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**Original article**

# Knowledge and Awareness about the relationship between periodontitis and diabetes mellitus among dental students

## Running title: The Relationship between Periodontitis and Diabetes.

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**ABSTRACT**

**Background:** Diabetes mellitus and periodontitis both are chronic diseases with a bidirectional relationship. Awareness of this association among future dental professionals is important for effective patient care.

**Objective:** This study aimed to assess the knowledge & awareness of the bidirectional relationship between diabetes and periodontitis in dental students of Krishna Vishwa Vidyapeeth University, Karad.

**Methods:** A cross-sectional questionnaire-based survey was conducted amongst 200 dental students from first-year to postgraduate level. The validated questionnaire consisted of 10 close-ended questions related to the systemic and oral manifestations of diabetes, its impact on periodontal health, and knowledge of preventive practices. Responses were analyzed using SPSS v21 with Chi-square tests to determine associations between academic year and awareness levels.

**Results:** A total of 200 students participated. Awareness improved with academic year: 1st year (33.7%) to interns (84.1%). A statistically-significant association was seen between academic year and awareness (Chi-square value = 42.76, df = 4, **$p < 0.001$**). Key gaps identified included misunderstanding of the bidirectional nature of diabetes and periodontitis, and limited knowledge on the role of glycemic control in oral health.

**Conclusion:** There is a positive trend in knowledge with academic progression. However, curricular reinforcement is needed, especially in early years.

**Keywords:** Diabetes mellitus, Periodontitis, Awareness, Dental students, Bidirectional relationship, Oral health.

## INTRODUCTION

Diabetes mellitus is a significant chronic non-communicable diseases globally, characterized by persistent-hyperglycemia due to impaired insulin secretion, insulin resistance, a combination of both [1]. According to the International Diabetes Federation (IDF), an estimated 537 million adults were having diabetes as of 2021, and this number is projected to rise to 643 million by the year 2030 and over 783 million by 2045, representing a growing burden on global healthcare systems [1].

While the systemic complications of diabetes such as nephropathy, retinopathy, cardiovascular disease, and neuropathy are well recognized, the oral implications of diabetes—particularly its strong association with periodontal disease—have often been overlooked in both clinical practice and public awareness.

Periodontitis is a chronic-inflammatory condition that results in the progressive destruction of the supporting structures including the periodontal ligament and alveolar bone. It is now well established that the relationship between diabetes and periodontitis is **bidirectional**, meaning that each condition can affect the onset and progression of other. On one hand, poorly controlled diabetes contributes to development and exacerbation of periodontal disease through mechanisms such as altered immune response, microvascular dysfunction, and impaired tissue repair. Hyperglycemia leads to increase in advanced glycation end-products (AGEs), which promote inflammation and compromise host defense, making the periodontal tissues more susceptible to bacterial invasion and damage. On the other hand, periodontal disease increases systemic inflammation by elevating pro-inflammatory cytokines like tumor necrosis factor-alpha (TNF-α) and interleukin-6 (IL-6), which can deteriorate insulin resistance and contribute to poor glycemic control [2–4].

Recent interdisciplinary consensus reports, such as those jointly published by the **European Federation of Periodontology (EFP)** and the **International Diabetes Federation (IDF)**, along with updated clinical guidelines from the **American Diabetes Association (ADA)**, now recognize periodontal health as an integral component of comprehensive diabetes management [5,6]. These reports recommend regular periodontal assessments for diabetic patients and stress the importance of collaborative care involving both medical and dental professionals. Despite this growing body of evidence and consensus, awareness of the oral-systemic link between diabetes and periodontitis remains insufficient—among patients and many healthcare providers, including dental practitioners.

For dental students, this link is particularly important as they form the next generation of oral healthcare providers. Their understanding of how systemic diseases like diabetes can influence oral health outcomes—and vice versa—has implications for clinical decision-making, patient education, and interdisciplinary collaboration. Inadequate knowledge at the student level can contribute to missed opportunities for early diagnosis, intervention, patient counseling.

