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KNOWLEDGE AND AWARENESS LEVEL OF PERIODONTAL DISEASES AMONG DIABETIC PATIENTS IN SAUDI ARABIA

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Abstract

background: Since diabetes mellitus and periodontal disease are the two most common and preventable non-communicable diseases in Saudi Arabia, there is currently little information available regarding how well the evidence linking the two conditions is applied in Saudi Arabian diabetic patients.

Objective: The study aimed to assess the knowledge and awareness of periodontal disease among diabetic patients in Saudi Arabia.

Methods: This is a cross-sectional study that was conducted between July - December 2024 in Saudi Arabia based on a structured questionnaire developed by the authors. The study plans to acquire individuals from around Saudi Arabia; a sample recruiting approach on Google Forms. Diabetic patients from Saudi Arabia were the inclusion criteria. Males and females over 18, diabetic patients in Saudi Arabia, individuals with or without knowledge of periodontal diseases, and those who consent to participate in the study and respond to the questionnaire. Male and female patients under the age of 18, non-Saudi diabetics, and non-diabetic patients were all excluded. According to a calculation based on prevalence estimation, a 95% confidence level, and a 5% acceptable error, the minimum target sample size is 384.

Results: The study found that a significant majority of respondents (84.2%) were aware of the link between gum health and diabetes, and 85.0% acknowledge that diabetes increases the risk of periodontal disease, indicating a solid foundational understanding. Moreover, 93.2% recognize the importance of routine dental check-ups for managing oral health. Despite these encouraging figures, concerning gaps in knowledge persist, with 39.9% uncertain about the diabetes-periodontal disease relationship and only 56.6% aware that diabetes can lead to such conditions. Additionally, about 79.5% understand the effects of diabetes on oral health, yet 64.2% have not been informed by their dentists about existing periodontal diseases, pointing to a communication gap. Knowledge levels vary, with 38.8% exhibiting moderate

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knowledge and 22.7% showing a low level of understanding. The awareness of periodontal risks is similarly uneven, with 43.4% reporting low awareness.

Conclusion: The study revealed significant gaps in the understanding of the relationship between diabetes mellitus and periodontal disease among diabetic patients in Saudi Arabia. While 84.2% of respondents are aware of the connection between gum health and diabetes, and 85.0% recognize that diabetes heightens the risk of periodontal disease, a notable 39.9% remain uncertain about this link, and only 56.6% are aware of how diabetes can lead to periodontal issues. This inconsistency in knowledge underscores the need for comprehensive educational initiatives targeting diabetic patients.

Keywords: knowledge, awareness, periodontal disease, diabetic, Saudi Arabia.

Introduction:

Periodontal disease, which encompasses gingivitis and periodontitis, is a common gum disease that affects the tissues surrounding and supporting teeth [1]. Diabetes mellitus (DM) is a metabolic condition that progresses over time and is typified by elevated blood glucose levels [2]. There is evidence in scientific literature linking diabetes mellitus with periodontal disorders [3]. According to data related to Saudi Arabia, the prevalence of diabetes mellitus (DM) was found to be 23.7% overall for both males and females living in rural and urban areas, with percentages for men and women being 26.2% and 21.5%, respectively [4]. Periodontal disease is considered the "sixth complication" after retinopathy, neuropathy, nephropathy, decreased wound healing, and macrovascular disease—the other five recognized complications of diabetes mellitus (DM) [5]. A cross-sectional study by Shimpi et al. (2018) conducted surveys among patients at a Wisconsin-based integrated medical-dental health-care organization to measure their awareness, knowledge, and behavior towards diabetes and periodontal disease. Only 51% of 946 patients were aware how periodontal disease affects blood sugar regulation [6]. In 2023, Alsharif et al. conducted a cross-sectional study in Asir, Saudi Arabia. To evaluate diabetic patients' understanding of the bidirectional association between diabetes, periodontal diseases, and risk factors. The study showed that individuals with diabetes had inadequate knowledge of the bidirectional association between diabetes and periodontal diseases [7]. A questionnaire-based study was published in 2023by Samah Ahmad et al. The study aimed to examine how diabetic patients' knowledge, attitude, and oral health practices affected primary care in Saudi Arabia in 2023. According to the study, people with diabetes have inadequate awareness of dental health and practice poor oral health practices [8]. Shoukree Benamar et al. (2024) accomplished a cross- sectional study to analyze diabetic patients' knowledge of the association between diabetes and periodontal disease, as well as the involvement of physicians in diabetic patients referred for dental treatment. The study found that diabetic patients have inadequate information regarding the association between diabetes and periodontal diseases. Health care professionals do not provide appropriate information to their patients about this critical relationship [9].

