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Research Paper

Statistical analysis of the way diabetes mellitus affects dental health in the governorates of salah al- din, nineveh, and kirkuk

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ABSTRACT

This study aimed at gaining more information on oral manifestations and familiarity with issues that are frequent with diabetes mellitus. Assessed data showed that diabetes mellitus is one of the most widespread chronic conditions characterized by an increased amount of sugar in the blood as a result of which a range of systemic complications affects the oral cavity. Clearly, there are several oral complications linked to diabetes such as xerostomia, periodontal disease, dental caries, gingivitis, increased risk of oral infections, burning mouth syndromes, taste disturbances, and slow healing of wounds. Probably, dental problems in patients with the diabetes mellitus are more than a big problem: they greatly improve their declining quality of life. Chronic oral complications, particularly those resulting from poor control of blood glucose can lessen the efficacy of the treatment, thus it is vital to prevent these complications and treat them properly.

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1. INTRODUCTION

Diabetes mellitus (DM) is a metabolic disease that is chronic in nature, and high blood sugar is the usual symptom, the disease occurs due to the lack of insulin production or adaptive resistance to insulin or a combination of both [1], [2], [3].

The persistence of hyperglycemia causes complications in peripheral areas of the body, on such being the oral cavity, so, the importance of tight control of sugar [4]. Some of the processes pertaining to diabetes with deformities known include the poor production, of collagen, infection, malnutrition, insensitive, and faulty WBC group. These are rules, which should be learned to understand and treat oral manifestations occurring in diabetes mellitus.

2. RELATED WORK

2.1. Oral Manifestations and Complications of DM

Diabetes mellitus (DM) presents a spectrum of oral manifestations and complications, including:

1. **Dry Mouth (Xerostomia):** Reduced saliva production.
2. **Tooth Decay:** Encompassing root caries.
3. **Periapical Lesions:** Issues around tooth apex.
4. **Gingivitis and Periodontal Disease:** Inflammation and disease of the gums and supporting structures.
5. **Oral Candidiasis:** Fungal infection.
6. **Burning Mouth (Glossodynia):** Sensation of oral burning.
7. **Altered Taste:** Distorted taste perception.
8. **Geographic Tongue:** Distinctive map-like patterns on the tongue.
9. **Coated and Fissured Tongue:** Tongue surface abnormalities.
10. **Oral Lichen Planus (OLP):** Inflammatory condition affecting oral mucous membranes.
11. **Recurrent Aphthous Stomatitis:** Recurring painful mouth ulcers.
12. **Increased Tendency to Infections:** Greater susceptibility to oral infections.
13. **Defective Wound Healing:** Impaired healing processes.

The degree and duration of hyperglycemia are generally correlated with the severity of problems related to diabetes [5]. It is essential to comprehend these oral symptoms in order to effectively manage and care for people with diabetes mellitus.

2.2. Xerostomia in Diabetes Mellitus

Individuals with diabetes commonly experience salivary dysfunction, resulting in reduced the flow of salivary and alterations in saliva composition. Globally, it is believed that between 34% and 51% of diabetic people have xerostomia. [1], [2] Xerostomia can result in a number of issues that can seriously affect a patient's quality of life, such as trouble swallowing, eating, and speaking. Adults with diabetes have been found in numerous studies to have decreased salivary function.

Although the exact cause is yet unknown, polyuria, autonomic neuropathies, microvascular abnormalities, and changes to the salivary glands' basement membranes are all possible contributing factors [2], [4], [6], [7], [8].

A noteworthy finding is the significant correlation between the glucose levels and xerostomia degree in saliva. Diabetics with poor glycemic control exhibit the highest levels of salivary dysfunction [4], [5]. Understanding and addressing xerostomia in diabetes are crucial not only for oral health but also for overall well-being and quality of life for individuals affected by this chronic metabolic condition

2.3. Dental Caries in Diabetes Mellitus

Dental caries is more likely to occur in diabetic patients and to reoccur. This vulnerability is caused by a decrease in saliva's ability to cleanse and buffer, an increase in salivary carbohydrates, and higher concentrations of lactobacilli, mutants streptococci, and oral yeasts. All of these illnesses work together to

increase the risk of tooth decay. Furthermore, persistent hyperglycemia can cause irreversible pulpitis, which can lead to pulp necrosis [1], [2], [5], [7], [8].

