

Prevalence of diabetes among patients and the assessment of the awareness of the bidirectional relation between diabetes and periodontal disease

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ABSTRACT

Aim: To assess the extent of self-awareness and knowledge of diabetes and its association with periodontal disease among patients seeking dental care. **Materials and Methods:** Data were collected in the form of a questionnaire from 150 consecutive adult patients from the outpatient department of Saveetha Dental College in Chennai, India. Complying patients were tested for diabetes mellitus by checking their random blood sugar and the results were correlated with the questionnaire and their periodontal findings. The findings were interpreted to examine the relationship between self-awareness and clinically diagnosed periodontitis. **Results:** One hundred fifty patients participated in the questionnaire and 70% were unaware of diabetes causing periodontal disease. A total of 47.3% of patients were also unwilling to get themselves tested for diabetes by their dentists as nearly 73.3% believed that they did not have diabetes. As a result, out of 150 patients, 41 consented to random blood sugar but only 23 patients followed up. Among these 23, 14 believed they were diabetic but only 12 of those 14 were proven to be so. Additionally, 20 patients were diagnosed with either localized or generalized chronic periodontitis while the remaining 3 patients had gingivitis. All 12 patients diagnosed with diabetes were affected by periodontitis as well. **Conclusions:** Patients are generally apprehensive and misinformed regarding the influence of periodontitis and diabetes between both diseases and must be educated by both the medical and dental practitioners regarding the implications of these chronic inflammatory diseases.

Keywords: Awareness, diabetes mellitus, gingival inflammation, hyperglycaemia, periodontal diseases

Introduction

Periodontitis is a multifactorial infection that affects the periodontal supporting structures, which is attributed to the host response to anaerobic gram-negative microorganisms present within dental plaque.^[1,2] The presence of long-standing bacterial plaque on

soft and hard structures in the oral cavity is responsible for the initiation of gingivitis which if untreated progresses to periodontitis. Susceptibility to periodontal diseases is also dependent on the interaction of risk factors such as genetic predisposition, smoking, stress, and certain systemic diseases such as diabetes.^[3] Diabetes mellitus is a metabolic disease that can be broadly classified into Type I, Type II, and gestational diabetes. Type I diabetes results from the autoimmune destruction of pancreatic beta cells resulting in the total loss of insulin secretion.^[4] Type II diabetes, on the other hand, results from insulin resistance, which alters the use of endogenously produced insulin at the target cells.^[5,6] In pregnant women without any previous history of diabetes, the development

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Received: 10-01-2020

Revised: 12-03-2020

Accepted: 21-03-2020

Published: 30-06-2020

Access this article online

Quick Response Code:



Website:
www.jfmpc.com

DOI:
10.4103/jfmpc.jfmpc_63_20

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How to cite this article: Mahtani AA, Jacob C, Lakshmanan R. Prevalence of diabetes among patients and the assessment of the awareness of the bidirectional relation between diabetes and periodontal disease. J Family Med Prim Care 2020;9:2774-80.

of increased blood-sugar levels is responsible for gestational diabetes. Postpartum, most women revert to their prediabetic states but are predisposed to the development of diabetes during the later stages of life.^[7] Women with gestational diabetes mellitus (GDM) in whom glucose tolerance becomes normal postpartum remain insulin-resistant compared with women with no history of GDM.^[8] A well-established bidirectional relationship has been documented between diabetes and periodontitis.^[9] Substantial evidence has demonstrated diabetes mellitus as a risk factor for the impairment of periodontal health while periodontal disease, in turn, is responsible for the adverse effects on glycemic control and the pathophysiology of diabetes-related complications.^[1] Another worrying indicator of the extent of the problem lies with the fact that both diseases are common in India, with India being touted the world's diabetic capital. As most individuals fail to screen themselves for both diseases due to a lack of awareness and knowledge, the interventional treatment performed may be a case of being too little and too late. This study thus aims to assess patient perception of both diabetes and periodontitis as well as to determine the prevalence of diabetic individuals who visit the dental clinic for various oral complaints based on their chief complaint and clinical examination.

Materials and Methods

The study was performed among 150 consecutive adult patients from the outpatient department of Saveetha Dental College, Chennai who complied to complete a questionnaire. These patients visited the department for various chief complaints and those who provided informed consent were recruited into the study. Questionnaires were made available in English as well as the local vernacular, Tamil.

