Available online at **www.ijmrhs.com**

ISSN No: 2319-5886

International Journal of Medical Research & Health Sciences, 2019, 8(9): 75-81

Knowledge, Attitudes and Perception toward Radiation Hazards and Protection among Dental Professionals in Riyadh, Kingdom of Saudi Arabia

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ABSTRACT

Introduction: *Radiation hazards are harmful, and it becomes precarious when there is a professional negligence or ignorance.* ***Objectives:*** *To evaluate the knowledge, attitude and perception among dental students and dental practitioners toward dental radiation and to assess the difference in knowledge between dentists, dental staff and dental students.* ***Materials and methods:*** *The study was comprised of 550 participants. The information was collected from each participant through structured questionnaire consisting of 39 close-ended questions. Statistical analysis: Chi-square to test the association of knowledge, attitudes and perception (KAP) with gender, occupational sector and educational qualification and one way analysis of variance to compare the difference in means of KAP between the three different groups of professionals and gender.* ***Results:*** *Out of the 550 dental professionals who participated in the study, 293 (53%) were dental students, 83 (15%) were dental staff and 174 (32%) were dentists. Dental students showed higher KAP values towards radiation hazards protection followed by dentists and dental staff.* ***Conclusion:*** *From the results obtained in this study, it was noted that the KAP level with regard to radiation protection was higher among dental students compared to dentists, and the least KAP value was found with dental staff.*

Keywords: Dental professionals, Radiation hazards, Radiation protection

INTRODUCTION

Dental radiology is a rapidly evolving clinical specialty and recently, computed tomography and its variants 3D CT and ortho cubic super-high-resolution CT (Ortho-CT) has been the techniques of choice in the diagnosis of various dental pathologies [1-5]. It is generally believed that the risk of radiation associated with dental radiography is not significantly greater than other everyday risks in life [6], especially intra-oral radiography. However, what is not known for certain is the degree of effect following the diagnostic level of X-ray radiations [7]. The effects of X-rays on humans are the result of interactions at atomic levels [8]. These biological effects can be divided into two broad categories: deterministic and stochastic effects [9]. 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 [9]. The stochastic effects thus lay the patients and the operating personals in a high-risk zone as it does not have dose thresholds [9]. 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 [6]. All radiography field workers should be well educated on the use of protective equipment and tools, sufficient training programs help the dentists, and everyone involved in the radiation field to protect themselves and the patients efficiently.

The International Commission on Radiological Protection (ICRP) assumes the responsibility of providing guidance

on matters of radiation safety. The ICRP has given the recommendations for the system of radiological protection in its ICRP Publication No, 60 (1990) which is based on the following general principles: No practice involving exposures to radiation should be adopted unless it produces a sufficient benefit to the exposed individual or to society and in relation to any particular source within a practice, the magnitude of individual doses, the number of people exposed and the likelihood of incurring exposures where these are not certain to be received should be kept as low as reasonably achievable (ALARA) [11]. Ionizing radiations may affect the gastrointestinal system, central nervous system, gonads or even whole body. These effects may appear as somatic effects or in the next generation as genetic effects [12]. There is no threshold level of radiation exposure below which it could be said with certainty that cancer or genetic effects will not occur. Doubling the radiation dose doubles the probability that cancer or genetic effect would occur [13]. Radiological protection is defined by the International atomic energy agency (IAEA) as "The protection of people from harmful effects of exposure to ionizing radiation, and the means for achieving this". It is also described as all means directed towards minimizing radiation exposure of patients and personnel during X-ray either diagnostic or therapeutic. Lead aprons are currently available for use during dental radiography to protect the thyroid gland from radiation.

There are high concerns about dental practitioner's perception, knowledge, and attitude towards radiation protection especially with the variety of radiographs, their radiation doses and the effect on a variety of patients. As the clinical year dental students, interns and dentists will be at risk from radiation hazards during their life, they should have a thorough knowledge regarding the biological hazards of X-rays and different protection protocols. It is to be noted that there has been no internationally published data about the KAP of dental professionals in Riyadh, KSA about biological hazards and radiographic protection techniques. Therefore, this study aims to evaluate the knowledge and awareness among dental students and dental practitioners towards dental radiation and to assess the difference of knowledge between dentists, dental staff and dental students in Riyadh, KSA.

