



## Knowledge, Attitudes, and Perception toward Radiation Hazards and Protection among Dentists in Iraq

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### ABSTRACT

**Aims** The dentists in Iraq usually operate the process of taking dental radiography by themselves. with the more uses of newer ionizing radiation modalities, there is an increased chance that dentists, co-workers, and patients are liable to face the harmful effect and hazards of radiation especially when there was negligence or ignorance. This study aimed to assess dentists' knowledge, attitude, and perception toward dental radiation.

**Instrument & Methods** This study was carried out on 322 dentists. The subjects were allocated into 2 groups general dental and dental specialists. Data were collected by a structured questionnaire consisting of 26 items and analyzed using the Chi-square test by SPSS 23 software.

**Findings** Out of the 322 dentists who participated in the study, 244 (74.6%) were General Dental Practitioners and 78 (23.9%) were specialist dentists. Specialist dentists showed higher knowledge, attitude, and perception values for radiation hazards protection than general dentists.

**Conclusion** From the results obtained in this study, it was clear that the knowledge, attitude, and perception level concerning radiation protection was higher among specialist dentists compared to general dental practitioners.

**Keywords** Dentists; General Practice Dental; Radiation

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## Introduction

The development of X-ray imaging around the late 1800s was one of the most significant advances in medical science [1]. X-imaging plays a vital role in healthcare [2], and dental X-rays are one of the most beneficial tools in modern dental health care. It plays a critical role in the process of treatment planning, disease progress management, and treatment outcome assessment in the maxillofacial region [3]. Radiographs are needed either for routine examinations, diagnostic procedures, treatment, or for follow-up of patients. Dentists use radiographs more often than healthcare professionals [4, 5]. Ionizing radiation emitted by diagnostic imaging sources such as X-rays, and computed tomography is not without danger [6]. Radiation is the transmission of energy through space, and matter, and occurs either in the form of particulate or nonparticulate, i.e. electromagnetic radiation (EMR).

EMR is the movement of energy through space as a combination of electric, and magnetic fields. Depending on their energy level, the EMR is grouped as ionizing, and non-ionizing radiation and the ionizing radiations induce various biological harmful effects [2, 4]. Despite it is not known for sure the degree of effect following the diagnostic level of X-ray radiation [7], it is generally believed that the risk of radiation associated with dental radiography is not significantly greater than other everyday risks in life [8].

Radiation is thought to have dose-dependent negative effects on the human body, raising the risk of cancer. When ionizing radiation interacts with human living tissue at the atomic level, biological effects occur [9]. The biological effects of x-radiation can be divided into deterministic, and stochastic effects. Deterministic effects are those effects in which the severity of the response is proportional to the dose. These effects occur in all people when the dose is large enough [10]. Deterministic effects have a dose threshold below which response is not seen. By contrast, stochastic effects are those for which the probability of occurrence of the change, rather than its severity, is dose-independent [11].

The stochastic effects thus lay the patients, and the operating personnel in a high-risk zone, as it does not have dose thresholds [8]. The stochastic effect is considered a direct function of dose. It is different from the deterministic effect in that it does not have a dose threshold. An example is a cancer. On the other hand, the deterministic effect (non-stochastic) is a threshold in which the severity of the disease increases with an increase in the absorbed dose above a threshold [12]. Harmfulness of dental x-rays seems to be very prominent when both the deterministic and the stochastic effects caused by dental x-rays on the human body are considered [13]. Keeping this in mind, the dental radiograph should be prescribed only for a patient when the benefit of

disease detection outweighs the risk of damage from X-radiations [14].

The dose-dependent adverse effects of X-rays have been linked to cancer, and have been a focus for many researchers studying cancer risk in adults, and children [15]. Prior to any research on X-rays, radiologists who were exposed to significant amounts of X-rays were shown to develop severe forms of dermatoses, cataracts, hematological disorders, and various cancers [16].

