SHORT REPORT

Assessment of knowledge, attitude, and practice of faculty and postgraduates toward Bisphenol A (BPA) exposure in dental care

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Abstract

Bisphenol A (BPA) is commonly used in resin-based dental materials and is categorised as an endocrine-disrupting compound. This study aimed to evaluate the knowledge, attitudes, and practice toward the use of BPA among faculty members and postgraduate students. In this descriptive study, a validated self-administered questionnaire was used, and 204 dentists were included, with a response rate of 56.2%. The findings revealed that faculty members had significantly better knowledge (p=0.024) and practice (p=0.036) and more positive attitudes (p=0.024) toward BPA exposure. Regression analysis showed a significantly positive effect of attending a workshop/lecture or reading an article about BPA on the participants' total mean knowledge (p<0.001) and practice scores (p<0.001). Furthermore, faculty members showed a significantly more positive attitude (p<0.001) toward BPA exposure. These results emphasise the importance of increased awareness and education concerning BPA exposure to ensure optimal dental care.

Keywords: Attitude, Bisphenol A-Glycidyl Methacrylate, Composite resins, Knowledge, Professional practice.

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Introduction

Bisphenol A (BPA) is a synthetic resin that has been used in the manufacture of plastic products and metal food cans since the 1960s. It is classified as an endocrine-disrupting chemical (xenoestrogen), which can impact both children's and adults' cognitive, reproductive, or endocrine functions. In dentistry, BPA is mainly used in the composition of resin-based dental materials, including sealants, resin composites, and orthodontic adhesives.[1,2] BPA-based monomers like bisphenol A diglycidyl ether methacrylate (Bis-GMA) and bisphenol A dimethyl acrylate (Bis-DMA) are commonly used in the organic matrix of these materials.[3]

The quantity of BPA in resin-based dental materials can vary significantly based on factors such as the product's brand, type, and formulation. BPA concentrations in these materials typically span a wide range, from very low levels, often measured in parts per million (ppm), up to a few percentage points by weight. The release of BPA from resin-based dental materials is attributed to the presence of impurities and the degradation of BPA-based monomers. Notably, the European Food Safety Authority has established a Tolerable Daily Intake for BPA at 4 µg/kg/day.[4,5] After the application of resin-based dental restorations, small amounts of BPA have been detected in patients' saliva, with an average concentration of 0.15 µg/L. Notably, these detected levels fall within the established safe limits and are unlikely to pose significant health risks. However, it is noteworthy that the potential absorption of BPA via the oral and gastrointestinal mucosa underscores potential risks encompassing both localised and systemic toxicity. Impurities and degradation of BPA-based monomers may account for the release of BPA from resin-based dental materials.[6]

The toxicity of BPA in resin-based dental materials is influenced by several factors. These encompass the material's composition, including BPA-based monomer type, and concentration, which influences BPA release. Leaching intensity, determined by factors like curing conditions and storage, affects exposure and associated risks. Interactions with other material components and degradation further modulate its toxicity. Managing these factors is crucial for ensuring the safety of BPA-containing resin-based dental materials.[6]

Given the rising focus on dental aesthetics and public concerns over amalgam restorations, resin-based composite restorations are now the preferred option for treating carious lesions in paediatric patients. Additionally, due to the growing awareness of health and safety risks related to BPA, dentists need up-to-date knowledge to address patient and parental concerns. Therefore, our study aimed to evaluate the knowledge, attitudes, and practice toward Bisphenol A among faculty members and postgraduate students at King Abdulaziz University Faculty

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of Dentistry (KAUFD) in Jeddah, Saudi Arabia. By assessing these factors, we aim to enhance dental care protocols and promote informed decision-making.

Methods and Results

This cross-sectional observational study was conducted among faculty members and postgraduate students at KAUFD between December 2017 and February 2018. An exemption for this study has been granted by the Ethics Committee of KAUFD (002-01-17). This study is a continuation of a previously published study to evaluate the knowledge, attitudes, and behaviour concerning BPA dental exposure among dentists in three different departments.[7] In the current study, the inclusion criteria encompassed all faculty members and postgraduate students across all dental departments.

The questionnaire included 10 knowledge-, four attitude-, and five practice-based questions. Participants received one score for each correctly answered knowledge- and 'yes' answered practice-based questions. The total knowledge and practice mean scores were calculated and ranged from zero (worst) to 10 (best) for knowledge-based questions and from zero (worst) to five (best) for practice-based questions. A five-point Likert scale that ranged from (1=strongly agree) to (5=strongly disagree) was used to score each attitude-based question. The total attitude score was calculated and ranged from five (best) to 20 (worst). Those who received a total score of five had positive attitudes and strongly agreed with all attitude questions. In addition, Cronbach's Alpha was used to assess the questions' reliability. For knowledge-based questions, α scored 0.91. For attitude-based questions, α scored 0.81, and for practice-based questions, α scored 0.086.

