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Dentists' Awareness, Knowledge, Attitudes, and Clinical Periodontal Practices Regarding Oral Healthcare for Individuals with Alzheimer's Disease: A Multi-national Cross-sectional Survey

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ABSTRACT

Objectives: This study assessed dentists' awareness, knowledge, attitudes, and self-reported clinical practices regarding oral and periodontal care in individuals with Alzheimer's disease (AD), and identified demographic and professional factors associated with higher awareness.

Materials and Methods: A cross-sectional questionnaire-based survey was conducted over one year among practicing dentists recruited through online professional networks and social media. A total of 450 complete responses were analyzed. The questionnaire assessed socio-demographic and professional characteristics, as well as AD–periodontal disease awareness, using a 10-item score of knowledge, attitudes, and clinical practices. Knowledge was categorized as poor (0–3), moderate (4–6), or good (7–10). Descriptive statistics, chi-square tests, Mann–Whitney U/Kruskal–Wallis tests, and binary logistic regression were used. Statistical significance was set at $p < 0.05$.

Results: Of the 450 dentists, 57.8% were aware of the relationship between AD and periodontal disease, while 66.7% believed that an association exists. Only 40.0% had read scientific literature on the topic and 26.7% had received formal education. Knowledge was predominantly moderate (46.7%), with a mean score of 5.4 ± 2.1/10. Attitudes were generally favorable: 62.2% agreed that periodontal disease may contribute to AD progression, and 82.2% expressed a need for further education. However, only 33.3% reported discussing AD risk with patients. Awareness was significantly associated with years of experience, qualification, and specialty. Regression analysis showed that >10 years of experience, periodontist specialty, and higher educational attainment were independently associated with higher awareness.

Conclusions: Dentists demonstrated moderate awareness and knowledge and generally positive attitudes, but clinical application was limited. Greater experience, postgraduate education, and periodontal specialization were associated with higher awareness. Strengthening dental education and interdisciplinary oral–systemic care may improve the integration of AD-related oral health considerations into dental practice.

Keywords: Alzheimer's disease, periodontal disease, Oral–systemic health, Dentists, Awareness, Knowledge, Cross-sectional study.

1. Introduction

Alzheimer's disease (AD) is a progressive neuro-degenerative disorder and the most common cause of dementia worldwide, characterized by cognitive decline, memory impairment, and functional deterioration. It represents a major global public-health challenge, particularly with the rapid ageing of populations, and its burden is expected to increase substantially in the coming decades (1,2). The pathophysiology of AD is complex and multi-factorial, involving the accumulation of amyloid-β plaques, neurofibrillary tangles, neuro-inflammation, and neuronal loss (3).

Periodontal disease is a chronic inflammatory condition affecting the supporting structures of the teeth and is highly prevalent among adults globally (4,5). It is initiated by microbial biofilms and characterized by a host-mediated inflammatory response that leads to progressive tissue destruction and alveolar bone loss (6). Beyond its local effects, periodontal disease has been increasingly recognized as a potential contributor to systemic conditions, including cardiovascular disease, diabetes mellitus, and adverse pregnancy outcomes (7,8).

In recent years, growing evidence has highlighted a possible association between periodontal disease and AD, emphasizing the role of chronic inflammation and microbial dissemination in neuro-degenerative processes (9). Periodontal pathogens, particularly *Porphyromonas gingivalis*, have been identified in the brains of patients with AD, suggesting a potential mechanistic link between oral infection and neuro-inflammation (10). Furthermore, systemic inflammatory mediators originating from periodontal tissues may contribute to blood–brain barrier disruption and promote neuro-degenerative changes (11). Emerging evidence suggests that this association may be mediated through multiple biological pathways, including systemic inflammation, direct bacterial translocation, and amyloid-β dysregulation, supporting a multi-factorial oral-brain axis (12).

Epidemiological studies have reported that individuals with poor oral health or chronic periodontitis may have an increased risk of cognitive decline and dementia (13,14). Although the exact causal relationship remains under investigation, the oral–systemic connection between periodontal disease and AD has gained significant attention in both dental and medical research communities (15).

