Original Article

Awareness and practice of oral complications due to diabetes mellitus among diabetes patients at Chengalpattu district, India: A cross-sectional study

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Abstract
Background: There is a sound pathophysiological framework for addressing oral health issues in general healthcare given the prevalence of oral diseases and their link to diabetes. However, many individuals with diabetes are unaware of the link between their disease and their oral condition, as well as the fact that they have a higher chance of experiencing a variety of difficulties with their oral health. The goal of this research was to assess the knowledge about oral complications due to diabetes mellitus among diabetes patients in Chengalpattu district, India.
Methods: A cross-sectional study including 470 diabetes patients was carried out over a period of 4 months from February to May 2022. Descriptive statistics and multivariate logistic regression analyses were performed using the Statistical Package for the Social Sciences (SPSS) version 21. $P < 0.05$ was considered statistically significant.
Results: Many of the study subjects were not aware of the relationship between oral problems and diabetes. The knowledge about oral complications of diabetes was limited to awareness about dental caries (28.9%), periodontal disease (35.1%), xerostomia (51.8%), oral candidiasis (15.7%), and oral cancer (9.6%). Education and the duration of time after a diabetes diagnosis were the two most crucial predictors of awareness of the complications.
Conclusion: Regarding the oral problems of diabetes, there is a dearth of knowledge, and this agreement is primarily associated with education and the duration of time from diabetes diagnosis.
Keywords: Diabetes mellitus, Oral complications, Knowledge, Awareness

Introduction

A complex metabolic disorder is known as diabetes mellitus, which affects how proteins, lipids, and carbohydrates are metabolized and are categorized by the incapacity of the organ to resist or produce insulin.[1] The World Health Organisation (WHO) has designated diabetes mellitus an epidemic since it has been spreading at such an alarming rate over the world.[2] Additionally, diabetes was identified as the nation's top contributor to disability-adjusted life years (DALYs, a metric that quantifies the sum of potential life lost due to premature mortality and years of productive life lost due to disability).[3]

About 4.22 billion people worldwide, or 8.3 percent of the world's population, were estimated to have diabetes mellitus in 2016. According to the WHO, diabetes causes approximately 1.5 fatalities worldwide on average each year, while complications related to diabetes cause another 2.2 million deaths.[4] The number of adults with diabetes mellitus was recently estimated at 463 million, and by the year 2045, it is anticipated that there will be 700 million. In the South-East Asian region, India has the highest number of adults with diabetes (72.9 million), and by 2045, that figure is projected to reach 134 million.[5]

The most common systemic issues that can result from diabetes mellitus include diabetic microangiopathies, atherosclerosis, diabetic ulcers, carpal tunnel syndrome, glaucoma, diabetic neuropathies, cataracts, oral or dermatological infections, and parodontopathies.[6] Hyposalivation, the altered chemical composition of

saliva, impaired immune function, and dietary changes that cause oral problems all contribute to hyperglycaemia, which alters the normal oral flora and raises the risk of infection. Hyperglycaemia also interferes with the healing of damaged mucous membranes. Numerous oral complications of diabetes, including periodontitis, dry mouth, root caries, candidiasis, and oral cancer, are reported in epidemiological research. Diabetes and periodontitis, which is frequently referred to as the sixth complication of diabetes, are linked by certain pathways.[7]

However, the link between diabetes and dental health is frequently unknown to people with diabetes, as well as the fact that they have a higher chance of experiencing a variety of difficulties with their oral health. Diabetes patients still have a poor understanding of and neglect oral health as a global health issue. There is a strong pathophysiological framework for addressing oral health issues in general healthcare given the prevalence of dental disorders and their link to diabetes. The study sought to evaluate patients' awareness of oral complications caused by diabetes mellitus in Chengalpattu district, India, in order to address the knowledge gap about oral complications and the risk it poses.

Methods

Study design and study settings

A descriptive cross-sectional study was conducted to assess the knowledge and practice of oral complications due to diabetes, over a period of 4 months from February to May 2022 among 470 diabetic patients. To ensure that both patients from the public and private zones participated in the research, participants were chosen from a private dental college, private diabetic clinics, and primary health centers in Chengalpattu, India. The guidelines of the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE initiative) served as the foundation for this study's development.