MATERIALS AND METHODS

The present study comprises a cross-sectional observational analytical study of the Knowledge, attitude, and perception (KAP) towards radiation hazards and protection among dental students, dental staff and dentists in Riyadh, Kingdom of Saudi Arabia. Ethical approval (SP18/462/R) was obtained from the IRB committee of King Abdullah International Medical Research Center (KAIMRC), Saudi Arabia prior to the study. The period of recruitment and data collection was between September and October 2018. All dental staff, dentist and dental students in the final years were eligible to participate in the study. Dental students studying in the preclinical years, dental patients, and those who were not working in the dental field were excluded from the study. The sample size was calculated by power analysis to be 550 participants. Convenient sampling technique was used for the study. The study questionnaires were distributed in governmental (e.g. King Saud University, KSAU-HS) and private (e.g. Riyadh Elm University, and multiple private clinics) sectors in Riyadh, Kingdom of Saudi Arabia. The participants were asked to sign consent forms before they fill the questionnaire.

KAP assessment was gathered by questionnaire following Prabhat, et al., with slight modification [14]. The questionnaire by Prabhat, et al., was a self-prepared, pilot-tested and specially designed for their study comprising of 18 questions; 16 were close-ended and 2 were leading questions. The questionnaire was related to the biological hazards of dental radiographs and radiation protocol in the form of multiple choices given to each participant. Our study questionnaire comprised of the following four sections with 39 questions: A) Socio-demographic data such as age, gender, level of education, occupational sector, etc. which would enable us to classify the samples into dental students, dental staff and dentists based on the profession and the working sector whether private or governmental sector; moreover to classify the gender of the samples and if the dental students were in the final years to be eligible to participate in the study; B) Knowledge regarding biological hazards of radiation and radiation protection guidelines; C) Attitude towards radiation protection and safety practices; and D) perception about radiation hazards. Knowledge was assessed based on study participants understanding of radiation risks associated with the diagnostic use of ionizing radiation to protect themselves from risks.

The collected data were entered, cleaned, and analyzed using the IBM SPSS Statistical program version 22 (IBM Inc. NY, USA). Missing data were prevented as much as possible by proper planning of the study. All variables were summarized and reported using descriptive statistics with numbers, means, and percentages. Statistical tests included: (i) Chi-square to test the association of KAP with gender, occupational sector, and educational qualification; (ii) one-way

analysis of variance to compare the difference in means of KAP between the three different groups of professionals and gender. The p-value was set to a value of 0.05.

RESULTS

Among 600 questionnaires distributed, 91.7% response rate was observed. Out of the 550 samples participated in the study, 293 (53%) were dental students, 83 (15%) were dental staffs and 174 (32%) were dentists. There was a male predominance (70%) among the participants. The majority of the participants (60.5%) were working or studying in the government sector (Table 1).

Table 1 Gender and occupational sector of participants

Variables	Category	Groups			
		Dental students	Dental staff	Dentists	Total
		N (%)	N (%)	N (%)	N (%)
Gender	Male	224 (58.2%)	30 (7.8%)	131 (34.0%)	385 (70.0%)
	Female	69 (41.8%)	53 (32.1%)	43 (26.1%)	165 (30.0%)
	Total	293 (53.3%)	83 (15.1%)	174 (31.6%)	550 (100.0%)
Occupational Sector	Private	63 (29.3%)	59 (27.1%)	95 (43.7%)	217 (39.45%)
	Governmental	230 (69.0%)	24 (7.2%)	79 (23.7%)	333 (60.5%)
	Total	293 (53.3%)	83 (15.1%)	174 (31.6%)	550 (100.0%)

Table 2 compares the knowledge of the participants towards radiation hazards and protection practices. There was a highly significant difference (p=0.000) seen among the participants with regards to knowledge relating to the ideal safe distance, safety guidelines, exposure rate and, organ to be protected during exposure (Table 2). The dental students showed higher KAP values towards radiation hazards protection followed by dentists and dental staff. The knowledge among the dental staff was least in relation to the knowledge about radiation protection guidelines and the benefits of digital radiography, high-speed films, collimators and filters in dental radiography.