Research has shown that compared to people without diabetes, those with diabetes had a higher risk of developing radiolucent periapical lesions and apical periodontitis [1], [5], [9]. The increased prevalence of dental issues in diabetes underscores the importance of comprehensive oral care and regular dental check-ups for individuals managing this chronic metabolic condition.

2.4. Periodontal Disease in Diabetes Mellitus

The alveolar bone loss, gingivitis, and periodontitis are associated with poor glycemic control. The prevalence of periodontal disease is higher in individuals with type I and II diabetes, with diabetic patients experiencing a 59.6% incidence compared to 39% in non-diabetic individuals [3], [7], [8], [10].

Changes in the host defensive response (such as neutrophil dysfunction), subgingival microbiota, collagen structure and metabolism, vascularity, gingival crevicular fluid, and inheritance patterns are some of the reasons that account for the increased susceptibility to periodontal disorders in diabetes. Additionally, risk factors like poor oral hygiene, inadequate metabolic control, longer diabetes duration, and smoking contribute to the heightened vulnerability of diabetic patients to periodontal disease [3], [6], [7], [8].

Notably, research has demonstrated that diabetes and periodontal disease are mutually related. Diabetes is unfavorably impacted by periodontal disease, although blood glucose control is positively impacted by treating periodontal disease. Treatment-induced pathogen removal lowers inflammation, which in turn lowers insulin resistance and blood glucose. Therefore, there is a reciprocal association between diabetes and periodontal disease [1], [3], [5], [10].

Adult patients' teeth become mobile and eventually fall out due to periodontal disease. Thus, controlling blood sugar levels and treating periodontitis are essential for preventing tooth loss [11]. This highlights the interconnected nature of oral and systemic health in individuals with diabetes

2.5. Oral Infections in Diabetes Mellitus

Individuals diagnosed with diabetes mellitus are more vulnerable to oral infections caused by bacteria and fungi. A decrease in salivary flow rate and the lack of its antibacterial properties lead to the emergence of these illnesses. In addition, impaired defense systems and poor metabolic regulation are major factors in the development of infections [2], [7], [8].

One of the most prevalent opportunistic fungal diseases is oral candidiasis, which is becoming more prevalent. Compared to people with type 2 diabetes and non-diabetic subjects, diabetic patients, particularly those with type 1 diabetes, exhibit higher rates of candida colonization [2], [12]. Predisposing factors, such as xerostomia, contribute to higher fungal carriage, with candida-related lesions including denture stomatitis, angular cheilitis, and median rhomboid glossitis [2]. Patients with diabetes who smoke, wear dentures, have poor glycemic control, use steroids and broad-spectrum antibiotics, and employ these behaviors are more likely to have a candida infection [2], [7], [8].

2.6. Burning Mouth

Diabetic individuals who have burning or dysesthesia in their mouths may have poor glycemic control, altered oral mucosa metabolism, angiopathy, candida infection, or neuropathy [1]. Neuropathic pain impairs both physical and psychological processes and presents as burning, tingling, electric shock, or stabbing feelings. Anxiety, despair, and sleep disturbance are linked to these feelings [1], [4].

2.7. Taste Dysfunction

Patients with poorly controlled diabetes may experience taste dysfunction, characterized by abnormal taste perception or raised detection thresholds linked to neuropathy and salivary dysfunction. This sensory deficiency can make it difficult to follow a nutritious diet and result in ineffective glucose management [1], [2], [4], [7], [8].

2.8. Oral Mucosa Alterations

Diabetes may be linked to a number of changes in the oral mucosa, including geographic tongue, coated and fissured tongue, recurrent aphthous stomatitis, and some premalignant diseases like lichen planus. It is currently unclear how susceptible these patients are to changes in the oral cavity, while xerostomia, smoking, immunological abnormalities, inadequate diabetes control, and microcirculatory changes have all been linked [1]. Due to its autoimmune nature, oral lichen planus (OLP) is more common in people with type 1 diabetes, and severe hyperglycemia can affect a patient's immune response [2], [3], [4], [5], [6], [7], [8].

