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Evaluation Of Knowledge, Attitude And Practices Regarding Periodontal Health Among Dental Undergraduate Students In The City Of Lakes, Bhopal: A Cross-Sectional Study

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Abstract:
Background: *Periodontal diseases are among the most prevalent oral conditions globally, with significant bidirectional associations with systemic diseases. Dental undergraduate students, as future oral health professionals, must possess adequate knowledge, positive attitudes, and appropriate clinical practices (KAP) related to periodontal health. Despite numerous KAP studies conducted globally, data from central India, particularly Bhopal, remain scarce.*
Materials and Methods: *A cross-sectional online survey was conducted among dental undergraduate students and interns from dental colleges in Bhopal (n = 1506) using convenience sampling. Sample size was calculated using OpenEpi Version 3 (minimum required n = 165). A structured 10-item Google Forms questionnaire assessed knowledge, attitude, and practices. Data were analyzed using IBM SPSS v30.0 with descriptive statistics, one-way ANOVA, and Pearson's correlation; $p < 0.05$ was significant.*
Results: *Of 1506 participants, 69.2% were female and 60.6% were aged 21–23 years. Knowledge was adequate for etiology (74.4%) and systemic associations (82.7%), but moderate for diagnosis (65.1%). Attitudes were predominantly positive (78–85% agreement). Practice was moderate: only 41.2% always advised patients on oral hygiene and 58.2% had not attended a CDE program in the past year. KAP scores improved significantly with academic year ($p = 0.001$), with interns performing best.*
Conclusion: *Dental students in Bhopal demonstrate adequate knowledge and positive attitudes but suboptimal clinical practice. Strengthening clinical training and continuing dental education is essential to bridge the knowledge-practice gap.*
Key Words: *Knowledge; Attitude; Practice; KAP; Periodontal health; BDS students; Cross-sectional study; Bhopal; Dental education.*

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I. Introduction

Periodontal disease encompasses a spectrum of inflammatory conditions of the supporting structures of the teeth, ranging from reversible gingivitis to irreversible periodontitis, and represents one of the most prevalent chronic diseases worldwide.[1] The pathogenesis involves complex interactions between subgingival microbial biofilm and the host immune-inflammatory response, resulting in progressive destruction of the periodontal ligament and alveolar bone.[1] Beyond oral consequences, periodontitis has well-established bidirectional associations with several systemic conditions. A strong link exists between periodontitis and diabetes mellitus, wherein periodontal infection worsens glycemic control and diabetes accelerates periodontal destruction.[2,3] Similarly, periodontal pathogens and associated inflammatory mediators have been implicated in the pathogenesis of cardiovascular diseases, adverse pregnancy outcomes including preterm birth and low birth

weight, and respiratory infections.[4,5] These associations underscore the importance of periodontal health as an integral component of overall systemic health.

Dental professionals serve as primary advocates and educators for oral health within the community. It has been well-established that the oral health knowledge, attitudes, and practices of dental students significantly influence their capacity to educate patients and promote preventive care.[6] Studies conducted among dental undergraduates across various countries have consistently demonstrated that KAP levels improve progressively with academic advancement, reflecting the positive impact of clinical training and curriculum exposure.[7,8,9] However, despite adequate theoretical knowledge, a persistent knowledge-practice gap has been observed, wherein students fail to consistently translate awareness into clinical behaviour — particularly in areas such as patient oral hygiene counselling, interdisciplinary referral, and personal preventive dental care.[10,11]

Several KAP studies on periodontal health have been conducted among medical students, nursing professionals, and dental practitioners in various parts of India and globally.[12,13] However, data specifically addressing dental undergraduate students in Bhopal — a city housing multiple dental institutions affiliated with various universities in Madhya Pradesh — remain limited. Furthermore, no large-scale, multi-college KAP survey targeting BDS students across all academic years, including interns, has been reported from central India.[14,15] The present study was therefore undertaken to assess KAP regarding periodontal health among dental undergraduate students in Bhopal, identify existing gaps, and lay the groundwork for a planned national multi-institutional study to generate representative data for evidence-based dental curriculum reform.

II. Aim And Objectives

Aim: To evaluate the knowledge, attitude, and practices (KAP) regarding periodontal health among dental undergraduate students in Bhopal, Madhya Pradesh.

Objectives:

1. To assess KAP regarding periodontal health among BDS students and interns.
2. To compare KAP scores across different academic years (BDS 1st year to internship).
3. To identify gaps in periodontal education and propose recommendations for curriculum improvement.
4. To establish a baseline for a future national multi-institutional KAP study across dental colleges in India.