Numerous studies, both in India and internationally, have attempted to assess the level of awareness among dental students regarding this bidirectional association. The results have been mixed. Some studies have shown that while interns and final-year students tend to possess a moderate to good understanding of the diabetes-periodontitis connection, students in earlier academic years often exhibit substantial gaps in both knowledge and clinical preparedness [7–11]. For instance, a study conducted in Saudi Arabia by Bahammam (2015) found that although awareness improved with academic progression, there remained significant deficiencies even among senior students in applying this knowledge clinically. Similarly, Preshaw et al. (2012) and Taylor & Borgnakke (2008) have long advocated for the integration of systemic health education into dental curricula, highlighting the role of dentists in early detection and interdisciplinary diabetes care [3,4,12].

Given this context, the purpose of present study is to assess the current level of knowledge and awareness among undergraduate dental students regarding the connection between diabetes and periodontal disease at Krishna Vishwa Vidyapeeth University. Moreover, the study seeks to determine whether the students' academic progression—moving from the early years of theoretical learning to more clinically focused training—correlates with a measurable improvement in understanding. By identifying gaps and trends in knowledge, this research hopes to inform curriculum development and promote a more holistic approach to oral-systemic healthcare among future dental professionals.

## MATERIALS AND METHODS:

**Study Design and Setting:**
This descriptive, cross-sectional study was done in June 2025 among undergraduate and postgraduate dental students at Krishna Vishwa Vidyapeeth University, Karad.

**Sample Size and Sampling Technique:**
The total of 200 students involve in the study, selected through stratified random sampling. The sample included equal representation from each academic level. Sample size (N)= Z^2 PQ/L^2

Z = standard normal variable at 95% CI (Confidence Interval) = 1.96
P = Factor of interest among the students
= 50%
Q = 100 – P = 50%
L = Margin of Error at 95% CI

= 7
Therefore,
N = (1.96)^2 (50)(50)/ (7)^2 N = 9604/ 49
N = 196
N= 200

**Questionnaire and Data Collection:**
A validated 10-item close-ended questionnaire assessed knowledge of the diabetes-periodontitis association. The tool was piloted among 20 students and refined based on feedback. It was then distributed digitally using Google Forms.

Questions included the effect of diabetes on periodontal tissues, recognition of bidirectional influence, common oral manifestations, and appropriate preventive strategies.

**Questionnaire Table:**

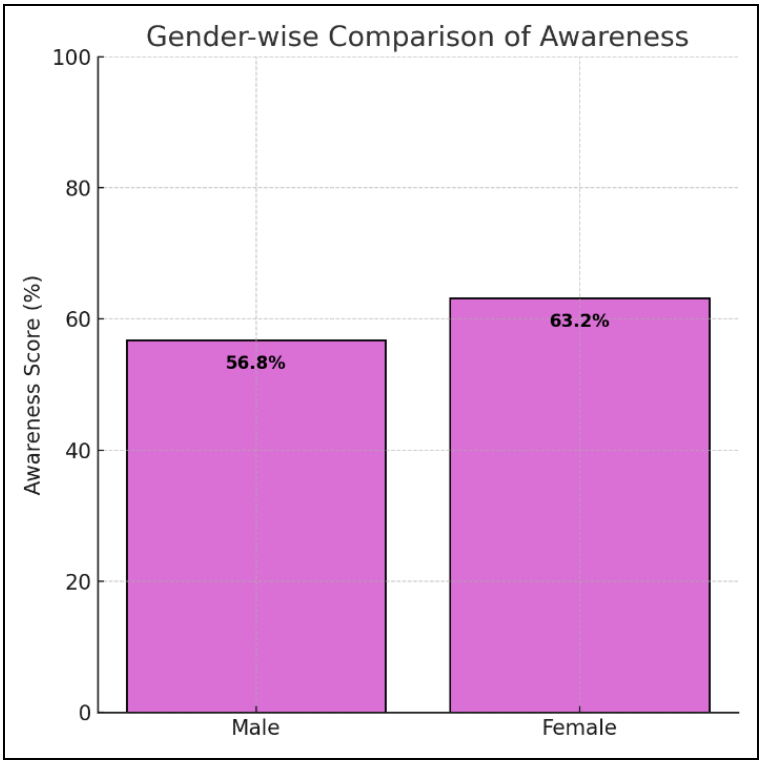
| Q.No | Question | Options |
|---|---|---|
| 1 | Are you aware of the co-relation between diabetes and periodontitis? | Yes / No |
| 2 | Relationship between diabetes and periodontitis? | Bidirectional / Diabetes reduces risk / Periodontitis improves control / Unrelated |
| 3 | Effect of poorly controlled diabetes on periodontal health? | Increases infections / Improves healing / No effect / Cures periodontitis |
| 4 | Common periodontal complication in diabetics? | Delayed healing / Hypercementosis / Saliva increase / Less plaque |
| 5 | Impaired periodontal outcome in diabetics? | All of the above / Bleeding reduction / Attachment gain / Pocket depth reduction |
| 6 | Can gum disease worsen diabetes? | Yes / No |
| 7 | Best prevention in diabetics? | Oral hygiene + glycemic control / Smoking / High-carb diet / Avoiding dentists |
| 8 | Common oral sign in diabetics? | Gum bleeding / Tooth whitening / Taste change / Tongue size increase |
| 9 | Periodontitis effect on diabetes? | Worsens sugar control / Improves sugar / Reduces BP / No effect |
| 10 | Dental visit frequency for diabetics? | Every 6 months / Only when pain / Every 5 years / Never |