The first part of the questionnaire included demographic details, questions pertaining to oral health, symptoms of diabetes-associated gingival problems and complications associated with both diseases. The second half of the questionnaire asked patients if they were willing to perform a random blood sugar (RBS) test to assess if they were affected by diabetes. Patients who agreed to the test were then subjected to an RBS and informed of their diabetic status.

Patients who were then found to be diabetic were subjected to a clinical assessment of their periodontal health to test whether they were also affected by periodontitis.

Results

Table 1: Demographic details

Table 2: Questionnaire Respondent's professional dental care and reported oral self-care

Table 3: Questionnaire Respondent's awareness of health problems associated with diabetes

Table 1: Demographic details		
Characteristic	Frequency	Percent
Gender		
Male	82/150	54.6%
Female	68/150	45.3%
AGE		
20-40	90/150	60%
40-60	55/150	36.6%
Above 60	5/150	3.33%
State/Union territory		
Tamil Nadu	144/150	96%
Andhra Pradesh	1/150	0.6%
Kerala	3/150	2%
Nagaland	1/150	0.6%
Uttar Pradesh	1/150	0.6%
Education		
10 th and Below	18/150	12%
12 th	49/150	32.6%
UG	58/150	38.6%
Masters	22/150	14.6%
Doctorate	3/150	2%
Occupation		
Business	12/150	8%
Engineer	6/150	4%
Municipal worker	11/150	7.3%
Housewife	8/150	5.3%
Others	113/150	75.3%
Family Income		
Below 10,000	44/150	29.3%
10,000-20,000	41/150	27.3%
20,000-30,000	32/150	21.3%
Above 30,000	33/150	22%

Table 4: Questionnaire Respondent's opinions regarding the dentist's involvement in diabetes care.

Graph 1: Number of patients out of the 23 thought to be diabetic and found to be affected

Graph 2: Number of patients out of the 23 thought to be diabetic and diagnosed with gum disease

Graph 3: Number of patients diagnosed with gingivitis and periodontitis

Discussion

The relationship between periodontal disease and several systemic diseases such as diabetes mellitus has been well recognized in the past decades.^[1] One hundred fifty patients participated in the questionnaire-study wherein 80% used a toothbrush and toothpaste for maintaining oral hygiene. The most frequent oral problems these patients experienced were tooth decay (23%; 43/150), bleeding while brushing (18%; 34/150), bad breath (16%; 30/150), dry mouth (9%; 5/150), and mouth ulcers (8%; 16/150), which were all commonly associated in patients with diabetes [Table 2]. Due to the significant reduction of salivary flow, dry mouth or xerostomia has been documented

as the most common oral manifestation of diabetes.^[10] The primary function of saliva is to facilitate lubrication and cleansing of the oral cavity to prevent the accumulation of plaque and debris, which could be a contributing factor in diabetes's increased risk for periodontal disease and dental caries.^[10-12] Classic signs

and symptoms of gingivitis include red, swollen, tender gums that may bleed on brushing.^[13] If gingivitis is not treated, it can and often will progress to periodontal disease.

Table 2: Questionnaire Respondent's professional dental care and reported oral self-care

	Frequency	Percent
Number of visits to the dentist per year		
Never	42/150	28%
1-2 times	83/150	55.3%
3-4 times	14/150	9.3%
>4 times	11/150	7.3%
Materials used to maintain oral hygiene		
Rinsing with water	4/150	2.6%
Fingers	9/150	6%
Tooth powder	9/150	6%
Neem Stick	9/150	6%
Toothbrush and toothpaste	120/150	80%
Brushing Frequency		
Less than once a day	3/150	2%
Once a day	83/150	55.3%
Twice a day	49/150	32.6%
More than twice a day	15/150	10%
Number of Oral health problems present		
Mouth dryness	18/150	9%
Delayed healing in mouth	9/150	5%
Gums bleeding on brushing	34/150	18%
Mouth ulcers	16/150	8%
Bad breath	30/150	16%
Tooth decay	43/150	23%
Fungal mouth infections	3/150	1%
Swollen or tender gums	7/150	4%
Loose teeth	10/150	5%
Taste problems	7/150	4%
Oral skin disease	1/150	0%
Burning sensation in the mouth	9/150	5%
None	3/150	2%

