

# Assessment of Medical Practitioners' Knowledge Regarding the Relationship Between Periodontal Disease and Diabetes Mellitus: A Questionnaire-based Cross-sectional Study

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## ABSTRACT

**Introduction:** Periodontal disease is a chronic inflammatory infectious disease that increases the host's overall inflammatory burden by inducing a persistent systemic inflammation. This burden has been linked to insulin resistance, the development of diabetes, and its complications. Periodontal therapy plays a vital role in controlling diabetes and its potentially fatal complications. Medical and dental professionals should be aware of this inter-relationship between the two diseases to facilitate proper diagnosis and predict better treatment outcomes.

**Aim:** To assess the knowledge of medical practitioners regarding periodontal disease and its inter-relationship with diabetes mellitus.

**Materials and Methods:** This was a questionnaire-based cross-sectional study conducted by using google forms between May 2022 and October 2022 among 150 medical practitioners. The questionnaire consisted of 15 questions divided into two parts. The first part gathered personal data, while the second

part focused on their knowledge about disease awareness. The collected data were analysed using percentages.

**Results:** Out of 149 participants, who sent completed questionnaires, only 8 practitioners (5.4%) referred all while 99 (66.4%) referred only a few of their patients for dental check-ups. Among them, only 39 participants (26.2%) referred patients for regular general dental check-ups without any complaints or findings. Although 112 (75.2%) had knowledge about the association, only 59 participants (39.6%) knew that it is bidirectional. A total of 80 (53.7%) responses understood that periodontal bacterial load and associated inflammation caused alterations in sugar levels. However, 68 (45.6%) were unaware that periodontal treatment can help improve glycaemic status.

**Conclusion:** It can be inferred that medical practitioners were not aware of the connection between periodontal disease and diabetes mellitus.

**Keywords:** Awareness, Hyperglycaemia, Inflammation, Periodontitis, Physician

## INTRODUCTION

Diabetes mellitus is a chronic metabolic disease characterised by increased blood sugar levels (hyperglycemia). It occurs due to several reasons such as defects in insulin secretion by the beta cell of the pancreas, resistance of cells to insulin action, or both [1]. Diabetes mellitus is considered a major health disease in the world and is a cause of many medical problems such as blindness (retinopathy), kidney failure (nephropathy), heart attack, stroke, delayed wound healing, and lower limb amputation. Among the dental complications, periodontitis is the most widely observed dental disease in such patients [2].

Periodontal disease is a multifactorial chronic inflammatory infectious disease mainly caused by dental plaque (bacteria) and their products [3]. There is a breakdown of the surrounding structures of the tooth. Diabetes mellitus is also a known risk factor for periodontal disease [4]. Studies [5,6] have suggested that patients with poor glycaemic control are at a greater risk for the development of periodontal disease than non-diabetic patients, and infection is seen with increased severity in diabetic patients.

It is a known fact that even in the absence of diabetes, acute bacterial and viral infections can increase insulin resistance in people [7,8]. As periodontal disease is an infectious disease, it has also been found to result in increased insulin resistance and poor glycaemic control [9,10]. The actions of proinflammatory cytokines such as Tumour Necrosis Factor-alpha (TNF- $\alpha$ ) and Interleukin-6 (IL-6) are linked to increased insulin resistance [11]. TNF- $\alpha$  and IL-6 also stimulate

greater C-reactive Protein (CRP) production in the liver, which may also increase insulin resistance [12].

Gram-negative organisms such as *P. gingivalis*, *Tannerella forsythensis*, and *Prevotella intermedia* have significantly higher serum markers of inflammation, such as CRP, IL-6, and fibrinogen, than subjects without periodontitis [13,14]. Thus, periodontitis with increased inflammatory markers increases the risk of insulin resistance.

Most diabetic patients are unaware of this relationship [15], which can be attributed to a lack of information provided by attending healthcare professionals. Medical practitioners should be aware of the dental aspect of it. Since there is a well-defined management of periodontal disease, it is imperative to know that effective periodontal therapy may help reduce systemic inflammatory markers and insulin resistance [16,17], as well as its potentially fatal complications.

