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## RESEARCH ARTICLE

### Endodontic Treatment in Pregnancy: Knowledge, Attitudes, and Practices of Dentists and Interns in Jeddah, Saudi Arabia

Khalid Aboalshamat<sup>1\*</sup>, Somaya Abdulrahman<sup>2</sup>, Jameelah Alowadi<sup>3</sup>, Najwa Al-Mutairy<sup>4</sup>, Mysam Fairak<sup>5</sup>, Noufah Alraithi<sup>6</sup>, Amani Alsolami<sup>3</sup>, Asma Alshahrani<sup>7</sup> and Wejdan Almansouri<sup>7</sup>

<sup>1</sup>Department of Preventive Dentistry, Dental Public Health Division, Faculty of Dentistry, Umm Al-Qura University, Makkah, Saudi Arabia

<sup>2</sup>Department of Dentistry, Faculty of Dentistry, Umm Al-Qura University, Makkah, Saudi Arabia

<sup>3</sup>Department of Dentistry, King Abdulaziz University, Jeddah, Saudi Arabia

<sup>4</sup>Department of Dentistry, Ibn Sina National college, Jeddah, Saudi Arabia

<sup>5</sup>Department of Dentistry, Ministry of Health, Arar, Saudi Arabia

<sup>6</sup>Department of Dentistry, Ministry of Interior, Taif, Saudi Arabia

<sup>7</sup>Department of Dentistry, Alfarabi college, Jeddah, Saudi Arabia

#### Abstract:

#### Aim:

Pregnant women require special consideration in dental treatment due to physiological changes during their pregnancy. The aim of this study is to assess the knowledge, attitudes, and practices of dentists and dental interns in Jeddah, Saudi Arabia, regarding endodontic treatment during pregnancy.

#### Methods:

A cross-sectional study was conducted using validated self-report questionnaires completed by 450 dental interns and dentists who treat pregnant women in governmental and private dental clinics in Jeddah, Saudi Arabia. The questionnaire measured participants' knowledge, beliefs, and actual practices regarding behavioral counseling and the treatment of pregnant patients. Descriptive statistics were generated, and significance was set at 0.05.

#### Results:

A total of 86.4% of the participants acknowledged the importance of endodontic treatment for pregnant patients and responded that most endodontic procedures are considered safe during the second trimester, including periapical radiographs (67.11%), endodontic treatment (81.11%), local anesthesia with and without epinephrine (70.67%), open access (83.78%), drainage of abscesses (76.89%), prescribing acetaminophen (75.56%), and prescribing antibiotics (61.11%). In addition, 57.8% knew that Nonsteroidal Anti-inflammatory Drugs (NSAIDs) are contraindicated. However, 69.33% considered panoramic radiographs contraindicated. Knowledgeable participants were significantly more likely to practice appropriate endodontic procedures. The majority (70.9%) were interested in more education about pregnant patients.

#### Conclusion:

Dental interns and dentists in Saudi Arabia have fair levels of knowledge about endodontic treatment of pregnant patients, and need to improve their knowledge, especially regarding radiographs and NSAIDs.

**Keywords:** Endodontic treatment, Pregnant patient, Knowledge, Attitude, Practice, Cross-sectional, Dentists.

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## 1. INTRODUCTION

Many pregnant women lack the proper knowledge about

dental care and oral changes that accompany pregnancy and can affect both the mother's oral health and that of the infant [1, 2]. Being aware of these changes is an important step in delivering proper oral health care for these patients [3]. In fact, neglect of oral hygiene can lead to periodontal problems and increased oral infections [4, 5]. Numerous studies worldwide

\* Address correspondence to this author at the Dental Public Health Division, Preventive Dentistry Department, Faculty of Dentistry, Umm Al-Qura University, Makkah, Saudi Arabia; Tel: +966125270000; E-mail: Ktaboalshamat@uqu.edu.sa

have reported that pregnant women have higher rates of untreated dental caries than women who are not pregnant [6 - 8], which may be the result of changes in the oral medium, including through vomiting, an elevation in acidity, and increasing sugary foods intake [9]. However, it should be noted that a pregnant woman is not medically compromised; therefore, dental treatment is acceptable, but special considerations are needed as their management may need some adjustments to the timing of certain treatments, types of dental treatments used, and drugs to be prescribed [10 - 12].

