

EVALUATION OF AWARENESS AND KNOWLEDGE OF IONIZING RADIATION-RELATED HAZARDS AND PROTECTIVE MEASURES AMONG PATIENT'S ACCOMPANYING PERSONS/CARETAKER IN BUNDELKHAND REGION OF CENTRAL INDIA IN A TERTIARY LEVEL TEACHING HOSPITAL IN BUNDELKH AND A MEDICAL COLLEGE, SAGAR (MADHYA PRADESH)

PUNYA PRATAP SINGH¹, VRESHBHAN AHIRWAR¹, JAGRATI KIRAN NAAGAR², MANOJ SAHU³,
RAJESH KUMAR MAURYA⁴, PRABHAT VERMA¹

¹Department of Radio Diagnosis, Bundelkhand Medical College, Sagar, Madhya Pradesh, India. ²Department of Obstetrics and Gynaecology, Bundelkhand Medical College, Sagar, Madhya Pradesh, India. ³Department of Anaesthesia, Bundelkhand Medical College, Sagar, Madhya Pradesh, India. ⁴Department of Radiotherapy, Bundelkhand Medical College, Sagar, Madhya Pradesh, India. Email: dr.jagratikirannaagar@gmail.com

Received: 28 March 2023, Revised and Accepted: 10 May 2023

ABSTRACT

Objective: Evaluation of awareness and knowledge of ionizing radiation related hazards and protective measures among patient's accompanying persons or caretaker in Bundelkhand region of central India in a tertiary level teaching hospital in Bundelkhand Medical College, Sagar, (M.P.).

Methods: This study was conducted as a questionnaire-based survey conducted in one tertiary-level teaching hospital in Bundelkhand Medical College, Sagar, M.P., from June 2021 to February 2022. A semi-structured questionnaire of 21 items was administered to 840 patient's accompanying persons/caretaker selected as per inclusion/exclusion criteria. Information on demographic variables of the respondents in their knowledge about ionizing radiation effects/hazard, radiation protection measures and source of their knowledge on ionizing radiation were taken and collected data used in the study by applying descriptive statistical analysis.

Results: Majority of the participants in our study were male 548 (63.3%). Most of the participants, 635 (75.6%), did not have knowledge of ionizing radiation. Only 320 (38%) knew that ionizing radiation is hazardous. The majority of the participants, 399 (76.7%), were informed about radiation by the radiographers, while 121 (23.2%) read about it. A larger number of the participants, 620 (73.8%), had no idea about the meaning of radiation protection. The majority of the participants, 678 (80.2%), assisted their relatives during the examination. Most of the participants, 676 (80.1%), have seen the radiation warning sign before.

Conclusion: This study showed that there is a low level of knowledge and awareness of radiation hazards and protective measures among patients' accompanying persons or caretakers. It is obvious that public education via new papers, TV, holdings, etc. will contribute immensely to the spreading of awareness of the harmful effects of ionizing radiation and the measurement of for radiation protection measures.

Keywords: Ionizing radiation exposure, Protection measures, Radiation protection.

© 2023 The Authors. Published by Innovare Academic Sciences Pvt Ltd. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>) DOI: <http://dx.doi.org/10.22159/ajpcr.2023v16i6.48328>. Journal homepage: <https://innovareacademics.in/journals/index.php/ajpcr>

INTRODUCTION

Medical imaging plays an important role in early diagnosis, early treatment, and postoperative monitoring. This will cause a significant positive impact on the prognosis and treatment of human diseases. Medical imaging modalities using ionizing radiation constitute about two-thirds of radiological procedures [1], thereby contributing as a major man-made source of secure radiation exposure to the public with potential biological effects [2]. Despite the various benefits of medical imaging in diagnosis, the associated radiation hazard is a public health concern. Exposure to low-level ionizing radiation at doses used in medical imaging can cause cancer [3].

During the recent decade of advancement of old and addition of new technology, an increase in radiological armamentaria with associated increases in imaging procedures and radiation exposure of patients undergoing radiological investigations as well as health personnel who work with this equipment was also noted. Previous studies revealed poor knowledge and awareness of radiation-related hazards among patients, as documented by Ugwuayi *et al.* [4]. They observed that the majority of participants (67.6%) knew that most of the medical imaging modalities used ionizing radiation, yet only a few (20.4%)

knew that radiation could be harmful. Poor knowledge of radiation protection and the effects of radiation among doctors who conduct radiological investigations, as seen in study conducted by Ighodaro and Igbinedion [5]. Awosan *et al.* also showed satisfactory knowledge of radiation hazards and knowledge of personal protective devices among radiologists, radiotherapists, and dental surgeons [6].

A study almost entirely in the United States of America by Sacks BP reported a significant level of exposure not only to patients but also to patients' relatives to ionizing radiation [7].