III. Materials And Methods

Study Design: A cross-sectional, questionnaire-based online survey was conducted among dental undergraduate students and interns enrolled in dental colleges in Bhopal, Madhya Pradesh, India.

Study Population and Sampling: A total of 1506 dental students from BDS 1st year through final year and internship were included using convenience sampling. Participation was voluntary and informed consent was obtained implicity through voluntary survey completion.

Sample Size Calculation: Sample size was calculated using OpenEpi Version 3 for estimation of proportion in a population. Assuming a hypothesized prevalence of 50%, confidence level 95%, power of 80%, absolute precision of 5%, and a design effect of 1, the minimum required sample size was calculated to be 165 participants. The final study sample of 1506 participants substantially exceeded this requirement, enhancing the statistical power and representativeness of the findings.

Data Collection Tool: A structured, self-administered questionnaire was distributed via Google Forms comprising 10 items in four sections:

Section A – Demographic Details (4 items).: Age, Gender, Academic Year, Clinical Posting in Periodontology.

Section B – Knowledge (3 items): Primary etiology of periodontal disease; systemic associations of periodontitis; gold standard for periodontal diagnosis.

Section C – Attitude (4 items): Likert-scale statements (Strongly Disagree to Strongly Agree) regarding the systemic relevance of periodontal health, universal periodontal screening, interdisciplinary management, and value of early diagnosis.

Section D – Practices (3 items): Frequency of advising patients on oral hygiene; attendance at CDE programmes; personal dental check-up habits.

Inclusion Criteria:

1. Dental undergraduate students (BDS 1st year, 2nd year, 3rd year, Final year) and interns enrolled in dental colleges in Bhopal, Madhya Pradesh.
2. Students willing to voluntarily participate and provide informed consent.
3. Students who completely filled the online questionnaire.

4. Students from all genders and age groups.
5. Students with access to internet or smartphone for online survey participation.

Exclusion Criteria:
1. Students who submitted incomplete or partially filled questionnaire responses.
2. Students who were unwilling to participate in the study.
3. Students from dental colleges outside Bhopal city.
4. Postgraduate dental students (MDS) and teaching faculty.
5. Students who had participated in a similar KAP survey within the preceding 3 months to avoid recall bias.

Statistical Analysis: Data were entered into Microsoft Excel and analysed using IBM SPSS Statistics version 30.0. Descriptive statistics were expressed as mean and standard deviation (SD) for continuous variables, and as frequency and percentage for categorical variables. The relationship between age and periodontal health awareness, as well as age and periodontal health practice, was assessed using Pearson's correlation coefficient (r), as the variables were continuous and normally distributed. One-way ANOVA was used to compare mean KAP scores across academic years. A p-value of < 0.05 was considered statistically significant.

IV. Results And Observations

A total of 1506 dental undergraduate students and interns from various dental colleges in Bhopal participated in the present cross-sectional study. All 1506 responses were complete and included in the final analysis.

Table 1. Age-wise Distribution of Study Participants (n = 1506)

Age Group (years)	Frequency (n)	Percentage (%)
18–20	283	18.8
21–23	913	60.6
24–26	272	18.1
27–30	38	2.5
Total	1506	100.0

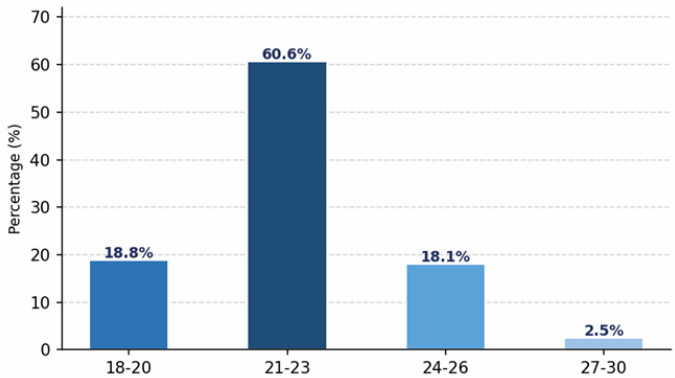

Figure 1. Age-wise Distribution of Study Participants (n = 1506)

Table 1 illustrates the age-wise distribution of study participants. The majority of participants belonged to the 21–23 years age group (60.6%), followed by those in the 18–20 years (18.8%) and 24–26 years (18.1%) categories. A very small proportion of participants (2.5%) were aged between 27–30 years. This distribution indicates that most respondents were in the mid-phase of their undergraduate dental education, which typically corresponds to increased academic and initial clinical exposure. (Figure 1)