**Ethical Consideration:**
Ethical clearance was obtained from the institutional ethics committee.(……) Participants gave informed consent before taking part, and anonymity was ensured. The first page of the Google Form will include an informed consent statement, explaining the study's purpose, voluntary participation, demographic data of the respondents and anonymous. Data will be aggregated and reported without identifying individual participants.

**Data Analysis:**
The data were entered in Microsoft Excel and analyzed using SPSS version 21. Descriptive statistics were used. Chi-square test was employed to assess the association between academic year and awareness level. Statistical significance set at $p < 0.05$.

## RESULTS

**Demographic Distribution:**
A total of **200 dental students** participated in the study. Of these, **52 students (26%)** were from the first year, **42 (21%)** from the second year, **34 (17%)** from the third year, **36 (18%)** from the fourth year, and **36 (18%)** were interns or postgraduate students. In terms of gender distribution, the sample consisted of **124 females (62%)** and **76 males (38%),** showing a female predominance in participation.



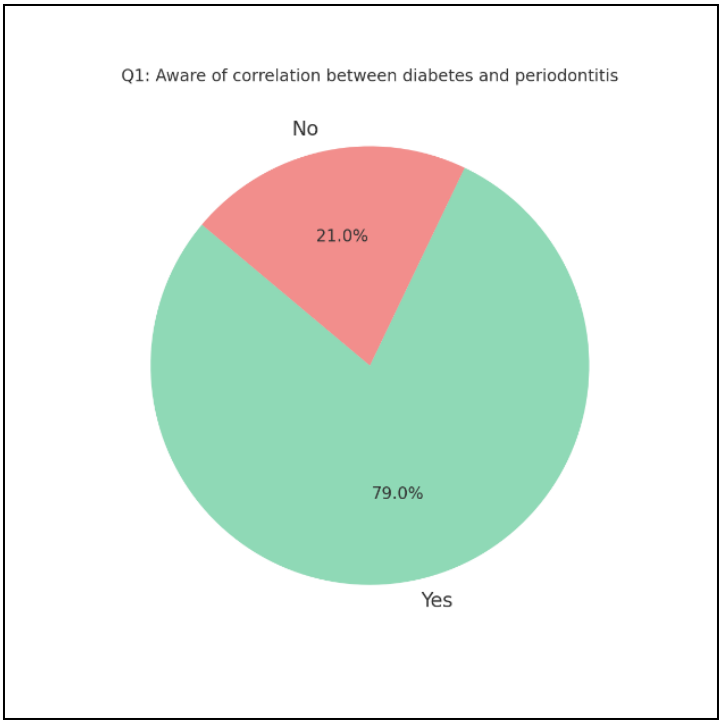

**Graph 1: Gender wise comparison of awareness**

When awareness levels were compared across academic years (Graph 2, Table 1), a clear upward trend was observed. Only **33.7% of first-year students** demonstrated adequate knowledge regarding the diabetes–periodontitis relationship, while the percentage gradually increased with academic progression: **45.2% in second year, 58.8% in third year, and 69.4% in fourth year.** The highest awareness was seen among **interns and postgraduate students (84.1%)**

