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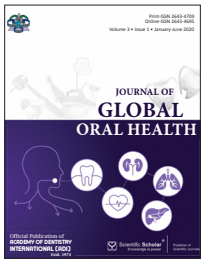

Research Article

A study on awareness, knowledge, and practice of radiation exposure protection protocols by dentists in a Nigerian teaching hospital

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ABSTRACT

Objectives: The role of dental radiography cannot be over-emphasized but the harmful effect of its radiation cannot be overlooked, thereby making the knowledge and practice of exposure protection very important. While studies on awareness, knowledge, and practice exposure protection are available in other countries, it appears that there is a dearth of such studies in our environment. The aim of this survey was to assess the awareness, knowledge, and practice of radiation hazards and exposure protection techniques of dentists in a Nigerian teaching hospital. **Materials and Methods:** This cross-sectional study design was conducted between December 2022 and February 2023 at the dental complex of a Nigerian teaching hospital among dental practitioners. The data were collected with a 23-item, structured, close-ended, and self-administered questionnaire. The data collected were age, gender, department of respondents, medical status, years of experience, and additional degree. Other collected data were awareness, knowledge, and practice of radiation protection. Both descriptive and inferential statistics were performed. The data were entered and analyzed using the Statistical Package for the Social Sciences, version 26 (IBM, Armonk, NY, United States of America). A critical probability level ($P < 0.05$) was used as the cutoff level for statistical significance. **Results:** A total of 100 questionnaires were distributed, and 82 were retrieved, giving a response rate of 82%. The mean age of the respondents was 45.3 ± 5.1 years. There were more males (58.5%) with a male-to-female ratio of 1.4:1. The prevalence of poor awareness and inadequate knowledge of radiation exposure protection was 48.2% and 22.4%, respectively. The prevalence of poor practice toward radiation exposure was 66.7%. Only years of experience and additional degree influenced the prevalence of inadequate knowledge of radiation exposure ($P < 0.05$). **Conclusion:** The prevalence of poor awareness, inadequate knowledge, and poor practice of radiation exposure protection, with values of 48.2%, 22.4%, and 66.7%, respectively, were quite high. The prevalence of inadequate knowledge of radiation exposure protection was influenced by years of practice and additional degrees.

Keywords: Awareness, Knowledge, Practice, Dentist, Radiation

INTRODUCTION

Ever since the discovery of X-ray by Wilhelm Conrad Roentgen in 1895, it has been a very important diagnostic tool in modern dentistry.[1] It is of great importance in multiple branches of dentistry due to the ability of the ionizing radiation to penetrate the soft tissue and reflect an image that cannot be seen on a sensor by the naked human eye. Its usage varies from diagnosing minor carious lesions to periapical lesions of odontogenic and non-odontogenic origin and for evaluation of cases for better treatment planning.[2,3]

Ionizing radiation can cause side effects by directly damaging the DNA of the living cell or indirectly by the formation of free radicals.[4] These unstable and reactive molecules tend to stabilize by rebinding and result in the formation of new toxic substances like hydrogen peroxide, which can cause cellular alterations.[5] The effects of X-ray radiation on humans are due to interactions at atomic levels.[6] These biological effects can be classified into two categories: Deterministic and stochastic effects.[7] In deterministic effects, the severity of the response is proportional to the dose. There is a dose threshold above which damaging insult starts to appear and below which response is not seen.[8] By contrast, stochastic effects can occur even at a low dose of radiation and lead to sublethal DNA damage.[9] Ionizing radiation can have long-term effects on different systems of the body. Such effects might appear as somatic effects or as genetic effects in the next generation.[10] There is definitely no threshold level of radiation exposure for the development of cancer or genetic effects to occur. The probability of developing cancer or genetic effects doubles with doubling the radiation dose.[11]

While studies[9-24] on awareness, knowledge, and practice exposure protection are available in other countries, it appears that there is a dearth of such studies in our environment. Therefore, the aim of this study was to evaluate the awareness, knowledge, and practice of radiation hazards and exposure protection techniques by dentists in a Nigerian teaching hospital.