Table 2. Gender-wise Distribution of Study Participants (n = 1506)

Gender	Frequency (n)	Percentage (%)
Male	464	30.8
Female	1042	69.2
Total	1506	100.0

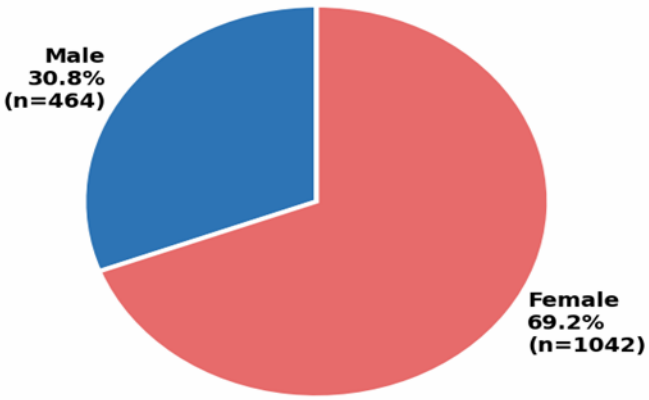

Figure 2. Gender-wise Distribution of Study Participants (n = 1506)

Table 2 presents the gender-wise distribution of study participants. The majority of participants were female (69.2%), while male participants constituted 30.8% of the total sample. This indicates a higher representation of female students in the study population. (Figure 2)

Table 3. Distribution of Study Participants According to Academic Year (n = 1506)

Academic Year	Frequency (n)	Percentage (%)
BDS 1st Year	284	18.9
BDS 2nd Year	415	27.6
BDS 3rd Year	336	22.3
Final Year	181	12.0
Intern	290	19.3
Total	1506	100.0

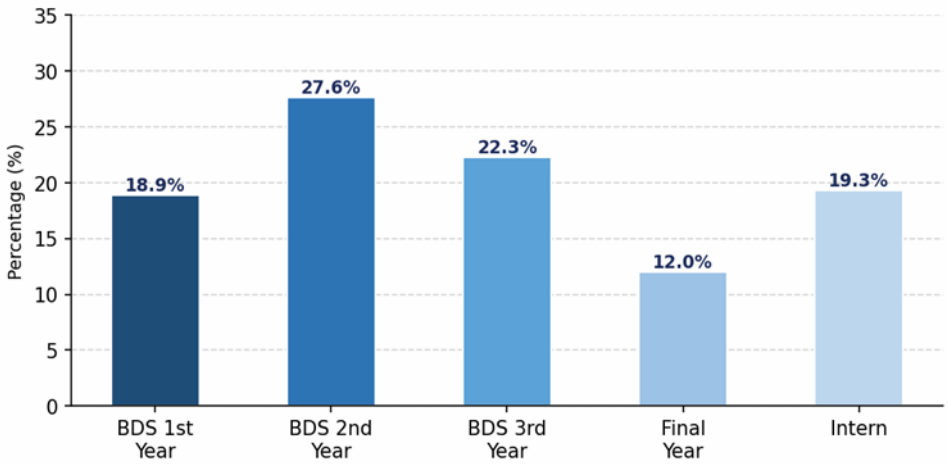

Figure 3. Distribution of Study Participants According to Academic Year (n = 1506)

Table 3 shows the distribution of participants according to academic year. The highest proportion of participants belonged to the second year (27.6%), followed by third-year students (22.3%) and interns (19.3%). First-year students accounted for 18.9%, while the final year had the least representation (12.0%). This distribution reflects a relatively balanced representation across different academic levels, with a slight predominance of preclinical and early clinical students. (Figure 3)

Table 4. Distribution of Study Participants according to Clinical Posting in Periodontology (n = 1506)

Clinical Posting	Frequency (n)	Percentage (%)
No	877	58.2
Yes	629	41.8
Total	1506	100.0