Dentists play a crucial role in the early identification and management of periodontal disease and may contribute to the prevention or mitigation of systemic complications associated with chronic oral inflammation (16). Therefore, adequate awareness and knowledge of the potential relationship between periodontal disease and AD are essential to support comprehensive patient care and interdisciplinary collaboration.

Despite growing scientific interest in the potential oral-systemic relationship between periodontal disease and AD, limited research has evaluated dentists' awareness, knowledge, attitudes, and clinical periodontal practices relevant to patients with AD, particularly in relation to demographic and professional characteristics (16,17). Identifying gaps in dentists' knowledge and awareness, as well as differences in attitudes and reported clinical practices, may help guide future educational and clinical training strategies.

Accordingly, it was hypothesized that dentists with greater clinical experience, postgraduate qualifications, and periodontal specialty would demonstrate significantly higher awareness, knowledge, and better clinical practices regarding Alzheimer's disease and periodontal health.

2. Materials and Methods

2.1 Study Design and Setting

This study was designed as a cross-sectional, questionnaire-based survey conducted over a period of one year among dental professionals. The questionnaire was distributed to practicing dentists from different countries in Libya to ensure a diverse sample representing various clinical backgrounds, levels of experience, and practice settings.

2.2 Study Population and Sampling

The target population included licensed dentists actively engaged in clinical practice. Participants were recruited using a non-probability convenience sampling technique through online distribution channels.

The sample size was determined using the standard formula for cross-sectional studies:

$$n = (Z^2 \times p(1 - p)) / d^2$$

where: n = required sample size.

Z = Z-score for 95% confidence level (1.96).

p = expected proportion (0.5, due to lack of prior data).

d = margin of error (0.05).

Based on this calculation, the minimum required sample size was 384 participants. To improve statistical power and compensate for incomplete responses, 450 fully completed questionnaires were included in the final analysis.

2.3 Questionnaire Development

The questionnaire was developed based on previously published studies assessing dentists' knowledge and awareness of oral–systemic health relationships, particularly the association between periodontal disease and systemic conditions.

The questionnaire was developed specifically for the present study rather than adopting a single standardized instrument, because the study aimed to assess several distinct domains: awareness, knowledge, attitudes, and clinical practices, specific to Alzheimer's disease and periodontal care (16-20). Items were informed by previously published oral–systemic health literature and adapted to the study objectives. Content review by dental and public-health experts was used to assess clarity, relevance, and appropriateness. However, because formal psychometric validation statistics were not reported in the current study, the instrument should not be described as a fully validated standardized questionnaire.

The final instrument consisted of five sections:

- Socio-demographic and professional characteristics.
- Awareness of the Alzheimer's disease–periodontal disease (AD–PD) association.
- Knowledge assessment (scored items).
- Attitudes toward the AD–PD relationship.
- Clinical practice-related questions.

Content validity was ensured through review by experts in dentistry and public health, who evaluated clarity, relevance, and appropriateness of the items.

2.4 Data Collection Procedure

The questionnaire was distributed electronically using an online survey platform (e.g., Google Forms). The survey link was shared through professional networks and social media platforms targeting dental practitioners across multiple countries.

Participation was voluntary, and informed consent was obtained from all participants prior to completing the survey.

2.5 Ethical Considerations

Ethical approval for the study was obtained from the appropriate institutional review board. The study adhered to the principles of the Declaration of Helsinki. All responses were anonymous, and confidentiality of participant information was strictly maintained.

2.6 Variables and Scoring System

For the purpose of this study, awareness referred primarily to participants' recognition and exposure to information concerning the potential AD–periodontal disease relationship, whereas knowledge referred to participants' factual understanding assessed through scored knowledge items. Attitudes represented participants' perceptions and opinions regarding the relationship and the dentist's role, while clinical practices represented self-reported actions undertaken in dental practice.

Awareness was assessed using dichotomous (Yes/No) items addressing dentists' recognition of the potential relationship between Alzheimer's disease and periodontal disease, their belief regarding the existence of such a relationship, exposure to scientific literature on the topic, and previous formal education. A composite awareness score was calculated from the awareness items and categorized into low, moderate, and high awareness. The numerical cut-off points used to define these categories should be reported explicitly based on the original scoring key.