**Table 1: Awareness levels across academic years**

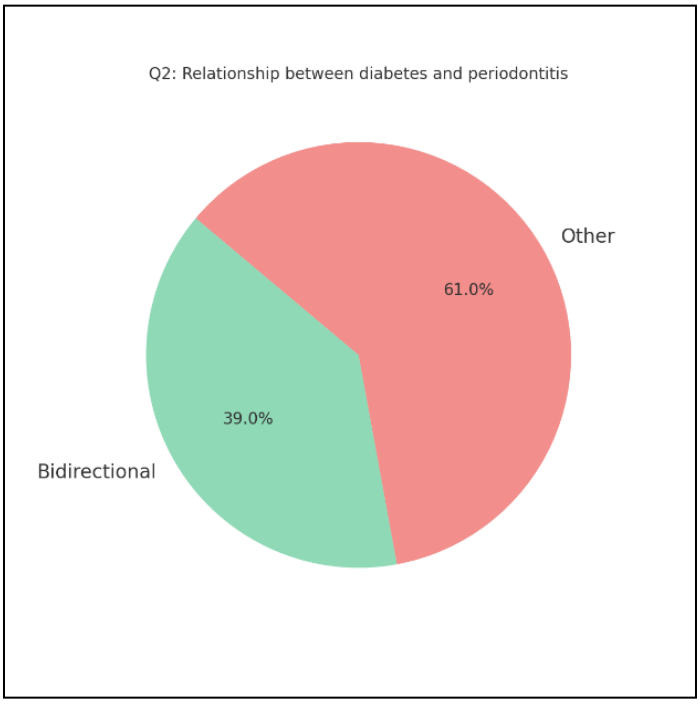
| Academic Year | Students (n) | Adequate Knowledge (%) |
|---|---|---|
| 1st Year | 52 | 33.7 |
| 2nd Year | 42 | 45.2 |
| 3rd Year | 34 | 58.8 |
| 4th Year | 36 | 69.4 |
| Interns/PGs | 36 | 84.1 |

A chi-square test confirmed a **statistically significant association between academic level and awareness** (Chi-square = 42.76, df = 4, $p < 0.001$), indicating that as students advance in their training, their understanding of this systemic–oral health link improves.