Various studies conducted in different parts of the world yield varied data on the knowledge of medical practitioners about the relationship between diabetes mellitus and periodontitis [18-22]. Few studies have been conducted among medical practitioners in India [23-25]. Thus, this study was conducted to assess the knowledge of medical practitioners about periodontal disease and its relation to diabetes mellitus. To our knowledge, this is the first study conducted in the state of Maharashtra, India.

## MATERIALS AND METHODS

This was a questionnaire-based cross-sectional study conducted between May and October 2022 among 150 medical practitioners

selected through a simple random sampling technique. These practitioners worked in various hospitals, clinics, and medical institutes located in the state of Maharashtra, India. A total of 150 medical practitioners were contacted using LinkedIn, and upon their approval, their email IDs were obtained. The questionnaire was sent to all physicians via email as an online link. Institutional ethical clearance (Registration number: EC/NEW/INST/2021/MH/0029) was obtained prior to the commencement of the study.

**Inclusion criteria:** Medical Practitioners (allopathic, homeopathic, and ayurvedic) working in hospitals, private clinics, and institutes in Maharashtra, who were willing to participate in the study were included.

**Exclusion criteria:** MBBS, BHMS, BAMS interns, and students, not yet practitioners, were excluded in the study.

**Sample size determination:** was done using OpenEpi software (version 3.04) [26], and a sample size of 150 was derived.

### Questionnaire [Annexure-1]

A closed-ended questionnaire consisting of 15 questions was used in this study. The authors developed the questionnaire to cover all relevant questions and assess exact knowledge and awareness. It was designed as a web-based questionnaire in two sections. The first section collected data on age, type of practice (public/private hospital/clinic), place of practice, and degree of specialisation (General practitioner/Resident doctor/Specialist/Super specialist). The second section examined the level of awareness. The responses to these questions were graded, with a score of 1 given for every correct answer and a score of 0 for every incorrect answer. Participants received an individual score out of 8, and a passing score was set at 4 or more, indicating knowledge about the relation between the two diseases.

A pilot study was conducted with 10% of the sample size (15 participants) to verify the face validity and content validity by experts. The questions were checked for common errors such as leading, confusing, and double-barreled questions. The internal consistency of our questionnaire was relatively high. The experts evaluated the usefulness of each question for achieving the study objective and provided suggestions to improve the clarity and accuracy of the questionnaire. Based on the experts' feedback, we further improved the clarity of the questions.

### STATISTICAL ANALYSIS

The data collected, which consisted of the participants' responses, was expressed as numbers and percentages. It was tabulated in an MS excel Spreadsheet (Version 2019). Descriptive statistics were performed using the Statistical Package for the Social Sciences software (SPSS, Version 20.0, IBM, USA). The data obtained were analysed using percentages.

### RESULTS

The questionnaire was sent to 150 medical practitioners in the state of Maharashtra, of which a total of 149 completed questionnaires were included in this study. Among the participants, 75 (50.3%) were between the age group of 25-45 years, followed by 55 (36.9%) who were above 45 years of age. Regarding their work settings, 74 (49.7%) worked in private hospitals and clinics, while 52 (34.9%) worked in institutes. In terms of specialisation, 69 (46.3%) of the surveyed practitioners were general practitioners, and 33 (22.1%) were specialists. Among the specialists, 104 (70%) were M.D. General Medicine, and 9 (6%) were superspecialists, either endocrinologists or diabetologists [Table/Fig-1].

More than half of the surveyed population, 104 (69.8%) referred very few to none of their patients for a dental check-up. Only 37 (24.8%) of the referrals were made because the practitioners

felt that dental intervention was required. Among the specialists, only 30.3% referred their patients for dental check-ups [Table/Fig-2].