Understanding the bidirectional relationship between diabetes mellitus and periodontal disease provokes clinician management of both diseases [10]. Furthermore, adding more baseline information about both diseases and their bidirectional relationship will improve patients guidelines [11]. One of the reasons for non-adherence to lifestyle modifications among diabetic patients is a lack of information [12]. As reported, the 23% prevalence of diabetic patients in Saudi Arabia is the reason why the understanding of the bidirectional relationship between the two diseases is important [13].

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Objective:
This study aims to assess the level of knowledge and awareness of periodontal disease among diabetics in KSA.

Materials and Methods:

Study design:
This cross-sectional study was conducted between July 2024 – December 2024 in Saudi Arabia based on a structured questionnaire developed by the authors. To acquire individuals from around Saudi Arabia, a sample recruiting approach on Google Forms.

Inclusion and Exclusion Criteria:
Diabetic patients from Saudi Arabia met the inclusion criteria. Males and females over the age of 18, diabetic patients in Saudi Arabia, individuals with or without knowledge of periodontal diseases, and those who consent to participate in the study and respond to the questionnaire. Male and female patients under the age of 18, non-Saudi diabetics, and non-diabetic patients were all excluded.

Sample size:
Data collection started in July 2024 and ended in December 2024. A target sample of 384 patients was used for data collection (confidence level: 95%; margin of error: 5%). With a 95% confidence level, the sample size was calculated using the following formula: n = P(1-P) * Zα 2 / d 2.
Determined the sample size.
Z: 1.96 is the z-value for the chosen degree of confidence (1-a).
P: An approximate measure of knowledge prevalence.
Q is equal to (1 – 0.50) = 50%, or 0.50.
D: A maximum inaccuracy of 0.05 is permitted.
The lowest sample size that could be determined was therefore n = (1.96)2 x 0.50 x 0.50/ (0.05) 2 = 384.

Method for data collection and instrument (data collection technique and tools):

A structured questionnaire was used as a study tool. Our questionnaire was developed after a rigorous literature search and adopting various published studies of a similar kind [7,12–15]. The final version of the questionnaire consisted of 31 statements in three sections. Section 1 starts with briefly describing the study and the consent question. Section 2 includes demographic features such as age, gender, residential area, educational qualifications, and income. Section 3: Participants were asked about their knowledge and awareness of the relationship between gum health and diabetes, gum recovery compared to healthy people, routine dental checkups and whether they are necessary to treat gum disease, diabetes medications and their relationship to gum disease, and their desire to participate in dental education programs for individuals with diabetes.

Scoring system:

In all, 31 statements served to assess the participants' attitudes and degree of knowledge. 8 statements for demographics, 9 for knowledge, and 14 for awareness. One point is given for correct answers, and zero points are given for incorrect answers or “I don't know." For scoring, we utilized Likert scales

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(dichotomous, three-point, and quality scales). The maximum score was 26 and was divided as follows: The original Bloom's cut-off points, 80.0%–100.0%, 60.0%–79%, and 59.0%, The participants divided into three groups based on their scores.

knowledge score varied from 0 to 8 points and was classified into three levels as follows: those with a score of 5 or below (≤ 5) were classified as having a low level of knowledge, those with scores between 6 and 7 as having a moderate level of knowledge, and those with scores 8 as having a high level of knowledge.
Awareness scores varied from 1 to 18 points and were classified into three levels as follows: those with a score of 11 or below (≤ 11) were classified as having a low level of awareness, those with scores between 12 and 13 as having a moderate level of awareness, and those with scores 14 or above (≥14) as having a high level
of awareness.

Pilot test:
The simplicity and feasibility of this study were tested by distributing the questionnaire to 20 individuals. Their responses were excluded from the final data of the study.

Analyzes and entry method:
The data was collected and entered on a Windows computer using Microsoft Excel 2019. After that, the data was transferred to SPSS version 20 for statistical examination.

Results:

Table (1) displays various demographic parameters of the participants with a total number of (732). The age distribution indicates a predominantly middle-aged demographic, with the 41 to 50-year range being the most populous at 30.6%, followed closely by those aged 25 to 40, illustrating a significant representation of mature individuals. Gender representation skews towards females, comprising 56.3% of the sample, which may reflect the societal norms or recruitment strategies in this context. Furthermore, the overwhelming majority of participants (98.6%) are Saudi nationals, suggesting a limited diversity in nationality. The marital status data reveals that married individuals account for a substantial 65.8% of the population, potentially influencing the social support dynamics within the group. Employment status shows a notable segment of unemployed individuals at 23.2%, which may warrant further investigation into the labor market conditions. Educational attainment is high, with 54.1% holding a bachelor's degree, reflecting the importance placed on education in this region. Income distribution varies widely, with 26.5% earning less than 1000 Saudi riyals monthly, highlighting potential economic disparities within the sample.