2.9. Poor Oral Wound Healing

One well-known risk associated with oral surgery for diabetic individuals is delayed healing of both soft and hard tissues. Delay in vascularization, reduced blood flow, hypoxia, innate immunity, growth factor production, and psychological stress are some of the factors that lead to prolonged wound healing [2], [3], [4], [5], [6], [7], [8], [9], [10], [11], [12], [13], [14]. For diabetes patients undergoing oral surgery, it is essential to comprehend and manage these aspects in order to improve their outcomes.

3. METHODOLOGY

3.1. Research Methodology: Electronic Questionnaire on Diabetes Complications

Our study involved the implementation of an electronic questionnaire across three governorates: Nineveh, Salah al-Din, and Kirkuk, as well as other regions. The primary objective was to investigate the complications arising from diabetes and provide substantiation for the previously mentioned complications [15].

3.2. Questionnaire Design

1. **Demographics:** Gathered information on age, gender, and residence.
2. **Diabetes History:** Explored the duration and type of diabetes.
3. **Complications Inquiry:** Asked about a number of consequences, including poor oral wound healing, xerostomia, dental caries, periodontal disease, oral infections, burning mouth, and taste dysfunction.
4. **Risk Factors:** Investigated lifestyle factors including smoking, oral hygiene practices, and overall metabolic control.

3.3. Data Collection

1. **Electronic Distribution:** Administered the questionnaire electronically to participants in the specified governorates.
2. **Informed Consent:** Ensured participants were informed about the study and obtained their consent before participation.

3.4. Data Analysis

1. **Quantitative Analysis:** Employed statistical methods to analyze the frequency and prevalence of reported complications.
2. **Correlation Analysis:** Explored potential correlations between complications, diabetes duration, and metabolic control.
3. **Comparative Analysis:** Compared complication rates across different governorates and demographic groups.

3.5. Ethical Considerations

1. **Confidentiality:** Ensured the privacy and confidentiality of participant data.
2. **Informed Consent:** Emphasized the voluntary nature of participation and provided detailed information about the study.

4. RESULTS AND DISCUSSION

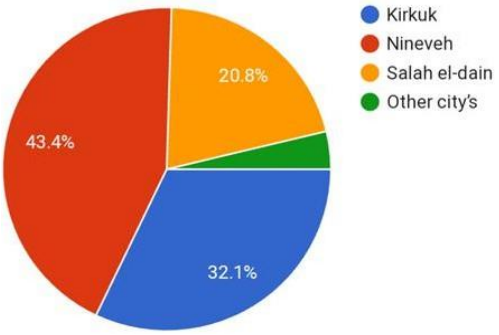
Result

4.1. Summary of Research Findings on Diabetes Complications

1. Address Distribution

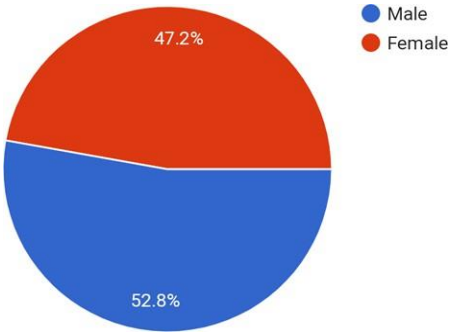
- Mainly conducted in three Iraqi governorates: Nineveh, Salah al-Din, and Kirkuk.

Majority of results obtained from Nineveh governorate, with additional data from Baghdad and Diyala governorates.



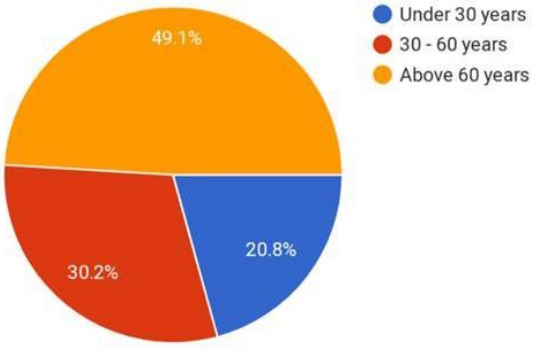
2. Gender and Diabetes

- Acknowledged the impact of sex and gender on diabetes incidence, symptoms, and response to therapy.
- Women generally experience greater longevity but may face worse health outcomes, particularly in the presence of obesity.
- Noted sex-gender differences in both type 1 and type 2 diabetes.