Knowledge was assessed using a structured 10-item score addressing factual understanding of Alzheimer's disease, periodontal disease, and their potential oral-systemic relationship. Each knowledge item contributed to a total score ranging from 0 to 10. Participants were categorized as having poor knowledge (0-3), moderate knowledge (4-6), or good knowledge (7-10). These cut-offs were used to classify the observed knowledge distribution.

Attitudes were assessed using four statements addressing dentists' perceptions of the potential role of periodontal disease in Alzheimer's disease progression, the dentist's role in identifying systemic health concerns, the potential importance of oral health in cognitive health, and the need for further education on oral-systemic relationships. Responses were recorded as agree, neutral, or disagree. Attitude results were presented descriptively as the proportion of participants selecting each response category. Because a validated composite attitude scale and predefined numerical cut-offs were not reported in the current study, the term "positive attitudes" should refer to the pattern of

agreement with the individual attitude statements rather than to a formally validated attitude score.

Clinical periodontal practices were assessed using four self-reported questions addressing consideration of systemic conditions during periodontal treatment, patient education regarding oral-systemic health relationships, discussion of Alzheimer's disease risk with patients, and referral for medical evaluation when systemic involvement was suspected. Responses were recorded as Yes/No and were summarized descriptively as frequencies and percentages. No composite clinical-practice score or predefined practice cut-off was reported in the current study.

2.7 Statistical Analysis

Statistical analysis was performed using IBM SPSS Statistics, version 26.0. Frequencies and percentages were calculated to describe categorical sociodemographic, professional, awareness, attitude, and clinical-practice variables, while means and standard deviations were used to summarize continuous variables.

The Shapiro-Wilk test was used to assess the distribution of continuous scores. Chi-square tests were used to examine associations between categorical awareness and knowledge levels and demographic/professional characteristics, including gender, years of experience, qualification, and specialty.

Because the knowledge score was not normally distributed, non-parametric tests, including the Mann-Whitney U test for comparisons between two independent groups and the Kruskal-Wallis test for comparisons among more than two independent groups, were used where appropriate. Binary logistic regression was performed to identify demographic and professional factors independently associated with high awareness. High awareness was entered as the binary dependent variable, while relevant demographic and professional characteristics were considered independent variables. Results from the logistic regression model were reported as odds ratios (ORs) with 95% confidence intervals (CIs). A two-sided p-value <0.05 was considered statistically significant.

3. Results

3.1 Socio-demographic and Professional Characteristics

A total of 450 dentists participated in this study. The mean age of participants was 32.8 ± 8.6 years, with the majority aged 20–29 years (40.0%). Females constituted slightly more than a half of the sample (53.3%). Regarding professional experience, 37.8% had less than 5 years of experience, while 28.9% had more than 10 years. Most participants held a bachelor's degree (64.4%), followed by a master's degree (24.4%) and specialist qualifications (11.1%). In terms of practice setting, 44.4% worked in private clinics, 28.9% in public institutions, and 26.7% in both sectors. The majority were general dentists (66.7%), followed by periodontists (15.6%) and other specialists (17.8%) (Table 1).

Table 1: Characteristics of participants (n = 450)

Variable	Category	n (%)
Age (years)	20–29	180 (40.0%)
	30–39	150 (33.3%)
	≥40	120 (26.7%)
	Mean ± SD	32.8 ± 8.6
Gender	Male	210 (46.7%)
	Female	240 (53.3%)
Years of experience	<5 years	170 (37.8%)
	5–10 years	150 (33.3%)
	>10 years	130 (28.9%)
Qualification	Bachelor	290 (64.4%)
	Master	110 (24.4%)
	Specialist/PhD	50 (11.1%)
Practice type	Private	200 (44.4%)
	Public	130 (28.9%)
	Both	120 (26.7%)
Specialty	General dentist	300 (66.7%)
	Periodontist	70 (15.6%)
	Other specialties	80 (17.8%)

3.2 Awareness of Alzheimer-Periodontal Disease Link

More than a half of the participants (57.8%) reported that they had heard of a potential relationship between Alzheimer's disease and periodontal disease, while 66.7% believed that such a connection exists. However, only 40.0% reported having read scientific literature on the topic, and 26.7% reported receiving formal education related to it. These findings indicate that general recognition of the topic was more common than formal educational or literature exposure (Table 2).