However, none of these previous studies recognize the similar radiation exposure of patients' relatives, who take care of patients during the treatment and management of disease in our region. A good knowledge of radiation hazards and safety could reduce the overall radiation exposure of the public as radiation protection practices are judiciously implemented. Radiation protection and safety procedures, according to the International Atomic Energy Agency (IAEA), are established to ensure the protection and safety of staff, patients and patient relatives (caregivers) during their stay in the radiology department [8]. In radiology departments, especially in government hospital, patient relatives and caregivers are often seen inside and around the diagnostic

room with an unjustified extent of knowledge and awareness of potential radiation hazards and protection measures.

There is a scarcity or dearth of data on patient relatives'/care giver's, extent of knowledge and awareness of radiation hazards and their protective measures. This study was done to assess the knowledge and awareness of radiation-related hazards and measures of radiation protection among patient relatives in Sagar (M.P.), India.

METHODS

This study was a questionnaire based prospective study and cross sectional tertiary level hospital based survey based which was conducted in a tertiary level teaching hospital in Bundelkhand Medical College, Sagar, (M.P.) from January 2021 to February 2022.

Twenty-one-item semi-structured questionnaires, written in the English language, with a convenience sample size of 840 participants were administered. The validity and reliability of the questionnaire were achieved by conducting a pilot study before this study. Thirty questionnaires were pretested with patients' relatives before the commencement of the study and the Cronbach alpha reliability test was conducted. The questionnaire had an acceptable internal consistency (Cronbach's alpha=0.81).

Only patients' relatives that came with their patients to the selected study centers during the period of this study, were able to read and write and consented to the study were included in this study. Non-patients' relatives and those that did not consent to participate in this study were excluded from this study.

The questionnaires were administered to the participants using the one-on-one method of administering questionnaires at the waiting areas of the Radiology Departments of the hospitals. All completed questionnaires were retrieved immediately by the researchers. Information on demographic variables of the respondents, knowledge of ionizing radiation effect, radiation protection, and source of their knowledge of ionization were collected using data pro forma.

Statistical analysis radiation

The data collected from the study were processed by S.P.S.S. version 21 and analysis was done using descriptive statistics.

RESULTS

In our study, majority of the participants were male 548 (65.3%). A total of 840 participants, the maximum percentage of 371 (44.2%) was in the age group of 26–35 years. Most of them 345 (41.1%) had education school level (Table 1).

With regard to the participants' knowledge about radiation hazards

Table 1: Socio-demographic of the patients' relative/caregivers

Class	Respondent	Frequency	Percentage
Gender	Males	548	65.3
	Females	292	34.7
	Total	840	100
Age (years)	18–25	130	15.4
	26–35	371	44.2
	36–45	186	22.2
	46–55	98	11.6
	56 and above	55	6.6
	Total	840	100.0
Education qualification	Pre primary	92	11.0
	Primary	176	21.1
	Secondary	345	41.1
	Bachelor of degree	143	17.0
	PG	58	6.9
	M.Phil / PHD	27	3.2
	Total	840	100.0

questions in (Table 2), 205 (24.4%) knew what ionizing radiation was. Of the total participants, 620 (73.8%) gave the answer that they have been previously exposed to ionizing radiation (Table 2). Majority of the participants 696 (80.6%) had stayed with their relative during the radiological examination that involves ionizing radiation (Table 2).

The participant's knowledge of radiation protection in (Table 3), showed that the majority of the participants 220 (26.2%), had no idea about radiation protection (Table 1): Sociodemographic of the patients' relative/caregivers.

Participants who knew about the meaning of radiation protection, 420 (19%) were informed by radiographers during radiological exposure (Table 3). Majority of the participants 565 (80.6%) assisted their relatives during radiological exemption coming to the ionizing radiation. Of those that assisted their relatives, 561 (80.6%) said they were given something to wear (Table 3). Out of 80.6% of the participants who were given something to wear while staying with their relative in the X-ray examination room, 426 (76%) knew why they were asked to wear the protective apron. The majority of the participants 553 (65%) stayed outside the examination room whenever they were asked to do so (Table 3).

With regard to the participant's knowledge of radiation signs as captured in (Table 4), showed that a total out of 840 participants, 678 (80.2%) said that they have seen the radiation warning sign before. Most of the participants who had seen the radiation warning sign 402 (59.3) did not know what is the meaning of the sign. Out of those that knew the meaning of the sign, 214 (77.5%) of the participants said they were informed about the meaning of the sign by radiographers (Table 4). A total of 507 (60.3%) participants had seen the radiation warning sign in the department, of which, 237 (39.7) they usually obeyed the sign (Table 4).