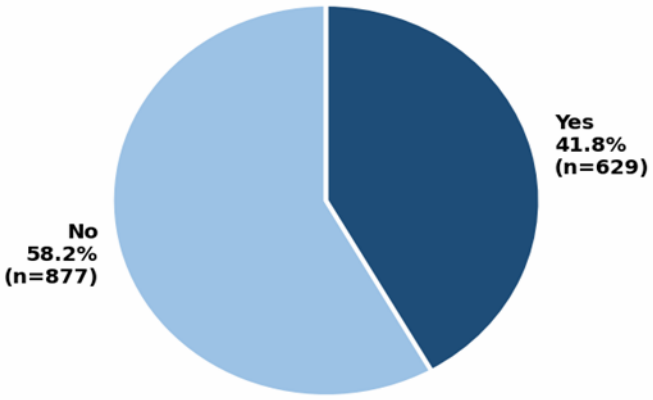

Figure 4. Distribution of Study Participants according to Clinical Posting in Periodontology (n = 1506)

Table 4 depicts the distribution of participants based on clinical posting in Periodontology. A majority of participants (58.2%) reported not having undergone clinical postings, whereas 41.8% had clinical exposure in Periodontology. This suggests that a considerable proportion of students were yet to gain hands-on clinical experience in periodontal care. (Figure 4)

Table 5. Frequency Distribution of Knowledge Responses Regarding Periodontal Health (n = 1506)

Knowledge Question	Option	n (%)
Q1. Primary etiological factors of periodontal disease	Trauma from occlusion	210 (13.9)
	Dental plaque biofilm	1120 (74.4)
	Calculus	120 (8.0)
	Systemic disease	56 (3.7)
Q2. Periodontitis is associated with	Diabetes mellitus	110 (7.3)
	Cardiovascular disease	85 (5.6)
	Preterm low birth weight	66 (4.4)
	All of the above	1245 (82.7)
Q3. Gold standard for diagnosis of periodontitis	Bleeding on probing	180 (12.0)
	Clinical attachment loss	980 (65.1)
	Tooth mobility	210 (13.9)
	Radiograph	136 (9.0)

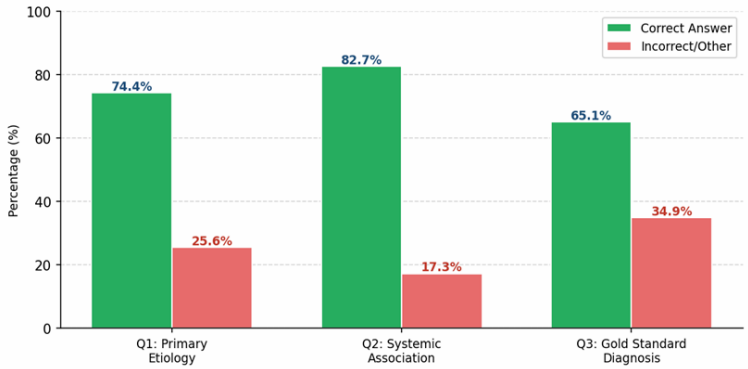

Figure 5. Frequency Distribution of Knowledge Responses Regarding Periodontal Health (n = 1506)

Table 5 presents the frequency distribution of knowledge responses regarding periodontal health among the study participants. A majority of participants (74.4%) correctly identified dental plaque biofilm as the primary etiological factor of periodontal disease, while smaller proportions selected trauma from occlusion (13.9%), calculus (8.0%), and systemic disease (3.7%).

With respect to the association of periodontitis with systemic conditions, a substantial proportion (82.7%) correctly responded with "all of the above," indicating good awareness regarding its link with diabetes mellitus, cardiovascular disease, and preterm low birth weight. However, a minority selected individual options such as diabetes mellitus (7.3%), cardiovascular disease (5.6%), and preterm low birth weight (4.4%).

Regarding the gold standard for diagnosis of periodontitis, 65.1% of participants correctly identified clinical attachment loss, whereas others selected bleeding on probing (12.0%), tooth mobility (13.9%), and radiograph (9.0%).

Overall, the findings suggest that while the majority of participants demonstrated adequate knowledge regarding the etiology and systemic associations of periodontal disease, comparatively lower awareness was observed in identifying the gold standard diagnostic criterion, indicating areas for improvement in clinical understanding. (Figure 5)

Table 6. Frequency Distribution of Attitude Responses Regarding Periodontal Health (n = 1506)

Attitude Question	Strongly Disagree n (%)	Disagree n (%)	Neutral n (%)	Agree n (%)	Strongly Agree n (%)
Q4. Periodontal health influences systemic health	30 (2.0)	85 (5.6)	210 (13.9)	720 (47.8)	461 (30.6)
Q5. Periodontal screening for every patient	25 (1.7)	70 (4.6)	180 (12.0)	760 (50.5)	471 (31.2)
Q6. Interdisciplinary management improves outcomes	20 (1.3)	60 (4.0)	190 (12.6)	780 (51.8)	456 (30.3)
Q7. Early diagnosis prevents destruction	18 (1.2)	55 (3.6)	160 (10.6)	800 (53.1)	473 (31.4)