Demographic details	Variables	n (%)
Age	<25 years	19 (12.8%)
	25-45 years	75 (50.3%)
	>45 years	55 (36.9%)
Type of practice	Public hospital	19 (12.8%)
	Private hospital/clinic	74 (49.7%)
	Institute	52 (34.9%)
	Does not practice	2.7% (4)
Specialisation	General practitioner	69 (46.3%)
	Resident doctor	38 (25.5%)
	Specialist	33 (22.1%)
	Super specialist	9 (6%)

[Table/Fig-1]: Demographic details of the study participants. N=149 participants

Do you refer your patients for a dental consultation?	Number	Percentage
All	8	5.4%
Many	37	24.8%
Very few	99	66.4%
None	5	3.4%
Reason for referral	Number	Percentage
Patient had oral complaints	58	39.8%
You felt that dental intervention is required	37	24.8%
You referred just for general dental check-up	39	26.2%
Patient requested a Referral	11	7.4%
Don't know	4	2.7%
Trend of referral		
Age	Total	Referred many to all patients (%)
<25 years	19	7 (36.8)
25-45 years	75	32 (42.6)
>45 years	55	6 (10.9)
Type of practice	Total	Referred many to all patients (%)
Public hospital	19	7 (36.8)
Private hospital/clinic	74	16 (21.6)
Institute	52	22 (42.3)
Does not practice	4	0 (0)
Specialisation	Total	Referred many to all patients (%)
General practitioner	69	24 (34.7)
Resident doctor	38	9 (23.6)
Specialist	33	10 (30.3)
Super specialist	9	2 (22.2)

[Table/Fig-2]: Details of referrals by the participants (N=149 participants).

Although 80 (53.7%) of the doctors understood that periodontal bacterial load and its associated inflammation are the main factors contributing to gum disease, which can lead to alterations in blood sugar levels, only 40 (26.8%) of the doctors knew that gum disease can also lead to insulin resistance, which, in turn, causes alterations in blood sugar levels [Table/Fig-3]. A total of 112 (75.2%) of the practitioners were aware of an association between oral disease and diabetes. However, only 38 (25.5%) of the doctors said that the treatment of gum disease improves blood sugar levels [Table/Fig-3].

When the overall disease awareness was assessed among the participants, it was found that only 61 participants (40.9%) obtained a score of 4 or more, indicating that they were aware [Table/Fig-4].

(a) Do you think there is an association between oral disease and diabetes?		
	Number	Percentage
Can't say	28	18.8%
No	9	6%
Yes	112	75.2%

(b) What is the association between oral disease and diabetes?		
	Number	Percentage
Bidirectional	59	39.6%
Diabetes causes oral disease	67	45%
Oral diseases cause diabetes	6	4%
Don't know	17	11.4%

(c) Which oral finding majorly affects the blood sugar levels?		
Oral findings	Number	Percentage
Caries/cavities	18	12.1%
Gum disease	96	64.4%
Pre-cancerous lesions	5	3.4%
Sensitivity of teeth	2	1.3%
Ulcerations	28	18.8%

(d) What according to you is the main factor of gum disease which leads alteration in sugar levels?		
Gum disease factor	Number	Percentage
Autoimmune diseases of gums	3	2.0%
Bacterial load and associated inflammation	80	53.7%
Non inflammatory gum enlargement	8	5.4%
Don't know	52	34.9%
None of the above	6	4.0%

(e) How does the factor of gum disease lead to alteration in blood sugar levels?		
Mechanism	Number	Percentage
Destruction of pancreatic cells	9	6.0%
Insulin resistance	40	26.8%
Both of the above	32	21.5%
Don't know	52	34.9%
None of the above	16	10.7%

(f) Which inflammatory markers majorly alter the blood sugar levels?		
IL-1 beta	8	5.4%
PGE-2	9	6.0%
TNF-alpha	13	8.7%
TNF-beta	4	2.7%
Don't know	115	77.2%

(g) Do you think, can treatment of gum disease improve glycaemic status of a patient?		
Yes, it does improve	5	3.4%
No, it does not improve	43	28.9%
To some extent	33	22.1%
Don't know	68	45.6%

(h) Elimination of which bacteria can lead to reduction in blood sugar levels?		
P.gingivalis	8	5.4%
Bacteroides	3	2.0%
E.coli	19	12.8%
P.intermedia	7	4.7%
Don't know	112	75.2%

**[Table/Fig-3]:** Knowledge of medical practitioners about periodontal disease and its relationship with diabetes mellitus.

