CODEN [USA]: IAJPBB ISSN : 2349-7750

INDO AMERICAN JOURNAL OF
PHARMACEUTICAL SCIENCES

SJIF Impact Factor: 7.187
https://doi.org/10.5281/zenodo.5818367

Available online at: http://www.iajps.com *Research Article*

KNOWLEDGE OF IONIZING RADIATION HAZARDS AND RADIATION PROTECTION PRINCIPLES AMONG MEDICAL STUDENTS OF QASSIM UNIVERSITY, SAUDI ARABIA

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Article Received: November 2021 **Accepted:** December 2021 **Published:** January 2022

Abstract:
Background: *The use of ionizing radiation has evolved significantly since the discovery of X-rays in 1895 to include not only medical purposes but also for security concerns. Despite the significant reduction in radiation dose, ionizing radiation is still a major concern for its potential to cause cancers and birth defects. In this study, we aim at identifying the gaps of knowledge regarding the topic and therefore implement educational activities in order to fill these gaps.*
Methodology*: cross-sectional study and conducted on 4th and 5th-year medical students of Qassim University. A total of 130 students completed a self-administered questionnaire from both male and female branches have participated in the survey.*
Result: *large proportion [61.5%] of the participants in this study demonstrated good knowledge of radiation hazards. 61.5% of the study participants thoughts objects insides room do not produce radiation. However, 46.2% highlighted X-ray is more dangerous than gamma. 43.8% of participants expressed that Radian is the DI unit for measuring radioactive materials. Regarding organ protection, 84.6% indicated that the thyroid gland is the most important organ to be protected against when it comes to head and neck radiography.*
Conclusion: *This study demonstrated good knowledge about radiation protection practices. The study result showed that there is no significant difference in the study participant's knowledge regarding gender and academic level.*
Keywords: *Radiation Hazards, Radiation Protection, non-ionizing radiation, ionizing radiation.*

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Please cite this article in press Abdulmalik Brahim Alrebdi et al, ***Knowledge Of Ionizing Radiation Hazards And Radiation Protection Principles Among Medical Students Of Qassim University, Saudi Arabia.,*** *Indo Am. J. P. Sci, 2022; 09[01].*

INTRODUCTION:

Ionizing radiation is an energy form released by atoms as electromagnetic waves [gamma rays] or subatomic particles [neutrons] [1]. The property that the unstable elements like Uranium have when they spontaneously disintegrate is called radioactivity, and the energy excess released is called ionizing radiation[1]. Unstable elements which disintegrate emitting ionizing radiation are called Radioisotopes [1]. Radioisotopes are sorted into categories based on the form of radiation they emit, the energy released, and the half-life. The half-life of radionuclide is the time required for such radionuclide to decay in amount and therefore activity half of its original value. Based on the electromagnetic spectrum, the frequency of the electromagnetic wave determines whether it's ionizing radiation or not, for example, ultraviolet, x-rays, and gamma rays are considered ionizing while non-ionizing radiation includes visible light, microwaves, infrared, and radio waves. Uses of Ionizing radiation include: industrial [nuclear power and fuel reprocessing plants], military [nuclear weapons and weapons of mass destruction], and medical [x-rays, CT scans, fluoroscopy, nuclear medicine, and radiotherapy]. The gray [Gy] is a measurement used to identify the absorbed radiation dose and is equivalent to one joule of absorbed radiation per kilogram unit of mass. The sievert [Sv] is however a more useful measurement in determining the amount of radiation the human body is exposed to and can cause damage to tissues causing cancer and birth deficits. Since humans can't sense ionizing radiation except at very high intensities, the Geiger counter is a device used to detect and calculate ionizing radiation levels. Typically, each human being is exposed to an average of 2.4 mSv per year from natural sources[2]. However, in some areas of the world, it might be 5-10 times higher than normal. The International Commission on Radiological Protection [ICRP] recommends not exceeding 1 mSv of effective does per year for artificial exposure on general public excluding occupational exposure [i.e., airline crew, people working in fields of uranium mining, nuclear power and fuel reprocessing plants, Industrial radiography, medical radiology, and nuclear medicine, etc.][3]. As for occupational exposure, the ICRP recommends not exceeding 50 mSv per year and 100 mSv for consecutive 5 years[3]. There are many sources of radiation both natural and human-made. Natural sources include cosmic radiation [radiation from the sun and stars], terrestrial radiation [from radioactive materials naturally found on earth, such as uranium, thorium, and radium], and internal radiation from potassium-40 and carbon-14 found on humans, however, it is negligible compare to cosmic and terrestrial radiation[4]. Exposure to 0.7 Gy [70 Rad] or more over a short period of time is enough to cause acute radiation syndrome also known as radiation stickiness, early symptoms include: nausea, vomiting, loss of appetite and occur over minutes or hours following the exposure. However, late symptoms depend upon the dose of radiation and include Infections, bleeding, dehydration, confusion and occur weeks or months after the exposure [5].

