

Original article

## Knowledge, Attitudes, and Practices Regarding the Association Between Periodontal Disease and Breast Cancer Among Libyan Dental Practitioners: A Cross-Sectional Study

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### ABSTRACT

Emerging evidence suggests a significant association between periodontal disease and breast cancer. Dental professionals play a crucial role in recognizing oral manifestations of cancer therapy and providing comprehensive patient care. This study was conducted to evaluate the knowledge, attitudes, and practices regarding this association among dental practitioners and dental students in Libya. A cross-sectional study was conducted among 100 dental healthcare workers and students in Libya using a validated questionnaire assessing knowledge, attitudes, and practices regarding the association between periodontal disease and breast cancer across six domains. Data were analyzed using descriptive statistics, chi-square tests, and logistic regression. The mean total knowledge score was 61.4%, indicating moderate knowledge. Although 71.0% were aware of the periodontal disease-breast cancer association, significant gaps were identified: only 29.0% correctly identified mammography as the gold standard screening method, and merely 42.0% understood Tamoxifen's mechanism. Recognition of clinical signs was higher, with 79.0% identifying "peau d'orange" and 76.0% recognizing medication-related osteonecrosis of the jaw. A significant knowledge gradient was observed, with specialists scoring 56% higher than students ( $p < 0.001$ ). Logistic regression confirmed professional experience as the primary predictor of high knowledge scores; those with more than five years of experience were 3.4 times more likely to achieve high scores ( $OR = 3.42$ ,  $p = 0.001$ ). Gender, age, and practice setting were not significant predictors. Libyan dental practitioners have moderate knowledge of the link between periodontitis and breast cancer. While awareness is high, significant gaps exist in screening protocols and medication knowledge. Clinical experience strongly predicts better understanding, with specialists outperforming students. Improving oral-systemic health education and fostering collaboration between dental and medical professionals are essential for better patient care.

### Introduction

The relationship between periodontal disease and breast cancer has emerged as a significant focus of biomedical research [1,2]. Periodontal disease affects approximately 45-50% of adults globally [3], while breast cancer remains the most prevalent malignancy among women, with 2.3 million new cases annually [4]. Recent epidemiological evidence demonstrates a significant association between these conditions. Meta-analyses report a 14-26% increased risk of breast cancer in individuals with periodontitis [5,6], with severe disease conferring 4.27-fold higher odds [7]. Biological mechanisms include hematogenous spread of *Fusobacterium nucleatum* to breast tissue, where it induces DNA damage and promotes tumor progression [8-12], and chronic systemic inflammation creating a pro-carcinogenic microenvironment [13].

In oncology, cancer treatments produce significant oral complications. Medication-related osteonecrosis of the jaw affects 1-12% of patients on bisphosphonates [14], aromatase inhibitors increase periodontitis severity [15], and xerostomia compromises quality of life [16]. Dental professionals play a critical role in recognizing oral manifestations of cancer therapy and providing preventive care [17]. However, recent studies identify knowledge gaps among dentists regarding oncological patient management [18,19]. In Libya, no studies have investigated knowledge of the association between periodontal disease and breast cancer among dental healthcare workers and students. Therefore, this study was conducted to evaluate the knowledge, attitudes, and practices regarding this association among dental practitioners and dental students in Libya.

## Methodology

### Study Design and Data Collection

A descriptive cross-sectional study was conducted to evaluate the knowledge, attitudes, and practices regarding this association among dental practitioners and dental students in Libya. Data were collected from Data collection was conducted over six months (October 2025 to March 2026) with a sample of 100 respondents across multiple dental healthcare settings in Libya.

Face-to-face interviews were conducted with all participants across all settings. Each 15–20-minute structured interview was conducted by trained research assistants in private settings, following a standardized protocol including introduction, question administration, clarification when needed, and completion verification.

Questionnaires were manually distributed to participants across the three settings. Paper-based questionnaires identical to the interview format were distributed with cover letters explaining study objectives. Participants completed questionnaires in 20-30 minutes, with on-site verification ensuring complete data collection. The questionnaire was developed based on an extensive review of the literature regarding breast cancer knowledge and oral-systemic health connections. The instrument was initially drafted in English, then translated into Arabic to accommodate the linguistic preferences of the target population.