DISCUSSION

This study was the first to evaluate the knowledge and the participant's knowledge of radiation signs to the best of our knowledge. The findings revealed that about 70% of the participants lack knowledge of ionizing radiation despite their relatives (the patients) being referred for ionizing radiation examinations. This poor knowledge and awareness of ionizing radiation by the present study population is similar to the finding of the study conducted by Hobbs *et al.*, who found poor knowledge about radiation exposure and risk among their participants [9]. According to Hobbs *et al.*, the participants' level of knowledge about radiation exposure and risk improved after the educational presentation [9]. Contrary to the index study finding, the study by Ugwuanyi *et al.*, reported that the majority of the respondents (67.6%) were aware of the uses of radiation medical imaging [4]. The differences could be attributed to the different sample sizes and the educational experiences of the participants recruited.

Majority of the participants in the present study did not know that ionizing radiation is hazardous to health. This finding is not a surprise as over 55% of the participants said they were not exposed to ionizing radiation before. This finding is in agreement with the finding of the study conducted by Ugwuanyi *et al.*, in which the majority of their participants 226 (79.58%) did not know that ionizing radiation is hazardous to health [4]. Over 75% of the participants were informed about the radiation hazards on health by the radiographers in this study. This implies that most radiographers give patients and their relatives more attention, which enables them to explain the effects of radiation to them. Majority of the participants in this present study, which accounted for 94.68% have not heard of anybody affected with ionizing radiation injury. This could be ascribed to the fact that majority of the participants were secondary school leavers who might have limited access to the Internet and other social media sources to obtain information on radiation injuries.

Most of the participants in this current study were not knowledgeable of the meaning of radiation protection and those that knows the

Table 2: Questions regarding participants' knowledge about radiation hazards

Questions	Respondent	Frequency	Percentage
Do you know what ionising radiation is?	Yes	205	24.4
	No	635	75.6
	Total	840	100
Have you been exposed to ionising radiation before?	Yes	650	77.4
	No	190	22.6
	Total	840	100
Do you know that ionising radiation is dangerous (hazardous) to health?	Yes	320	38.1
	No	520	61.9
	Total	840	100
If the above question is yes how did you know?	Read about it (1. Daily news, 2. Digital media, 3. Online, 4. Read)	121	23.3
	Informed by the radiographer	399	76.7
	Total	520	100
Have you heard about anybody affected by ionising radiation exposure?	Yes	54	6.4
	No	786	93.6
	Total	840	100
Have you stayed with your relative during examination involving ionising radiation before? (Table 2): Knowledge	Yes	678	80.1
	No	162	19.9
	Total	840	100

Table 3: The participant's knowledge of radiation protection

Questions	Respondent	Frequency	Percentage
Do you know what radiation protection means?	Yes	220	26.2
	No	620	73.8
	Total	840	100
If yes how did you know?	Read about it	24	10.9
	Informed by the radiographer	42	19
	No	154	70
Have you ever assisted your relative during examination involving ionising radiation room?	Total	220	100.0
	Yes	696	82.8
	No	144	17.2
If the above question is yes, did they give you to put anything on when you are assisting your patient during examination?	Total	840	100.0
	Yes	561	80.6
	No	135	19.4
If the above question is yes, did you know why they ask you to put the thing on?	Total	696	100
	Yes	426	76
	No	135	24
Have you ever been asked to stay outside the examination room and you refuse maybe because of your relative? (Table 3): Knowledge of radiation	Total	561	100
	Yes	553	65.8
	No	287	34.2
	Total	840	100.0

Table 4: The participant's knowledge of radiation signs

Questions	Respondent	Frequency	Percentage
Have you seen this radiation warning sign before?	Yes	678	80.1
	No	162	19.9
	Total	840	100
If the above questions are yes, do you know the meaning of the sign?	Yes	276	40.7
	No	402	59.3
	Total	678	100
If the above questions are yes, how did you know the meaning of the sign?	Informed by the radiographer	214	77.5
	I understand the warning signs	62	22.5
	Total	276	100
Is the sign in this radiology department?	Yes	507	60.3
	No	333	39.7
	Total	840	100
Do you always obey the sign? (Table 4): Knowledge of radiation	Yes	237	34.9
	No	441	65.1
	Total	678	100.0

meaning of radiation protection, were informed by radiographers. Most of the participants usually stayed outside the examination room whenever they were asked to do so, but when needed to assist

their relatives (the patients), a greater number responded to have stayed inside the X-ray room during the investigations. This implies that in some situations, depending on the patients' health challenge,

the radiographers may either require the assistance of the patient's relatives in the X-ray rooms or be asked to stay outside the examination room while the investigation is ongoing. The present study finding was in agreement with the finding of the study conducted by Aldossari *et al.*, who reported that of the total participants, 45.53% were aware that their relatives should be asked to stay outside the X-ray room during X-ray investigations to avoid unnecessary exposure to ionizing radiations [10].