In this regard, international authorities such as the International Commission of Radiation Protection (ICRP) issue guidelines for restrictions on the amount of radiation received by both professionally exposed individuals, and the public [17, 18]. The "As Low As Reasonably Achievable" (ALARA) principle sets limits on occupational, and public exposures to ensure that no one is exposed to doses that are unacceptably high [19]. Some of the previous studies documented that there was insufficient knowledge among dental practitioners, and dental students about understanding radiation, and safety protocols [20, 21].

Most Iraqi dentists have been exposed to x-rays radiation, because they usually take the film by themselves, as no x-rays operators are working with them in their clinics. Dental clinics whether public or private have x-rays equipment ranging from the old intraoral radiography to more recent computed tomography. This study aimed to evaluate the level of understanding of knowledge, attitude, and perception (KAP) among Iraqi dentists.

## Instrument & Methods

Our study is a cross-sectional questionnaire-based, analytic, and observational that evaluates the KAP toward radiation protection, and hazards among Iraqi dentists whether they are general dental practitioners (GDPs) or specialist dentists (SDs), regarding dental radiology safety standards. We obtained ethical approval from the council of the college of dentistry of Al-Iraqi University in Baghdad, Iraq. The data collection started from January to March 2022.

The questionnaires were formulated using google forms that include 26 questions. The link to the google forms was distributed and sent to Iraqi dentist groups in the WhatsApp application in which 322 dentists participated in this study. The dentists that participated in this study were of different age groups and graduated from different dental schools. We followed the KAP evaluation that was present in Rabhat *et al.* with slight modification [22]. The questionnaire consists of 26 questions. The first two questions are related to gender and age. The third question clarifies whether the participant is GDP or SD. The questions from 4 to 13 evaluate the knowledge regarding radiation protection, and hazards. The questions from 14 to 20 assess the

attitude toward radiation protection, and safety measures and questions from 21 to 26 assess the perception regarding radiation hazards.

The data was analyzed using SPSS 23 software through the Chi-square test which a p-value was set at 0.05.

## Findings

In total, 322 dentists participated in the study. Most participants were 25-35 years and GDP (Table 1).

Table 2 shows the responses of GDPs and SDs to participants' knowledge. There was a clear consensus between these two groups on questions 1, 2, 3, 6, and 7. The response to question 4 shows a significant difference in awareness of deterministic, and stochastic effects in dental radiography in the SDs group. However, the response to question 5 (awareness of ALARA or ALADA) shows a deficiency in the knowledge of both groups regarding this important principle. The response to questions 8, 9, and 10 shows significant differences between the SD, and GDP groups in terms of the use of dental radiography in pregnant women, the ideal distance for an operator to stand while taking intraoral dental radiography, and the most important organ that must be protected during dental radiography.

On the assessment of the attitude of both GDPs, and SDs toward radiation protection (Table 3), there was a consensus noted in the answers of both groups to questions No. 1, 2, 3 4, and 5. However, the response to questions 6, and 7 (usage of leaded apron on regular basis, and the reason for not using it) show that 12.8%, and 27.3% of GDPs, and SDs are using it, respectively.

On evaluating the perception of participants toward radiation protection (Table 4) there was a clear consensus in their responses to questions No. 2, 3, 4, 5, and 6. However, 51.7% of GDPs, and 51.9% of SDs

believe that full mouth dental radiographic technique delivers more radiation to the patient when compared to panoramic radiography.

There was no significant relationship between the safety of periapical radiographs, and holding the dental film by dentists or patients. Also, there was no significant relationship between the safety of the periapical radiograph among Gender, age groups, and using a leaded apron. In addition, the study shows no significant relationship between knowledge about collimators, the dose of digital x-ray machines, the ideal distance for x-rays, the difference between Orthopantomogram, and full mouth, the importance of organs affected by radiation, the vulnerability of children, and features to radiation, and being a specialist. However, there was a significant relationship between the type of X machine used in the dental clinic, the use of a leaded apron ( $p=0.14$ ), the type of x-rays machine, and being a specialist dentist ( $p=0.25$ ). Also, there was a significant relationship between the knowledge of film speed, and being a specialist ( $p=0.019$ ). At the same time, there was a highly significant relationship between being a specialist dentist, and the use of a leaded apron ( $p=0.004$ ), also being a specialist dentist, and a radiograph is contraindicated for pregnant women ( $p=0.001$ ).