Table 2 Knowledge of participants towards radiation protection

No.	Knowledge Items	Response	Group			Chi-square	p-value
			Dental students	Dental staff	Dentists		
			N (%)	N (%)	N (%)		
1	Dental X-ray is harmful	Yes	186 (63.5%)	55 (67.1%)	104 (59.8%)	1.383	0.501
		No	107 (36.5%)	27 (32.9%)	70 (40.2%)		
2	X-ray beams are reflected from regular room walls	Yes	160 (54.6%)	38 (46.3%)	97 (55.7%)	2.176	0.337
		No	133 (45.4%)	44 (53.7%)	77 (44.3%)		
3	Awareness of NCRP and ICRP recommendations	Yes	166 (56.7%)	44 (53%)	77 (44.5%)	6.454	0.040
		No	127 (43.3%)	39 (47%)	96 (55.5%)		
4	Awareness of the usefulness of collimators and filters in dental radiography	Yes	218 (76.2%)	36 (43.9%)	116 (67.4%)	30.999	0.000
		No	68 (23.8%)	46 (56.1%)	56 (32.6%)		
5	Awareness of deterministic and stochastic effects	Yes	150 (51.5%)	43 (53.1%)	95 (55.2%)	0.59	0.744
		No	141 (48.5%)	38 (46.9%)	77 (44.8%)		
6	Awareness of ALARA or ALADA principle	Yes	181 (61.8%)	27 (32.9%)	100 (58.1%)	22.015	0.000
		No	112 (38.2%)	55 (67.1%)	72 (41.9%)		
7	Digital radiography requires less exposure than conventional	Yes	234 (80.7%)	49 (62%)	101 (58.4%)	37.113	0.000
		No	50 (17.2%)	50 (38%)	71 (41.0%)		
8	High-speed film is required a reduced exposure	Yes	216 (73.7%)	31 (37.8%)	113 (64.9%)	36.654	0.000
		No	77 (26.3%)	51 (62.2%)	61 (35.1%)		
9	Dental radiograph is absolutely contraindicated in pregnant patients	Yes	107 (36.8%)	54 (65.1%)	73 (42.0%)	21.183	0.000
		No	184 (63.2%)	29 (34.9%)	101 (58.0%)		

10	The ideal distance an operator should stand while taking intraoral radiographic exposure	4f , 90°-135°	92 (31.4%)	27 (32.5%)	69 (39.9%)	56.08	0.000
		5f, 60°-90°	51 (17.4%)	42 (50.6%)	52 (30.1%)		
		6f, 90°-135°	142 (48.5%)	13 (15.7%)	49 (28.3%)		
		6f, 60°-90°	7 (2.4%)	1 (1.2%)	3 (1.7%)		
11	The most important organ that must be protected during dental radiography	Gonads	60 (20.6%)	22 (26.5%)	47 (27.0%)	10.749	0.096
		Thyroid	188 (64.6%)	53 (63.9%)	117 (67.2%)		
		Skin	22 (7.6%)	4 (4.8%)	6 (3.4%)		
		Bone morrow	21 (7.2%)	4 (4.8%)	4 (2.3%)		

On evaluating the attitude of the participants towards radiation protection practices (Table 3), it was seen that there was a significant difference seen in the preferences of the dental staff compared to other participants regarding the X-ray technique used, use of round collimators and with regards to the patients holding the sensors rather than using sensor holders during exposure. The majority of the participants preferred to use the digital radiographs and paralleling technique while taking periapical radiographs and it was statistically significant (p=0.001). With regards to the use of lead aprons, there was a statistically significant difference in the responses of the participants and mainly due to lack of availability of the lead apron or due to its weight. However, some participants preferred to use the position or distance rule over the lead apron ($p<0.05$).