Eligibility criteria

The study included individuals who had a history of diabetes mellitus. The selected participants had a confirmed diagnosis of diabetes and were under treatment with frequent recall visits. All the participants with well-controlled diabetes (HbA1c < 8) were included in the study. Participants who refused to participate in the study were excluded from participating in the research. All study participants provided signed, informed permission prior to being enrolled.

Sample size estimation

The power of the study was kept at 80%, 5% alpha error with a 95% confidence level, and the estimated sample size was 470 using G*Power software version 3.0. The required sample was recruited using convenience sampling.

Research instrument

The fixed-choice questionnaire was created after a thorough analysis of the current research and anonymity was maintained. A pilot study involving 20 diabetic patients showed that it was feasible, and the questionnaire's internal consistency was determined to be satisfactory (Cronbach's alpha = 0.81). The questionnaire included the following information grouped under 4 domains:

i. Demographic information (age, gender, education, area of residence (rural or urban), type of diabetes centers);
ii. Medical information (the duration of time from diabetes diagnosis);
iii. Knowledge of the oral complications of diabetes, such as dental caries, periodontal diseases, xerostomia, oral candidiasis, and oral cancer;
iv. Experience with periodontal disease and xerostomia, two oral problems of diabetes, both in the present and in the past.

The researcher verbally posed the questions in Tamil (the regional spoken dialect) to the patients who had difficulty reading and writing and completed the form in their presence. For statistical analysis, responses to questions about knowledge of the oral complications of diabetes were dichotomized as either "Yes" or "No."

Statistical analysis

The data were analyzed by using the Statistical Package for the Social Sciences version 21.0 (SPSS Inc., Chicago, IL, USA) for both descriptive and inferential statistics. Univariate statistical analysis of differences between subgroups was performed using the chi-square test. Stepwise logistic regression analysis was used to determine the association between knowledge of oral complications and diabetes. The value of $P < 0.05$ was considered significant.

Results

Table 1 describes the details of the population based on demography and medical status. A total of 460 study participants completed the study, of which 280 (59.6%) were female and 190 (40.4%) were male. The study population was composed of 89 (19%) participants in the < 30 age category, 127 (27%) in the 30–50 category, and 254 (54%) in the > 50 categories. About 59.6% of the sample group had completed their undergraduate studies at the secondary level. The majority of participants (40.4%) reported that they had been diagnosed with diabetes for 5–9 years.

The relationship between diabetes and oral complications was unrecognized by a significant number of participants. Regarding the knowledge and awareness of oral complications associated with diabetes among diabetic patients, 28.9% were aware of their higher risk for dental caries, 35.1% for periodontal disease, 51.8% for

Table 1. Distribution of the participants according to demography and medical status

Variables	No. (%)
Gender	
Male	280 (59.6)
Female	190 (40.4)
Age (y)	
<30	89 (19)
30–50	127 (27)
>50	254 (54)
Education	
Primary (School)	157 (33.4)
Secondary (undergraduate)	280 (59.6)
Tertiary (post-graduate)	34 (7.2)
Place of residence	
Rural	325 (69.1)
Urban	145 (30.9)
Years diagnosed with diabetes	
<5 years	153 (32.6)
5–9 years	190 (40.4)
10+years	127 (27)
Type of diabetes clinic	
Public	185 (39.3)
Private	285 (60.6)

Table 2. Distribution based on awareness of oral complications and oral complications experience

Variables	Responses		
	Yes	No	Don't know
Caries	136 (28.9%)	243 (51.8%)	91 (19.3%)
Periodontal disease	166 (35.1%)	211 (44.8%)	94 (20.1%)
Xerostomia	243 (51.8%)	237 (29.1%)	90 (19.1%)
Oral candidiasis	74 (15.7%)	334 (71.1%)	62 (13.2%)
Oral cancer	45 (9.6%)	212 (45.1%)	213 (45.3%)

xerostomia, 15.7% for oral candidiasis, and 9.6% for oral cancer (Table 2).

According to Table 3, knowledge of at least one oral complication of diabetes was significantly predicted (P < 0.05) by age, gender, education level, years since diabetes diagnosis, and type of diabetes treatment clinic. Age was not related to knowledge about dental caries, periodontal diseases, xerostomia, or oral candidiasis (P value 0.405, 0.502, 0.130, 0.914, respectively), but was associated with knowledge about oral cancer (P = 0.000). There was no evidence that knowledge of any oral problems of diabetes was related to residence. Of these, education, and duration since diagnosis of diabetes, were significantly correlated with knowledge about all three oral problems analysed.

