

Knowledge, Attitude, and Behavior of Restorative, Orthodontic, and Pediatric Departments' Members toward Bisphenol A Dental Exposures

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ABSTRACT

Aim and Objectives: The aim of this study is to evaluate the knowledge, attitude, and behavior of Restorative, Orthodontic, and Pediatric Dentistry Departments' members at King Abdulaziz University (KAU), Jeddah, Saudi Arabia, toward bisphenol A (BPA) dental exposure.

Materials and Methods: A survey was pretested for face and content validity. It included ten knowledge-, four attitude-, and five behavior-based items. The collected data were analyzed using Windows SPSS software version 22 (IBM Corp., Armonk, NY, USA). Significant levels were set at 0.05.

Results: A total of 109 members participated in this study. Most of them (80 [73.4]) had never attended a lecture or read an article on BPA dental exposure previously. The restorative department members showed the highest (mean \pm standard deviation score) in knowledge-based questions (3.32 ± 3.323), and those who reported that they had heard of BPA previously, read an article, or attended a lecture on BPA received significantly higher mean knowledge scores ($P < 0.0001$). The pediatric dentistry departments' members showed significantly higher agreements to attitude questions. Only ten participants (9.2%) followed the recommended guidelines to reduce patients' exposure to BPA during the application of BPA-containing dental materials.

Conclusions: Reading an article or attending a lecture on BPA significantly improves the knowledge scores. Therefore, there is a need to increase the awareness on BPA dental exposure among different departments' members in KAU to ensure that BPA exposure to patients is minimized and to ensure the spread of this knowledge to the dental students.

KEYWORDS: Attitude, behavior, bisphenol A, composite restorations, dentists, knowledge

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INTRODUCTION

For years now, the use of composite resins and sealants has become a common practice in pediatric dentistry.^[1] Although composite resin restorations and sealants offer excellent esthetic and functional properties,^[2] their composition that contains derivatives of bisphenol A (BPA) has raised many concerns due to its potential toxicity.^[3,4] It has been reported to negatively affect behavior in children^[5,6] and cause spontaneous abortion or abnormal gestation time if exposure occurred during gestation, obesity in children, and other detrimental health effects.^[7] The prohibition

of the use of BPA in food-related products for children in many countries since 2009 effectively decreased the BPA exposure among the children, and therefore, the average BPA intake among children was found to be decreased from 2011.^[8]

Some of the most extensively used BPA derivatives in dental composite resins are BPA diglycidyl methacrylate

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(bis-GMA), in particular, and BPA dimethacrylate (bis-DMA), composing the monomer part of the composite resin.^[9] These derivatives leach out of the restorations when incompletely polymerized, and bis-DMA was found to undergo hydrolysis by salivary esterases to form BPA.^[10,11] Consequently, several studies have reported BPA detected in the saliva of patients following the placement of composite resin sealants in different amounts.^[12-14]

Dental care providers has the responsibility to ensure the safety of patients and do everything they can to limit patients' exposure to potentially harmful substances. To our knowledge, no studies have been published that report the awareness of different departments' members in Jeddah, Saudi Arabia, concerning the issue of BPA in the dental field. The aim of this study was to assess the knowledge, attitude, and practice of Restorative, Orthodontic, and Pediatric Dentistry Departments' members in King Abdulaziz University (KAU), Jeddah, Saudi Arabia, regarding BPA dental exposure. The null hypothesis for this study was different departments' members at KAU are not fully aware of BPA dental exposure and are not following the guidelines in their practice to help minimize it.

MATERIALS AND METHODS

STUDY SAMPLE

This cross-sectional study was conducted among Restorative, Orthodontic, and Pediatric Departments' members. The self-administered questionnaire was distributed among all members (182 members) at KAU in Jeddah, Saudi Arabia. This study was approved by the Research Ethics Committee of the Faculty of Dentistry in KAU (002-01-17). The questionnaire was distributed between December 2017 and February 2018. Consent approval letter including study description, what is BPA, and benefits expected from the study was approved and signed by participants before answering the questionnaire.