This study also found that most participants had seen the radiation warning sign before, although, majority of them do not know the meaning of the sign. These findings indicate that the radiation warning signs in most X-ray units were normally placed at strategic places making them more visible to all those that visited the unit. There are little or no inscriptions of signs, which explained the meaning of the warning signs, while larger numbers of those that have seen the radiation warning sign said they, obeyed the sign whenever they see it. This could be attributed to the fact that the frequent display of these signs on the X-ray door informed them of the associated dangers with ionizing radiation.

CONCLUSIONS

Our study showed a poor level of awareness and knowledge of imaging radiation-related hazards and protection measures among patient's according person of caretakers obvious that public education newspapers, T.V, hoardings, Pumblete, etc. will contribute immensely to the promotion of awareness of the harmful effect of ionizing radiation and radiation protection measures. We therefore recommend that aside the radiation warning sign which is often placed conspicuously, there should be an inscription explaining the meaning of the sign. Government, health professionals, and regulatory bodies should intensify efforts in creating public awareness of radiation hazards.

ACKNOWLEDGMENTS

We acknowledge Dr. Rajendra Gupta for guiding us in every step of research work. We also acknowledge Dr. Kavita Gahlot, Dr. Bheekam Patel, Dr. Sushil Gour, Dr. Chandra Pratap Singh, and Dr. Ajay for her assistance with the radiologic findings and Mr. Indal Singh for his assistance in statistical analysis. We would also like to thank Mr. Shri Jalim Singh, Smt. Pushpa Singh, Smt. Pooja Singh, Mr. Rahul Shrivastava, Mr. Akhilesh Pathak, Mr. Anuj Singh Senger and Dr. Ravikant Gupta for their support and technical help during study.

AUTHORS' CONTRIBUTIONS

Dr. Punya Pratap Singh and Dr. Vreshbhan Ahirwar are mainly involved in data collection and arranging data to proper evaluation by statistical methods. Dr. Jagrati Kiran Nagar is out corresponding author and done main role in arranging this manuscript. Dr. Manoj Sahu, Mr. Rajesh Kumar Maurya and Dr. Prabhat Varma are helped in arranging manuscript, arranging data in table form, preparing discussion & conclusion.

COMPETING INTERESTS

Nil.

REFERENCES

1. Roobottom CA, Mitchell G, Morgan-Hughes G. Radiation-reduction strategies in cardiac computed tomographic angiography. *Clin Radiol* 2010;65:859-67. doi: 10.1016/j.crad.2010.04.021, PMID 20933639
2. United Nations Scientific Committee on the Effects of Atomic Radiation. Sources and Effects of Ionising Radiation. UNSCEAR 2008 Report to the General Assembly with Scientific Annexes. New York: United Nations; 2010.
3. Smith-Bindman R, Lipson J, Marcus R, Kim KP, Mahesh M, Gould R, *et al.* Radiation dose associated with common computed tomography examinations and the associated lifetime attributable risk of cancer. *Arch Intern Med* 2009;169:2078-86. doi: 10.1001/archinternmed.2009.427, PMID 20008690
4. Ugwuayi DC, Chiegwu HU, Anakwe AC, Ebubechukwu OS. Assessment of patients awareness and attitude towards radiation exposure in Nnamdi Azikiwe University Teaching Hospital, Nnewi, Anambra State, Nigeria. *Int J Curr Res* 2017;9:58137-40.
5. Ighodaro EO, Igbinedion BO. Justification of doctors' referral for radiological imaging among some Nigeria doctors. *Sahel Med J* 2017;20:112-22.
6. Awosan KJ, Ibrahim M, Saidu SA, Ma'aji SM, Danfulani M, Yunusa EU, *et al.* Knowledge of radiation hazards, radiation protection practices and clinical profile of health workers in a teaching hospital in Northern Nigeria. *J Clin Diagn Res* 2016;10:LC07-12. doi: 10.7860/JCDR/2016/20398.8394, PMID 27656470
7. Sachs BP. A 38-year-old woman with fetal loss and hysterectomy. *JAMA* 2005;294:833-40. doi: 10.1001/jama.294.7.833, PMID 16106009
8. International Atomic Energy Agency, Vienna. Radiation Protection and Safety in Medical Uses of Ionising Radiation; IAEA Specific Safety Guide No. SSG-56. Vienna: International Atomic Energy Agency; 2018.
9. Hobbs JB, Goldstein N, Lind KE, Elder D, Dodd GD, Borgstede JP. Physician knowledge of radiation exposure and risk in medical imaging. *J Am Coll Radiol* 2018;15:34-43. doi: 10.1016/j.jacr.2017.08.034, PMID 29100884
10. Aldossari H, Naji AA, Al Shammari AK. Evaluation of awareness on radiation protection and knowledge about ionising radiation among patients awaiting radiological examinations: A cross-sectional survey. *Austin J Radiol* 2019;6:1100.