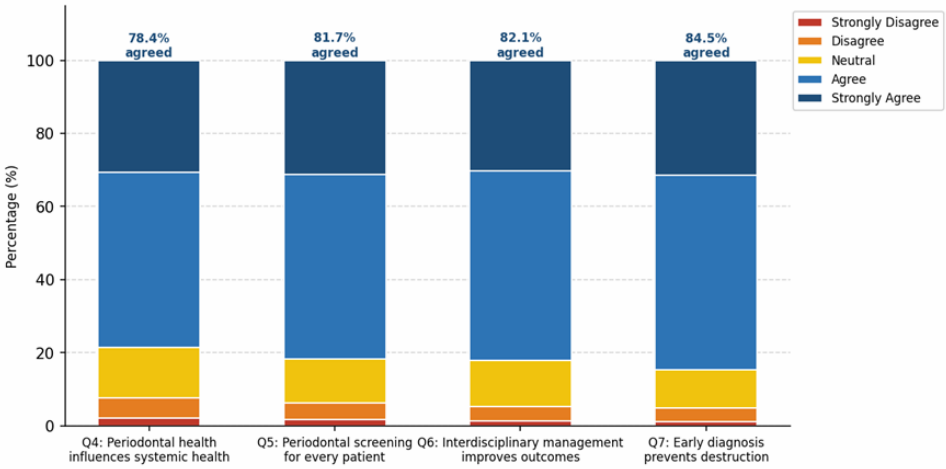

Figure 6. Frequency Distribution of Attitude Responses Regarding Periodontal Health (n = 1506)

Table 6 presents the attitude of study participants toward periodontal health. A majority of participants exhibited a positive attitude across all statements. Regarding the influence of periodontal health on systemic health, most participants 78.4% (either agreed or strongly agreed) , indicating good awareness of the oral-systemic link.

Similarly, 81.7% of participants (agree + strongly agree) supported the need for periodontal screening for every patient, reflecting a strong preventive outlook. In terms of interdisciplinary management, a substantial proportion (51.8% agreed and 30.3% strongly agreed) acknowledged its role in improving periodontal outcomes.

Furthermore, the importance of early diagnosis was well recognized, with 53.1% agreeing and 31.4% strongly agreed that early diagnosis prevents advanced periodontal destruction. Only a minimal percentage of participants expressed disagreement across all attitude parameters.

Overall, the findings demonstrate a predominantly positive attitude toward periodontal health and its clinical significance among dental students. (Figure 6)

Table 7. Distribution of Practice-related Responses among Study Participants (n = 1506)

Variable	Response	n	%
(Q8) Advising patients regarding oral hygiene	Always	620	41.2
	Sometimes	580	38.5
	Rarely	210	13.9
	Never	96	6.4
(Q9) Attended periodontal CDE program in last 1 year	Yes	629	41.8
	No	877	58.2
(Q10) Frequency of own dental check-up	6 monthly	410	27.2
	Yearly	520	34.5
	Only when problem	480	31.9
	Never	96	6.4

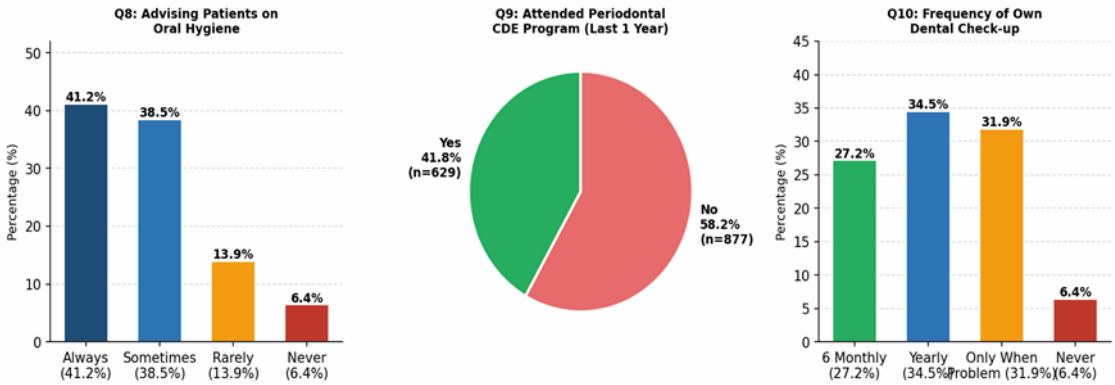

Figure 7. Distribution of Practice-related Responses among Study Participants (n = 1506)