## DISCUSSION

The results from the present study revealed that medical practitioners generally lacked thorough awareness of the relationship between periodontal disease and diabetes mellitus. They also exhibited limited

Disease awareness score (out of 8)	Number	Percentage
0	12	8.1%
1	24	16.1%
2	37	24.8%
3	15	10.1%
4	32	21.5%
5	18	12.1%
6	11	7.4%
<b>Total</b>	<b>149</b>	<b>100%</b>

Specialisation	No. of participants (out of 149) with a score of 4 or more (Total n=61)
General practitioner	13 (8.66%)
Resident doctor	18 (12%)
Specialist	24 (16%)
Super specialist	06 (4%)
<b>Total</b>	<b>61 (40.66%)</b>

**[Table/Fig-4]:** Overall disease awareness of the study participants. There were 0 participants under score 7 and 8.

knowledge about periodontal disease. Numerous studies have been conducted discussing the association between periodontal infection and systemic diseases, especially diabetes mellitus. These studies have concluded that there is a bidirectional relationship between them [27-30]. They have deduced that controlling the occurrence and spread of gingivitis and periodontitis in patients may play a crucial role in reducing the systemic inflammatory burden and its impact on insulin. This knowledge would be beneficial in managing alterations in blood sugar levels in patients with or without diabetes mellitus. Interestingly, most of these studies have observed that the medical fraternity is largely unaware of this association [20-22].

According to the observations of the present study, it was revealed that 69.8% referred very few to none of their patients for a general dental check-up. In the study by Al-Habashneh R et al., among the Jordanian population, it was revealed that only 53.3% of doctors advised their patients to visit the dentist regularly [21]. In a study conducted by Lin H et al., the results revealed that only 26.6% of endocrinologists reported frequently advising patients with diabetes mellitus to have a dental visit [22]. Additionally, a study by Obulareddy VT et al., reported that only 17.8% of doctors referred their patients for a dental check-up [23]. The probable reason behind these findings of fewer referrals in most of the studies is not very surprising because oral health has not traditionally been viewed as part of a general assessment within medical practice. Also, medical professionals may not be receiving or gathering adequate information about oral health problems related to diabetes from relevant sources. This inter-relationship has not been the topic of professional focus in non-dental literature nor in non-dental conferences. There should be more collaboration between medical doctors and dentists or periodontists to facilitate the exchange of relevant knowledge.

Regarding knowledge about the bidirectional relationship of the two diseases, it was reported to be 60.4% among the participants in the present study. In the study by Obulareddy VT et al., only 43.2% believed in the same [23]. Approximately 42.2% of participants agreed with this relationship in the study carried out by Al-Khabbaz AK et al., [20]. Additionally, oral health education appears to be limited in undergraduate and postgraduate medical degree programs. A pilot study by Mouradian WE et al., observed that medical students had insufficient knowledge of oral systemic interactions and oral health disparities across all training years [31]. This suggests that more awareness and training in oral health are needed for medical professionals to facilitate a change in their scope of knowledge and practice.