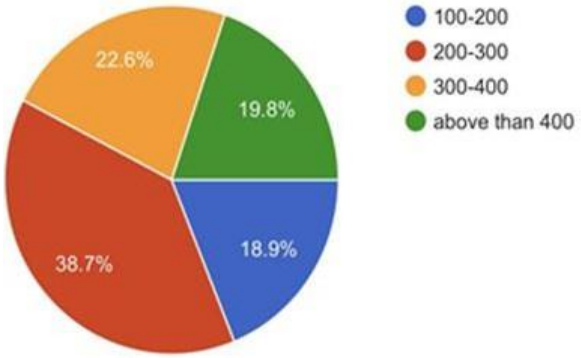


3. Age and Diabetes

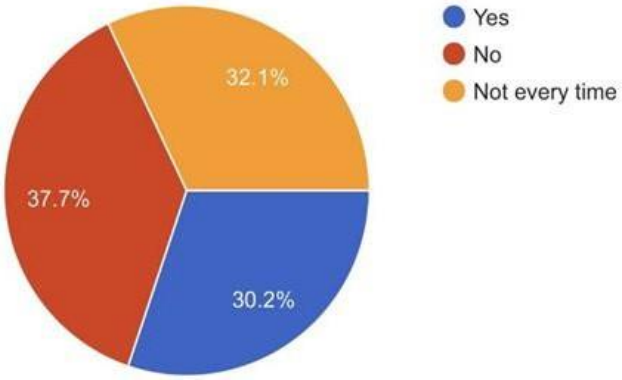
- Diabetes can occur at any age, but less common in those under 45 years old.
- Incidence recorded as 20% in those under 30 years, increasing to 30% for ages 30-60, and peaking at 49% for those over 60.



4. Brushing Habits

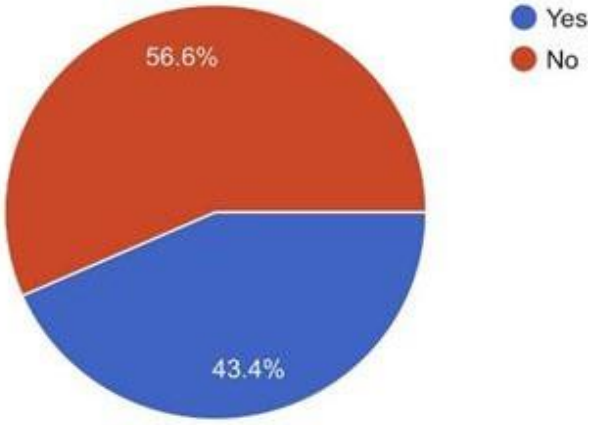


- Chart revealed varying commitment levels to regular teeth brushing among diabetics:
- 32% fairly necessary but not regular.
- 37% do not brush regularly.
- 30% committed to regular brushing.



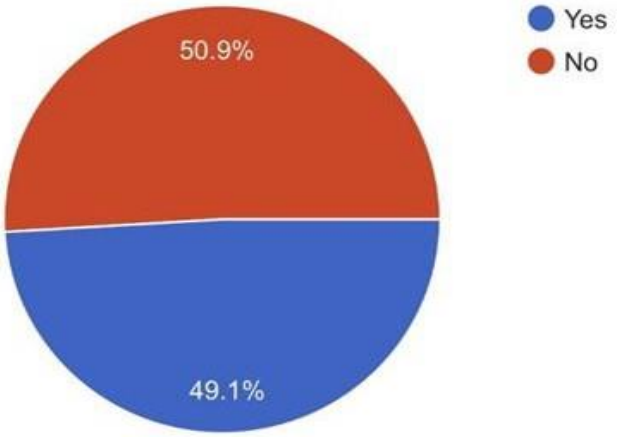
5. Smoking and Diabetes

- Highlighted the link between smoking and increased risk of type 2 diabetes.
- Found that more than 5 out of 10 diabetic patients were smokers.