Root Canal Treatment (RCT) is used with pregnant patients to control the spread of disease, keep a healthy oral environment, and minimize the expected complications that could occur later in pregnancy or during the postpartum period [12]. It is important to remove diseased pulp tissue at any time during pregnancy [11] because odontogenic infections have the ability to advance quickly to deep-space infections that eventually affect the oropharyngeal airway [5].

RCT usually requires radiographic exposure, local anesthetic agents, irrigation, intra-canal medications, and drugs such as analgesics and antibiotics [11]. The major biological risk from exposure to radiation is carcinogenesis; however, radiographs are considered to be safe for mother and fetus when used with proper positioning of the radiograph towards the mouth and avoiding the abdomen, using high-speed film, wearing a lead apron, and wearing a thyroid protecting collar [13 - 16]. One study noted that if a mother received 1,250 dental radiographs, her fetus would be exposed to the same amount of radiation as any fetus whose mother lives in typical circumstances in the state of Colorado in the United States [13]. Furthermore, local anesthesia is relatively safe when given properly and in measured quantities during pregnancy [5, 17]. Studies have shown no atypical side effects or complications after the use of anesthetic agents that contain epinephrine with vasoconstriction up to 0.1 mg for epidural anesthesia during labor [18]. Lidocaine does not have harmful effects on the mother or fetus [19]. Despite some studies recommending delaying the use of any chemicals during the first trimester of pregnancy [5, 19], a longitudinal study showed no teratogenic effect when using local anesthesia, even during the first trimester [17].

The use of contraindicated medications by pregnant women can be a problem, more so in some countries than others [20]. In fact, the systematic review indicated that pain killers are common among pregnant women worldwide [20]. This can be accentuated when the dentist prescribes inappropriate drugs. Instead of receiving proper therapeutic dental effects, overuse of these medications may have dangerous effects on the fetus and the mother [21].

Therefore, it is important that dentists and dental students be knowledgeable and have an appropriate attitude towards endodontic treatments for pregnant women. A study of Nigerian dentists found that 91.8% believed that RCT is generally safe for pregnant patients, but only 77% believed that the use of a local anesthetic with epinephrine is safe, and only 57.4% believed that radiographs are safe for pregnant patients [11]. The study also indicated that the level of knowledge varies significantly among the different specialties. In another

study, 99% of Australian dentists agreed that pregnant patients should get dental examinations; however, only 22% had good knowledge about treating pregnant women in dental clinics [22]. In fact, dentists with low levels of knowledge were more likely to delay dental appointments or request consent from a medical physician before providing treatment [22]. Given that 95.7% requested further information about treating pregnant women, there is an indication that a need exists to boost dentists' knowledge about treating pregnant women in dental clinics [22].

A prior study was conducted in Riyadh, Saudi Arabia, among dental students and interns that showed 82.9% of the respondents believed that the second trimester is the best period to treat pregnant women, but only 63.8% believed that diagnostic radiographs are not contraindicated for pregnant women [23]. The authors of this study concluded that dental students have some knowledge about treating pregnant women, but it is inadequate [23].

However, no similar study has assessed the knowledge, attitudes, and practices of dentists in other Saudi Arabian cities with regard to RCT in pregnant women. Hence, this study aimed to assess the knowledge, attitudes, and practices of dentists regarding endodontic treatment during pregnancy, in Jeddah, Saudi Arabia, as the second-largest city in the country with a large population of dentists [24].

## 2. MATERIALS AND METHODS

This cross-sectional study was designed to assess the levels of knowledge, attitudes, and practices of dental practitioners and dental interns in Jeddah, Saudi Arabia, regarding the endodontic treatment of pregnant patients. The participants were recruited from four major government hospitals and private dental clinics in Jeddah from November to December 2019. A convenience sampling method was used. The inclusion criteria were dentists or dental interns who currently treat pregnant women in any specialty, including as a general dentist, endodontist, restorative dentist, family dentist, or advanced restorative dentist. The exclusion criteria included other specialties that do not involve endodontic treatment, such as pedodontics, orthodontics, and maxillofacial specialties. The research team members were available to answer any query from participants to reduce self-reported bias. The sample size was determined by using 5% as the precision level, a prevalence estimation of 50%, and 95% as the confidence interval, resulting in a minimum sample size of 385 participants. To allow for the expected dropout rate, 450 dentists and dental interns were invited to participate in the study.