Table 3: Questionnaire Respondent's awareness of health problems associated with diabetes

	Frequency	Percent
Awareness of problems linked to gum disease		
Diabetes	51/150	34%
Heart disease	8/150	5.3%
Pre-term birth weight babies	4/150	2.6%
Stroke	5/150	3.3%
Lung disease	5/150	3.3%
None of the above	74/150	49.3%
Diabetes can		
Affect any age group	73/150	48.6%
Only affect adults	27/150	18%
May affect pregnant women	13/150	8.6%
Only affect those who are overweight	37/150	24.6%
Diabetes has no role in gum disease?		
Yes	45/150	30%
No	51/150	34%
Sometimes	54/150	36%

Some patients might experience recurring halitosis or a bad taste in the mouth even if the disease is not advanced.^[13] Therapeutic goals for patients with periodontal disease and gingivitis in patients with diabetes must involve the elimination of infection by the removal of plaque and calculus, facilitating a decrease in inflammatory response and maintenance of glycemic control.^[13] The study also revealed that an overwhelming number of patients (70%) were unaware of diabetes causing periodontal disease and that except for diabetes (34%; 51/150); periodontitis had very minimal systemic complications with 49.3% (74/150) patients believing there was no such relation [Table 3].

In addition, only 55.3% (83/150) of patients visited their dentist as frequently as once or twice in a year [Table 2]. In another study, the lack of awareness and poor oral self-care was partly explained by the fact that over two-thirds of the respondents reported that they had never received any oral care advice from any health professionals in relation to their diabetes, despite high levels of dental attendance.^[9] This suggests that general dental practitioners do not routinely discuss how diabetes can affect oral health and self-care prevention methods with patients.^[9] A total of 47.3% (71/150) of patients were also unwilling to get themselves tested for diabetes by their dentists, as nearly 73.3% (110/150) believed that they did not have diabetes. As a result, out of 150 patients, 41% (61/150) consented to an RBS but only 23 patients followed up [Table 4]. Among these 23, 14 believed they were diabetic and a majority of them (12 patients) were proven to be so [Graph 1].

Diabetes is diagnosed if a random glucose level of >200 mg/dl is present. A fasting glucose of >126 mg/dl or glucose of >200 mg/dl 2 hours after a 75-g glucose load is also diagnostic.^[14] Additionally, 20 patients were diagnosed with periodontitis (14 with generalized chronic periodontitis and 6 with localized chronic periodontitis) while the remaining 3 patients had gingivitis. All 12 patients diagnosed with diabetes were affected by periodontitis as well [Graphs 2 and 3]. Severe periodontitis affects 10–15% of adults.^[15] Epidemiological data confirm that diabetes is a major risk factor for periodontitis with the risk of periodontitis increasing nearly three-fold in diabetic individuals compared with non-diabetic individuals.^[16] There is a clear relationship between the degree of hyperglycemia and the severity of periodontitis. The mechanisms that link these two conditions involve aspects of immune functioning, neutrophil activity, and cytokine biology. The two-way relationship between diabetes and periodontitis has established that diabetes increases the risk for periodontitis, and periodontal inflammation negatively affects glycemic control. There is an increase in anaerobic bacteria and the circulating cytokines, which cause insulin resistance leading to an increase in the amount of glucose in circulation. This cycle continues and worsens the glycemic and periodontal state. Oxidative stress also causes the production of accumulated glycated end

products (AGE), which leads to increased formation of glycated collagen that are friable and alters collagen metabolism and turnover leading to the pocket formation.