### Survey Content and Domains

The questionnaire was designed to capture comprehensive data across six distinct domains, comprising a total of 17 questions. Domain 1 collected demographic information, including age, gender, educational level, and years of professional experience, to characterize the study population of dental practitioners and students. Domain 2 assessed breast cancer risk factors through identification of the most important non-modifiable risk factor for breast cancer. Domain 3 evaluated clinical signs and diagnosis, including recognition of "peau d'orange" as a clinical sign of breast cancer and knowledge of the gold standard diagnostic modality for population screening. Domain 4 examined treatment mechanisms and complications through five questions addressing the mechanism of action of Tamoxifen, complications associated with bisphosphonate use (medication-related osteonecrosis of the jaw), oral side effects of chemotherapy or radiation therapy (mucositis), causes of xerostomia in patients receiving Anastrozole, and oral conditions resulting from aromatase inhibitor therapy. Domain 5 investigated pre-treatment dental considerations, including critical information required from oncologists before elective oral surgery and the importance of pre-chemotherapy dental evaluation. Domain 6 explored the association between oral health and breast cancer through three questions assessing awareness of a potential link, perceived mechanisms connecting gum disease to breast cancer, and beliefs regarding the preventive role of oral care.

### Statistical Analysis

Data were analyzed using SPSS version 26.0. Descriptive statistics (frequencies, percentages, means, standard deviations) for all variables. Multiple response questions were analyzed using binary coding. Chi-square tests compared subgroups (students vs. practitioners, females vs. males, different experience levels), with statistical significance set at  $p < 0.05$ .

## Results

### Demographic Characteristics of the Study Population

A total of 100 healthcare professionals and trainees participated in this study. The demographic characteristics of the respondents are presented in Table 1.

The study comprised 86 females (86.0%) and 14 males (14.0%), with a mean age of 26.4 years (SD = 6.3). The largest age group was 19-25 years (58.0%), followed by 26-35 years (32.0%) and 36-50 years (10.0%). Regarding professional status, students constituted the largest category (47.0%), followed by interns (24.0%), general practitioners (24.0%), and specialists (5.0%). In terms of clinical experience, 47.0% were students, 29.0% had less than five years of experience, 11.0% had 5-10 years, and 13.0% possessed more than ten years of experience. Participants were recruited from three practice settings: university hospitals (45.0%), private dental clinics (25.0%), and public hospitals (30.0%).

**Table 1: Demographic Characteristics of Participants (N=100)**

| Characteristic      | Category             | n  | %    |
|---------------------|----------------------|----|------|
| Gender              | Female               | 86 | 86.0 |
|                     | Male                 | 14 | 14.0 |
| Age Group (years)   | 19-25                | 58 | 58.0 |
|                     | 26-35                | 32 | 32.0 |
|                     | 36-50                | 10 | 10.0 |
| Professional Status | Student              | 47 | 47.0 |
|                     | Intern               | 24 | 24.0 |
|                     | General Practitioner | 24 | 24.0 |

|                     |                         |    |      |
|---------------------|-------------------------|----|------|
|                     | Specialist              | 5  | 5.0  |
| Clinical Experience | No experience (student) | 47 | 47.0 |
|                     | <5 years                | 29 | 29.0 |
|                     | 5-10 years              | 11 | 11.0 |
|                     | >10 years               | 13 | 13.0 |
| Practice Setting    | University Hospital     | 45 | 45.0 |
|                     | Private Dental Clinic   | 25 | 25.0 |
|                     | Public Hospital         | 30 | 30.0 |

### Knowledge, Attitude, and Practice (KAP) Scores

The mean total KAP score for all respondents was 61.4 (SD = 14.2) out of a possible 100 points, with scores ranging from 28 to 94. The distribution of respondents across knowledge categories is shown in Table 2.

The majority of respondents (42.0%) fell into the moderate knowledge category, while 31.0% demonstrated good knowledge, and only 8.0% achieved excellent scores. Notably, 19.0% of participants exhibited limited or poor knowledge, representing a significant subgroup requiring targeted educational intervention.

**Table 2: Distribution of KAP Score Categories (N=100)**

| Score Category | Score Range | n  | %    | Mean Score (SD) |
|----------------|-------------|----|------|-----------------|
| Excellent      | 80-100      | 8  | 8.0  | 86.2 (4.8)      |
| Good           | 65-79       | 31 | 31.0 | 72.4 (3.6)      |
| Moderate       | 50-64       | 42 | 42.0 | 58.6 (4.2)      |
| Limited        | 35-49       | 15 | 15.0 | 43.8 (3.4)      |
| Poor           | 0-34        | 4  | 4.0  | 31.5 (2.8)      |

### Domain-Specific Knowledge Performance

The study revealed a striking contrast in knowledge levels among healthcare professionals. While participants demonstrated strong awareness of the oral-systemic connection, with robust recognition of "peau d'orange" (79.0%) and MRONJ (76.0%), critical knowledge gaps were identified in essential clinical areas.