SUBJECTS AND METHODS:

A cross-sectional study was distributed among 4th and 5th-year medical students from both male and female branches at Qassim College of Medicine in Buraydah city, Saudi Arabia. the questionnaire was adopted from a previous study after reviewing the literature. The instructions on how to answer the questionnaire were discussed with the students. The questionnaire consisted of eight questions made as multiple choices questions, the survey was made to evaluate the level of knowledge regarding ionizing radiation hazards and radiation protection principles. It covered the different radiological modalities like CT scan, MRI, and X-Ray. The study involved 130 participants divided into 100 males and 30 females. The selection was made by using the simple random sampling method. And the population size was 200. Informed consent has been collected from all participants.

RESULTS:

A total of 130 participants completed the survey questionnaire. The results showed that 76.9% of the study participants were males compared to 23.1% of them were females. Moreover, more than half of the study participants [52.3%] were in year four of educational level. The results also indicated that 47.7% of the study participants were in year five of their study. Table 1 presents the sociodemographic characteristics of the study participants.

Table 1: Sociodemographic Characteristics of Participants [n = 130]

Characteristics	Frequency	Percentage
Gender		
Male	100	76.9%
Female	30	23.1%
Education level		
Year four	68	52.3%
Year five	62	47.7%

The responses to individual knowledge of ionizing radiation hazards and protection principles statements are listed in Table 2. 61.5% of the study participants thoughts objects insides room do not produce radiation when the procedure is performed whilst 38.5% believed objects can emit radiation after the procedure. In addition, when they were asked about the dangers of Gamma and X-rays. More than half of the study participants indicated that Gamma radiation is more dangerous than normal x-ray. However, 46.2% highlighted X-ray is more dangerous than gamma. It is apparent from this table that more than half of the study participants agreed that intravenous contrast material used in angiograms is radioactive compared to 47.7% of students who reported that the material is not radiologically active. The most interesting aspect of this table is that when participants were asked about the procedures is associated with a greater dose of radiation. The study participants answer CT scan produces greater radiation followed by Barium Enema. Furthermore, the least proportion believed that chest x-ray and skull x-ray procedures could emit radiation. Furthermore, 43.8% of participants expressed that Radian is the DI unit for measuring radioactive materials. Also, 22.3% of students stated that Sievert is a measuring unit of radioactive. Approximately 17.7% and 16.2% believed that Becquerel and Gray are measuring units of radioactivity, respectively. When asked about MRI of the spine of 45 minutes length is equivalent to the dose of radiation, more than half of the study participants [56.9%] responded that it is equal to zero chest x-ray. Around one-third of the study sample, indicated that it is equivalent to either 25 or 15 chest x-ray and the least proportion believed it to be equal to 5 chest x rays. Regarding organ protection, 84.6% indicated that the thyroid gland is the most important organ to be protected against when it comes to head and neck radiography, followed by spinal cord and brain, skin tissue, and esophagus.

Table 2: Study Participants Answers towards Ionizing Radiology [n = 130]

Statements	Frequency	Percent
After completion of an X-ray examination, objects in the room emits radiation		
True	50	38.5%
False	80	61.5%
Gamma-ray is more hazardous than an X-ray		
True	70	53.8%
False	60	46.2%
The intravenous contrast material used in angiogram is radioactive		
True	68	52.3%
False	62	47.7%
Which of the following procedures is associated with a greater dose of radiation?		
CT scan		
Barium Enema	114	87.7%
Chest X-ray	9	6.9%
Skull X-ray	5	3.8%

	2	1.5%
The SI unit for measuring radioactive is Sievert [SV] Radian [Rad] Becquerel [Bg] Gray [Gy]	 29 57 23 21	 22.3% 43.8% 17.7% 16.2%
An MRI of the spine of 45 minutes length is equivalent in the dose of radiation to 25 chest X-ray 15 chest X-ray 5 chest X-ray 0 chest X-ray	21 23 12 74	16.2% 17.7% 9.2% 56.9%
Which of the following organs is more important to be protected against radiation in head and neck radiography? Esophagus Thyroid gland Spinal cord and brain Skin tissue	3 110 10 7	2.3% 84.6% 7.7% 5.4%

The results of the association between the study participant's demographic data and question answers to the knowledge of ionizing radiation hazards and protection principles indicated that there is no association between students' gender and their answers [p>0.05]. Also, this was the case in relation to the education levels [p>0.05]., as reported in Table 3.