MATERIALS AND METHODS

Due to the negligible risk of this study to the respondents, ethical approval was not sought by the authors. This study was conducted between December 2022 and February 2023 at the dental complex of a Nigerian teaching hospital. This was a cross-sectional study design. The sample size was determined using the Yamane formula[21] for a finite population. With a margin of error of 5% and a confidence level of 95%, the minimum sample size (N) was estimated to be 62. Therefore, the study of 62 respondents will give meaningful statistical deductions. However, the sample size was increased to 68 to compensate for 10% attrition. The study population was made up of dental practitioners. All participants were provided with relevant information regarding the study and informed consent was obtained from them. Recruitment was based on participants' voluntariness to take part in the study. All dental practitioners who gave their consent to be part of the study by agreeing to fill the questionnaire were included in the study. Excluded were those who did not give consent to participate in the study. The tool used in this study was validated in a previous study.[25] The data were collected with a 23-item, structured, close-ended, and self-administered questionnaire which was pretested for feasibility. The questionnaire was pretested among ten patients that were not part of the present study and modifications were made accordingly on the questionnaire. The questionnaire was divided into three sections to collect information on demography (six items); awareness and knowledge toward radiation protection (seven items); and practice of radiation protection (ten items). To estimate the level of awareness, knowledge, and practice, the prevalidated questionnaire was modified. While the level of awareness was categorized as poor and good, that of knowledge was categorized as adequate and inadequate. The level of practice was categorized as poor and good practice too. For the level of practice, responses like "frequently" were considered good practice while responses such as "occasionally" and "never" were regarded as poor practice.

The data collected were age, gender, department of respondents, medical status, years of experience, and additional degree. Other collected data were awareness, knowledge, and practice of radiation protection. Both descriptive and inferential statistics were analyzed. In the descriptive statistics, the categorical variables were expressed in frequency and percentages while numerical variables were expressed in mean and standard deviation. In the inferential statistics, the Chi-square test was used to find any association between the dependent and independent variables. The data were entered and analyzed using the Statistical Package for the Social Sciences, version 26 (IBM, Armonk, NY, United States of America). A critical probability level ($P < 0.05$) was used as the cutoff level for statistical significance.

RESULTS

A total of 100 questionnaires were distributed, and 82 were retrieved, giving a response rate of 82%. Table 1 shows the demographic characteristics of the respondents. The mean age of the respondents was 45.3 ± 5.1 years. Most (39%) of the respondents were within the age range of 31–40 years and this was followed (37.8%) by those in 20–30 years. There were more (58.5%) males with a male-to-female ratio of 1.4:1. The department of oral and maxillofacial surgery had the highest proportion (32.1%) of the respondents and this was followed (18.3%) by periodontology with the least (3.7%) proportion from public dental health. Among the respondents, junior registrars were the most (28%) followed by senior registrars (23.2%). Most (42.7%) of the respondents had working experience <6 years while those with experience more than 15 years were the least (13.4%). Less than half (34.1%) of the respondents had additional degrees, of which 12 (14.6%) respondents had fellowship degrees and 16 (19.5%) had master's degrees. Table 2 shows the awareness and knowledge of radiation protection by the respondents. More than half (76.8%) of the respondents were familiar with the as low as

Table 1: The demographic characteristics of the respondents (*n*=82).

Variables	Frequency	Percentage
Age group (years)		
20–30	31	37.8
31–40	32	39.0
41–50	16	19.5
51–60	2	2.4
61–70	1	1.2
>70	0	0.0
Gender		
Male	48	58.5
Female	34	41.5
Department of respondents		
Oral and maxillofacial surgery	27	32.1
Conservative dentistry	9	11.0
Prosthodontics	4	4.9
Periodontitis	15	18.3
Public dental health	3	3.7
Oral medicine	4	4.9
Oral pathology	7	8.5
Orthodontics	4	4.9
Pedodontics	4	4.9
Family dentistry	5	6.1
Medical status		
Students	16	19.5
House officer	12	14.6
Junior registrar	23	28.0
Senior registrar	19	23.2
Consultant	12	14.6
Years of experience		
1–5	35	42.7
6–10	20	24.4
11–15	16	19.5
>15	11	13.4
Additional degree		
Yes	28	34.1
No	54	65.9

n = 82 number of participants

Table 2: The awareness and knowledge of radiation protection by the respondents (*n*=82).