Categorical variables were calculated as percentages and compared using the Chi-square test, odds ratios (OR), and confidence intervals (CI). The total scores for knowledge-attitude-and practice-based questions were calculated as means and standard deviations (±SD) and compared using a one-way ANOVA and Mann-Whitney U Test for non-parametric data. However, Ordinal regression analysis was carried out to reduce the effect of confounders. These confounders included: participants' gender and rank (faculty member or postgraduate student). The P value was set at 0.05.

A total of 363 dentists were approached, and 204 of them agreed to participate, with a response rate of 56.2%. Most of them, 103 (50.5%), were faculty members; 128 (62.7%) were females with a mean age of 34.45±10.03 years. Of the total participants, 114 (55.9%) had heard of BPA dental exposure previously, with a significant difference between faculty members (71 [68.9%]) and postgraduate students (43 [42.6%]), (p<0.001, OR: 2.99, and 95% CI 1.69 to 5.31). In addition, 42(20.6%)—including 27(26.2%) faculty members and 15(14.9%) postgraduate students—had attended a workshop/lecture or read an article on BPA dental exposure before. In comparison, only 4 (2%) reported that they were previously asked about BPA dental exposure by a patient.

Of the total participants, 58 (57.3%) faculty members and 72 (71.3%) postgraduate students answered "*I do not know*" to all knowledge-based questions. The mean of correctly answered knowledge-based questions was 1.74±2.68 out of 10, indicating poor knowledge regarding BPA dental exposure among the participants. The mean knowledge score was significantly higher among faculty members at 2.17±2.89 than among postgraduate students at 1.31±2.38 (p=0.024). Participants' responses to each knowledge-based question are presented in Table 1.

Of the total participants, 126(61.8%) had a positive attitude and answered agree or strongly agree to all attitude-based questions. The mean score of the attitude-based questions answered by all the participants was 7.98±2.731, indicating a positive attitude toward BPA dental exposure among the participants. Faculty members scored lower total mean scores in attitude-based questions (6.592 ±2.286) and showed significantly more positive attitudes than postgraduate students (7.061±3.046) (p=0.024).

With a mean of 1.56±0.68 faculty members significantly agreed more than postgraduate students (1.98±1.04) that dentists must educate themselves about BPA dental exposure (p<0.001). They also agreed significantly more (1.49 ±0.67) than postgraduate students (1.70±0.82) that dentists must follow the recommendations when using BPA-containing dental materials (p=0.04).

The practice-based questions' total mean score was 0.79±1.47 out of five. Most participants, 144 (70.7%), answered no to all practice-based questions and scored zero. The mean score for yes-answered practice-based questions was significantly higher among faculty members at 1.05±1.70 compared to postgraduate students at 0.52±1.137 (p=0.036). Participants' response to each practice-based question is presented in Table 1.

Regression analysis adjusting the odd ratio (AOR) for the relationship between the total mean score in knowledge-, attitude-, and practice-based questions and respondent gender and rank is presented in Table 2. Participants who had attended a workshop/lecture or read an article about BPA dental exposure had significantly higher AOR for total mean knowledge scores (p<0.001, AOR: 30.383, and 95% 13.005-70.982) and higher AOR for total mean practice scores (p<0.001, AOR: 33.027, and 95% 14.741-73.994).

Table-1: Faculty members and postgraduate students' correct responses to knowledge- and practice-based questions.