Table 3: Relationships between Statements Answers and Participant Characteristics.

Statement	Gender		χ2	p	Education level		χ2	p
	M	F			Fourth	Fifth		
After completion of an X-ray examination, objects in the room emits radiation	69	61	2.3	0.17	68	62	1.68	0.17
Gamma-ray is more hazardous than an X-ray	63	67	4.2	0.12	63	67	2.36	0.11
The intravenous contrast material used in angiogram is radioactive	72	58	1.21	0.21	66	64	1.84	0.41
Which of the following procedures is associated with a greater dose of radiation?	61	69	2.22	0.33	71	59	3.24	0.34
The SI unit for measuring radioactive is	64	66	3.21	0.42	65	65	4.25	0.24
An MRI of the spine of 45 minutes length is equivalent in the dose of radiation to	62	68	1.35	0.24	60	70	3.57	0.34

DISCUSSION:

To the best of our knowledge, this study was first in attempting to examine knowledge and awareness about radiation hazards among medical students of Qassim University, Saudi Arabia. In relation to the study characteristics, the majority of our study sample were males. This is consistent with other studies which reported that the majority of medical students were males. This could make difference in the results. The result of the present study indicated that there is no statical significant difference in medical student knowledge about ionizing radiation in relation to gender.

Differences in knowledge levels among genders were reported in 2016 by Awosan et al. [2016][6]. They have found that female students had slightly lower knowledge about ionizing radiation demonstrated in their overall score of 42%, while male students scored 57%. Similarly, the conducted study confirmed that female students scored 43%, while male students 51% on the pre-lecture questionnaire about protection principles about ionizing radiation.

Furthermore, the main findings of this study are that most participants considered radiation exposure that occurs as a part of daily work to be very hazardous. Furthermore, most of the participants reported that they consider gamma-ray to be more hazardous than X-rays. The proportion of students who recognized this principle was 53.8%.

A large proportion [61.5%] of the participants in this study demonstrated good knowledge of radiation hazards. This finding is consistent with that obtained in a study conducted in three hospitals in Port Harcourt, Nigeria, in which 58.7% of radiographers were aware of the dangers of ionizing radiation [Abdellah, Attia, Fouad, & Abdel-Halim, 2015][7]. On the contrary, Booshehri, Ezoddini, and Nozari [2012] reported a poor level of awareness of the basic principles of radiation protection and patients' exposure in a study among doctors in Ile-Ife, Nigeria [19], while Alavi, Dabbagh, Abbasi, and Mehrdad [2017][8] reported poor knowledge of radiation protection among dentists in Yazd dental office. This could affect their risk perception of radiation hazards and by extension their compliance with radiation protection practices.

The results of the current study revealed that the majority of the study participants thought that objects in the room do not emit radiation after an examination. This is supported by previous studies which demonstrated Several publications proved that the knowledge of medical students on ionizing radiation and radiation protection is very poor [Paolicchi et al., 2016][9].

Whereas awareness of dosimeter as the device for measuring radiation exposure was high among the participants, less than a third [30.0%] knew the limit on the effective dose of ionizing radiation for a radiation worker. This is of serious concern because they could develop a complacent attitude towards radiation safety challenges at work, more so that studies conducted among various specialties of health workers demonstrated poor knowledge of radiation dose imparted during common radiological procedures and the consequent risk to themselves and their patients [Alzubaidi et al., 2017[10]; Briggs-Kamara, Okoye, & Omubo-Pepple, 2013][11]. A major concern about the prevalent underestimation of radiation dose exposures in these studies was the exposure of patients to increasing radiological investigations and the attendant radiation hazards.

The level of knowledge about radiation hazards and protection did not differ significantly between medical students according to gender and academic levels. This result is similar to many past findings. Studies that have been conducted among medical students have shown that they possess inadequate knowledge about radiation protection.

The main limitations of the study are that the items of the questionnaires that were used in past studies and this research may have been different. Therefore, direct comparisons between the present and past findings must be made with caution. In addition, the sample size is small which may limit the generalizability of the study. Moreover, the study participants were selected non-randomly which also minimizes the generalizability of the study results.

CONCLUSION:

This study demonstrated good knowledge about radiation protection practices. The study result showed that there is no significant difference in the study participant's knowledge regarding gender and academic level.

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