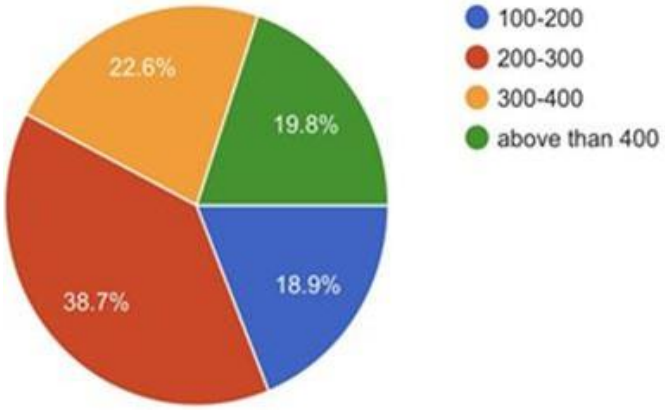
6. Xerostomia

- Xerostomia, a common condition in the general population, was found in 50% of diabetics in the study.



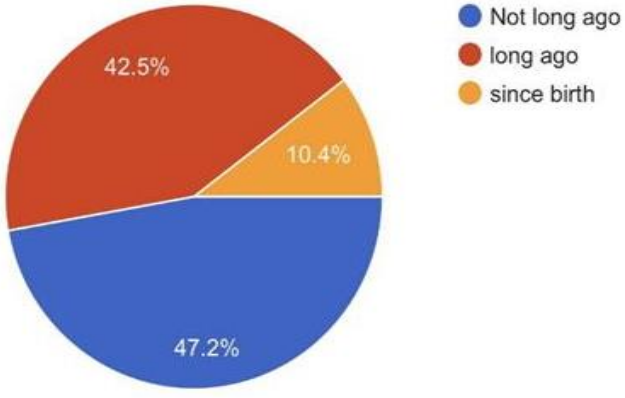
7. Blood Glucose Level (Random)

- Normal range is typically 125 mg/dL or lower; levels of 200 mg/dL or higher of ten indicate diabetes.



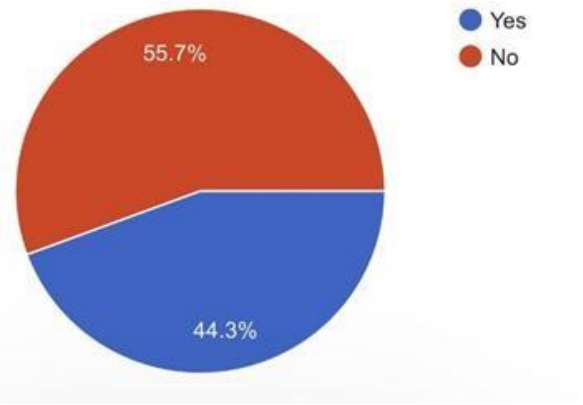
8. Diabetes Detection Period

- Results showed that 42% had long-term awareness of their diabetes, 47% discovered it recently through routine examinations, and 10% were diagnosed during the study or by chance.



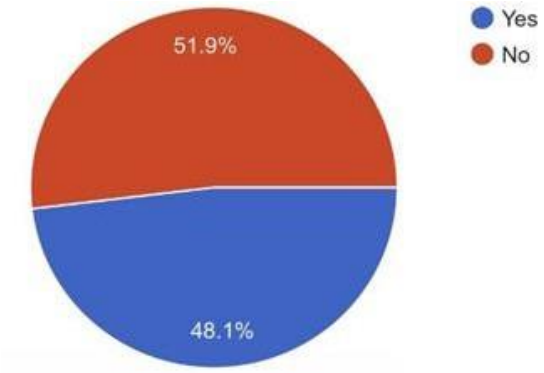
9. Doctor Monitoring

- Many patients, both type 1 and type 2, lacked a dedicated doctor to monitor their health condition, potentially leading to advanced symptoms due to health neglect.



10. Losing Teeth

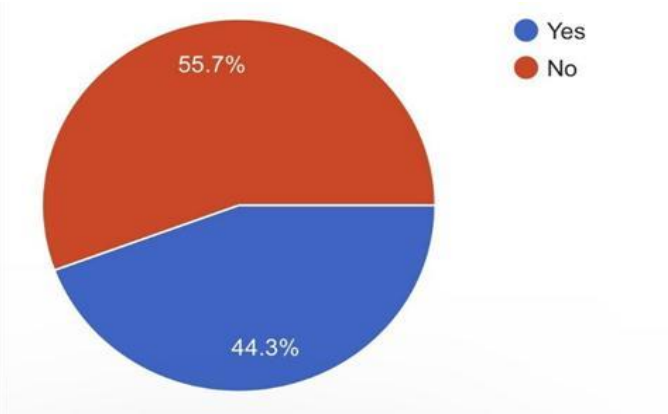
- Consistent with recent studies, 51% of diabetic patients had lost one or more teeth after developing type 2 diabetes, often due to periodontal diseases.