Most concerning, only 29.0% correctly identified mammography as the gold standard screening method, while 32.0% continued to select breast self-examination, a technique no longer recommended by major guidelines. Knowledge of medication mechanisms was also deficient, with only 42.0% understanding Tamoxifen's action as a Selective Estrogen Receptor Modulator and just 52.0% recognizing Anastrozole-induced xerostomia. Performance across the five knowledge domains varied considerably, as presented in Table 3.

Respondents demonstrated the highest performance in domains related to the oral-systemic connection, achieving 74.7% and 70.0% of maximum scores in the oral health-breast cancer association and pre-treatment dental considerations, respectively. This indicates good awareness of emerging concepts. However, performance was significantly lower in foundational clinical areas, with risk factor knowledge (53.0%) and clinical signs and diagnosis (54.0%) ranking lowest.

**Table 3: Domain-Specific Knowledge Scores (N=100)**

| Domain                                | Maximum Score | Mean Score (SD) | % of Maximum |
|---------------------------------------|---------------|-----------------|--------------|
| Oral Health-Breast Cancer Association | 15            | 11.2 (2.9)      | 74.7         |
| Pre-Treatment Dental Considerations   | 15            | 10.5 (3.1)      | 70.0         |
| Treatment Mechanisms & Complications  | 40            | 23.6 (7.8)      | 59.0         |
| Clinical Signs & Diagnosis            | 20            | 10.8 (4.2)      | 54.0         |
| Risk Factors                          | 10            | 5.3 (3.8)       | 53.0         |

### Awareness of the Oral Health-Breast Cancer Association

A substantial majority of respondents (71.0%) reported awareness of a possible link between periodontal disease and breast cancer. Furthermore, an overwhelming 85.0% expressed belief that oral care can contribute to breast cancer prevention. These findings indicate strong acceptance of the oral-systemic connection among healthcare professionals in this cohort.

Among respondents aware of the association, the most frequently cited mechanisms were bacterial spread through the bloodstream (52.0%) and chronic inflammation (42.0%). However, 22.0% could not identify any specific mechanism despite being aware of the association, highlighting an opportunity for more detailed education on biological pathways.

### Knowledge Scores by Professional Status and Experience

A clear and statistically significant gradient in knowledge was observed across professional levels and experience categories. Specialists scored 56% higher than students (82.4 vs. 52.8,  $p < 0.001$ ), and those with more than 10 years of experience scored 48.7% higher than students (78.5 vs. 52.8,  $p < 0.001$ ). All pairwise comparisons between professional levels were statistically significant ( $p < 0.05$ ), confirming progressive knowledge acquisition with professional advancement. This gradient was consistent across all knowledge domains, indicating comprehensive learning through clinical experience as demonstrated in Table 4.

**Table 4: Mean KAP Scores by Professional Status and Clinical Experience (N=100)**

| Characteristic      | Category                            | n  | Mean Score (SD) | p-value |
|---------------------|-------------------------------------|----|-----------------|---------|
| Professional Status | Student in 4th year                 | 47 | 52.8 (11.4)     | <0.001* |
|                     | Intern                              | 24 | 60.4 (10.8)     |         |
|                     | General Practitioner                | 24 | 71.6 (9.2)      |         |
|                     | Specialist                          | 5  | 82.4 (6.8)      |         |
| Clinical Experience | No experience (student in 4th year) | 47 | 52.8 (11.4)     | <0.001* |
|                     | Less than 5 years                   | 29 | 63.7 (10.2)     |         |
|                     | 5-10 years                          | 11 | 70.2 (8.6)      |         |
|                     | More than 10 years                  | 13 | 78.5 (7.4)      |         |

\* $p < 0.05$  was considered statistically significant.

### Multivariate Predictors of High Knowledge Scores

Logistic regression analysis confirmed that professional status and clinical experience were the only significant independent predictors of high knowledge scores (scores in the top quartile). Interns were 2.8 times more likely than students to achieve high scores ( $p = 0.03$ ), general practitioners were 5.7 times more likely ( $p < 0.001$ ), and specialists were 8.9 times more likely ( $p < 0.001$ ). Those with more than five years of clinical experience were 3.4 times more likely to be high performers ( $p = 0.001$ ). Gender, age, and practice setting were not significant predictors after adjustment, confirming that professional development and clinical experience, not demographic characteristics, are the primary drivers of knowledge acquisition, as mentioned in Table 5.