**Table 1)** demographic characteristics of the subjects

Variables	Number	Percent
<b>Gender</b>		
Man	179	54.7
Woman	143	43.7
<b>Age (Year)</b>		
25-35	239	73.9
36-45	38	12.4
46-55	45	13.7
<b>Specialty</b>		
GDP	240	76.4
DS	78	23.6

**Table 2)** Frequency of participants' knowledge of radiation protection (Numbers in parentheses are in percent)

No.	Items	Response	GDP Group	SD Group
1	Dental X-rays are harmful	Yes	220 (90.9)	72 (93.5)
		No	21 (8.7)	5 (6.5)
2	X-ray beams are reflected from regular room walls	Yes	148 (76.0)	54 (70.1)
		No	58 (24.0)	23 (29.9)
3	Collimators and filters are useful in dental radiography	Yes	222 (91.7)	70 (90.9)
		No	20 (8.3)	7 (9.1)
4	Awareness of deterministic, and stochastic effects in dental radiography	Yes	157 (64.9)	65 (84.4)
		No	85 (35.1)	12 (15.6)
5	Awareness of ALARA or ALADA principle	Yes	100 (41.3)	47 (61.0)
		No	142 (58.7)	30 (39.0)
6	Digital radiography requires less exposure than conventional-rays	Yes	205 (84.7)	70 (90.9)
		No	37 (15.3)	7 (9.1)
7	The high-speed film is required a reduced exposure	Yes	179 (74.0)	67 (87.0)
		No	63 (26.0)	10 (13.0)
8	A dental radiograph is absolutely contraindicated in pregnant patients	Yes	169 (69.8)	35 (45.5)
		No	73 (30.2)	42 (54.5)
9	The ideal distance an operator should stand while taking intraoral radiographic exposure	4f, 90°-135°	49 (20.2)	13 (16.9)
		5f, 60°-90°	50 (20.7)	8 (10.4)
		6f, 90°-135°	100 (41.3)	42 (54.5)
		6f, 60°-90°	43 (17.8)	14 (18.2)
10	The most important organ that must be protected during dental radiography	Skin	21 (8.7)	3 (3.9)
		Thyroid	165 (68.2)	53 (68.8)
		Gonads	38 (15.7)	16 (20.8)
		Bone Marrow	18 (7.4)	5 (6.5)

**Table 3)** Frequency of participants' attitude towards radiation protection (Numbers in parentheses are in percent)

No.	Questions	Response	GDP Group	SD Group
1	Type of X-ray machine you are using in your workplace	Digital	124 (51.2)	51 (66.2)
		Conventional	118 (48.8)	26 (33.8)
2	Asking the patient to hold the film during X-ray exposure	Yes	193 (79.8)	60 (77.9)
		No	49(20.2)	17 (22.1)
3	Preference to hold the film during X-ray exposure	Yes	90 (37.2)	24 (31.2)
		No	151 (62.4)	53 (68.8)
4	Personal monitoring badges (badge film) should be worn by the operator	Yes	198 (81.8)	69 (89.6)
		No	44 (18.2)	8 (10.4)
5	Following the radiation protection protocol in the future	Yes	219 (90.5)	74 (96.1)
		No	23 (9.5)	3 (3.9)
6	Usage of the leaded apron regularly	Always	31 (12.8)	21 (27.3)
		often	22 (9.1)	10 (13.0)
		Sometimes	67 (27.7)	19 (24.7)
		Rarely	30 (12.4)	13 (16.9)
		Never	92 (38.0)	14 (18.2)
7	If never /rarely/sometimes, the reason would be	Not available	126 (52.1)	34 (44.2)
		Because of its heavyweight	54 (22.3)	15 (19.5)
		Used by others	15 (6.2)	4 (5.2)
		Don't Know	47 (19.4)	24 (31.2)