Table (1): Sociodemographic characteristics of participants (n=732)

Parameter		***No.***	***Percent (%)***
Age (Mean: 38.2, STD:12.8)	25 years or less	190	26.0
	25 to 40	212	29.0
	41 to 50	224	30.6
	More than 50 years old	106	14.5

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Gender	Female	412	56.3
	Male	320	43.7
Nationality	Saudi	722	98.6
	Non-Saudi	10	1.4
Marital status	Single	228	31.1
	Married	482	65.8
	Divorced	8	1.1
	Widowed	14	1.9
Employment status	Student	146	19.9
	Employed	332	45.4
	Unemployed	170	23.2
	Retired	84	11.5
Residential region	Northern region	4	.5
	Southern region	548	74.9
	Center region	58	7.9
	Eastern region	14	1.9
	Western region	108	14.8
Educational level	Primary school	18	2.5
	Middle school	32	4.4
	High school	150	20.5
	Diploma	100	13.7
	Bachelor's degree	396	54.1
	Postgraduate degree	32	4.4
	Uneducated	4	.5
Monthly income	Less than 1000 Saudi riyal	194	26.5
	1000 – 5000	138	18.9
	5001 – 10000	120	16.4
	10001 – 15000	154	21.0
	More than 15000 Saudi riyal	126	17.2

As shown in figure 1, the data presented regarding the awareness of the relationship between Diabetes Mellitus and periodontal disease, specifically periodontitis, reveals significant insights into public knowledge on this crucial health issue. Out of a total of 732 respondents, a substantial 414 individuals, representing approximately 56.5%, acknowledged that a link exists between diabetes and periodontal disease. Conversely, 26 respondents, accounting for about 3.6%, indicated a lack of awareness, while 292 participants, or 39.9%, remained uncertain about this association.

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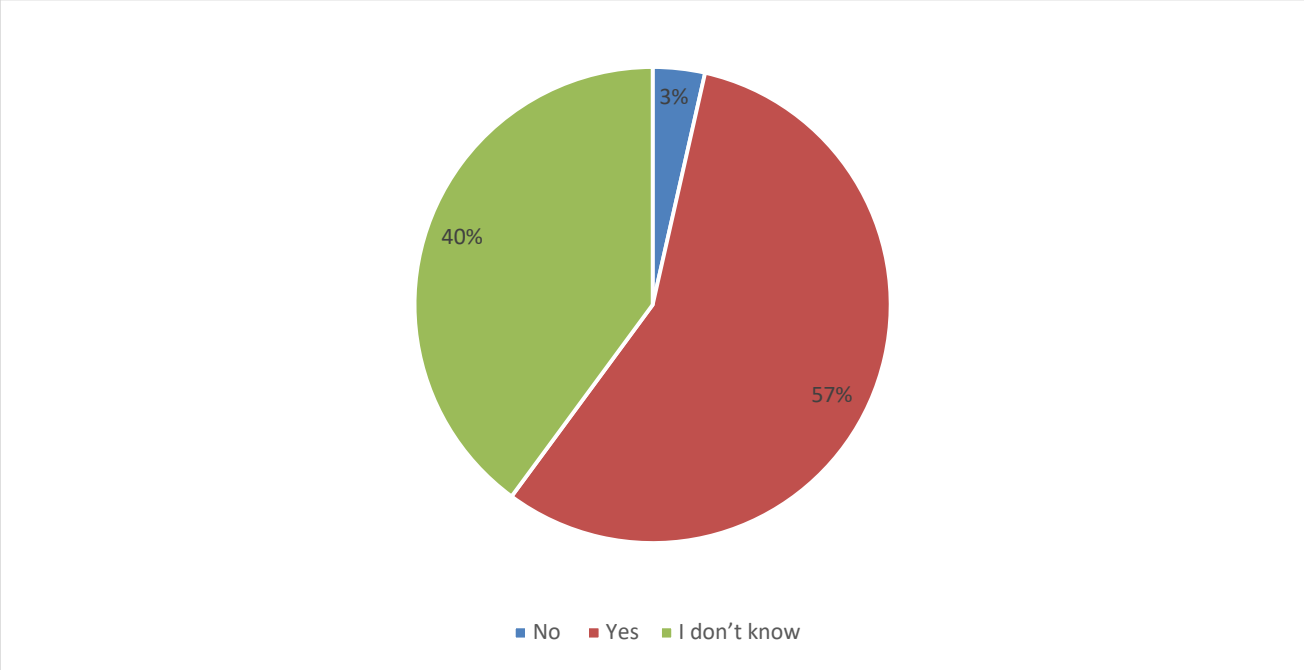
Figure (1): Illustrates the consequences of DM and relation to periodontal diseases according to participants.