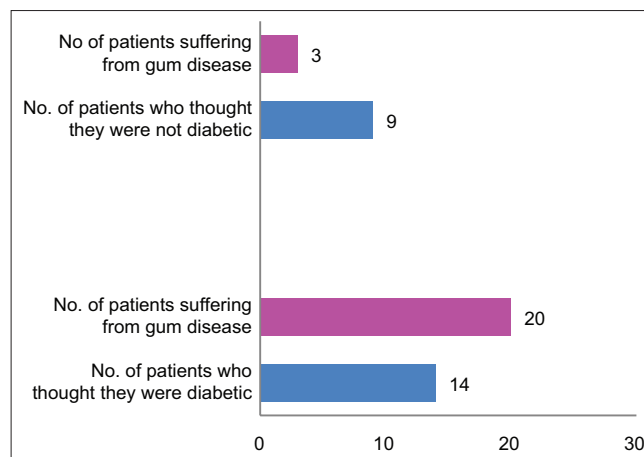
Incidences of macroalbuminuria and end-stage renal disease are increased two-fold and three-fold, respectively in diabetic individuals who also have severe periodontitis compared to diabetic individuals without severe periodontitis.^[15] The level of glycemic control is of key importance in determining increased risk. For example, in the US National Health and Nutrition Examination Survey (NHANES) III, adults with an HbA_{1c} level of >9% had a significantly higher prevalence of severe periodontitis than those without diabetes after controlling for age, ethnicity, education, sex, and smoking.^[17] The importance of

diabetes as a major risk factor for periodontitis became apparent in the 1990s in a number of cross-sectional and longitudinal studies investigating the Pima Indian population. The prevalence and incidence of periodontitis were greater in Pima Indians who had type 2 diabetes mellitus compared with those who did not,^[18,19] with an approximately three-fold increased risk for periodontitis.^[20] Severe periodontitis at baseline was associated with an increased risk of poor glycemic control (HbA_{1c} > 9.0%) at follow-up (minimum 2 years), suggesting that severe periodontitis was a risk factor for compromised diabetes management.^[21] In a 7-year prospective study of 5,848 non-diabetic individuals aged 30–59 years, the effect of periodontitis on diabetes incidence (defined as fasting plasma glucose >6.9 mmol/l, equivalent to >125 mg/dl) was also assessed.^[22] The impact of periodontitis on changes in HbA_{1c} was assessed in a prospective 5-year study of 2,973 non-diabetic individuals.^[23] Those participants with the most advanced periodontitis at baseline demonstrated an approximately five-fold greater absolute increase in HbA_{1c} over the 5 years of the study compared with those with no periodontitis at baseline.

In addition, various studies have reported that the prevalence and severity of non-oral diabetes-related complications, including retinopathy, diabetic neuropathy, proteinuria and cardiovascular complications, are correlated with the severity of periodontitis.^[24-27] In the early 1990s, periodontitis was referred to as the ‘sixth complication of diabetes^[28] and in 2003 the ADA acknowledged that periodontal disease was often found in people with diabetes.^[29,30] The adverse consequences of periodontal disease in diabetes would presumably be minimized or prevented if diabetes itself could be prevented. The prospects of preventing diabetes vary with the type of diabetes. The American Diabetes Association classifies diabetes into two major types: 1 and 2. Type-1 diabetes is due to autoimmune or idiopathic destruction

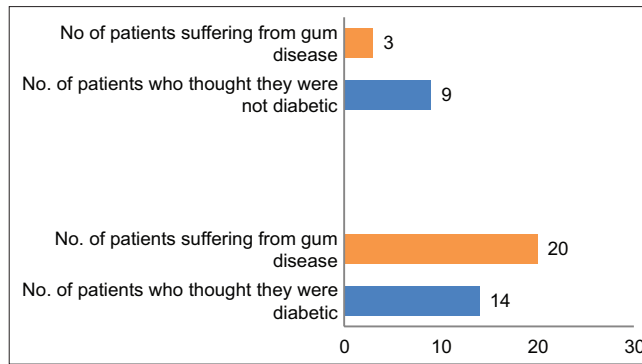
Table 4: Questionnaire Respondent’s opinions regarding the dentist’s involvement in diabetes care

	Frequency	Percent
Do you think you may have diabetes		
Yes	15/150	10%
No	110/150	73.3%
Maybe	25/150	16.6%
Should dentists be involved in diabetic screening?		
Yes	42/150	28%
No	71/150	47.3%
Depends on the oral problem	37/150	24.6%
If dentists did offer screening, would you be willing to participate?		
Yes	61/150	41%
No	89/150	59%
Would you like to be followed up two weeks from now to check your diabetic status?		
Yes	34/150	23%
No	116/150	77%