VALIDATION SURVEY

The survey was pretested for face and content validity. Up to five faculty members at KAU were given the same survey individually and asked to rate each question using a 5-point Likert scale to test the content validity. The scale ranged from very important to not important. The face validity was also tested by questioning a total of ten randomly selected dentists.

SURVEY CONTENT

The questionnaire was designed after a literature review was performed and consisted of four parts. Part one included demographic questions about the gender, age, and to which department the participants belong.

Furthermore, they were asked if they had ever heard or had been asked by a patient about BPA or if they had ever attended a lecture or read an article about BPA dental exposure. The second part included ten knowledge-based questions. A score of 1 was given for each correctly answered question, and the mean passing score was set on 5. The third category consisted of four attitude-related items. The answers to these questions were graded by a 5-point Likert scale ranging from strongly agree to strongly disagree. The fourth category consisted of five close-ended questions on practice items.

STATISTICAL ANALYSIS

Categorical variables were displayed as percentages and compared using the Chi-square test. However, attitude-related questions were displayed in means and standard deviations (SDs) and compared using one-way ANOVA. For each knowledge-based question answered correctly, participants were awarded a score of 1, and thus the total score ranged from 0 to 10. Means of the total scores were compared using one-way ANOVA. Significant levels were set at 0.05.

RESULTS

A total of 109 dentists (59.9% response rate) participated in the study. The demographic characteristics of the participants are represented in Table 1. Out of the total sample, 71 (65.1%) participants had heard of BPA previously. However, 80 (73.4%) had never previously attended a lecture or read an article on BPA dental exposure. When comparing different departments, restorative dentistry showed a significantly higher number of members who had heard ($P < 0.001$, odds ratio [OR]: 11.13 and 95% confidence interval [CI]: 3.488–40.59), attended, or read a lecture on BPA ($P < 0.0028$, OR: 11.05 and 95% CI: 2.29–53.295) compared to orthodontists [Table 2]. Moreover, none of

Table 1: Demographic characteristics of the participants (n=109)

Variables	Mean	SD
Age (years)	34.49	10.03
	Number	Percentage
Gender		
Female	83	76.1
Male	26	23.9
Department		
Restorative	37	33.9
Orthodontic	31	28.4
Pediatric	41	37.6
Qualification		
Consultant	48	44
Residents	61	56

SD=Standard deviation

the participants had been asked by their patients about BPA previously.

KNOWLEDGE-BASED QUESTIONS

The frequency of each question answered correctly is represented in Table 3. Questions regarding “BPA is found in methacrylate-based (Bis-DMA and Bis-GMA) resin dental materials such as sealants and composite restorations,” BPA is found in amalgam restorations, and “BPA is a structural component in hard, clear plastic bottles (baby bottles and metal cans)” showed the highest correct responses from the included participants (36.7%, 34.9%, and 29.4%, respectively), with the orthodontic department showing the lowest statistically significant correct responses. On the other hand, “Bis-DMA resin

monomer releases up to eighty times more BPA than Bis-GMA resin monomers” showed the lowest correct responses (4 [3.7%]) among the participants.

When the knowledge-based questions were scored from 0 to 10, the mean ± SD score for the total participants was 2.28 ± 2.984 which was statistically significantly lower than the mean passing score of 5 (*P* < 0.0001). In addition, 79 (72.5%) participants scored <5, and 62 (59.9%) scored 0: 15 (40.5%) from the restorative, 25 (80.6%) from the orthodontics, and 22 (53.7%) from the pediatric dentistry department). Moreover, there was a statistically significant relation between the mean knowledge scores and the participants' department (*P* = 0.001), with the restorative department

Table 2: Distribution of participants who affirmed hearing (*n*=71), reading, or attending a lecture on bisphenol A dental exposures (*n*=29) according to their gender, department, and qualification