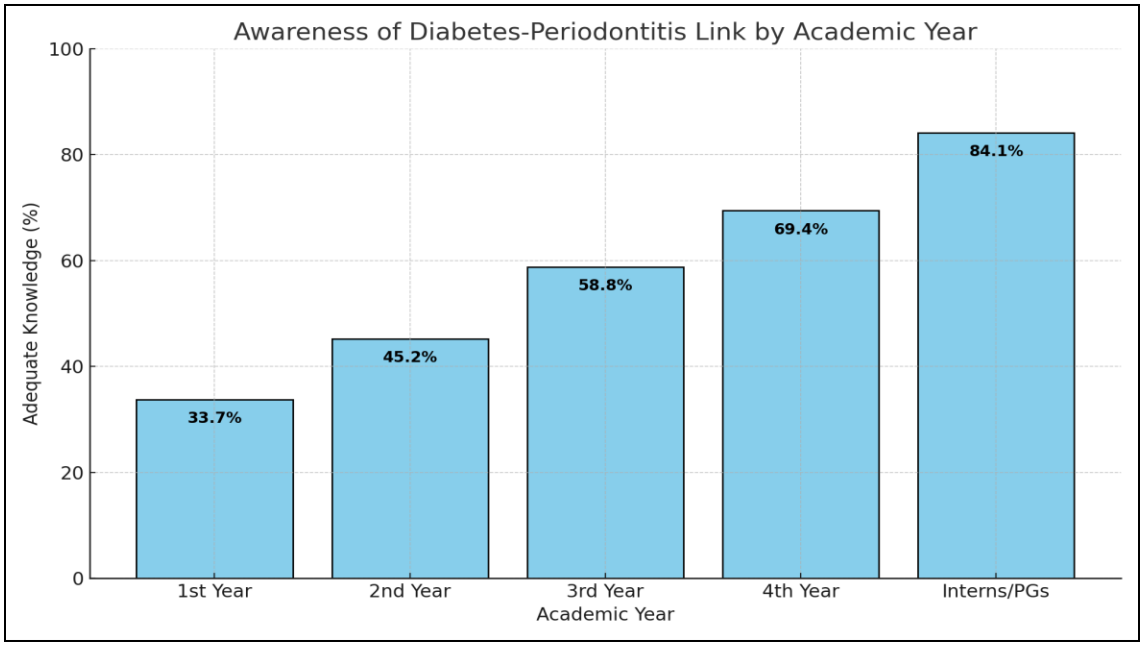



**Graph 2: Awareness about the co-relation between diabetes and periodontitis**

When asked specifically about the bidirectional relationship between diabetes and periodontitis, only **39% of participants** responded correctly (Graph 3). Although this reflects some degree of awareness, it also highlights a substantial knowledge gap, especially among students in the early years of study. Further stratification by academic year (Graph 4) reinforced the same pattern—awareness levels increased progressively as students advanced in their training. Interns and postgraduates showed the highest correct response rate compared to preclinical students.