Table 7 illustrates the practice-related responses of the study participants. Regarding patient education, 41.2% of participants reported always advising patients about oral hygiene practices, while 38.5% did so sometimes, indicating that the majority were engaged in patient education to some extent. However, a notable proportion reported rarely (13.9%) or never (6.4%) advising patients. With respect to professional development, only 41.8% of participants had attended a periodontal continuing dental education (CDE) program in the past year, whereas 58.2% had not, suggesting limited participation in continuing education activities. In terms of personal oral health practices, the majority of participants reported visiting a dentist either yearly (34.5%) or only when experiencing a problem (31.9%), while 27.2% followed a 6-monthly check-up schedule. A small proportion (6.4%) reported never undergoing dental check-ups. Overall, while participants demonstrated moderately good clinical practices, there remains scope for improvement in consistent patient education, continuing education participation, and preventive dental behaviour.

Table 8. Comparison of Mean Knowledge, Attitude, and Practice Scores across Academic Years with One-way ANOVA (n = 1506)

Academic Year	n	Knowledge (Mean ± SD)	Attitude (Mean ± SD)	Practice (Mean ± SD)
BDS 1st Year	284	1.52 ± 0.85	15.48 ± 3.09	6.16 ± 1.54
BDS 2nd Year	415	1.63 ± 0.92	15.55 ± 3.22	6.36 ± 1.44
BDS 3rd Year	336	1.76 ± 0.83	15.86 ± 3.43	6.86 ± 1.40
Final Year	181	1.89 ± 0.87	15.92 ± 3.57	6.99 ± 1.37
Intern	290	2.17 ± 0.95	16.71 ± 3.04	7.54 ± 1.15
Total	1506	1.77 ± 0.92	15.86 ± 3.27	6.73 ± 1.49
F-value		24.56	7.04	49.71
p-value		0.001*	0.001*	0.001*

**Statistically significant*

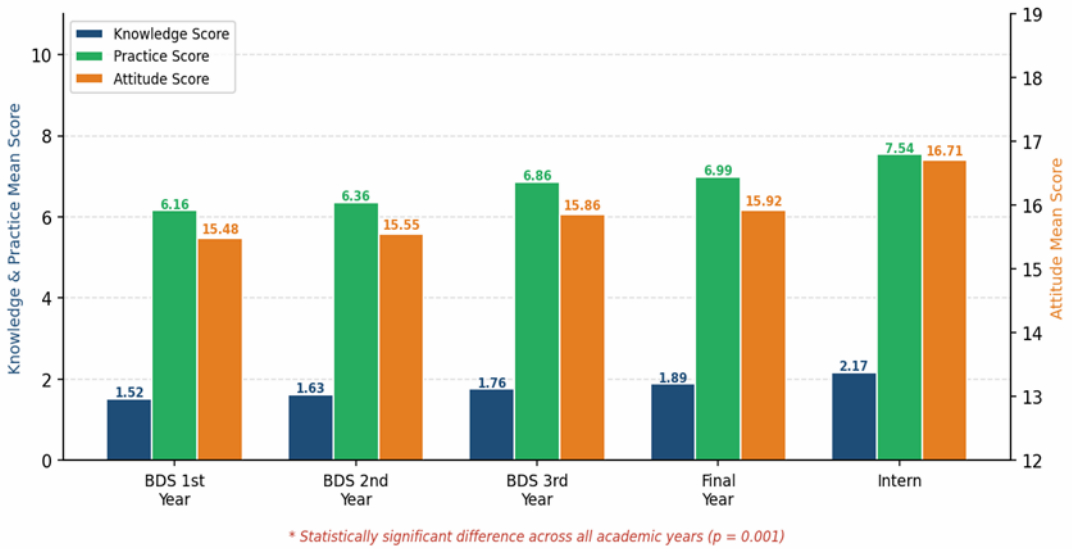

Figure 8. Comparison of Mean Knowledge, Attitude, and Practice Scores across Academic Years with One-way ANOVA (n = 1506)

Table 8 shows the comparison of mean knowledge, attitude, and practice scores across different academic years using one-way ANOVA. A statistically significant difference was observed in all three domains — knowledge, attitude, and practice — across academic levels (p = 0.001).