Participants signed a consent form before completing the study's hard copy self-administered questionnaire, which was done on a voluntary basis during the participants' free time and which were kept completely anonymous. Participants needed four to six minutes to complete the questionnaire, which was delivered by a member of the research team so they would be available to answer any questions from the participants.

The questionnaire was adopted from two previous studies and modified for this study [11, 25]. It consisted of 39 items divided into four sections. The first section, encompassing 16

questions, measured participants’ knowledge regarding treating pregnant patients, including items regarding the importance of RCT in pregnancy, positioning of pregnant patients, and the safety of pregnant mother and fetus when using RCT materials. Questions about the safe period of pregnancy for conducting several RCT procedures were also included here, including taking radiographs, RCT implementation, local anesthesia with and without epinephrine, accessing cavities, and using common orally administered drugs such as paracetamol, ibuprofen, and amoxicillin. A total knowledge score was calculated by adding the totals for the correct answers.

The second section measured the actual practices of the participants with pregnant patients in the second trimester. This section included 10 questions, including the same items mentioned in section one, with answers ranging from “usually” to “sometimes,” “often,” “never,” and “not certain.” The third section included seven questions regarding beliefs about behavioral counseling in the treatment of pregnant patients and included explorations of opinions about dental treatment as a part of prenatal care, the time frame in which to seek dental care, and the best health care professional to provide oral health consultations and care, along with the ability and skills for counseling pregnant patients, the importance of counseling, and the motivation to learn more about pregnant patient oral care. This section’s questions were answered on a five-point Likert scale ranging from strongly disagree to strongly agree. Finally, the fourth section collected demographic information, including age, gender, work status, dental specialty, and the number of years in practice. The study was approved by the Institutional Review Board of Umm Al-Qura University, Faculty of Dentistry, with number 153-19. The questionnaire was face validated by a pilot study of 10 dentists for syntax,

organization, spelling, grammar, and clarity of the questions before creating the final version.

**2.1. Statistical Analysis**

The data were collected, tabulated, and analyzed using SPSS version 23 (IBM Corp., Armonk, NY, USA), and descriptive statistics were generated using mean, standard deviation, frequency, and percentages. Chi-square, Fisher’s exact test, t-test, ANOVA, and linear regression were used to compare participant responses, and statistical significance was set at 0.05. There was less than 1% of the missing value that was replaced using the expectation-maximization method.

**3. RESULTS**

Data were collected from 450 participants who responded to the original 550 invitations (response rate = 81.81%). Participant mean age was 31.12 with a standard deviation of 7.53. The median of the duration of practice was 1.5 years, with the range being 0 to 40 years. The demographic data are detailed in Table 1.

Participants were asked questions about their knowledge of endodontic treatment of pregnant patients, and the answers are detailed in Tables 2 and 3. The correct choice for items in Table 2 was “Yes,” and the best choice for items in Table 3 was “second trimester” as the safest trimester [25], with the exception of ibuprofen, which is considered to be contraindicated for pregnant women [26, 27]. When correct answers and best choices were totaled, the mean was 11.74 and the standard deviation was 3.06, with a range of possible scores from 16 (highest knowledge score) to zero (lowest knowledge score).

**Table 1. Participant demographic data (n = 450).**

Variable		Count	Percentage
Gender	Male	186	41.3%
	Female	264	58.7%
Work status	Intern	206	45.8%
	General dentist	153	34.0%
	Specialist or consultant	91	20.2%
Specialty	Interns	206	45.8%
	General dentist	127	28.2%
	Family dentist	4	0.9%
	Conservative dentistry	15	3.3%
	Endodontic dentistry	36	8%
	Restorative dentistry	35	7.8%
	Advanced restorative dentistry	11	2.4%
Other	16	3.6%	

**Table 2. Participant knowledge regarding safe endodontic procedures for pregnant patients, part I (n = 450).**

Item	Correct choice	N	%
It is important to provide appropriate endodontic treatment for dental pain and infection with pregnant patients.	Yes	389	86.4%
The pregnant patient should be positioned in a special way.	Yes	372	82.7%

(Table 2) contd....