S. No.	Author's name (year)	Place of study	No. of subjects	Objective	Conclusion
1.	Al- Habashneh R et al., (2010) [21]	Jordan	164	To assess Jordanian doctors' knowledge of the connection between diabetes and oral health and assess their willingness to advise their diabetic patients to seek dental treatment.	There was limited knowledge of the relationships between oral health and diabetes.
2.	Al-Khabbaz AK et al., (2011) [20]	Kuwait	232	To evaluate the knowledge of dental and medical practitioners concerning the effects of diabetes on periodontal health and to find out if the practitioners are aware of the bidirectional relationship between periodontal diseases and DM.	There was limited knowledge of the relationships between periodontal disease and Diabetes mellitus.
3.	Owens JB et al., (2011) [18]	North Carolina, USA	115 endocrinologists	To determine the knowledge and practice behaviours of endocrinologists who treat patients with any type of diabetes.	Endocrinologists had some knowledge about oral health and believed that it is linked to periodontal disease.
4.	Lin H et al., (2014) [22]	Southern China	297 endocrinologists	To compare the opinions of dentists and endocrinologists regarding diabetes mellitus and periodontitis.	Endocrinologists and dentists were not equally equipped with the knowledge about the relationship between DM and periodontitis.
5.	Obulareddy VT et al., (2018) [23]	Nellore, Andhra Pradesh, India	60	To assess the knowledge, attitudes, and practice behaviours of endocrinologists, general medicine practitioners, and diabetologists on the relationship between periodontal disease and DM.	There existed a wide gap between their practice behaviours and current scientific evidence.
6.	Nordin NN et al., (2021) [19]	Malaysia	725	To investigate the awareness, knowledge, attitudes and practices in the management of Diabetes mellitus patients with periodontal disease in primary care clinics of Malaysia.	Most medical practitioners had sufficient knowledge on Periodontal disease, but a negative attitude in its management.
7.	Present study	Maharashtra, India	149	To assess the knowledge of medical practitioners about periodontal disease and its inter relationship with diabetes mellitus.	Medical practitioners were not aware of the connection between periodontal disease and diabetes mellitus.

[Table/Fig-5]: Comparison of previously done studies with the present study [18-23].

The present study revealed that 45% of practitioners were aware of the relationship where diabetes causes oral diseases, in contrast to only 4% who were aware of oral diseases causing diabetes mellitus. Similarly, Al-Habashneh R et al., pointed out that 70% of doctors had heard about the possible connection between diabetes and oral health, but 68% of the participants disagreed that periodontal health can affect glycaemic control among patients with diabetes, while 30% believed that it did have an effect [21]. In the study by Al-Khabbaz AK et al., in 2011, 75.4% of medical practitioners believed that diabetes affects periodontal health, whereas only 44% knew that periodontal health affects metabolic control [20].

The above results suggest that the two-way relationship between DM and PD was inadequately emphasised. A study by Tse SY in the Hong Kong population also found a decrease in the percentage from 90% acknowledging the effect of poor DM control on PD to 76% thinking contrarily [32]. However, only one study by Panakhup M et al., mentioned that 97.3% of physicians were aware of the association [33]. But out of the 97.3%, only 70.0% were aware that treatment of periodontal disease helps improve glycaemic control in Diabetes Mellitus patients. All of the above studies suggest that the diabetes mellitus to periodontitis relationship has been mentioned more frequently than the periodontitis to diabetes mellitus relationship. This indicates that it is time to promote interprofessional education and collaboration between medical and dental health providers regarding the exact association.

In the present study, only 25.5% of the medical practitioners felt that providing periodontal treatment to patients does improve glycaemic status in diabetic patients. The study by Al-Khabbaz AK et al., mentions that 59.5% of physicians believed that poorly controlled diabetics should have more frequent periodontal treatment [20]. In the study done by Anandkumar AS and Sankari R the reported responses were 39.2% on the idea that periodontal treatment improves glycaemic status [34]. Similar studies have been compared in [Table/Fig-5] [18-23].