Based on the composite awareness scoring system, 31.1% of participants were classified as having low awareness, 42.2% as having moderate awareness, and 26.7% as having high awareness. The numerical cut-off values defining these categories should be reported in the Methods section according to the original scoring key.

Table 2: Awareness level of dentists regarding the Alzheimer's disease–periodontal disease (AD-PD) association (n = 450)

Awareness item	Yes	No.
Have you heard of the AD–PD link?	260 (57.8%)	190 (42.2%)
Do you believe that there is a connection?	300 (66.7%)	150 (33.3%)
Have you read studies on this topic?	180 (40.0%)	270 (60.0%)
Have you received formal education on it?	120 (26.7%)	330 (73.3%)

3.3 Knowledge Regarding the AD-PD Association

The overall knowledge level among participants was moderate. Approximately 46.7% demonstrated moderate knowledge, while 28.9% had poor knowledge and only 24.4% exhibited good knowledge (Table 3).

The mean knowledge score was 5.4 ± 2.1 (out of 10). The Shapiro-Wilk test indicated that the data was not normally distributed ($p < 0.05$). Accordingly, non-parametric tests were applied for inferential analysis.

Table 3: Knowledge score distribution regarding AD-PD association (n = 450)

Level of knowledge	Score range	n (%)
Poor	0-3	130 (28.9%)
Moderate	4-6	210 (46.7%)
Good	7-10	110 (24.4%)

3.4 Attitudes toward the AD–PD Association

Participants generally expressed favorable responses toward the role of oral health and dental professionals in relation to Alzheimer's disease. Specifically, 62.2% agreed that periodontal disease may contribute to Alzheimer's disease progression, 71.1% agreed that dentists play a role in the early detection of systemic diseases such as AD, and 64.4% agreed that improving oral health may reduce the risk of cognitive decline. In addition, 82.2% agreed that further education on oral–systemic health relationships was needed (Tabe 4).

Table 4: Attitudes of dentists toward the AD–PD association (n = 450)

Statement	Agree	Neutral	Disagree
Periodontal disease may contribute to Alzheimer's disease progression.	280 (62.2%)	100 (22.2%)	70 (15.6%)
Dentists play a role in early detection of systemic diseases like AD.	320 (71.1%)	80 (17.8%)	50 (11.1%)
Improving oral health may reduce the risk of cognitive decline.	290 (64.4%)	90 (20.0%)	70 (15.6%)
More education is needed on the oral-systemic link.	370 (82.2%)	50 (11.1%)	30 (6.7%)

3.5 Clinical Practice Related to AD-PD Association

In clinical practice, 68.9% of participants reported considering systemic conditions when managing periodontal disease. Furthermore, 60.0% indicated that they educate patients about oral–systemic health relationships. However, only 33.3% had discussed Alzheimer's disease risk with their patients. Nearly a half (48.9%) reported referring patients for medical evaluation when systemic involvement was suspected (Table 5).

Table 5: Clinical practice related to AD–PD association (n = 450)

Practice item	Yes n (%)	No n (%)
Do you consider systemic conditions when treating periodontal disease?	310 (68.9%)	140 (31.1%)
Do you educate patients about oral–systemic health links?	270 (60.0%)	180 (40.0%)
Have you ever discussed AD risk with patients?	150 (33.3%)	300 (66.7%)
Do you refer patients for medical evaluation when needed?	220 (48.9%)	230 (51.1%)

3.6 Association between Knowledge Level and Demographic Variables

Chi-square analysis revealed a statistically significant association between knowledge level and both years of experience ($p = 0.01$) and qualification ($p = 0.001$). Dentists with more than 10 years of experience and those with higher qualifications demonstrated significantly better knowledge levels. No significant association was observed between gender and knowledge level ($p = 0.18$) (Table 6).