Item	Correct choice	N	%
It is safe to use irrigation agents (e.g., sodium hypochlorite) during RCT for pregnant patients.	Yes	382	84.9%
It is safe to use obturation material (gutta-percha) during RCT for pregnant patients.	Yes	408	90.7%
It is safe to use root sealer during RCT for pregnant patients.	Yes	401	89.1%
It is safe to use inter-appointment medicaments during RCT for pregnant patients.	Yes	364	80.9%

RCT: Root canal treatment

**Table 3. Participant knowledge regarding safe endodontic procedures for pregnant patients, part II (n = 450).**

Procedure	Safe in first or later trimester n (%)	1st trimester n (%)	2nd trimester n (%)	3rd trimester n (%)	Contraindicated or uncertain n (%)
A single periapical radiograph	351 (78)	124 (27.56)	302 (67.11)	175 (38.89)	99 (22)
Full-mouth radiograph	138 (30.67)	30 (6.67)	115 (25.56)	45 (10)	312 (69.33)
Endodontic treatment	418 (92.89)	131 (29.11)	365 (81.11)	168 (37.33)	32 (7.11)
Administer local anesthesia with epinephrine	360 (80)	117 (26)	318 (70.67)	146 (32.44)	90 (20)
Administer local anesthesia without epinephrine	404 (89.78)	189 (42)	318 (70.67)	228 (50.67)	46 (10.22)
Access opening to relieve pain	425 (94.44)	266 (59.11)	377 (83.78)	283 (62.89)	25 (5.56)
Make incision to drain abscess	406 (90.22)	233 (51.78)	346 (76.89)	249 (55.33)	44 (9.78)
Prescribe acetaminophen, such as paracetamol	403 (89.56)	280 (62.22)	340 (75.56)	300 (66.67)	47 (10.44)
Prescribe NSAIDS such as ibuprofen	142 (31.56)	36 (8)	97 (21.56)	69 (15.33)	308 (68.44)*
Prescribe antibiotics such as amoxicillin or clindamycin	328 (72.89)	163 (36.22)	275 (61.11)	199 (44.22)	122 (27.11)

Note: Participant answers for first, second, and third trimesters are not cumulative, as some participants chose more than one trimester. \* Among 308 (68.44%) participants, 260 (57.8%) answered that ibuprofen was contraindicated, and 48 (10.6%) were uncertain.

Using linear regression, total knowledge score on the endodontic treatment of pregnant patients was shown to be significantly related to age, with  $F(1,448) = 6.182, p = 0.013, R^2 = 0.014$ , and to years of practice, with  $F(1,448) = 6.028, p = 0.014, R^2 = 0.013$ . A t-test showed that the total knowledge score was not significantly different between males and females. Using ANOVA, the total knowledge score was shown to be significantly related to work status,  $F(2,447) = 14.342, p < 0.001$ , and a post hoc Tukey’s test showed that interns ( $m = 10.93, SD = 3.61$ ) scored significantly lower than general dentists ( $m = 12.39, SD = 2.4$ ) and specialists/consultants ( $m = 12.51, SD = 2.11$ ). However, general dentists and specialists/consultants were not significantly different from each other.

Participants’ answers regarding their actual practice in the dental clinic for endodontic treatment of pregnant patients are shown in Table 4. Dichotomizing the participants’ practices into proper practices and improper ones (signified by answering “never” or “not certain” for all items except for using ibuprofen) and using the chi-square test revealed a significant relationship between item knowledge and item practices, and it was more likely that participants with accurate knowledge would provide proper treatment practices for each item shown in Table 4, with  $p < 0.001$ .

Participants had different attitudes regarding endodontic treatment for pregnant patients, and the answers are shown in Table 5.