Questions	Faculty members (103) n (%)	Postgraduate students (101) n (%)	Total 204 (%)	P-value OR (CI)**
Correctly answered knowledge-based questions				
Mean of total knowledge score	2.17±2.89	1.31±2.38	1.74±2.679	**0.024***
Is BPA a structural component found in plastic bottles?	28 (27.2)	19 (18.8)	47 (23.0)	0.325 1.61(0.83-3.12)
Does BPA bind to oestrogen receptors and cause hormonal disturbance?	17 (16.5)	13 (12.9)	30 (14.7)	0.76 1.34 (0.61-2.92)
Could prenatal BPA exposure be associated with neurodevelopmental and reproductive adverse effects throughout the baby's lifespan.	16 (15.5)	12 (11.9)	28 (13.7)	0.688 1.36 (0.61-3.05)
Is BPA found in methacrylate-based (Bis-DMA and Bis-GMA) resin dental materials?	33 (32)	18 (17.8)	51 (25.0)	**0.04*** 2.17 (1.13-4.19)
Is BPA found in amalgam restorations?	38 (36.9)	20 (19.8)	58 (28.4)	**0.007*** 2.37 (1.26-4.46)
Are infants, young children, and pregnant or lactating women the least sensitive to BPA?	24 (23.3)	22 (21.8)	46 (22.5)	0.38 1.09 (0.57-2.11)
Is up to 80 times more BPA released from Bis-DMA resin monomer than Bis-GMA resin monomers?	7 (6.8)	0	7 (3.4)	0.06 15.78 (0.89-280)
Can BPA be detected in patients' urine and saliva after the placement of sealants or composite restorations?	19 (18.4)	7 (6.9)	26 (12.7)	0.05* 3.04 (1.22-7.59)
Does the risk of exposure to BPA increase with small and shallow composite restorations compared to multi-surface restorations?	20 (19.4)	13 (12.9)	33 (16.2)	**0.05** 1.63 (0.76-3.49)
Does rubber dam application reduce the exposure to BPA?	20 (19.4)	8 (7.9)	28 (13.7)	**0.02*** 2.8 (1.17-6.70)
Answered yes to practice-based questions				
Mean total practice score	1.05±1.70	0.52±1.137	0.79±1.469	**0.036***
Do you check the content of dental materials, including BPA, before use?	2 (1.9)	0	2 (1)	0.3 5 (0.24-105.5)
Do you recommend to your patients that they reduce their use of BPA-containing plastic bottles and cans?	11 (10.7)	4 (4)	15 (7.4)	0.13 2.3 (0.72-7.71)
Do you follow the recommendations to reduce the risk of BPA exposure when you apply composite restorations or sealants?	18 (17.5)	6 (5.9)	24 (11.8)	**0.04*** 3.35(1.27-8.84)
Do you try to keep up to date with the new research in the field of BPA dental exposure?	12 (11.7)	4 (4)	16 (7.8)	0.051 3.2 (0.99-1.27)
Do you try to decrease your personal consumption of BPA-containing plastic bottles?	26 (25.2)	13 (12.9)	39 (19.1)	**0.02*** 2.29 (1.1-4.76)

*Significant at p< 0.05; using chi-square for categorical variables and Mann-Whitney U test for non-parametric continuous data, **OR and CI measures if possible; OR: Odds ratio; CI: Confidence interval

Table-2: Regression analysis for the relationship between total mean score in knowledge, attitude, and practice-based questions and respondent gender, rank, and department.

Variable	Total mean knowledge score			Total mean attitude score			Total mean practice score		
	p-value	AOR	95% CI	*p*-value	AOR	95% CI	*p*-value	AOR	95% CI
Gender									
Female	0.829	1.084	0.520-2.260	0.154	0.680	0.401-1.155	0.677	1.162	0.572-2.363
Male		1		1			1		
Group									
Faculty member	0.206	1.524	0.793-2.926	<0.001*	0.366	0.215-0.623	0.303	1.501	0.693-3.254
Postgrad student		1		1			1		
Attended a workshop/lecture or red an article on BPA									
Yes	<0.001*	30.383	13.005-70.982	0.304	0.706	0.364-1.371	<0.001*	33.027	14.741-73.994
No		1		1			1		

*Significant at $p<0.05$.

Faculty members (AOR: 0.366 and 95% CI: 0.215-0.623) had a significantly lower AOR for total mean attitude score ($p<0.001$) and showed more positive attitudes concerning BPA dental exposure.

Discussion

This study assessed knowledge, attitudes, and practice toward BPA among faculty members and postgraduate

students at KAUFD. The study revealed limited knowledge of BPA controversies among participants, especially postgraduate students, but faculty members displayed better knowledge. This observation aligns with the findings of Kumar et al (2021), who reported that older and more experienced dentists exhibited the highest knowledge about BPA.[8] Similarly, in a study conducted in 2017 among university students in Lebanon, it was observed that there was a lack of awareness regarding BPA. However, students in health-related disciplines, with higher education levels, and from higher-income households showed better knowledge, attitude, and practice regarding BPA.[9] These findings highlight the need to include BPA research in postgraduate curricula and promote the ongoing educational initiative.

Furthermore, we observed that more faculty members as compared to postgraduate students reported compliance with the recommended guidelines while administering composite restorations and sealants, as well as making efforts to reduce the use of BPA-containing plastic containers. This observation suggests that despite their limited knowledge of the potential side effects and controversies surrounding BPA, faculty members effectively utilise their knowledge to minimise BPA exposure for themselves and their patients.

The results of this report can be generalised to similar populations by stratifying the findings and mitigating the impact of confounding variables through regression analysis. However, it is essential to acknowledge that the survey's low response rate is a limitation, which may have introduced sampling bias. Despite the potential for increased accuracy, numerous studies have noted no statistically significant effect of response rate on outcome.[10]

Conclusion

The study reveals that faculty members possess greater knowledge, practice, and a more positive attitude toward BPA as compared to postgraduate students. To ensure optimal dental treatment and address BPA-related concerns, it is crucial to raise awareness and provide continuous education for dental professionals.

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