Table 6: Association between knowledge level and selected variables (chi-square test)

Variable	Poor n (%)	Moderate n (%)	Good n (%)	p-value
Gender				0.18
Male	70	90	50	
Female	60	120	60	
Years of experience				0.01
<5 years	70	80	20	
5–10 years	40	80	30	
>10 years	20	50	60	
Qualification				0.001
Bachelor	110	130	50	
Master	15	60	35	
Specialist	5	20	25	

3.7 Association Between Awareness Level and Demographic Variables

A statistically significant association was found between awareness level and years of experience ($p=0.001$), qualification ($p = 0.002$), and specialty ($p=0.001$). Dentists with greater clinical experience, higher academic qualifications, and those specializing in periodontology exhibited higher awareness levels. No significant association was found between gender and awareness ($p = 0.07$).

3.8 Multivariate Analysis

Multivariate logistic regression analysis identified significant predictors of high awareness among participants. Dentists with more than 10 years of experience were significantly more likely to demonstrate high awareness (OR = 2.8, 95% CI: 1.7–4.6, $p=0.001$). Periodontists showed the strongest association, being 3.5 times more likely to have high awareness compared to general dentists (OR = 3.5, 95% CI: 1.96.2, $p < 0.001$). Additionally, higher educational attainment was independently associated with increased awareness, as dentists with postgraduate qualifications were more than twice as likely to exhibit high awareness (OR = 2.2, 95% CI: 1.4–3.5, $p = 0.002$).

4. Discussion

The present study investigated dentists' awareness,

knowledge, attitudes, and clinical practices regarding the potential association between Alzheimer's disease (AD) and periodontal disease (PD). Overall, the findings revealed moderate knowledge and awareness levels, positive attitudes, but limited formal education and incomplete translation into clinical practice.

The majority of participants were young to early-middle-aged dentists with a predominance of general practitioners. This demographic structure may explain the moderate knowledge level observed, as early-career dentists typically rely on undergraduate education, which may not sufficiently cover emerging oral–systemic links.

In the present study, higher experience and postgraduate qualifications were significantly associated with better knowledge and awareness. This is consistent with previous research showing that postgraduate-trained dentists and specialists, particularly periodontists, demonstrate significantly higher awareness of systemic associations of periodontal disease due to enhanced exposure to periodontal biology and inflammatory mechanisms related to systemic diseases (12,21).

More than a half of the participants in this study reported awareness of the AD-PD relationship, while only 40% had read scientific literature and 26.7% had formal education on the topic. This reflects a gap between general awareness and evidence-based knowledge.

Similar findings have been reported in previous studies assessing dentists' understanding of oral–systemic relationships, where awareness is relatively high, but detailed scientific understanding remains limited (18,22). This suggests that although the concept of oral–systemic interaction is widely recognized; it is not yet fully integrated into structured dental curricula.

Systematic reviews have shown growing evidence supporting a biological association between periodontitis and Alzheimer's disease, with inflammatory and microbial pathways being strongly implicated in disease progression (23-25).

The mean knowledge score in this study (5.4 ± 2.1) reflects a moderate understanding among dentists. Only 24.4% demonstrated good knowledge, indicating that most participants possess partial or general rather than in-depth knowledge.

This finding aligns with previous observational studies showing that knowledge of periodontal–systemic links among dentists is often moderate and varies significantly depending on educational background and exposure to continuing professional development programs (19,20).

Despite moderate knowledge, dentists in this study showed generally positive attitudes, with most agreeing that periodontal disease may contribute to Alzheimer's disease progression and that dentists play a role in systemic disease detection.

This positive attitude is consistent with previous literature showing that dentists generally acknowledge the importance of oral–systemic health integration even when detailed knowledge is limited (26). The strong agreement regarding the need for further education reflects readiness among dental professionals to adopt new evidence into clinical practice.

Although 68.9% of participants reported considering systemic conditions in periodontal management, only 33.3% had discussed Alzheimer's disease risk with patients. This highlights a clear gap between knowledge/attitude and actual clinical implementation.

