 53.6% in females and 46.4% in males,

revealing a male-to-female ratio of 1:1.2. However, this difference is not statistically significant. This finding aligns with Shaw and Khan (2025) [14], indicating a higher prevalence of DC in diabetic females, contradicting Meyrema and Kedir (2018) [30], who stated that males are more likely to face DC hazards.

Higher HbA1c levels, indicating long-term high blood sugar, have been related to an increased risk of DC in patients with diabetes [31]. Among our entire study sample, 23.9% of the DPs were classified as having controlled diabetes (HbA1c ≤ 7%), while 76.1% were identified as having uncontrolled diabetes (HbA1c > 7%). On the other hand, an analysis of HbA1c levels among DPs with DC, 75.6% were classified as uncontrolled and 24.4% as controlled, with a p-value of 0.762 indicating no significant correlation. These findings were consistent with Manatunge *et al*., (2024) [32], who reported that poor glycemic control rendered DPs prone to having DC, as well as Mohan *et al*., (2022) [33], who found that greater HbA1c levels increased the possibility of DC in T2DM patients. They also agreed with Malvania (2016) [34], who observed that uncontrolled DPs had a considerably higher incidence of DC than controlled DPs; this could be associated with the higher occurrence of xerostomia due to salivary gland malfunction and the ageing process in DPs, particularly those with inadequate glycemic regulation. Our study results contrast with Lina *et al*., (1999) [35], who found no correlation between the prevalence of DC and insufficient glycemic control, which contradicts to many recent studies [61-67].

CONCLUSION

The results indicate a significantly higher prevalence of DC among Libyan DPs, particularly those with uncontrolled T2DM. This suggests that DC could serve as an important clinical oral marker for poor glycemic control in undiagnosed diabetes cases. Additionally, the findings reveal a greater incidence of DC in middle-aged individuals and females. Decreasing the prevalence of DC and implementing efficient preventive strategies are crucial for maintaining the ideal oral health of DPs. These measures not only lower the prevalence of DC but also enhance overall health, underscoring the importance of proactive oral health care.

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