The mean knowledge score demonstrated a progressive increase from BDS 1st year (1.52 ± 0.85) to interns (2.17 ± 0.95), indicating improvement in theoretical understanding with advancing academic level. Similarly, the attitude scores were highest among interns (16.71 ± 3.04), reflecting a more positive perception toward periodontal health among students with greater clinical exposure.

The practice scores also showed a steady rise across academic years, with interns recording the highest mean score (7.54 ± 1.15), followed by final-year and third-year students. First- and second-year students exhibited comparatively lower practice scores, suggesting limited clinical application at earlier stages of training.

Overall, the findings indicate that knowledge, attitude, and practice related to periodontal health improve significantly with increasing academic level and clinical exposure, with interns demonstrating the most favorable outcomes across all domains.

Table 9. Correlation between Knowledge, Attitude, and Practice Scores (n = 1506)

Variables	Knowledge (K)	Attitude (A)	Practice (P)
Knowledge (K)	1	0.226**	0.132**
Attitude (A)	0.226**	1	0.112**

Practice (P)	0.132**	0.112**	1

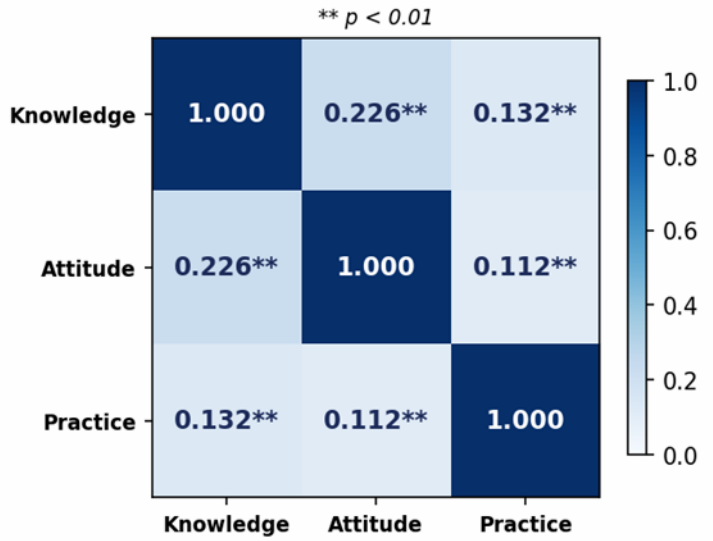

*Figure 9. Pearson Correlation Heatmap between KAP Domains (** p < 0.01)*

Table 9 depicts the correlation between knowledge, attitude, and practice scores among the study participants. A statistically significant positive correlation was observed between all three domains.

The correlation between knowledge and attitude was weak but significant ($r = 0.226$, $p < 0.01$), indicating that participants with higher knowledge levels tended to have a more positive attitude toward periodontal health. Similarly, a positive correlation was found between knowledge and practice ($r = 0.132$, $p < 0.01$), suggesting that better knowledge is associated with improved clinical practices.

Additionally, the correlation between attitude and practice ($r = 0.112$, $p < 0.01$) was also weak but statistically significant, implying that a positive attitude may contribute to better periodontal health practices.

Overall, although all correlations were statistically significant, their weak strength indicates that factors beyond knowledge and attitude — such as clinical exposure and training — may play a crucial role in influencing practice behaviours.

V. Discussion

This cross-sectional study evaluated KAP related to periodontal health among 1506 dental undergraduate students and interns across dental colleges in Bhopal — representing one of the largest such datasets from central India. The findings of adequate knowledge, positive attitude, but moderate and inconsistent clinical practices are consistent with patterns reported in similar KAP studies conducted among dental students globally.[8,9,10]

Regarding knowledge, 74.4% of participants correctly identified dental plaque biofilm as the primary etiological factor of periodontal disease. This finding is consistent with Al-Zawawi et al., who demonstrated that 90.9% of students exposed to periodontal courses correctly identified plaque as the primary risk factor, whereas 86.4% of unexposed students incorrectly chose caries — highlighting the critical role of periodontal education in shaping accurate etiological knowledge.[13] The high awareness of systemic associations (82.7%) in the present study is comparable to findings of Vishalakshy et al., who reported that clinical students were 2.4 times more aware of periodontal health than preclinical students.[7] However, the moderate identification of clinical attachment loss as the diagnostic gold standard (65.1%) aligns with Ahamed et al., who noted that clinical dental students demonstrated significantly better diagnostic knowledge than preclinical students.[24] Similar knowledge gaps across academic levels were also reported by Panguluri et al. among dental students.[16]