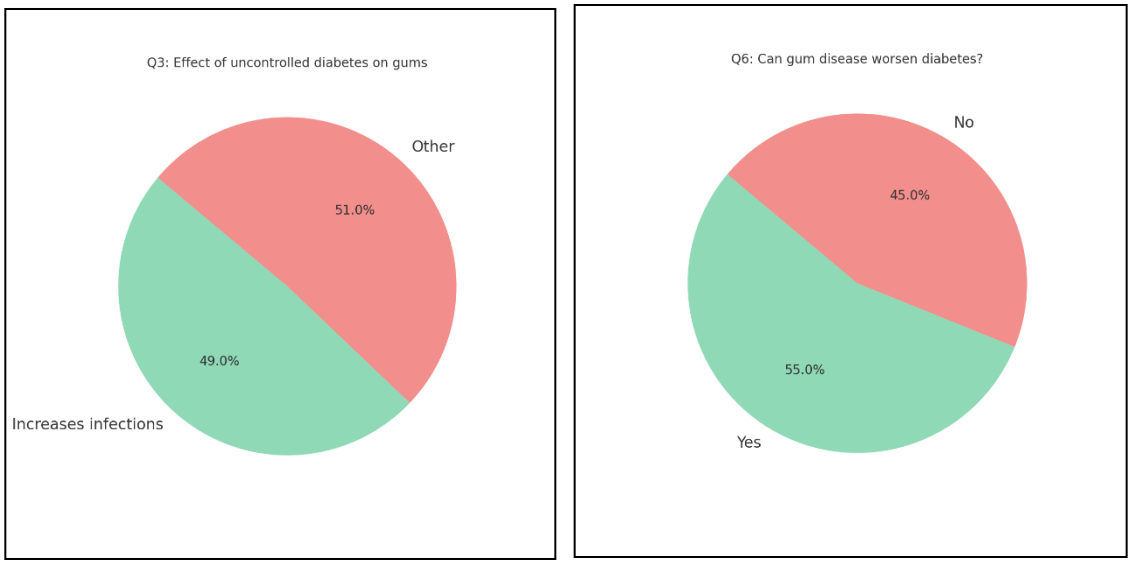



**Graph 3: Knowledge about the relationship between diabetes and periodontitis**




**Graph 4: Awareness of diabetes periodontitis link by academic year**

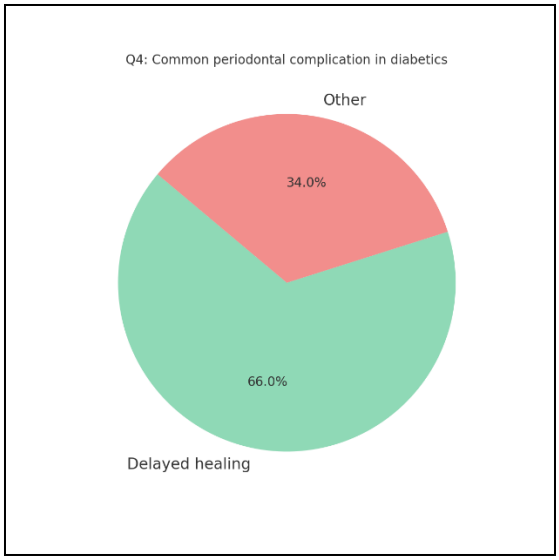
Knowledge of how uncontrolled diabetes affects periodontal health was mixed. **About 49% of students** were aware that poor glycemic control can worsen periodontal outcomes (Graph 5). Additionally, **55% correctly identified that gum disease itself can further deteriorate diabetic control** (Graph 6). Together, these findings suggest that while half of the respondents were aware of the mutual influence of these conditions, a significant proportion still lacked a comprehensive understanding.




**Graph 5 & 6: Knowledge about effect of uncontrolled diabetes on periodontal health**

Only **34% of students** recognized that effective management of periodontitis could lead to improvements in glycemic control. This indicates that while most students understood the negative effects of diabetes on periodontal tissues, fewer were aware of the reverse benefits of periodontal therapy on systemic health.

Most participants (**79%)** agreed that diabetes increases the risk of developing periodontitis, showing a reasonably high level of awareness in this regard. Similarly, **66% of students** knew that **delayed wound healing** is a common complication in diabetic patients with periodontal involvement (Graph 7).




**Graph 7: Knowledge about common periodontal complication in patients with diabetes**

When asked about preventive measures, **56% of respondents** acknowledged that maintaining good oral hygiene practices combined with effective glycemic control can significantly reduce the risk of complications.
These results emphasize the progressive increase in awareness with academic experience but also highlight persistent misconceptions.

## DISCUSSION

The present study demonstrates a clear and encouraging trend: dental students' knowledge and awareness regarding the link between diabetes and periodontitis significantly improve as they get admitted to higher class through their academic years. Interns and final-year dental students demonstrated a significantly high level of understanding about the association between diabetes and periodontal disease when compared to students in the earlier years of their education. This improvement can largely be credited to their broader clinical exposure, where theoretical concepts are no longer just textbook material but are actively applied in patient care. During this stage of training, students frequently interact with such patients who present with systemic health conditions, including diabetes. These experiences help solidify their knowledge, as they begin to see firsthand how systemic diseases can manifest in the oral cavity. Additionally, the opportunity to work closely with mentors during clinical postings allows them to discuss case scenarios, receive immediate feedback, and understand the practical implications of medical-dental interactions. As a result, these students are more likely to appreciate the importance of a holistic approach to dental care, recognizing that managing oral health is not limited to the mouth but intricately connected to the patient's overall health.. This pattern is consistent with findings from previous studies, such as those conducted by Shetgaonkar et al. and Sriram & Kumar, both of which concluded that-students with more clinical experience tend to exhibit a stronger grasp of the oral-systemic health connection, particularly concerning the bidirectional relationship between diabetes and periodontal disease [8,9].

Despite this upward trend, significant knowledge gaps persist—especially among first- and second-year students who are still in the foundational phases of their training. At this stage, the curriculum often emphasizes basic sciences, and the clinical relevance of systemic conditions like diabetes is not yet totally integrated into their understanding of oral diseases. Similar deficiencies in awareness among early-year dental students have been reported in other studies as well. Bahammam and Fatima et al. observed that junior students frequently lacked adequate knowledge about the biological mechanisms linking periodontitis to diabetes and underestimated the clinical significance of this association [10,11].