**Table 4)** Frequency of participants' perception regarding radiation protection (Numbers in parentheses are in percent)

No.	Questions	Response	GPD Group	SD Group
1	In your opinion, which radiographic technique delivers more radiation to the patients?	Full mouth	125 (51.7)	46 (59.7)
		Panoramic	117 (48.3)	31 (40.3)
2	The average dose from periapical radiography is lower when compared with daily background radiation	Yes	184 (76.0)	56 (72.7)
		No	58 (24.0)	21 (27.3)
3	The radiation dose associated with one periapical radiograph is safe and has no impact on health.	Yes	178 (73.6)	58 (75.3)
		No	64 (26.4)	19 (24.7)
4	Every radiation exposure brings the possibility of the occurrence of harmful effects	Yes	188 (77.7)	58 (75.3)
		No	54 (22.3)	19 (24.7)
5	The risk involved with radiation should be lower than the benefits from diagnostic information.	Yes	205 (84.7)	67 (87.0)
		No	37 (15.3)	10 (13.0)
6	Children and fetuses are more vulnerable to radiation hazards	Yes	220 (90.9)	70 (90.9)
		No	22 (9.1)	7 (9.1)

**Discussion**

There are raising concerns regarding the level of understanding of the KAP of radiation hazards, and protection in Iraqi dentistry practice. Up to our knowledge, there is no study has been yet conducted in Iraq to assess such concerns. This study aimed to highlight the KAP among dentists. Dental radiology is taught during the 3rd year in the colleges of dentistry in Iraq as theory, and practical courses, which include radiation hazards, and protection knowledge.

Our findings show a clear difference in replying to the questions correctly. Although the false answers were minimal, this reflects the need for more education, and training programs in dental radiography, especially for GDPs in Iraq.

The answers, which assess the knowledge of radiation protection, show that the participants have deficiencies in the correct information regarding the reflection of x-rays beams from regular walls, awareness of deterministic effects, and stochastic effects, uses of dental x-rays in pregnancy. In addition, there was poor knowledge regarding the ALARA principle, the ideal distance an operator should stand while taking intraoral radiographic exposure, and the most important organ that must be protected during dental radiography.

Similarly, the answers that evaluate the attitude of participants toward radiation protection, and hazards show that 51.2% of GDPs, and 66.2% of SDs use a digital type of x-rays machine in the workplace, respectively. While assessing the usage of a leaded apron on regular basis we found that only 12.8% of GDPs, and 27.3% of SDs used it. The reason for not using an apron in both groups is because either it is not available or due to other reasons such as its heavyweight or used by others.

In assessing the perception of the x-rays radiation protection, also we have a clear weakness in the information regarding which radiographic technique delivers more radiation to the patients. Our results show that only 51.7% of GDPs, and 59.7% SDs believe that the full mouth technique delivers more radiation to the patients. While 48.3% of GDPs, and 40.3% of SDs believe that panoramic type of x-rays delivers more radiation to the patients, respectively.

After reviewing, the literature there was a shortage of studies on KAP among Iraqi health professionals. However, there were some international studies discussing the same subject. Svenson & Peterson showed that Swedish dental practitioners with 5-25 years of experience have a higher level of Knowledge than those with lesser or greater years of experience [23].

In our study, we found that Iraqi dentists that have a degree in any dental specialty have a higher level of Knowledge about x-rays protection, and hazards compared to non-SD.

Bashir *et al.* found higher KAP values in dental students regarding radiation hazards protection followed by dentists, and dental staff [24]. This might be explained by the fact that dental students still have fresh information regarding radiological hazards. This information might fade away with practice.

In the study of Aravind, most of the dentists (71%) instruct their patients to hold the intraoral periapical (IOPA) film with their fingers while carrying out the radiographic exposure [25]. In the same study of Aravind only 22% of the practitioners were aware of special situations such as pregnant women, and children who are more susceptible to the hazardous effect of radiation [25], While in our study 82.6% believe that personal monitoring badges should be worn by the dentists.