Variables	Frequency	Percentage
Are you familiar with the ALARA principle?		
Yes	63	76.8
No	19	23.2
Are you familiar with the recommendations of the NCRP and ICRP?		
Yes	16	19.5
No	66	80.5
Does digital radiography require less exposure than conventional?		
Yes	47	57.3
No	35	42.7
Do high-speed films reduce exposure?		
Yes	49	59.8
No	33	40.2
Specify the importance of the use of collimators and filters in dental radiography?		
Very important	69	84.1
Moderately important	10	12.2
Unimportant	3	3.7
Which collimator helps in reducing the patient's exposure?		
Round	53	64.6
Rectangular	23	28.0
Not sure	6	7.3
What is the ideal distance of the operator position distance rule when exposed to dental radiography?		
4 ft, 90–135°	22	26.8
4 ft, 60–90°	25	30.5
6 ft, 90–135°	18	22.0
6 ft, 60–90°	14	17.1
Not sure	3	3.7
Level of awareness		
Good	44	51.8
Poor	41	48.2
Level of knowledge		
Adequate	66	77.6
Inadequate	19	22.4

n = 82 number of participants, ALARA: As low as reasonably achievable, NCRP: National council on radiation protection and measurements, ICRP: International commission on radiological protection

reasonably achievable (ALARA) principle. Surprisingly, more than one-third (80.5%) of the respondents were not familiar with the recommendations of National council on radiation protection and measurements (NCRP) and international commission on radiological protection (ICRP). More (57.3%) than half of the respondents knew that digital radiography requires less exposure than conventional radiography. More than two-thirds of the respondents said that the use of collimators and filters in dental radiography is very important while just three (3.7%) agreed that it is unimportant. More than half (64.6%) of the respondents answered that a round collimator helps to reduce patient exposure. The prevalence of poor awareness and inadequate knowledge of radiation exposure protection was 48.2% and 22.4%, respectively. Table 3 summarizes the response on the practice of radiation exposure protection by the respondents. Of the 78 (84.2%) of the respondents that use a lead apron for patients during exposure, more than half use it occasionally, and a proportion of respondents as high as 13 (15.5%) never use a lead apron. More than half (65.5%) of the respondents never used the thyroid collar for patients during exposure. Only 23 (28%) do ask patients to hold the film while taking radiographs while 11 (13.4%) respondents frequently stand

Table 3: The practice of radiation exposure protection by the respondents (*n*=82).

Variables	Frequency	Percentage
Do you use lead aprons for patients during exposure?		
Frequently	24	29.3
Occasionally	54	54.9
Never	13	15.9
Do you use thyroid collars for patients during exposure?		
Frequently	5	6.1
Occasionally	20	24.4
Never	57	65.5
Do you ask patients to hold the film while taking radiographs?		
Frequently	23	28.0
Occasionally	39	47.6
Never	20	24.4
Do you stand directly in the path of the primary radiation?		
Frequently	11	13.4
Occasionally	33	40.2
Never	38	46.3
Do you stand behind a lead barrier during exposure?		
Frequently	20	24.4
Occasionally	36	43.3
Never	26	31.7
If within the same area do you stand 6 ft away from the primary X-ray beam during exposure?		
Frequently	21	25.6
Occasionally	37	45.1
Never	24	29.3
Do you hold the film in the patient's mouth during exposure?		
Frequently	36	43.9
Occasionally	29	35.4
Never	17	20.7
Do you stay within the same clinic during X-ray exposure?		
Frequently	46	56.1
Occasionally	24	29.3
Never	12	14.6
If you decide to stay within the same clinic during X-ray exposure, do you use a lead apron on a regular basis?		
Frequently	16	19.5
Occasionally	43	52.4
Never	23	28.0
Do you allow people to come inside the room during exposure to X-rays?		
Frequently	11	13.4
Occasionally	42	51.2
Never	29	35.4
The practice of radiation exposure protection		
Good	28	33.3
Poor	56	66.7

n = 82 number of participants

directly in the path of the primary radiation. Twenty-six (31.7%) respondents never stand behind a lead barrier during exposure. When asked if they stayed within the same clinic during X-ray exposure, only 12 (14.6%) of them responded "never." Twenty-three (28%) of the respondents said that they never used a lead apron on a regular basis if they decided to stay within the same clinic during exposure. More than half (64.6%) of the respondents said that they allow people to come inside the room during exposure to X-rays.