Biologically, the connection between diabetes and periodontitis is now well recognized and strongly supported by scientific evidence. This relationship works in both directions and is grounded in clear, well-understood physiological processes which explain how one condition can influence the other. On one hand, diabetes—particularly when poorly controlled—can impair host immune responses, reduce neutrophil function, and hinder wound healing, thereby creating an oral environment conducive to periodontal destruction. Chronic inflammation in the periodontal tissues can exacerbate systemic inflammatory load, elevate cytokine levels such as TNF-α and IL-6, and further worsen insulin resistance. These

mechanisms have been discussed by Preshaw et al. and Taylor & Borgnakke, who stressed that effective management of either condition can positively influence the other [3,4].

Reflecting importance of these findings, leading health-organizations have called for an integrated approach to managing diabetes and oral health. The American Diabetes Association (ADA) recommends routine periodontal assessments for individuals with diabetes as part of comprehensive disease management [5]. Likewise, the joint consensus statement released by the European Federation of Periodontology (EFP) and the International Diabetes Federation (IDF) underlines the role of oral healthcare providers in early identification and intervention for diabetic patients [6]. These international endorsements validate the need for association between dental and medical professionals, a message further reinforced by scholars like Lamster et al. and Mealey & Oates, who argue that dentists are not just oral health providers but also integral to systemic disease surveillance and management [13,14].

What's especially encouraging is that clinical research shows taking care of oral health doesn't just improve the mouth—it can also positively impact overall health, particularly in people living with diabetes. A Cochrane systematic review conducted by Simpson et al. revealed that non-surgical periodontal therapy can lead to a modest but meaningful reduction in HbA1c levels—approximately 0.4%—demonstrating that periodontal care plays a tangible role in improving glycemic control [15]. Though modest, this effect is comparable to the impact of adding a second-line antidiabetic medication, further highlighting the clinical value of periodontal intervention.

Given these multidimensional benefits, it becomes imperative to revisit and revise current dental education strategies. The findings of this study, combined with global-literature, make a compelling case for the early inclusion of oral-systemic health concepts—especially the diabetes-periodontitis link—into the undergraduate dental curriculum. Rather than limiting this topic to advanced clinical years or elective modules, should be embedded from the first-year onward to nurture a foundational understanding.

Incorporating innovative teaching methods could bridge existing knowledge gaps. Interactive, case-based learning enables students to apply theoretical knowledge to practical scenarios and strengthens critical thinking. Interprofessional education, where dental students collaborate with medical, nursing, or pharmacy students, promotes holistic understanding and teamwork—skills vital for managing chronic, multifactorial conditions like diabetes. Clinical exposure, even in the preclinical years through observation, simulations, or early patient interaction, can contextualize systemic health in dental practice and enhance student engagement.

In conclusion, while academic progression is positively correlated with increased knowledge and awareness of the diabetes-periodontitis relationship, this improvement should not rely solely on clinical exposure. It is the responsibility of dental institutions to embed systemic health concepts early in the curriculum and reinforce them throughout the educational journey. This not only empowers future dentists with the knowledge to provide comprehensive-care but also contributes to a more integrated healthcare system where oral health is rightfully considered a key component of general well-being.

## CONCLUSION

While dental students demonstrate increasing knowledge about the diabetes-periodontitis relationship with academic level, foundational awareness remains insufficient in early years. This study underscores the importance of restructuring dental curricula to emphasize systemic-disease interactions early and consistently. Doing so will prepare future dentists for more holistic, patient-centered care that acknowledges the inseparable connection between oral and systemic health.

**Recommendations**

- Introduce oral-systemic health modules early in the curriculum.
- Conduct interdisciplinary seminars involving medical and dental students.
- Incorporate case-based clinical discussions focusing on diabetic patients.
- Facilitate periodic workshops and CME sessions on systemic disease correlations.
- Promote awareness through student-led research and outreach programs.

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