As illustrated in table (2), The highlights insights regarding the knowledge level of periodontal diseases among diabetic patients, revealing both awareness and areas needing attention. A substantial majority of respondents (84.2%) recognize the connection between gum health and diabetes, an encouraging sign of understanding the interplay between these conditions. Similarly, 85.0% acknowledge that diabetes increases susceptibility to periodontal disease, underscoring the necessity for targeted dental care within this population. Most notably, an impressive 93.2% of participants believe in the importance of routine dental examinations for managing dental health. However, concerning gaps in knowledge remain, with 39.9% unsure about the relationship between diabetes and periodontal disease, and only 56.6% aware that diabetes can lead to such conditions. The primary sources of information appear to be family, friends, and healthcare providers, highlighting the role of personal networks in health education.

Table (2): Parameters related to knowledge level of periodontal diseases among diabetic patients (n=732).

Parameter		***No.***	***Percent (%)***
Do you believe there is a connection between gum health and diabetes?	No	116	15.8
	Yes	616	84.2
Are you aware that gum disease may be cured with dental treatment?	No	116	15.8
	Yes	616	84.2
Does having diabetes make you more susceptible to periodontal disease?	No	110	15.0
	Yes	622	85.0
	No	50	6.8

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Do you believe routine dental examinations and treatment are necessary for treating periodontal disease?	Yes	682	93.2
Were you informed that diabetes may cause premature tooth loss?	No	120	16.4
	Yes	612	83.6
Do you believe that, in comparison to people who do not have diabetes, your wound recovery is different?	No	36	4.9
	Yes	696	95.1
Did you know that one of the consequences of Diabetes Mellitus is periodontal disease, which also called periodontitis?	No	26	3.6
	Yes	414	56.6
	I don't know	292	39.9
Does smoking make people with diabetes more susceptible to gum disease?	No	22	3.0
	Yes	554	75.7
	I don't know	156	21.3
Informational source for individuals aware of the connection between gum disease and diabetes mellitus? (More than 1 choice) *	Family or friend	390	53.3
	Provider of healthcare.	212	28.9
	Books, periodicals, or newspapers.	198	27.0
	On the television	178	24.3
	I don't have a source	104	14.2

Results may overlap

As illustrated in figure (2), the data reveals a significant insight into perceptions regarding the impact of diabetes medications on the periodontium. Out of the total 732 respondents, a majority, comprising 32.8% (240 individuals), believe that diabetes medications do indeed affect periodontal health. Conversely, a notable 20.5% (150 respondents) expressed their disagreement with this assertion. Interestingly, a considerable portion of the population, accounting for 46.7% (342 individuals), remains uncertain about the effects, indicating a lack of clarity surrounding this issue.

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Figure (2): Illustrates the effect of DM medications on the periodontium according to participants.