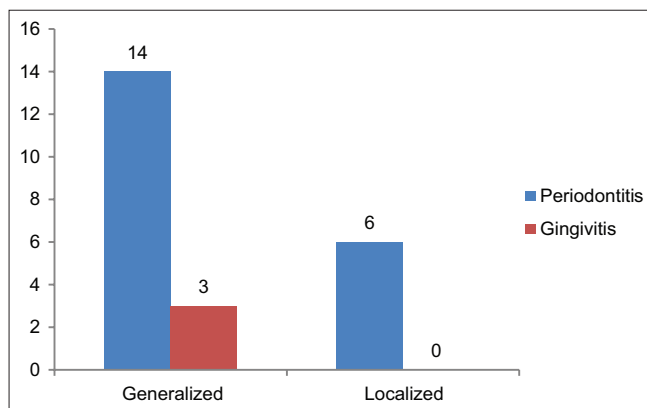
Graph 1: Number of patients out of the 23 thought to be diabetic and found to be affected

	Number of patients who thought they were diabetic	Number of patients who thought they were not diabetic
Number of patients suffering from gum disease	14	9
	20	3



Graph 2: Number of patients out of the 23 thought to be diabetic and diagnosed with gum disease

	Number of patients who thought they were diabetic	Number of patients who thought they were not diabetic
Number of patients found to be diabetic	14	9
	12	11



Graph 3: Number of patients diagnosed with gingivitis and periodontitis.

	Generalized	Localized
Periodontitis	14	6
Gingivitis	3	0

of the pancreatic beta cells. Type-2 diabetes results from a combination of defects in insulin secretion and insulin action. Research in the prevention of type-1 diabetes has focused on immune modulation, but so far has not met with reproducible success. By contrast, studies show that prevention research in type-2 diabetes, including lifestyle modification aimed at weight loss and increased physical activity or drugs affecting insulin resistance or secretion, has been at least partially successful.^[31-33] Studies have also provided evidence that control of periodontal infection has an impact on the improvement of glycemic control.^[34-36] In 2008, a meta-analysis of nine studies involving 485 patients reported a significant reduction of HbA_{1c} of 0.46% following periodontal treatment.^[37] Most recently, the Cochrane Collaboration has reported on studies that investigated the relationship between periodontal treatment and glycemic control in people with diabetes.^[38] Shortcomings of this survey would include the unwillingness of the patients to test for their RBS thus negatively impacting our sample size.

A study conducted amongst Spanish adults with diabetes also found that poor self-reported oral health was higher among people with diabetes compared to non-diabetes controls.^[39] Dentists and physicians should increase their awareness with their diabetic patients, especially those with lower educational levels, with missing teeth, osteoporosis, and depression.^[40]

The presence of periodontal pathogens and their metabolic byproducts in the mouth may, in fact, modulate the immune response beyond the oral cavity, thus promoting the development of systemic conditions. A cause-and-effect relationship has not been established yet for most of the diseases, and the mediators of the association are still being identified. A better understanding of the systemic effects of oral microorganisms will contribute to the goal of using the oral cavity to diagnose and possibly treat non-oral systemic disease.^[41]

In regards to family medicine and primary healthcare, the early diagnosis of periodontitis during routine dental checkup can aid in the earlier treatment of the disease. It will also allow the dentist to advice screening of blood sugar levels due to the bidirectional relationship between diabetes and periodontitis. This provides the ability to lower the glucose levels during its initial stages and help control it thereby improving the quality of the patient's health and lifestyle. This study provides a platform for underground diabetic patients who were identified by oral screening and found to be suffering from periodontitis to seek care and improve their oral and systemic health. It increases awareness amongst patients and motivates them to maintain better oral hygiene.

Conclusions

The management of diabetes is complex and the prevention of cardiovascular and microvascular disease, through early detection and management of complications, are key components. Lifestyle intervention, education, self-management, and self-monitoring are also important, in addition to treatments to reduce blood glucose, blood

pressure, and lipids. Medical and dental professionals are challenged to stay abreast of the ever-changing flood of evidence in the literature regarding the severity of diabetes and the bidirectional relationship between diabetes and periodontal disease. Medical and dental education and collaborations for the improved systemic and oral health of the population can be fostered via diabetes screening in the dental office. A supportive and facilitative approach by the dental team is essential, but there must be a clear understanding that patient-performed plaque control is the vehicle to control the inflammation which drives periodontal tissue destruction.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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