Variables	Heard about BPA before		Read an article or attended a lecture on BPA dental exposure	
	<i>n</i> (%)	<i>P</i> OR (95% CI)	<i>n</i> (%)	<i>P</i> OR (95% CI)
Gender				
Female	51 (61.4)	0.148	21 (25.3)	0.582
Male	20 (76.9)	0.478 (0.173-1.318)	8 (30.8)	0.762 (0.289-2.01)
Department				
Restorative**	32 (86.5)		16 (43.2)	
Orthodontic	11 (35.5)	<0.001*	2 (6.5)	0.0028*
		11.13 (3.488-40.59)		11.048 (2.29-53.295)
Pediatric	28 (58.3)	0.07	11 (26.8)	0.1309
		2.971 (0.941-9.379)		2.078 (0.805-5.366)

*Significant level set at 0.05, **Reference. OR=Odds ratio, CI=Confidence interval, *n*=Number of participants, BPA=Bisphenol-A

Table 3: Distribution of participants according to their correct responses to knowledge questions

Questions	Department			Total <i>n</i> (100%)	<i>P</i>
	Restorative	Orthodontic	Pediatric		
BPA is a structural component in hard, clear plastic bottles (baby bottles and metal cans)	13 (40.6)	4 (12.5)	15 (46.9)	32 (29.4)	0.05*
BPA belongs to a group of compounds known as xenoestrogens, which can bind to estrogen receptors causing hormonal disturbance	9 (47.4)	2 (9.5)	10 (47.6)	21 (19.3)	0.154
Prenatal exposure to BPA may be associated with neurodevelopmental and reproductive adverse effects throughout the life span of the baby	8 (29.6)	1 (5.3)	9 (47.4)	19 (17.4)	0.146
BPA is found in methacrylate-based (Bis-DMA and Bis-GMA) resin dental materials such as sealants and composite restorations	21 (52.5)	5 (12.5)	14 (35)	40 (36.7)	0.01*
BPA is found in amalgam restorations	20 (52.6)	4 (10.5)	14 (36.8)	38 (34.9)	0.002*
Infants, young children, and pregnant or lactating women are the least sensitive to BPA	12 (38.7)	5 (16.1)	14 (45.2)	31 (28.4)	0.112
Bis-DMA resin monomer releases up to eighty times more BPA than Bis-GMA resin monomers	3 (75)	0	1 (25)	4 (3.7)	0.244
After the placement of sealants or composite restorations, BPA levels can be detected in urine and saliva	12 (60)	0	8 (40)	20 (18.3)	0.013*
There is greater risk of exposure to BPA in small and shallow composite restorations compared to large and deep restorations	16 (66.7)	2 (8.3)	6 (25)	24 (22.0)	>0.0001
The use of a rubber dam reduces the exposure to BPA	8 (40)	1 (5)	11 (55)	20 (18.3)	>0.0001

*Significant level set at 0.05. Bis-GMA=Bisphenol A diglycidyl methacrylate, BPA=Bisphenol A, Bis-DMA=Bisphenol A dimethacrylate

showing the highest mean \pm SD score (3.32 ± 3.323). In addition, those who reported that they had heard of BPA previously, read an article, or attended a lecture on BPA received higher mean knowledge scores ($P < 0.0001$) compared to those who did not, which was also predicted after conducting ordinal regression analysis for the included variable ($P < 0.0001$ and 0.003 , respectively) [Table 4].

ATTITUDE-BASED QUESTIONS

Most of the participants answered positively to all the attitude-based questions. However, the pediatric dentistry departments' members showed significantly higher agreements to attitude-based questions compared to other departments in their willingness to increase their knowledge on BPA dental exposure ($P = 0.002$) and follow the proposed guidelines when applying BPA-containing dental materials ($P = 0.035$) [Table 5].