The attitude domain was the strongest performer in the present study, with 78–85% of participants expressing agreement or strong agreement across all four Likert-scale items. This aligns with Belludi et al., who observed that as the education level increased among interns, postgraduates, and academicians, attitudes toward oral health also improved progressively.[8] Jadhav et al. similarly found that first-year dental students demonstrated a more positive attitude toward periodontal diseases compared to students from medical, pharmacy, physiotherapy, and nursing faculties — confirming that even early dental education instils a favourable professional orientation.[15] The positive attitudes observed across all academic years in our study are also consistent with Aljrais et al., who found no statistically significant difference in attitude scores between

dental and pharmacy students despite significant knowledge differences, suggesting that attitude may be influenced by factors beyond formal dental education.[11]

Practice scores identified the most significant gaps in the present study. The finding that 20.3% of students rarely (13.9%) or never (6.4%) counselled patients on oral hygiene is clinically significant, as oral hygiene instruction is a cornerstone of preventive periodontal care. Ahmad et al. similarly reported that despite significant improvement in knowledge and attitude scores across academic levels, oral hygiene practice scores of postgraduate residents were statistically lower than undergraduate clinical students, attributed to higher stress levels.[9] Only 41.8% of participants had attended a CDE program in the past year, reflecting limited engagement with continuing professional development — a pattern consistent with Khanna et al., who observed that 45.5% of dental domain participants visited the dentist only when a problem arose and only 30.2% maintained 6-monthly check-up schedules.[10] Shahid et al. confirmed that while dental students exhibit the highest knowledge and practice scores among healthcare students, practice gaps persist even within the dental cohort, necessitating targeted behavioural interventions.[14] Onwubu et al. and Guan et al. similarly highlighted that practice behaviour is influenced by factors beyond knowledge and attitude, including institutional environment, peer behaviour, and individual motivation.[17,18]

The progressive, statistically significant improvement in all KAP domains from BDS 1st year to internship ($p = 0.001$) reinforces the critical role of clinical exposure and curriculum progression in shaping periodontal health behaviour. Interns consistently outperformed all other academic groups across knowledge (2.17 ± 0.95), attitude (16.71 ± 3.04), and practice (7.54 ± 1.15) domains. This mirrors findings from Vishalakshy et al., who reported interns to be 2.56 times more aware of periodontal health than students, with a statistically significant p-value < 0.01.[7] Al-Zawawi et al. confirmed that 68.3% of students with periodontal course exposure reported that it positively influenced their daily self-care practices.[13] Ahamed et al. similarly demonstrated that clinical dental students had significantly better oral health knowledge, attitude, and behaviour than preclinical students.[24] Panguluri et al. and Dayakar et al. also documented significant KAP differences across academic levels among professional students.[16,19]

The weak but statistically significant positive correlations between all KAP domains ($r = 0.112–0.226$, $p < 0.01$) confirm the multi-factorial nature of oral health behaviour among dental students. Guan et al. reported comparable weak correlations between knowledge and practice among medical college undergraduates, emphasizing that knowledge acquisition alone does not translate linearly into behavioural change.[17] Onwubu et al. similarly concluded that adequate knowledge does not guarantee good dental practices, with utilization of dental care remaining low despite high knowledge levels among university students.[18] Karaca and Bakir further demonstrated that among health field students, attitude scores did not always correspond with practice improvement, reinforcing the need for competency-based training and mentorship to bridge the knowledge-practice gap.[21]

Limitations of this study include its cross-sectional design, which precludes causal inference, and the use of convenience sampling, which may limit generalizability. Self-reported data may carry social desirability bias. Future studies should employ validated objective clinical assessments and longitudinal designs to track KAP trajectories across the dental training continuum. The planned national multi-institutional study will address these limitations by including a larger, geographically diverse sample across dental colleges in India.

VI. Conclusion

Dental undergraduate students and interns in Bhopal demonstrate adequate knowledge and predominantly positive attitudes toward periodontal health; however, clinical practice behaviour remains moderate and inconsistent. KAP scores improve significantly with advancing academic level and clinical exposure, with interns performing best across all domains — confirming the vital role of clinical training in translating knowledge into practice. The knowledge-practice gap identified underscores the urgent need for strengthening clinical training, increasing access to continuing dental education programs, and integrating competency-based periodontal practice into the undergraduate curriculum. These findings establish an important baseline for a larger national multi-institutional study aimed at generating evidence-based recommendations for periodontal education reform across India.

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Conflict of Interest: The authors declare no conflict of interest.

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