Multivariate logistic regression analysis revealed that knowledge of at least one systemic complication of diabetes among diabetic patients was significantly predicted by factors including education and the duration since diagnosis of diabetes (P = 0.005) (Table 4). Being diagnosed with diabetes for more than ten years before the study and having only completed secondary school were both significant predictors for knowledge regarding the oral complications of diabetes. With higher levels of education, there was a higher chance that people would be aware of the increased risk of oral complications.

Discussion

The incidence of diabetes mellitus has increased dramatically over the previous 20 years with 1.6 million cases being identified each year in India. Elderly people are more likely than younger people to get diabetes, and people with diabetes mellitus have a two- to four-fold higher risk of acquiring systemic and oral complications.[8] The current study was conducted with the aim of assessing knowledge about the oral problems owing to diabetes mellitus among diabetes patients since it is vital for diabetes patients to have thorough understanding about the risk of oral disorders due to diabetes.

The study's results showed that the majority of participants were unaware of the link between the risk of dental issues and diabetes. Diabetes patients seem unable to understand how their risk for several oral health complications is elevated. In accordance with Boyer et al study evidence, the frequency of knowledge about the increased risk of caries (28.9%), periodontal problems (35.1%), xerostomia (51.8%), oral candidiasis (15.7%), and oral cancer (9.6%) is found in the present study findings.[9] About 35.1% of diabetic patients listed periodontitis as a potential consequence of diabetes, which is consistent with the findings of the majority of the studies analyzed in Poudel and colleagues' systematic review.[10] In line with Paurobally et al, over half of the subjects (50.6%) had periodontal disease.[11] A growing corpus of research indicates a bidirectional association between diabetes and periodontal disease.[12] Periodontitis is more likely to develop in those with diabetes[9], and periodontal inflammation impairs glycemic control.[13]

According to the study's findings, which are consistent with those of Eldarrat, 50.2% of diabetic patients had xerostomia, and 51.8% were unaware of the detrimental effect of xerostomia due to diabetes on their oral health. It is clear that the most typical oral symptom of diabetes is a marked decrease in salivary flow, which results in xerostomia.[2] The administration of specific drugs in the management of diabetes may provide an explanation for the connection between knowledge and the experience of xerostomia.[14] It is essential to educate diabetic patients about the decrease in salivary flow and make them aware of the reduction in salivary flow. Diabetic patients should also be referred to a dentist for an evaluation.

Table 3. Factors related to knowledge about oral complications of diabetes

Variables	Dental caries			Periodontal diseases			Xerostomia			Oral candidiasis			Oral cancer		
	Yes	No	P value	Yes	No	P value	Yes	No	P value	Yes	No	P value	Yes	No	P value
Gender			0.011*			0.149			0.905			0.716			0.319
Male	25.9	74.1		36.2	63.8		52.6	47.4		23.7	76.3		25.3	74.7	
Female	30.9	69.1		37.7	62.3		51.1	48.9		19.1	80.6		27.2	72.8	
Age (y)			0.405			0.502			0.130			0.914			
<30	47.2	52.8		38.9	61.1		52.8	47.2		19.4	80.6		36.1	63.9	
30–50	37.3	62.7		37.3	62.7		56.7	43.3		14.9	85.1		17.9	82.1	0.000*
>50	26.2	73.8		40.0	60.0		52.7	47.3		16.5	83.5		18.1	81.9	
Education			0.016*			0.041*			0.000*			0.000*			0.000*
Primary (School)	30.5	69.5		40.5	59.5		53.2	46.8		26.9	83.1		28.7	71.3	
Secondary (undergraduate)	30.7	69.3		38.1	61.9		54.1	45.9		46.9	53.1		27.1	72.9	
Tertiary (postgraduate)	32.4	67.6		44.1	55.9		70.6	29.4		87.5	12.5		33.1	66.9	
Place of residence			0.810			0.311			0.335			0.32			0.078
Rural	27.3	72.7		35.9	64.1		48.1	51.9		23.8	76.2		27.8	72.2	
Urban	30.8	69.2		38.5	61.5		56.0	44.0		31.8	68.2		24.6	75.4	
Years diagnosed with diabetes			0.013*			0.000*			0.014*			0.029*			0.002*
<5 years	23.6	76.4		27.6	72.4		44.1	55.9		27.6	72.4		33.5	66.5	
9–5 years	29.4	70.6		39.2	60.8		54.2	45.8		17.6	82.4		20.9	79.1	
≥10 years	32.7	67.3		43.8	56.2		56.9	43.1		19.0	81.0		23.2	76.8	
Type of diabetes clinic															
Public	28.3	71.7		37.7	62.3	0.093	51.6	48.4	0.999	22.8	77.2		21.9	78.1	0.020*
Private	34.2	65.8	0.605	31.6	68.4		52.6	47.4	0.614	13.2	86.8		30.1	69.9	