Table 4 shows factors associated with inadequate knowledge of radiation exposure protection by the respondents. The age, gender, department of respondents, and medical status of the respondents did not ($P > 0.05$) influence the prevalence of inadequate knowledge of radiation exposure, but their years of experience ($P = 0.01$) and additional degree ($P = 0.02$) significantly influenced the prevalence.

DISCUSSION

This study determined the level of awareness and knowledge as well as the type of practice of radiation exposure protection protocols by dentists in a Nigerian teaching hospital.

Most of the respondents in this study were within the age range of 31–40 years and the same age group was reported in the previous studies[9,10] outside this country. More male respondents were observed in our study which contrasted previous study[10] but in agreement with others. On awareness of radiation exposure protection, 76.8% of respondents familiar with the ALARA principle were higher than 68.1% and 65% reported by Almohaimede *et al*.,[10] and Kamran *et al*.,[9] respectively. Surprisingly, more than one-third (80.5%) of the respondents were not familiar with the recommendations of NCRP and ICRP and these findings differ from 34% to 40% reported in the previous studies.

The overall prevalence of inadequate knowledge of radiation exposure protection observed in the present study was 22.4% and this low value could be related to the setting of the study. However, this finding could not be compared since it appears none of the previous studies[9,10] determine overall prevalence as in the present study. As regards the practice of radiation exposure protection, the prevalence of poor practice toward radiation exposure was 66.7% and this was seen as unacceptable due to the stochastic and non-stochastic effects of X-ray radiation. Moreover, 78 (84.2%) of the respondents use a lead apron for patients during exposure, more than half use it occasionally, and a proportion of respondents as high as 13 (15.5%) never use a lead apron. Almohaimede *et al*.,[10] reported that only 27% of dentists in their study used a lead apron compared to 84.2% in the present study. More than half (65.5%) of the respondents never used the thyroid collar for patients during exposure and a similar finding was reported by Kamran *et al*.,[9] who observed 71.8% of dentists that never use

Table 4: Factors associated with inadequate knowledge of radiation exposure protection by the respondents (*n*=82).

Variables	Inadequate knowledge		Chi value (χ)	*P*-value
	Yes (*n*=19)	No (*n*=66)		
Age group (years)				
20-30	8	24	1.03	0.91
31–40	7	26		
41–50	4	13		
51–60	0	2		
61–70	0	1		
>70	0	0		
Gender				
Male	41	8	2.42	0.12
Female	25	11		
Department of respondents				
Oral and maxillofacial surgery	5	22	14.9	0.09
Conservative dentistry	3	7		
Prosthodontics	3	1		
Periodontitis	5	11		
Community dentistry	2	2		
Oral medicine	0	4		
Oral pathology	0	7		
Orthodontics	0	4		
Pedodontics	0	4		
Family dentistry	1	4		
Medical status				
Students	4	12	0.33	0.99
House officer	3	10		
Junior registrar	5	18		
Senior registrar	5	16		
Consultant	2	10		
Years of experience				
1–5	7	28	1.45	0.01
6–10	5	15		
11–15	6	13		
>15	1	10		
Additional degree				
Yes	4	24	22.4	0.02
No	15	42		

n = 82 number of participants

thyroid collar. Alarmingly, more than half of the respondents said that they allow people to come inside the room during exposure to X-rays. It is, therefore, suggested that protective gadgets be provided to relatives of patients if they must be allowed to be in the exposure room. In this study, years of experience and additional degrees were the significant factors that contributed to the prevalence of inadequate knowledge. This is similar to previous studies[18,20,23] that reported a positive correlation between the academic level and the use of lead aprons and thyroid collars.

We would like to acknowledge several limitations of our study. First, causality could not be assessed due to the cross-sectional nature of the study, and second, the sample size could be relatively small. Finally, being a single-center study, the findings need to be interpreted with caution.

CONCLUSION

The prevalence of poor awareness, inadequate knowledge, and poor practice of radiation exposure protection prevalence of 48.2%, 22.4%, and 66.7%, respectively, were quite high. The prevalence of inadequate knowledge of radiation exposure protection was influenced by years of practice and additional degrees. The results of the present study can help design continual education programs at regular intervals at institutional and national levels for strict observance of radiation protection guidelines with more emphasis on young end users.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Conflicts of interest

There are no conflicts of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The author(s) confirms that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

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