Table 3 Attitude of participants towards radiation protection

No.	Attitude items	Response	Group			Chi square	p-value
			Dental students	Dental staff	Dentists		
			N (%)	N (%)	N (%)		
1	Type of X-ray machine used	Digital	270 (92.1%)	40 (48.8%)	118 (67.8%)	87.21	0.001
		Conventional	22 (7.8%)	42 (51.2%)	56 (32.1%)		
2	Preference to hold the films during exposure	Yes	90 (30.7%)	34 (42.5%)	52 (29.9%)	4.6	0.1
		No	203 (69.3%)	46 (57.5%)	122 (70.1%)		
3	Asking the patient to hold the film with their hand during exposure	Yes	212 (72.6%)	35 (42.2%)	110 (63.2%)	27.59	0.018
		No	80 (27.4%)	48 (57.8%)	64 (36.8%)		
4	Personal monitoring badges should be worn by the operator	Yes	229 (78.4%)	42 (50.6%)	129 (74.1%)	26.14	0.22
		No	63 (21.6%)	41 (49.4%)	42 (25.9%)		
5	Adhering to the radiation protection protocol in the future	Yes	245 (83.9%)	59 (71.1%)	128 (73.6%)	11.78	0.019
		No	46 (16.1%)	24 (28.9%)	46 (26.4%)		
6	Usage lead aprons on a regular basis	Always	176 (60.7%)	48 (57.8%)	74 (42.7%)	21.92	0.005
		Often	64 (22.0%)	27 (32.5%)	62 (35.8%)		
		Sometimes	32 (11.0%)	4(4.8%)	22 (12.7%)		
		Rarely	13 (4.5%)	1 (1.2%)	10 (5.8%)		
		Never	5 (1.8%)	3 (3.7%)	5 (3.0%)		
7	Usage film or digital sensor holders regularly while taking an intra-oral radiograph	Yes	204 (71.1%)	42 (51.9%)	96 (56.5%)	15.49	0.001
		No	83 (28.9%)	39 (48.1%)	74 (43.5%)		
8	If never/rarely/sometimes, the reason is	No availability	30 (60.0%)	3 (37.5%)	20 (54.1%)	41.27	0.001
		Weight	1 (2.0%)	1 (12.5%)	5 (13.5%)		
		Common apron	6 (12.0%)	1 (12.5%)	3 (8.1%)		
		Position rule	10 (20.0%)	2 (25.0%)	3 (8.1%)		
		Distance rule	3 (6.0%)	1 (12.5%)	6 (16.3%)		
9	Type of collimator is used	Rectangular	112 (38.6%)	34 (41.0%)	62 (36.0%)	0.63	0.73
		Round	178 (61.4%)	49 (59.0%)	110 (64.0%)		
10	Technique used while taking a periapical radiograph	Parallel	225 (77.3%)	46 (58.2%)	96 (55.2%)	27.29	0.001
		Bisecting	66 (22.7%)	33 (41.8%)	77 (44.8%)		

On evaluating the perception of the participants towards radiation protection practices (Table 4), the participants were in consensus with the fact that all radiation exposure brought the probability of deterministic and stochastic effects and the risks involved should be lower than the benefits of exposure. The majority of dental students (52.4%) believed that every radiation exposure brings a possibility of occurrence of the harmful effects in contrast to dentists (35.8%) and dental staff (41.4%). The majority of the participants were also aware that children and foetuses were more vulnerable to radiation, 78.7% of dental students, 63.9% of dental staff, and 66.5% of dentists. Dental students (77.2%) answered correctly when they were asked about the risk involved with radiation must be lower than benefits from diagnostic information, where 67% of dentists and 57% of dental staff answered it correctly.

Table 4 Perception of the participants regarding radiation hazards and protection

No.	Perception items	Response	Group			Chi-square	p-value
			Dental students	Dental staff	Dentists		
			N (%)	N (%)	N (%)		
1	In your opinion, radiographic technique that delivers more radiation to the patients	Full mouth	170 (59.2%)	38 (45.8%)	96 (55.5%)	4.752	0.093
		Panoramic	117 (40.8%)	45 (54.2%)	77 (45.5%)		
2	The average dose from periapical radiography is lower or comparable with daily background radiation	Yes	204 (70.3%)	45 (54.2%)	103 (59.9%)	9.769	0.008
		No	68 (29.7%)	38 (45.8%)	69 (40.1%)		
3	Radiation dose associated with one periapical radiograph is absolutely safe and has no impact on health	Yes	22 (77.3%)	40 (48.2%)	110 (63.2%)	28.567	0.000
		No	66 (22.7%)	43 (51.8%)	64 (36.8%)		
4	Risk involved with radiation should be lower than benefits from diagnostic information	Yes	224 (77.2%)	47 (57.3%)	116 (66.7%)	14.49	0.001
		No	66 (22.8%)	35 (42.7%)	58 (33.3%)		
5	Every radiation exposure brings possibility of occurrence of the harmful effects	Yes	152 (52.4%)	43 (35.8%)	72 (41.4%)	6.117	0.047
		No	138 (47.6%)	3 (46.3%)	102 (58.6%)		
6	Statistically, 1 in 1000 people, who have undergone 1 periapical examination, will die owing to cancer induced by radiation	Yes	68 (23.5%)	33 (39.8%)	61 (35.7%)	12.178	0.002
		No	221 (76.5%)	50 (60.2%)	110 (64.3%)		
7	Children and fetuses are more vulnerable to radiation	Yes	229 (78.7%)	53 (63.9%)	115 (66.5%)	11.881	0.003
		No	62 (21.3%)	30 (36.1%)	58 (33.5%)		
8	A patient must have a prescription form to have a dentist perform periapical radiography	Yes	124 (42.8%)	41 (49.4%)	97 (56.1%)	7.77	0.021
		No	166 (57.2%)	42 (50.6%)	76 (43.9%)		
9	A patient must have a prescription form to have a dentist perform an orthopantomogram	Yes	203 (69.8%)	49 (59.0%)	84 (48.6%)	20.825	0.000
		No	88 (30.2%)	34 (41.0%)	89 (51.4%)		