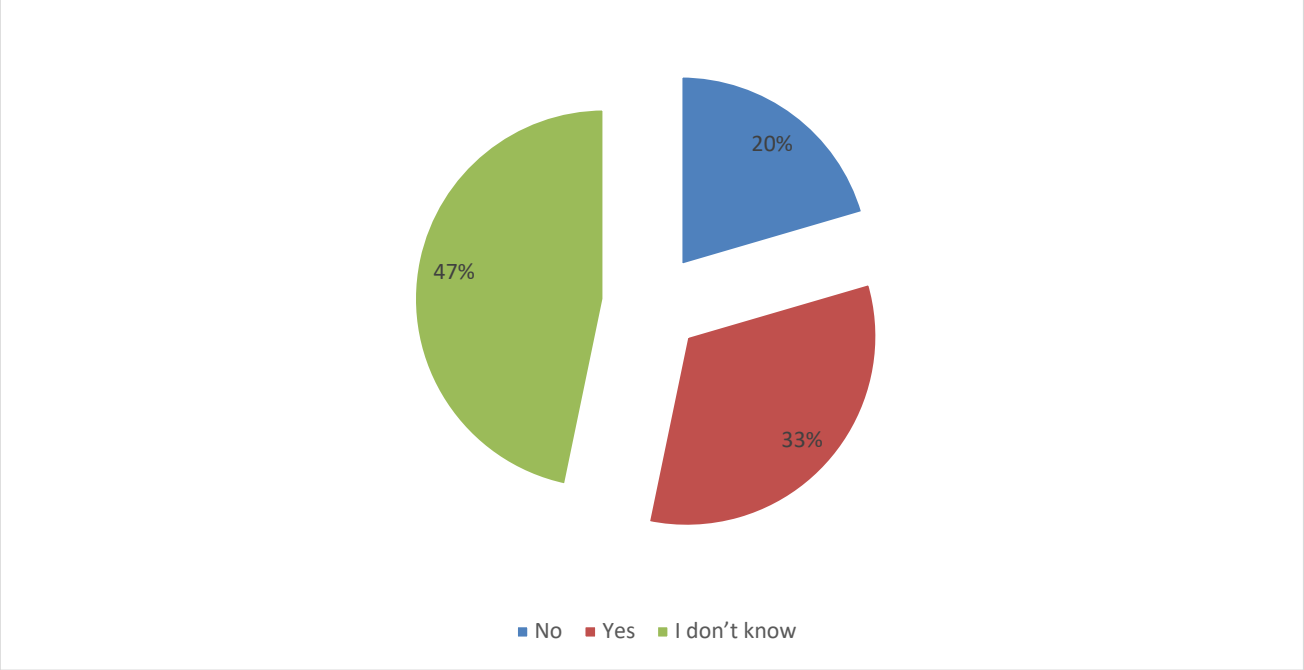

Table (3) reveals notable trends regarding participants' awareness of the implications of periodontal diseases among diabetic patients, revealing both a commendable level of awareness and significant areas for improvement. Approximately 79.5% of participants recognize that diabetes can affect oral health, yet a considerable 64.2% report that their dentist has not informed them of any existing periodontal disease, underscoring a potential communication gap in patient education. Furthermore, while 71.6% acknowledge the increased risk of gum disease in diabetic individuals, a striking 61.5% indicate that they have never been advised to enhance their dental hygiene due to their condition. The respondents express varying degrees of understanding regarding the relationship between diabetes and periodontal issues; only 21.6% rate their knowledge as "very high".

Table (3): participants' awareness level of periodontal diseases among diabetic patients (n=732).

Parameter		***No.***	***Percent (%)***
Are you aware that diabetes may influence your oral health?	No	40	5.5
	Yes	582	79.5
	I don't know	110	15.0
Has your dentist informed you that you suffer from a periodontal disease?	No	470	64.2
	Yes	262	35.8
Do you know that people with diabetes have a higher risk of developing gum disease?	No	64	8.7
	Yes	524	71.6
	I don't know	144	19.7
How well do you estimate you understand the connection between periodontal disease and diabetes?	Very high	158	21.6
	Above average	138	18.9
	Average	280	38.3

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	Below average	86	11.7
	Very low	70	9.6
Do you know that diabetes can impact the condition of the bone and gums that surround your teeth, causing periodontal diseases to worsen?	No	70	9.6
	Yes	520	71.0
	I don't know	142	19.4
Have you ever been advised to take additional care of your dental health because you have diabetes?	No	450	61.5
	Yes	282	38.5
Are you aware that diabetes can cause dry mouth?	No	84	11.5
	Yes	480	65.6
	I don't know	168	23.0
Are you sufficiently educated about diabetes?	No	342	46.7
	Yes	390	53.3
Do you believe that overall health may be impacted by diabetes?	No	32	4.4
	Yes	620	84.7
	I don't know	80	10.9
Do you believe that using diabetes medications affects the periodontium?	No	150	20.5
	Yes	240	32.8
	I don't know	342	46.7
Do you believe that individuals with diabetes need to have regular periodontal and dental exams and treatments?	No	52	7.1
	Yes	550	75.1
	I don't know	130	17.8
Do you believe that controlling diabetes can slow the advancement of periodontal disease?	No	42	5.7
	Yes	528	72.1
	I don't know	162	22.1
Do you think it's necessary for diabetic patients to get oral health education?	No	16	2.2
	Yes	634	86.6
	I don't know	82	11.2
If there were a dental education program for individuals with diabetes, would you be willing to take part in it?	No	76	10.4
	Yes	476	65.0
	I don't know	180	24.6

The data presented in Table 4 provides a comprehensive overview of the knowledge levels regarding periodontal diseases among diabetic patients, revealing a noteworthy distribution across three defined categories. Notably, a significant 38.8% of respondents exhibited moderate knowledge, closely followed by a high knowledge level at 38.5%. Conversely, a considerable proportion, 22.7%, demonstrated a low level of understanding, which is concerning given the documented interplay between diabetes and periodontal health.