BEHAVIOR-BASED QUESTIONS

Only one (0.9%) of the participants reported that he/she regularly checked the BPA content of the dental materials before using them in dental practice. Twelve (11%) of them tried to keep up to date with the new researches in the field of BPA dental exposure. Although

26 (23.9%) tried to reduce their personal consumption of BPA-containing plastic bottles, only ten (9.2%) followed the recommended guidelines to reduce patients' exposure to BPA during the application of composite restorations and sealants and advise their patients to reduce the use of BPA-containing plastics and cans.

DISCUSSION

The aim of the present study was to evaluate the knowledge, attitude, and behavior among Restorative, Orthodontic, and Pediatric Dentistry departments' members at KAU, Jeddah, Saudi Arabia. We intended to learn how much dentists knew and what they practiced regarding a controversial component in the materials they use on a daily basis in order to evaluate the need for specific instructions and/or educational materials on BPA. It also reflects whether this knowledge and practice is reflected in the didactic/clinical courses taught to dental students at KAU. We hypothesized that dentists in KAU do not know much about BPA and BPA dental exposure. It is imperative to be knowledgeable on the subject considering the abundance of studies highlighting the potential dangers excess exposure to BPA can cause and hence, dentists can do their part in minimizing exposure to it and be able to address any questions or concerns expressed by patients.

In 2009, Swan *et al.*^[15] and Braun *et al.*^[16] focused on the effects of BPA as an endocrine disruptor in the prenatal period, concluding that it affects brain development of the fetus. They found that it affects fetal sex hormones, subsequently altering behavior in toddlers, with different results between the two sexes. Furthermore, it is believed to possibly increase the chances of abortion, alter gestation time, cause defects in the male genitalia, and increase the risk of asthma for the child.^[7] BPA is also believed to affect the regulation of thyroid hormones, with studies reporting it acting as a selective thyroid antagonist in rats^[17] and in mice.^[18]

Regarding BPA dental exposure, detectable levels of BPA in the saliva of patients who had received sealants were first detected in 1996 by Olea *et al.*, which stimulated a public concern, especially for children.^[12] An important

Table 4: Distribution of participants according to their mean scores in knowledge-based questions

Participants' description	Mean \pm SD	P
Department		
Restorative	3.32 \pm 3.232	0.001*
Orthodontic	0.77 \pm 1.647	
Pediatric	2.46 \pm 3.131	
Gender		
Female	2.18 \pm 2.914	0.557
Male	2.58 \pm 3.239	
I heard of BPA before		
Yes	3.45 \pm 3.097	$P < 0.0001$ *
No	0.08 \pm 0.487	
Attended a course or read an article on BPA		
Yes	5.72 \pm 2.086	$P < 0.0001$ *
No	1.02 \pm 2.164	

*Significant level at 0.05. SD=Standard deviation, BPA=Bisphenol A

Table 5: The mean and standard deviation of the attitude-based questions according to different departments

Questions	Restorative	Orthodontics	Pediatrics	P
Do dentists need to educate their patients about the potential risk of BPA exposure?	2.03 (0.866)	2.06 (0.892)	1.68 (0.96)	0.136
If you have a chance to enhance your knowledge on BPA dental exposure, would you take it?	1.65 (0.676)	2 (0.856)	1.37 (0.662)	0.002*
Do dentists need to follow the proposed guidelines when applying BPA-containing dental materials?	1.62 (0.721)	1.65 (0.755)	1.27 (0.633)	0.035*
Do dentists need more information on BPA dental exposure?	1.65 (0.753)	1.81 (0.792)	1.54 (1.027)	0.436

*Significant level at 0.05, Scores range from 1 to 5=Strongly disagree to strongly agree, respectively. BPA=Bisphenol A

study and one which again elevated the concern for BPA dental exposure was by Bellinger *et al.* as part of the New England Children's Amalgam Trial who compared the behavior of children after amalgam and composite restorations. They reported worse psychosocial behavior among children after composite restorations compared to the amalgam group.^[5] In contrast, several studies have stated that the exposure to BPA from dental materials is minimal and appears to pose no known health risk.^[11-14] It is worthy to mention that manufacturers are not mandated to report the exact composition of their composite resins, and some have refused to share the composition of their composite resins when asked.^[19]

In the present study, the mean score in the knowledge-based questions for the total participants was significantly lower than the mean passing score of 5, which indicated insufficiency in their knowledge about BPA dental exposure. In addition, those who reported that they had heard of BPA before, read an article, or attended a lecture on BPA received higher mean knowledge scores compared to those who did not, which emphasized the need to provide education lectures to improve the knowledge among the members at KAU.