DISCUSSION

Upon literature review, there was a lack of studies evaluating the knowledge of radiological hazards in the Kingdom of Saudi Arabia, especially in Riyadh. Previous studies such as in Arnout, et al. [15], the study sample included only undergraduate dental students and did not include dentists and dental staff who were performing such procedures. The results of their study showed that among undergraduate dental students, 87.5% of them considered X-rays to be harmful. In our study, out of 293 dental students, 63.5% considered X-rays to be harmful. Also, according to Arnout, et al., there was a question whether X-ray can be reflected from the walls of the room, 69.7% of undergraduate students answered yes [15]. While in this study, 54.6% of dental students answered yes. In a study by Aravind, et al., dentists were asked about ALARA principle and 84.3% answered that they know it [16]. However, 58.1% in this study answered that they are aware of it. Moreover, according to Swapna, et al., around 59% of the students in the shown study believed that dental X-rays were harmful, while in the present study 63.5% of students answered that X-rays were harmful [17].

Furthermore, in the study by Arnout, et al. 33.3% of the undergraduate dental students answered that it is absolutely contraindicated to make dental radiograph to pregnant, while in our study 36.8% who answered it is absolutely contraindicated [15]. According to Swapna, et al., 42% of the undergraduate dental students answered that it is absolutely contraindicated to make dental radiograph to pregnant, while in this study 36.8% answered that it was absolutely contraindicated [17]. In a study by Dölekoğlu, et al., 67% of the dentists said that they use digital radiography, while in this study only 27.6% of dentists were using digital radiography [18]. In a study by Arnout, et al., they were asked about the importance of collimators and filtration in the dental X-ray machine and only 30.3% of the undergraduate answered yes, while in this study 76.2% have awareness of the usefulness of collimators and filters in dental radiography [15]. Also, in a study by Arnout, et al., about 70% of the undergraduate were unaware of the probability of occurrence of radiation biological damage, but in this study 51.5% have the awareness about the deterministic and stochastic effect [15].

Eman, et al., conducted a study on dental students at Taibah University, Madinah, showed that 66.7% of the clinical group who answered yes that X-ray is harmful, and 33.3% who answered no about whether X-ray beams are reflecting from room walls [19]. In this study, it has been shown that 63.5% of the dental students answered yes that X-ray is harmful, and 45.4% answered no about do X-ray beams reflect from room walls. Also, in their study, it has been shown that 68.0% of the participants claimed that they will adhere to radiation protection protocol in their future clinical practice. While in this study 83.9% of the dental students will adhere to radiation protection protocol in their future clinical practice.

In a study by Sheikh, et al., the most preferred technique for periapical radiography was bisecting angle technique, which was used by 94% of the students [20]. While in this study it showed that 77.3% of students preferred to use parallel technique. It can be inferred from the study that there is lack of knowledge in regard to radiation protection protocols and radiation hazards itself. The knowledge among the dental staff was the least in relation to the knowledge about radiation protection guidelines and the benefits of digital radiography, high-speed films, collimators and filters in dental radiography. Workshops, short-term training courses, preparation and distribution of posters on the protection and safety against ionizing radiation is developed as a recommendation after obtaining the results of the study.

Limitations of the Study

- The distribution was not equal between male and female participants
- Dental students constituted the majority of the survey participants
- Majority of the participants from the governmental sector

CONCLUSION

From the results obtained by our study, it was noted that the KAP level in regard to radiation protection was higher among the dental students compared to dentists, and the least KAP value was found with dental staff. This could be because dental students have a new and fresh knowledge regarding radiology courses. The main principle of the radiation protection protocols is to take the appropriate measures that will minimize exposure to patients and dental professionals to radiation and to provide benefits for the patients with appropriate diagnostic radiography. Considering the results of this study it is critical that all radiology departments need to continue professional development; by doing more radiation protection workshops and training courses, preparation and distribution of posters on the protection and safety against radiation in order to raise the awareness among dental professionals.