**Table 5: Logistic Regression Analysis of Factors Associated with High KAP Scores**

| Variable            | Comparison             | Odds Ratio (OR) | 95% CI     | p-value |
|---------------------|------------------------|-----------------|------------|---------|
| Professional Status | Intern vs. Student     | 2.84            | 1.12-7.21  | 0.03*   |
|                     | GP vs. Student         | 5.68            | 2.34-13.82 | <0.001* |
|                     | Specialist vs. Student | 8.92            | 2.86-27.84 | <0.001* |
| Clinical Experience | >5 years vs. ≤5 years  | 3.42            | 1.68-6.96  | 0.001*  |
| Gender              | Female vs. Male        | 1.32            | 0.58-3.01  | 0.51    |
| Age                 | Per year increase      | 1.06            | 0.98-1.15  | 0.14    |

\* Note GP: General Practitioner

\* $p < 0.05$  was considered statistically significant.

### Discussion

This study evaluated knowledge, attitudes, and practices regarding the association between periodontal disease and breast cancer among 100 dental practitioners and dental students (4<sup>th</sup> year) in Libya. The sample was predominantly female (86.0%) with a mean age of 26.4 years, reflecting the feminization of dentistry globally [3]. Students comprised 47.0% of participants, followed by interns (24.0%), general practitioners (24.0%), and specialists (5.0%).

A majority (71.0%) were aware of a link between periodontal disease and breast cancer, and 85.0% believed oral care contributes to prevention. Cited mechanisms included bacterial spread (52.0%) and chronic inflammation (42.0%), consistent with current evidence [1,2,8-13]. However, 22.0% could not identify specific mechanisms despite awareness. This awareness level exceeds that reported in general oral-systemic health studies, suggesting breast cancer receives focused attention in professional education.

Recognition of "peau d'orange" was strong (79.0%). However, only 29.0% correctly identified mammography as the gold standard screening method, while 32.0% selected breast self-examination, a technique no longer recommended [4].

Knowledge of medication mechanisms was deficient: only 42.0% understood Tamoxifen's mechanism, and 52.0% recognized Anastrozole-induced xerostomia. These gaps are clinically significant, as breast cancer patients experience substantial oral health changes during treatment [17]. Higher knowledge of MRONJ (76.0%) reflects strong emphasis on this complication in dental education [14]. Knowledge that aromatase inhibitors increase periodontitis risk (59.0%) aligns with

Park et al. [15]. The mean KAP score was 61.4 (SD=14.2), indicating moderate knowledge. While 39.0% achieved good or excellent scores, 19.0% exhibited limited or poor knowledge, representing a target group for intervention. These findings align with Gvozdkova and Simionidi [18], who reported significant knowledge gaps among dentists regarding oncological patient management.

Significant knowledge differences were observed; specialists scored 56% higher than students (82.4 vs. 52.8,  $p<0.001$ ). Those with >10 years of experience scored 48.7% higher than students. Logistic regression confirmed professional status and clinical experience as the only significant predictors of high scores. Interns were 2.8 times, general practitioners 5.7 times, and specialists 8.9 times more likely than students to achieve high scores. Those with >5 years of experience were 3.4 times more likely to be high performers. Gender, age, and practice setting were not significant predictors. Our findings are consistent with recent international research. Wang et al. [5] and Corbella et al. [6] reported similar associations between periodontitis and cancer risk. Aparna et al. [7] demonstrated a dose-response relationship between periodontitis severity and breast cancer risk in Indian women (OR 4.27 for severe disease), underscoring the clinical relevance of this association.

Gvozdkova and Simionidi [18] surveyed dentists and found significant knowledge gaps in oncological patient management, mirroring our findings. Dental Tribune [19] emphasized the essential role of dental professionals in patient education across the Middle East and North Africa region, supporting our recommendation for enhanced curricula. The biological mechanisms identified in our study (bacterial spread, chronic inflammation) align with recent discoveries. Gaba et al. [8] confirmed *Fusobacterium nucleatum* presence in breast tumor tissue. Sharma et al. [10] demonstrated that this pathogen induces DNA damage and promotes tumor progression. Cheng et al. [13] showed that periodontal inflammation recruits metastatic breast cancer cells by increasing myeloid-derived suppressor cells. Parida et al. [9] demonstrated that this oral microbe can be internalized by breast cancer cells and promotes mammary tumorigenesis.

## Conclusions

Libyan dental practitioners demonstrated moderate knowledge regarding the association between periodontitis and breast cancer. Although awareness of this association was relatively high, significant deficiencies were identified in critical clinical areas, including breast cancer screening protocols and pharmacotherapeutic mechanisms. Clinical experience was the primary determinant of knowledge acquisition, with specialists exhibiting superior comprehension compared to students. Enhanced integration of oral-systemic health education into dental curricula and strengthened interdisciplinary collaboration between dental and medical practitioners are imperative to optimize comprehensive patient care.

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