**Table 4. Relationship between participant knowledge and their dental practices regarding the endodontic treatment of pregnant patients.**

Item	Often	Sometimes	Never	Not certain
Single periapical radiograph	248 (55.11)	120 (26.67)	72 (16)	10 (2.22)
Full-mouth radiograph	64 (14.22)	61 (13.56)	287 (63.78)	38 (8.44)
Endodontic treatment	242 (53.78)	168 (37.33)	31 (6.89)	9 (2)
Administer local anesthesia with epinephrine	208 (46.22)	150 (33.33)	77 (17.11)	15 (3.33)
Administer local anesthesia without epinephrine	262 (58.22)	151 (33.56)	22 (4.89)	15 (3.33)
Access opening to relieve pain	339 (75.33)	103 (22.89)	7 (1.56)	1 (0.22)
Make incision and drain abscess	300 (66.67)	114 (25.33)	12 (2.67)	24 (5.33)
Prescribe acetaminophen such as paracetamol	315 (70)	117 (26)	14 (3.11)	4 (0.89)
Prescribe NSAIDS such as ibuprofen	90 (20)	86 (19.11)	233 (51.78)	41 (9.11)
Prescribe antibiotics such as amoxicillin or clindamycin	194 (43.11)	141 (31.33)	76 (16.89)	39 (8.67)

**Table 5. Participant attitudes regarding endodontic treatment for pregnant patients.**

Item	Strongly disagree n (%)	Disagree n (%)	Neutral n (%)	Agree n (%)	Strongly agree n (%)
Routine endodontic treatment should be part of prenatal care.	44 (9.8%)	78 (17.3%)	112 (24.9%)	129 (28.7%)	87 (19.3%)
Pregnant patients are more likely to seek dental care if their physicians recommend it.	16 (3.6%)	43 (9.6%)	88 (19.6%)	211 (46.9%)	92 (20.4%)
Physicians are better able than dentists to counsel pregnant patients about oral health.	107 (23.8%)	132 (29.3%)	80 (17.8%)	91 (20.2%)	40 (8.9%)
My practice is too busy to add counseling for pregnant patients.	126 (28%)	153 (34%)	89 (19.8%)	73 (16.2%)	9 (2%)
I have the skills to counsel pregnant patients.	16 (3.6%)	49 (10.9%)	155 (34.4%)	179 (39.8%)	51 (11.3%)
It is important to counsel pregnant patients about how decay can affect the baby.	22 (4.9%)	32 (7.1%)	96 (21.3%)	196 (43.6%)	104 (23.1%)
I am interested in getting information about continuing dental education on treating pregnant patients.	15 (3.3%)	27 (6%)	89 (19.8%)	166 (36.9%)	153 (34%)

**4. DISCUSSION**

In general, participant knowledge was better than the midpoint, and knowledge levels rose with increased age and years in practice. Dental interns had lower knowledge scores than graduated dentists, specialists, and consultants. Our study indicated that dental interns and dentists have fair levels of knowledge that need improvement. This is similar to previous studies in Nigeria [11] and Saudi Arabia [23], but different from others in India [25], Australia [22], and Saudi Arabia [28]. It should be noted that this difference might be due to different levels of education between cities and countries and the type of continuous education participants receives. In fact, there is variation regarding different items, as will be discussed in detail below.

Studies had some controversial and different opinions

toward RCT and their procedures. This is summarized in Table 6, and discussed below with more details. In fact, several studies revealed that some dentists are reluctant to treat pregnant patients due to uncertainty and fear of harming the fetus [29 - 32]. The majority of participants in our study acknowledged the importance of providing endodontic treatment and pain relief for pregnant patients, which was similar to responses in a previous study [11]. The majority of the study participants knew that pregnant patients require special positioning, which was similar to a prior study in Nigeria, but higher than a previous local Saudi Arabian study (27%) [28]. The reason for this is likely that the prior Saudi study was specifically assessing the dentist's knowledge about a semi-reclined position with a pillow under the patient's right side [28].