Table (4): Shows knowledge level of periodontal diseases among diabetic patients score results.

	Frequency	**Percent**
High level of knowledge	282	38.5
Moderate knowledge	284	38.8
Low level of knowledge	166	22.7
Total	732	100.0

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The data presented in Table 5 highlights the awareness levels of periodontal diseases among diabetic patients, revealing critical insights into public health education gaps. Notably, a significant proportion of respondents, totaling 318 individuals or 43.4%, reported a low level of awareness concerning the risks and implications of periodontal disease. This finding is particularly concerning, considering the established connection between diabetes and oral health complications. Conversely, 264 patients (36.1%) demonstrated a high level of awareness, while only 150 individuals (20.5%) possessed a moderate understanding.

Table (5): Shows awareness level of periodontal diseases among diabetic patients score results.

	Frequency	**Percent**
High level of awareness	264	36.1
Moderate awareness	150	20.5
Low level of awareness	318	43.4
Total	732	100.0

Table (6) shows that knowledge level of periodontal diseases has statistically significant relation to age (P value=0.015), marital status (P value=0.0001), occupational status (P value=0.050), educational level (P value=0.026), and monthly income (P value =0.003). It also shows statistically insignificant relation to gender, nationality, and residential region.

Table (6): Relation between knowledge level of periodontal diseases and sociodemographic characteristics.

Parameters		***Knowledge level***		***Total (N=732)***	***P value****
		High knowledge	**Moderate or low**		
Gender	Female	168	244	412	0.155
		59.6%	54.2%	56.3%	
	Male	114	206	320	
		40.4%	45.8%	43.7%	
Age	25 years or less	58	132	190	0.015
		20.6%	29.3%	26.0%	
	25 to 40	88	124	212	
		31.2%	27.6%	29.0%	
	41 to 50	100	124	224	
		35.5%	27.6%	30.6%	
	More than 50 years old	36	70	106	
		12.8%	15.6%	14.5%	
Nationality	Saudi	280	442	722	0.225
		99.3%	98.2%	98.6%	
	Non-Saudi	2	8	10	
		0.7%	1.8%	1.4%	
Marital status	Single	64	164	228	0.0001
		22.7%	36.4%	31.1%	

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	Married	212	270	482	
		75.2%	60.0%	65.8%	
	Divorced	0	8	8	
		0.0%	1.8%	1.1%	
	Widowed	6	8	14	
		2.1%	1.8%	1.9%	
Occupational status	Student	50	96	146	0.050
		17.7%	21.3%	19.9%	
	Employed	146	186	332	
		51.8%	41.3%	45.4%	
	Unemployed	56	114	170	
		19.9%	25.3%	23.2%	
	Retired	30	54	84	
		10.6%	12.0%	11.5%	
Residential region	Northern region	2	2	4	0.471
		0.7%	0.4%	0.5%	
	Southern region	206	342	548	
		73.0%	76.0%	74.9%	
	Central region	26	32	58	
		9.2%	7.1%	7.9%	
	Eastern region	8	6	14	
		2.8%	1.3%	1.9%	
	Western region	40	68	108	
		14.2%	15.1%	14.8%	
Educational level	Primary school	6	12	18	0.026
		2.1%	2.7%	2.5%	
	Middle school	8	24	32	
		2.8%	5.3%	4.4%	
	High school	44	106	150	
		15.6%	23.6%	20.5%	
	Diploma	44	56	100	
		15.6%	12.4%	13.7%	
	Bachelor’s degree	168	228	396	
		59.6%	50.7%	54.1%	
	Postgraduate degree	12	20	32	
		4.3%	4.4%	4.4%	
	Uneducated	0	4	4	
		0.0%	0.9%	0.5%	
Income	Less than 1000 Saudi riyal	54	140	194	0.003
		19.1%	31.1%	26.5%	
	1000 – 5000	52	86	138	
		18.4%	19.1%	18.9%	
	5001 – 10000	48	72	120	
		17.0%	16.0%	16.4%	

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	10001 – 15000	74	80	154	
		26.2%	17.8%	21.0%	
	More than 15000 Saudi riyal	54	72	126	
		19.1%	16.0%	17.2%	

P value was considered significant if ≤ 0.05.