Data are expressed as percent.
Chi-square test; *P<0.05.

Table 4. Predictors for various oral complications (dependent variables) using Logistic regression analysis

Factors	Dental caries OR (95% CI)	Periodontal diseases OR (95% CI)	Xerostomia OR (95% CI)	Oral candidiasis OR (95% CI)	Oral cancer OR (95% CI)
Education					
Primary (School)	1.0	1.0	1.0	1.0	1.0
Secondary (undergraduate)	2.3 (1.20–4.40)	2.4 (1.32–4.22)	3.1 (1.76–5.31)	3.2 (1.96–5.30)	2.6 (1.55–4.24)
Tertiary (postgraduate)	1.5 (0.56–4.25)	2.7 (1.11–6.34)	6.2 (2.43–15.74)	5.9 (3.27–10.64)	4.1 (2.29–7.43)
Years diagnosed with diabetes					
<5 years	1.0	1.0	1.0	1.0	1.0
5–9 years	1.3 (0.81–2.13)	1.6 (1.06–2.54)	1.9 (1.01–2.13)	2.2 (1.28–3.64)	1.8 (1.03–3.05)
≥10 years	1.8 (1.21–2.72)	2.1 (1.46–3.06)	2.7 (1.11–6.34)	2.0 (1.28–3.10)	1.7 (1.10–2.69)

CI, confidence interval; OR, odds ratio.
* $P<0.05$.

Only 15.7% of diabetic patients were aware that oral candidiasis is a potential oral consequence of diabetes, according to the results of the current study. The additional significant conclusion from this study was that patients with diabetes know limited about xerostomia. The possibility that candida organisms have a greater chance of proliferating when saliva's antimicrobial action is compromised and blood and saliva glucose concentrations are high is a possible explanation for the biological link between diabetes and xerostomia.[15] Both dental and medical health practitioners need to feel accountable for educating patients about dry mouth and how to avoid related oral issues.

The current research also found another significant finding that diabetic patients know little about the links between diabetes and oral cancer. Only 9.6% of participants were aware that diabetes-related oral problems could involve oral cancer. Hyperglycemia-induced oxidative

stress and DNA damage, insulin receptor activation, and insulin-like growth factor receptor activation via hyperinsulinemia, which results in accelerated cell cycle progression or chronic inflammation, are potential explanations for the correlation between DM and cancer.[16] Therefore, individuals with diabetes who are directed to dental care specialists for evaluation and monitoring should have oral screening done.

Education and duration since diagnosis of diabetes was observed in our study to strongly predict awareness of all oral complications of diabetes. Awareness increases with an increase in the level of education (except for caries and periodontal problems) and with the duration since diagnosis of diabetes (except for oral candidiasis and oral cancer). The correlation between awareness and education level supports earlier studies.[17] The explanation might be that people with poor levels of education deficit in the literacy needed to educate themselves about the associations between diabetes and other diseases and are therefore unaware of the causal relationship between oral complications and diabetes.

Strengths and Limitations

The present study had the following limitations. The study was done in a hospital setting, but a community-based study setting would have better represented the diabetic adult population for generalisability. In addition, as it is cross-sectional, the study does not allow firm conclusions to be drawn regarding causality. Despite these limitations, the results of this study can be considered important baseline data for further studies in this area. The study comes to the firm conclusion that an integrated strategy that includes oral health may improve community health and enable the effective utilization of resources.

Conclusion

Most diabetic patients fail to recognize their increased likelihood of oral problems. Furthermore, the grade of education and the duration of diabetes appear to be the key predictors of awareness of all oral complications. These findings might indicate that diabetes patients are not informed about the higher risk of oral problems during diagnosis and treatment. The collaborative management of patients with diabetes might enable medical and dental teams to work more closely together to achieve goals.

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