**Table 6. The latest evidence-based recommendation on Root Canal Treatment (RCT) for pregnant women.**

Item	Evidence Base from Literature
<b>RCT</b>	<b>Second trimester</b> is the preferred time for RCT [11, 23, 25, 28], with a semi-reclined position with a pillow under the patient's right side [28]. Nevertheless, guidelines about safe endodontic procedures usually do not specify procedures by trimester [14, 36 - 38].
<b>Dental x-ray</b>	There is <b>no evidence</b> linking dental x-rays used with appropriate precaution to fetal complications, even for panoramic radiographs [38, 39].
<b>Local Anesthesia:</b>	
a) Lidocaine and prilocaine, with or without epinephrine	They are <b>not contraindicated</b> for pregnant patients or fetuses [27], even in the first trimester [17].
b) Bupivacaine and mepivacaine.	<b>Contraindicated</b> , as found to be associated with embryocide in rabbits when using the maximum daily dose [37, 40].
<b>Inter-appointment medications: dental irrigation, obturation materials, root sealer, and inter-appointment</b>	Most probably <b>safe</b> , because they do not pass beyond the root and are apparently safe [11], but no clear study has investigated the long-term effects on the fetus.
<b>Antibiotics</b>	The most common antibiotics, such as amoxicillin, clindamycin, metronidazole, and penicillin, are <b>safe</b> for pregnant patients

(Table 6) contd....

Item	Evidence Base from Literature
Acetaminophen (paracetamol)	The <b>safest</b> analgesic for pregnant patients [41, 42] and with breastfeeding [27]. However, some studies showed associated with Attention Deficit Hyperactivity Disorder (ADHD), behavioral complications for the fetus [44, 45] and reduced frequency of hematopoietic stem cells [35].
NSAIDs	NSAIDs are <b>not recommended</b> [27] because studies have linked NSAIDs to embryonic implantation disturbance and contraction ductus arteriosus [46, 47].

Our results showed that more than 80% of dental interns and dentists knew that dental irrigation, obturation materials, root sealer, and inter-appointment medications are safe during RCT for pregnant patients. However, this was higher than the percentage of correct answers in a previous study in Nigeria [11], which ranged from 44.3% (dental irrigation) to 80.3% (dental sealer). The reason for this difference is not known. However, it should be mentioned that although these medications do not pass beyond the root and apparently safe [11], no clear study has investigated the long-term effects on the fetus. Nevertheless, according to the current knowledge, such materials have not been reported to create any special danger for the mother or fetus if used properly [11, 33].

Studies have shown that the second trimester is the preferred time for a majority of dental interns and dentists to treat pregnant patients with RCT [11, 23, 25, 28], which was also found in our study. In fact, it was recommended that any elective dental procedures should be delayed until the end of the pregnancy and that urgent procedures should be done during the second trimester [34]. A review of the literature and guidelines revealed a few restrictions on endodontic treatments for specific procedures to be done during specific periods only. For example, the use of acetaminophen was found to be associated with some problems in the third trimester [35]. Guidelines about safe endodontic procedures usually do not specify procedures by trimester [14, 36 - 38], and it might be beneficial to place a special focus on this point in future research.

Among the participants, 22% to 69.33% indicated that it was contraindicated (or uncertain) to take, respectively, a single periapical radiograph or panoramic radiograph with pregnant patients in the second trimester. This percentage is similar to the ranges in studies from Nigeria (42.6%) [11] and India (42% to 61%) [25], but higher than local studies in Saudi Arabia (36% to 36.2%) [23, 28]. The difference might be due to some studies assessing the safety of radiographs in general, while others differentiate between periapical and panoramic radiographs. The higher percentage for panoramic radiographs than periapical radiographs is notable. Nevertheless, according to the American College of Obstetricians and Gynecologists Committee on Health Care for Underserved Women, as well as other studies, there is no evidence linking dental x-rays used with appropriate precaution to fetal complications, even for panoramic radiographs [38, 39]. Thus, this point needs to be emphasized to dentists, especially with regard to panoramic radiographs, in Saudi Arabia.

In this study, 10.22% to 20% considered local anesthesia to be contraindicated or uncertain. This is similar to a previous study in Nigeria [11] but lower than studies in India (44%) [25] and local studies in Saudi Arabia [28]. It is not known why there is a variation in the percentages, especially for the local studies, but it might be due to receiving different education.