Such a knowledge–practice gap has been widely reported in oral–systemic research, where dentists often acknowledge systemic associations, but do not consistently apply them in clinical communication or treatment planning due to lack of clear clinical guidelines or confidence in discussing emerging evidence (27,28).

Multivariate analysis identified experience, qualification, and specialty as significant predictors of awareness. Periodontists demonstrated the highest awareness levels.

This finding is supported by previous studies indicating that periodontists consistently demonstrate greater awareness of systemic associations compared to general practitioners due to their specialized training in periodontal inflammation and systemic interactions (29-31).

This study has several limitations that should be considered when interpreting the findings. First, the cross-sectional design precludes the establishment of causal relationships between variables. Additionally, the use of a convenience sampling method may introduce selection bias, potentially limiting the generalizability of the results. The reliance on self-reported data also raises the possibility of reporting bias, as participants may overestimate or underestimate their knowledge, attitudes, or clinical practices. Furthermore, the online

distribution of the questionnaire may have excluded dentists with limited access to digital platforms, thereby affecting the representativeness of the sample. Finally, the absence of qualitative data restricts a more in-depth understanding of participants' perspectives and underlying reasons behind their responses.

The findings of this study have important implications for both clinical practice and public health. Enhancing dentists' awareness of the relationship between periodontal disease and systemic conditions, such as Alzheimer's disease, may strengthen their role in the early identification of patients at risk. This supports the adoption of preventive and holistic approaches to dental care, where oral health is considered an integral component of overall health. Furthermore, improving knowledge in this area may encourage more effective interdisciplinary collaboration, ultimately leading to better patient outcomes. Increased awareness of the oral–brain connection also contributes to the broader understanding of the impact of oral health on neuro-degenerative diseases.

The findings of this study have several implications for dental clinical practice. Although a considerable proportion of dentists reported awareness of the potential relationship between periodontal disease and Alzheimer's disease and expressed generally favorable attitudes toward oral–systemic health, specific clinical application was less consistent. In particular, only 33.3% of participants reported discussing Alzheimer's disease risk with patients, despite 68.9% reporting that they considered systemic conditions when managing periodontal disease. This gap suggests a need to strengthen the translation of oral-systemic health knowledge into routine clinical communication and patient care. Dental professionals may benefit from structured continuing professional education addressing oral health considerations in individuals with Alzheimer's disease, including periodontal assessment, patient and caregiver education, and appropriate communication with other healthcare professionals. Interdisciplinary collaboration between dentists, physicians, and other healthcare providers may also facilitate more comprehensive care for patients with complex medical needs. In addition, dental education programs could incorporate oral–systemic health concepts and emerging evidence concerning periodontal health and Alzheimer's disease to strengthen dentists' preparedness for managing medically complex patients. However, these findings should not be interpreted as evidence that periodontal disease causes Alzheimer's disease or that periodontal treatment prevents Alzheimer's disease, as the present study assessed dentists' awareness, knowledge, attitudes, and self-reported clinical practices rather than causal clinical outcomes.

5. Conclusions

Dentists demonstrated moderate awareness and knowledge regarding the Alzheimer's disease–periodontal disease association, with generally positive attitudes, but limited clinical application. Experience, higher education, and specialty were significant predictors of awareness. Strengthening undergraduate curricula and continuing professional education is essential to bridge the gap between scientific evidence and clinical practice.

Based on the findings of this study, several recommendations can be proposed. There is a clear need to integrate oral–systemic health concepts, particularly the association between Alzheimer's disease and periodontal disease, into undergraduate dental curricula to enhance foundational knowledge. In addition, the development of structured continuing professional education programs is essential to update practicing dentists on emerging scientific evidence. Promoting interdisciplinary collaboration between dental professionals, physicians, and neurologists is also crucial to support comprehensive patient care. The establishment of clinical guidelines addressing communication of systemic risks to patients would further facilitate the translation of knowledge into practice. Moreover, future research should adopt longitudinal study designs to better explore causal relationships and assess the long-term clinical implications of the AD-PD association.

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Conflict of Interest

The authors declare no conflict of interests.

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