The findings of the present study and various other studies in the literature highlight the gap in knowledge and practice among healthcare providers. It appears that physicians who treat diabetic patients clearly need training campaigns and intervention programs. Distribution of educational packages to all healthcare providers in healthcare centers can be initiated, including information pertaining

to the association or relationship between these two diseases. Medical professionals should be informed about their important role in initiating dental referrals and promoting oral health in non-diabetic, prediabetic, or diabetic subjects. They should also be reminded or educated regarding the clinical practice recommendations made by the American Diabetes Association, which emphasise that referral for a dental examination is an important component of comprehensive diabetes evaluation [35]. Medical professionals should continue educating individuals with diabetes about the need for periodic dental and periodontal examinations (every 6 months or more frequently) as recommended by the American Dental Association [36]. It is not only the responsibility of the medical fraternity to raise awareness, but it is also strongly recommended for dentists and periodontists to regularly refer severe periodontitis patients for diabetes mellitus evaluation.

### Limitation(s)

The responses from the participants were not collected based on years of experience. An equal number of participants from different age groups were not included. Additionally, along with medical practitioners, interactions with diabetic patients could have provided insights into the information shared by their consulting doctors. A larger sample size would have been beneficial in understanding responses on a wider scale.

### CONCLUSION(S)

In light of the results of our investigation, it is reasonable to conclude that not all practitioners were entirely aware of the relationship between periodontitis and diabetes mellitus. Medical practitioners need to broaden their knowledge to effectively handle and manage diabetic patients, improving their health status. They should advise their patients to undergo regular dental check-ups and refer more diabetic patients to manage the disease comprehensively. This approach can help control diabetes and prevent the occurrence of potentially fatal complications. By working together, medical and dental professionals can contribute to alleviating the suffering experienced by diabetic patients and help them lead healthier lives.

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#### PLAGIARISM CHECKING METHODS:

- Plagiarism X-checker: Jul 04, 2023
- Manual Googling: Aug 30, 2023
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**[ANNEXURE-1]**

Diabetes mellitus is one of the most common chronic diseases worldwide. Individuals with diabetes are at higher risk of developing further health-related complications and disorders. In addition, there is indication, that patients with diabetes suffer more often from dental disease compared to individuals without diabetes. This questionnaire aims to assess the knowledge of medical practitioners regarding this relationship.

**A) Personal data**

1. **Email id.:**
2. **Age**
  - <25 years
  - 25-45 years
  - >45 years
3. **Where do you practice?**
  - Public hospital
  - Private hospital/Clinic
  - In an Institute
  - Does not practice
4. **Place of practice (City/District and State)**
5. **How do you practice as a medical professional**
  - General practitioner
  - Resident doctor
  - Specialist
  - Superspecialist

**B) Disease awareness**

6. **Do you refer your patients for a dental consultation?**
  - None
  - Very few
  - Many
  - All
7. **What was the most frequent reason for referral?**
  - Patient had oral complaints
  - You felt that dental intervention is required
  - You referred just for general dental check-up
  - Patient requested a referral
8. **Do you think there is an association between oral disease and diabetes?**
  - Yes
  - No
  - Can't say
9. **What is the association of oral disease and diabetes?**
  - Oral diseases cause diabetes
  - Diabetes cause oral disease
  - Bidirectional
  - Don't know
10. **Which oral findings majorly affect the blood sugar levels?**
  - Caries/cavities
  - Gum disease
  - Ulcerations
  - Pre-cancerous lesions
  - Sensitivity of teeth
11. **What according to you is the main factor of gum disease which leads to alteration in sugar levels?**
  - Bacterial load and associated inflammation
  - Non inflammatory gum enlargement autoimmune
  - Diseases of gums
  - Don't know
  - None of the above
12. **How does the factor of gum disease lead to alteration in blood sugar levels?**
  - Insulin resistance
  - Destruction of pancreatic cells
  - Both of the above
  - None of the above
13. **Which inflammatory markers majorly alter the blood sugar levels?**
  - IL1-beta
  - PGE-2
  - TNF-alpha
  - TNF-beta
  - Don't know
14. **Do you think, can treatment of gum disease improve glycaemic status of a patient?**
  - Yes, it does improve
  - No, it does not improve
  - To some extent
  - Don't know
15. **Elimination of which bacteria can lead to reduction of blood sugar levels?**
  - P.gingivalis
  - Bacteroides
  - E.coli
  - P.intermedia
  - Don't know