Furthermore, the mean knowledge score was the highest among the restorative department members and the lowest among the orthodontic department members. This can be because the restorative department members focus the most among other departments on dental materials in their teaching and practice on a daily basis, with an even higher emphasis on the specifics of dental materials in their postgraduate education.

Regarding the attitude-based questions, most of the participants agreed to all the attitude-based questions. The pediatric dentistry department members showed significantly higher agreements to attitude-based questions in their willingness to increase their knowledge on BPA dental exposure and follow the proposed guidelines when applying BPA-containing dental materials. This can be because pediatric dentists deal with children who are readily affected by endocrine disruptors including BPA.^[20] Moreover, the innate intention of not wanting to cause harm to a child and the fact that children almost always present with guardians or caretakers who may ask about BPA and other dental materials may contribute to the positive attitude among pediatric dentists to learn the most about any materials used in pediatric dentistry that may be harmful including BPA.

For any dentist to make informed decisions on material selection, he/she needs both to keep up to date with the most current research findings and to know the

composition of the composite resin he/she is using.^[21] This will help them adjust their practice as needed to reduce patients' exposure to BPA. In the current study, only one (0.9%) of the participants reported that he/she usually check the BPA content of the dental materials before using them and 12 (11%) of them try to keep up to date with the new researches in the field of BPA dental exposure. This indicated the need to increase their awareness and behavior toward BPA-containing materials, aiming to further reduce patients' dental exposure to BPA.

The questionnaire was self-administrative and was pilot tested, which decreased the number of participants and therefore reduced the response rate. In addition, the attitude-based questions may be subject to response bias.

Although the study was carried out in KAU, based on our knowledge, it is the first study that evaluated and compared knowledge, attitude, and behavior among dentists toward BPA. Therefore, it could build up the baseline for future studies that aim to improve the awareness of BPA among dentists and communities worldwide.

The highest percentage of uncured monomer is in the superficial layer of uncured resin. Therefore, removing this layer using prophylaxis cup,^[22] rubber dam application,^[23] and gargling with water for 30 s after the placement of restorations significantly reduces the potential BPA exposure to the patient.^[24] Furthermore, for light-cured composite resins, decreased curing time and increased curing light-tip distance are both associated with a statistically higher release of BPA.^[25] Only ten (9.2%) of our participants are following the recommended guidelines to reduce patients' exposure to BPA during the application of composite restorations and sealants and advise their patients to reduce the use of BPA-containing plastics and cans. Therefore, educational lectures that highlight this public concern are highly needed to influence the change and improve the current dental knowledge, attitude, and practice at KAU and then gradually across the dental community worldwide.

Regarding the limitations of this study, a small sample size study was done in the university as a pilot study to measure the level of knowledge among some of the most educated dentists in the country. This served as a starting point to raise the awareness on BPA dental exposure and to encourage dentists to generally learn more about the components of the materials they use for patients on a regular basis.

CONCLUSIONS

1. Most of the restorative, orthodontic, and pediatric dentistry departments' members had never previously

attended a lecture or read an article on BPA dental exposure

2. Restorative dentistry departments' members scored the highest in knowledge-based questions on BPA dental exposure
3. Most participants answered positively to all the attitude-based questions. However, the pediatric dentistry department showed significantly higher agreements to attitude-based questions
4. Almost none of the participants reported that he/she checked the BPA content of the dental materials before using them in dental practice.

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CONFLICTS OF INTEREST

There are no conflicts of interest.

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