Arnout *et al.* investigated the importance of collimators, and filtration in the dental X-ray machine, and only 30.3% of the undergraduate answered yes [26]. Also, in a study by Arnout *et al.*, about 70% of the undergraduate were unaware of the probability of occurrence of radiation biological damage [26].

According to Shahab *et al.*, 30% of participants believed that panoramic exposure gave more radiation dose to patients than full-mouth periapical radiography, and 39% knew that a pregnant woman should not have any periapical radiographs [5].

In our study, 90.2% of dentists considered x-rays harmful. This might reflect a higher awareness level of Iraqi dentists in this regard. Similarly, the dentists in the current study seem to have a higher appreciation for the usefulness of collimators, and filters (90.2%).

The International Commission on Radiological Protection implemented the ALARA principle (as low as reasonably achievable) to weight risk/benefit when using radiation in all aspects of medicine. In our study, 45.9% of dentists were aware of the ALARA principle. This might inform the need for more focus on the need to educate dental students and dental practitioners alike on this important principle.

In the current study, 53.8 % of dentists were using digital radiography, and 44.3% were using a conventional x-ray machine. Digital radiography is widely available in Iraqi dental practice because of its affordability, easiness of use, and practicality.

The majority of the subjects (69.3%) are unaware of the stochastic, and deterministic effects. Having such a high percentage increases the need to consider stochastic, and deterministic effects in continuous education programs.

Based on the findings, 76.2% of the subjects have

awareness of the usefulness of collimators, and filters in dental radiography, and 51.5% of dentists have awareness of the deterministic, and stochastic effects.

The results showed that 62.4% of dentists believe that dental radiography is contraindicated in pregnant women. Also, 98% of the practitioners were aware of the function of thermo-luminescent dosimeter (TLD) badges, but only 2% of them were using TLD badges in their practices [25]. Many studies showed no need for a protective lead apron during pregnancy, and deem routine use unnecessary unless they are used to allay perceived patient anxiety. Therefore, providing there is sound clinical justification, pregnant women should not have their treatment deferred due to potential fetal risk from ionizing radiation from intraoral dental radiography. ARPANSA recommends that a lead apron be used when the primary beam is positioned towards the patient's trunk, e.g. an occlusal maxillary view [27].

In our study, 45.6% of the subjects believed that panoramic x-ray is associated with a higher radiation dose than full mouth, and 62.4% of the subjects believed that pregnant women should not expose to dental radiology. This is lower than the percentage provided by Aravind *et al.* (84.3%) [25]. Panoramic radiograph ARPANSA and the European Academy of Dentomaxillological Radiology guidelines emphasize that there is no evidence supporting the routine use of lead apron or thyroid shielding in panoramic imaging if the thyroid is outside the primary beam. Thyroid shielding may interfere with the primary beam, and cause artifacts. It may also obscure anatomical structures or ptosis, which may lead to the need for repeat exposure. Rottke *et al.* found no statistically significant difference in abdominal dose when a panoramic radiograph was performed with, and without the application of a lead apron, like the torso of the patient is not in the primary beam, and as previously mentioned, lead aprons cannot protect the patient from internal body scatter [28].

This is consistent with the percentage provided by Dölekoğlu *et al.* which 67% of their participant confirmed the use of digital radiography [29]. This percentage is consistent with Razi *et al.* study (70%) [30]. However, it is less than Aravind *et al.* result (88%) [25].

Following the international guidelines of radiation protection in dental practice will reduce the exposure of patients, dentists, and other dental professionals to radiation hazards, and improve dental diagnostic radiography. To achieve this objective, schools of dentistry in Iraq must continue to improve radiology courses taught to dental students. Also, the ministry of health and the Iraqi dental association need to continue the development of dental radiology education by conducting seminars, workshops, and training programs to

protect all field workers, and patients efficiently.

## Conclusion

It might be conceived that the level of knowledge, attitude, and perception toward radiation protection, and hazards in Iraqi dentists is not optimal. However, the study shows that the SDs are more aware than GDPs in certain items of KAP.

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