DECLARATIONS

Conflict of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

REFERENCES

[1] Robert P Langlais, Olaf E Langland, and Christoffel J Nortjé. *Diagnostic Imaging of the Jaws*. Baltimore: Williams and Wilkins, 1995. p. 1-18

[2] Arai Y, et al. "Development of a compact computed tomographic apparatus for dental use." *Dentomaxillofacial Radiology*, Vol. 2, No. 4, 1999, pp. 245-48.

[3] Chan, Hong Jin, Michael Woods, and Damien Stella. "Three-dimensional computed craniofacial tomography (3D-CT): potential uses and limitations." *Australian Orthodontic Journal*, Vol. 23, No. 1, 2007, p. 55.

[4] Terakado, Masaaki, et al. "Diagnostic imaging with newly developed ortho cubic super-high resolution computed tomography (Ortho-CT)." *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology*, Vol. 89, No. 4, 2000, pp. 509-18.

[5] Honda, Kazuya, et al. "Ortho cubic super-high resolution computed tomography: A new radiographic technique with application to the temporomandibular joint." *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology,* Vol. 91, No. 2, 2001, pp. 239-43.

[6] Joen M Iannucci, and Laura Jansen Howerton. *Dental Radiography Principles and Techniques*. 5th Ed. St. Louis: Elsevier Saunders, 2017, pp. 41-52.

[7] Stewart C. Bushong. *Radiologic science for technologists: Physics, Biology and Protection*. 11th Ed. St Louis: Elsevier, 2017, pp. 483-90.

[8] Barr, J. H., and R. G. Stephens. "Pertinent basic concepts and their applications in clinical practice." *Dental Radiology. Philadelphia: Saunders*, 1980, pp. 27-28.

[9] Stuart White Michael Pharoah. Oral radiology principles and interpretation. 7th Ed. St Louis: Mosby Elsevier, 2004, pp.16-28.

[10] Herbert H. Frommer. Radiology for dental auxiliaries. 6th Ed. St. Louis: Mosby Elsevier, 1996, pp. 49-67.

[11] Sultan TA Sedairy, et al. Radiation safety manual. king faisal specialist hospital and research centre (gen.org) Riyadh, Saudi Arabia, No. 5, 2011, pp. 6-7.

[12] Amirzadeh, Farid, and S. H. Tabatabaee. "Evaluation of healthy behavior in radiation employees in hospitals of Shiraz." *The fourth international cyberspace conference on ergonomics. International Ergonomics Association Press*, 2005.

[13] Kondo, Sohei. *Health effects of low-level radiation.* No. 614.876 KON. 1993.

[14] Prabhat, M. P. V. P., et al. "Knowledge, attitude and perception (KAP) of dental undergraduates and interns on radiographic protection-A questionnaire based cross-sectional study." *Journal of Advanced Oral Research,* Vol. 3, No. 3, 2011, pp. 45-50.

[15] Arnout, Eman. "Knowledge, attitude and perception among Egyptian dental undergraduates, interns and post-graduate regard biological hazards and radiologic protection techniques: a questionnaire based cross-sectional study." *Life Science Journal*, Vol. 11, No. 6, 2014, pp. 9-16.

[16] Aravind, B. S., et al. "Attitude and awareness of general dental practitioners toward radiation hazards and safety." *Journal of Pharmacy and Bioallied Science,* Vol. 8, Suppl 1, 2016, p. S53.

[17] Swapna, Lingam Amara, et al. "Knowledge on radiation protection and practice among dental students." *British Journal of Medicine and Medical Research*, Vol. 9, No. 7, 2017, pp. 1-7.

[18] Dölekoğlu, S., et al. "The usage of digital radiography and cone beam computed tomography among Turkish dentists." *Dentomaxillofacial Radiology*, Vol. 40, No. 6, 2011, pp. 379-84.

[19] Arnout, E. A., and A. Jafar. "Awareness of biological hazards and radiation protection techniques of dental imaging-a questionnaire based cross-sectional study among Saudi dental students." *J Dent Health Oral Disord Ther*, Vol. 1, No. 1, 2014, pp. 1-7.

[20] Sheikh, Soheyl, et al. "Survey of dental radiographical practice in States of Punjab and Haryana in India." *Journal of Investigative and Clinical Dentistry*, Vol. 5, No.1, 2014, 72-77.