11. Pain and Oral Infections

- Identified a small percentage of patients with pathological injuries resulting from health neglect and high blood glucose levels, such as oral thrush (candidiasis).

These findings emphasize the multifaceted impact of diabetes on oral health and underscore the importance of comprehensive care, including regular monitoring, lifestyle modifications, and dental hygiene practices, to mitigate complications and improve overall well-being.



4.2. Discussion

Conclusions from the Study on Diabetes Mellitus and Oral Complications

1. Significant Oral Complications

- The study identified significant oral complications in individuals with Diabetes Mellitus (DM).

- Diabetics with oral manifestations exhibited notably higher levels of Fasting Blood Glucose (FBG) and Postprandial Blood Glucose (PPBG) compared to those without oral complications.

2. Association with Glycemic Control

- The presence of oral manifestations in DM patients indicated poorly controlled glycemic status.
- The study emphasized the importance of evaluating oral conditions as an indicator of long-term complications related to diabetes.

3. Microvascular and Macrovascular Complications

- Diabetics with oral diseases were found to have a higher prevalence of both microvascular and macrovascular complications associated with DM.
- This highlights the systemic impact of diabetes on various aspects of health, including the oral cavity.

4. Need for Evaluation

- The presence of oral manifestations in DM patients serves as a crucial signal for healthcare providers to assess and evaluate the overall health status of individuals with diabetes.
- Timely intervention and management are essential to prevent and address potential long-term complications.

5. Knowledge Gap and Health Education

- The study identified a general lack of knowledge regarding oral comorbidities among people with diabetes.
- There is a pressing need for appropriate health education and health promotion initiatives to enhance awareness and understanding of the relationship between diabetes and oral health.

6. Implications for Public Health

- The findings underscore the importance of integrating oral health assessments into routine diabetes care.
- Public health initiatives should focus on comprehensive education and promotion strategies to improve oral health outcomes for individuals managing diabetes.

5. CONCLUSION

The findings from this electronic questionnaire will contribute to a deeper understanding of diabetes-related complications in the specified regions, offering insights into the prevalence and potential correlations among different complications. This research aims to enhance knowledge for effective preventive strategies and management approaches tailored to the unique characteristics of these populations.

In conclusion, the study emphasizes the intricate relationship between diabetes and oral health, highlighting the need for proactive monitoring, early intervention, and educational efforts to enhance the overall well-being of individuals living with Diabetes Mellitus.

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Author Contributions Statement

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Dr. Reem Adeeb	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓
Zainab Mustafa Mahdi		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	
Musab A. Alsumaidaie	✓		✓		✓	✓		✓		✓		✓		✓
Amir A. Aljobory		✓		✓	✓		✓		✓		✓		✓	
Abd-Aladeem Al-luhaeby	✓		✓			✓		✓		✓		✓		✓

C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

Conflict of Interest Statement

The authors declare that there are no conflicts of interest regarding the publication of this paper.

Informed Consent

All participants were informed about the purpose of the study, and their voluntary consent was obtained prior to data collection.

Ethical Approval

The study was conducted in compliance with the ethical principles outlined in the Declaration of Helsinki and approved by the relevant institutional authorities.

Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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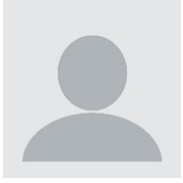
	**Zainab Mustafa Mahdi,** is affiliated with the College of Pharmacy, University of Tikrit, Iraq. Her research interests include clinical pharmacy, metabolic diseases, and the pharmacological aspects of chronic illnesses. She has experience in health-related data collection and analysis. Her work emphasizes the role of preventive healthcare and patient awareness in managing diabetes-related complications.
	**Musab A. Alsumaidaie,** is a researcher in the Department of Public Health, Iraq. His academic focus includes epidemiology, community health, and chronic disease prevention. He has participated in public health surveys and data-driven health assessments. His contributions support understanding the population-level impact of diabetes and associated oral health issues.

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