Table (7) shows that awareness level of periodontal diseases has statistically significant relation to gender (P value=0.004), age (P value=0.002), marital status (P value=0.0001), occupational status (P value=0.019), and monthly income (P value =0.025). It also shows statistically insignificant relation to nationality, residential region, and educational level.

Table (7): Awareness level of periodontal diseases in association with sociodemographic characteristics.

Parameters		***Awareness level***		***Total (N=732)***	***P value****
		High or moderate awareness	**Low level of awareness**		
Gender	Female	252	160	412	0.004
		60.9%	50.3%	56.3%	
	Male	162	158	320	
		39.1%	49.7%	43.7%	
Age	25 years or less	92	98	190	0.002
		22.2%	30.8%	26.0%	
	25 to 40	110	102	212	
		26.6%	32.1%	29.0%	
	41 to 50	142	82	224	
		34.3%	25.8%	30.6%	
	More than 50 years old	70	36	106	
		16.9%	11.3%	14.5%	
Nationality	Saudi	410	312	722	0.288
		99.0%	98.1%	98.6%	
	Non-Saudi	4	6	10	
		1.0%	1.9%	1.4%	
Marital status	Single	98	130	228	0.0001
		23.7%	40.9%	31.1%	
	Married	306	176	482	
		73.9%	55.3%	65.8%	
	Divorced	2	6	8	
		0.5%	1.9%	1.1%	
	Widowed	8	6	14	
		1.9%	1.9%	1.9%	
Occupational status	Student	78	68	146	0.019
		18.8%	21.4%	19.9%	

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	Employed	194	138	332	
		46.9%	43.4%	45.4%	
	Unemployed	84	86	170	
		20.3%	27.0%	23.2%	
	Retired	58	26	84	
		14.0%	8.2%	11.5%	
Residential region	Northern region	0	4	4	0.136
		0.0%	1.3%	0.5%	
	Southern region	314	234	548	
		75.8%	73.6%	74.9%	
	Central region	32	26	58	
		7.7%	8.2%	7.9%	
	Eastern region	10	4	14	
		2.4%	1.3%	1.9%	
	Western region	58	50	108	
		14.0%	15.7%	14.8%	
Educational level	Primary school	8	10	18	0.372
		1.9%	3.1%	2.5%	
	Middle school	14	18	32	
		3.4%	5.7%	4.4%	
	High school	82	68	150	
		19.8%	21.4%	20.5%	
	Diploma	64	36	100	
		15.5%	11.3%	13.7%	
	Bachelor's degree	228	168	396	
		55.1%	52.8%	54.1%	
	Postgraduate degree	16	16	32	
		3.9%	5.0%	4.4%	
	Uneducated	2	2	4	
		0.5%	0.6%	0.5%	
Income	Less than 1000 Saudi riyal	92	102	194	0.025
		22.2%	32.1%	26.5%	
	1000 – 5000	78	60	138	
		18.8%	18.9%	18.9%	
	5001 – 10000	72	48	120	
		17.4%	15.1%	16.4%	
	10001 – 15000	90	64	154	
		21.7%	20.1%	21.0%	
	More than 15000 Saudi riyal	82	44	126	
		19.8%	13.8%	17.2%	

P value was considered significant if ≤ 0.05.

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Discussion:

Diabetes is a persistent metabolic disorder characterized by hyperglycemia, which can result in lasting damage to various organs, such as the heart, eyes, kidneys, nerves, and the vascular system, including the periodontium. Its chronic nature leads to a notable increase in morbidity and mortality rates. Periodontitis is the most prevalent oral infection among humans and is the primary reason for tooth loss in adults. It has been recognized as the sixth complication of diabetes due to its associated signs and symptoms.[16] The connection between periodontal diseases and diabetes has gained recent attention from healthcare professionals, owing to significant evidence highlighting a bidirectional relationship; diabetes mellitus (DM) heightens the risk of periodontitis, while periodontal inflammation adversely affects glycemic control.[17] The current increase in diabetes cases is attributed not only to genetic factors but also to environmental influences resulting from lifestyle choices. The International Diabetes Federation aims to prevent Type 2 diabetes by managing modifiable risk factors, categorizing individuals into two target groups: those at high risk of developing Type 2 diabetes and the general population, akin to the approach for periodontal disease.[18] For effective management of both DM and periodontitis, the role of patients is crucial. A lack of knowledge is one of the factors contributing to non-adherence to lifestyle changes.[19] Thus we aimed in this study to assess the knowledge and awareness of periodontal disease among diabetic patients in Saudi Arabia.