However, lidocaine and prilocaine, with or without epinephrine, are not contraindicated for pregnant patients or fetuses, according to the US Food and Drug Administration (FDA) and American Academy of Pediatrics (AAP) [27], even in the first trimester [17]. However, other local anesthetic agents, such as bupivacaine and mepivacaine, have been found to be associated with embryocide in rabbits when using the maximum daily dose [37, 40].

Based on large epidemiologic studies, acetaminophen (paracetamol) is considered the safest analgesic for pregnant patients [41, 42]. The AAP considers acetaminophen safe with breastfeeding [27]. Other studies have found it to be safe in the first trimester [43]. However, other studies have indicated that long-term use of acetaminophen is associated with Attention Deficit Hyperactivity Disorder (ADHD) and behavioral complications for the fetus [44, 45]. Another study found that acetaminophen is associated with reduced frequency of hematopoietic stem cells [35]. In our study, 62.22% of the participants considered acetaminophen safe during the second trimester, which is similar to a previous study in Saudi Arabia among dental interns (55%) [28].

Conversely, NSAIDs are not recommended by the FDA [27] and are contraindicated because studies have linked NSAIDs to embryonic implantation disturbance and contraction ductus arteriosus [46, 47]. In fact, 57.8% of the respondents in our study could identify NSAIDs as contraindicated, but 31.56% considered it safe, similar to a previous study in Saudi Arabia (38%) [28]. This is a serious problem and should be highlighted due to potentially serious complications.

Using amoxicillin was considered to be safe in the second trimester by 61.11% of participants in our study, which was similar to two previous studies in India (77.1%) [48] and Saudi Arabia (65%) [28], but lower than another study in Saudi Arabia (96.1%) [23]. Indeed, the FDA lists the most common antibiotics, such as amoxicillin, clindamycin, metronidazole, and penicillin, as safe for pregnant patients [27].

It was noted that knowledgeable participants with specific information were linked with the application of appropriate practices in all of the items, which is similar to a previous study of the same topic [25]. A majority of our participants had positive attitudes regarding counseling pregnant patients and believed they have the time and ability to do so. This was also found in a previous study in India [25]. Moreover, 70.9% of our participants indicated wanting to get more information and training to boost their knowledge regarding dealing with pregnant patients. This was also reported in previous studies, which increases the likelihood of having continuing education to focus on this desired aspect for dental interns and dentists in Saudi Arabia [23, 25, 49].

This study has several strengths, such as being conducted

among multiple centers, both governmental and private, and using a validated questionnaire that has been previously tested for validity. This study was also the first in Saudi Arabia to investigate domains of knowledge in terms of trimesters. However, this study also used a convenience sample and so cannot be generalized to all of Saudi Arabia. It also used a self-report questionnaire. It is recommended that future studies be conducted with dental students' by level and the educational system materials to track students from the undergraduate level. The inclusion of continuing education materials for graduates aimed at increasing their levels of confidence and knowledge regarding pregnant patient management might also be helpful. Finally, it is better to generate new guidelines for treating pregnant patients that include a discussion of procedures by trimester.

## CONCLUSION

Dental interns and dentists in Saudi Arabia have fair levels of knowledge regarding the endodontic treatment of pregnant patients. Two-thirds of them knew that most endodontic procedures are appropriate and that NSAIDs are contraindicated. However, many also considered panoramic radiographs to be contraindicated. Continuing education courses are important for boosting dental practitioners' second-trimester knowledge, especially regarding the use of radiographs and NSAIDs.

## ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study received the approval of the Institutional Review Board of Umm Al-Qura University, Saudi Arabia with Approval number 153-19.

## HUMAN AND ANIMAL RIGHTS

No animals were used in this research. All humans research procedures were followed in accordance with the ethical standards of the committee responsible for human experimentation (institutional and national), and with the Helsinki Declaration of 1975, as revised in 2013. (<http://ethics.iit.edu/ecodes/node/3931>).

## CONSENT FOR PUBLICATION

The patient signed a consent form to participate in this study.

## STANDARD FOR REPORTING

Strobe guidelines and methodology were followed to conduct the study.

## AVAILABILITY OF DATA AND MATERIAL

The data that support the findings of this study are available from the corresponding author, [K. A], upon reasonable request.

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None.

## CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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Declared none.

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