In comparing our study findings with those of previous research, it is evident that there are both similarities and differences in awareness regarding the relationship between diabetes and periodontal disease. For instance, a study by Ummadisetty et al. reported that only 47.7% of diabetic patients recognized their susceptibility to gum diseases, a figure significantly lower than the 84.2% awareness rate found in our investigation regarding the link between gum health and diabetes [20]. Similarly, Rola Al Habashneh noted that only 48% of diabetic individuals acknowledged their heightened risk for gum diseases and oral health complications, aligning with the lower awareness levels observed in our comparative studies [21]. Moreover, our findings indicate that a concerning proportion of respondents (39.9%) remain uncertain about the diabetes-periodontal disease relationship, while Bahammam reported that merely 46.7% understood that high blood sugar levels correlate with increased gum problems [22]. Additionally, only 21.8% were knowledgeable about the impact of gum disease on blood sugar control in diabetic patients, a significant awareness gap reflected in our own results, where only 56.6% recognized diabetes's potential to exacerbate periodontal issues. Surprisingly, a controlled study conducted in Sweden revealed that 83% of diabetic patients were unaware of the link between periodontal disease and diabetes, which further underscores the insufficient awareness within this demographic compared to our findings [23]. In contrast, a cross-sectional study in the USA highlighted that diabetic individuals exhibit less concern for their oral health and are less likely to visit dental practitioners when compared to their non-diabetic counterparts, indicating a broader trend of neglect in oral health among diabetics [24]. A separate study involving 390 diabetic patients found that a mere 18.2% recognized the impact of diabetes on their oral health, exhibiting an alarming lack of awareness that is not as pronounced in our cohort [25]. Further supporting the variance in awareness, a community trial in Finland discovered that diabetic patients reported brushing their teeth less frequently than non-diabetics, indicating poor oral hygiene practices despite a clear understanding of health implications [26]. In the Arab world, a study in Jordan showed that approximately 48% of diabetic patients were cognizant of their vulnerability to periodontal diseases, albeit this figure is closer to our own finding of 43.4% low awareness regarding periodontal risks [27]. Additionally, survey conducted in Riyadh, Saudi Arabia, of female Saudi diabetic patients assessing their knowledge and attitude regarding oral health, it was found that the majority of these diabetic patients lacked knowledge about the relationship between diabetes and periodontal health [28]. A more recent study conducted in Abha, Saudi Arabia, illustrated

that there is deficiency in the awareness and dental health knowledge among diabetic patients. The results showed that 52.3% of the participants were not aware that diabetic patients are more susceptible to oral diseases [29]. In a complementary investigation conducted by Neel Shimpi et al. [30], findings highlighted a notable discrepancy in knowledge. While over 80% of participants accurately responded to inquiries about the symptoms of gum disease and the preventive role of oral health practices in diabetes management, only 51% acknowledged the impact of periodontal disease on blood sugar regulation. This suggests a significant gap in understanding the interrelationship between these two chronic conditions, similar to the gaps identified in our own study. Furthermore, the research indicated that respondents demonstrating "poor to fair" knowledge concerning the DM- periodontal disease association exhibited a strong inclination ($p < .0001$) to seek additional information about this relationship, emphasizing an opportunity for targeted educational efforts.

Conclusion:
In conclusion, this study highlights a significant level of awareness among diabetic patients in Saudi Arabia regarding the link between periodontal disease and diabetes; however, substantial knowledge gaps remain. While a high percentage of respondents recognized the connection between gum health and diabetes, a notable portion exhibited uncertainties regarding the bidirectional impacts of these two conditions. The findings emphasize the critical need for improved communication and education by healthcare professionals, particularly dentists, to bridge these gaps and enhance patient understanding. Addressing these educational deficiencies is crucial for fostering better lifestyle adherence, optimizing diabetes management, and ultimately improving oral health outcomes for individuals managing both diabetes and periodontal disease. The results suggest that tailored interventions and comprehensive health education are necessary to empower patients and mitigate risks associated with periodontal complications in diabetic individuals.

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Ethical approval:
After fully explaining the study and emphasizing that participation is optional, each participant gave their informed consent. The information gathered was safely stored and utilized exclusively for study.

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The authors declare no conflict of interest.

Informed consent:
Written informed consent was acquired from each individual study participant.

Data and materials availability:
All data associated with this study are present in the paper.

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