Acta Scientiarum

http://periodicos.uem.br/ojs
ISSN on-line: 1807-8648
Doi: 10.4025/actascihealthsci.v45i1.59256

Increasing awareness of radiation hazard and radiation protection among medical staff

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ABSTRACT. The purpose of this study was to measure and increase the awareness of the risk of ionizing radiation and its protection among medical staff (non-radiological staff) at Najran region. This study was conducted in selected hospitals and health centers in the Najran region, for the medical staff (both gender, age: 22-60 years), as they were classified into four groups doctors, nurses, administrative staff, and workers, in which their data were collected through a distributed questionnaire. A two-stage questionnaire, where the first phase included their general awareness of the risks of ionizing radiation and its protection, while the second phase included measuring their awareness post the educational week that was held on September 26, 2020 - October 1, 2020. The general result of the study showed insufficient awareness of the risk of ionizing radiation and its protection among medical staff, adequate awareness increase after implementing the educational week, and the estimated rate of increasing their awareness by 90% in different gender and ages groups. The group of males and females between the ages of 22 and 30 recorded the highest participation and awareness at both pre and post-educational weeks compared to other groups.It is important to improve the level of knowledge and awareness regarding radiation hazards and radiation protection to prevent injuries among medical staff in hospitals.

Keywords: radiation hazards; medical staff; awareness; occupational health.

Received on May 18, 2021.
Accepted on October 28, 2021.

Introduction

Radiation is a form of energy that travels through the air in energizing waves or particles (Millan & Baker, 2012). There are different types and sources of radiation, including natural and human-made sources, and some kinds of radiation cause damage to biological tissues (Mustapha, Patel, & Rathore, 1999; Feinendegen, Pollycove, & Sondhaus, 2004).

Radiology uses non-invasive imaging to diagnose patients' conditions and low doses of radiation to create detailed images of the affected area, including diagnostic radiographs (x-rays, computed tomography, ultrasound, magnetic resonance imaging, nuclear medicine examinations) (Andrews et al., 2004). To identify a wide range of problems such as bone fractures, heart disease, blood clots, gastrointestinal diseases, physicians can use diagnostic radiology to monitor a patient's body response to a specific treatment. They can also detect multiple types of cancer using these techniques (Larson et al., 1999; Choi et al., 2004).

There are two types of radiation: non-ionizing radiation and ionizing radiation (International Commission on Non-Ionizing Radiation Protection [ICNIRP], 2020). Non-ionizing radiation contains enough energy to move the atoms in a molecule around them or make them vibrate, but not enough to remove electrons from the atoms (Alcocer, Alcocer, & Marquez, 2021). Examples of this type of radiation are microwaves, visible light, and radio waves (Zamanian & Hardiman, 2005). The second type, ionizing radiation, increases the risk of cancer or direct tissue damage when enough particles are broken down so that cells cannot function (Ward, 1988). Ionizing radiation has many practical uses in medicine, research, and construction, but it is very dangerous if used incorrectly or with high doses (Sherer, Visconti, Ritenour, & Haynes, 2013). Examples of this type are x- rays, 'gamma rays, and neutron radiation' (Korkut, Gencel, Kam, & Brostow, 2013).

The level of knowledge of the medical staff about radiation protection is essential to reduce their exposure to ionizing radiation while conducting radiological examinations, and policies support radiation protection in medical practice to ensure the safety of the medical staff (Le Heron, Padovani, Smith, &Czarwinski, 2010;

Mazlan et al., 2018; Shabani et al., 2018). However, many studies revealed a lack of knowledge about Ionizing radiation and its effects in radiological examinations by medical staff (Jindal, 2015; Saeed et al., 2018). Therefore, this study aimed to investigate the knowledge and awareness of the medical staff about appropriate exposure to ionizing radiation during common radiological examinations and their awareness of radiation protection. We hypothesize a lack of knowledge of radiation hazards and protection among medical staff in Najran, which can be enhanced using educational programs.

Material and methods

We designed a cross-sectional study, and this study was conducted between September to November 2020. We designed an online questionnaire to evaluate knowledge about the risk of radiation and protection. We sent the questionnaires and educational videos to the medical staff in the Najran region and south of Saudi Arabia, except the radiology department staff, in Arabic and English (Shariat, Tamrin, Arumugam, & Ramasamy, 2016). We also explained the study goals and objectives to the medical staff of the Najran University, and they could decide whether to participate in the study or not. The institutional review board of the Najran University approved the study protocol (Ethic number: NU2020/3A/3453).

A group was created in social media, including Telegram, Twitter, and What's app. Medical staff were invited to join these online groups after face to face explanation about the study goals in hospitals and medical centers. The group's link was published to join it through an advertisement containing Barcode that included a link to join the groups. 160 - 200 medical staff of different gender and ages joined the group. We sent the questionnaire one week later. The awareness and knowledge about the risk of radiation and protection were assessed using the questionnaire tool. This questionnaire was designed to assess the level of awareness of the medical staff. The questionnaire was translated into Arabic and English using the back-translation technique.

Questionnaire

The questionnaire questions were divided into three sections:

The first section was about the risk of radiation, which aimed to make the medical staff aware of the risk of ionizing radiation and their short and long-term effects and related diseases. The second section was about radiation protection, which aimed to spread awareness about the importance of radiation protection. The third section aims to ensure that every pregnant health worker is aware of the necessary procedures and preventions while exposed to radiation to avoid any risks affecting her and her fetus's health.

All the questions were formulated in a multiple-choice format with 3 to 4 options with only one correct answer. It consisted of 5 questions evaluating awareness and knowledge of the medical staff about the risk of ionizing radiation and associated biological effects. Moreover, 5 questions evaluated the knowledge and awareness of medical staff about radiation protection and its importance in minimizing radiation effect. Seven questions evaluated awareness of pregnant medical staff about radiation exposure.

The educational week

The educational week was organized by flyer leaflets and videos in both Arabic and English, and the flyer talked about all sections of the questionnaire and answered medical staff questions to educate them about the dangers of radiation and protection methods. The participant were asked to join a telegram private group and we were recived the comfirmation from each participant after viewing and acceccing each educational file, then we relased the next educational material. In addition if there was any question they could make a call or visit us simply.

The material of the educational week was created according to the questions that the participants were asked at the 1st questioner. These questions represent the most important safety aspects in awareness of radiation hazards and radiation protection. These materials were created earlier prior to the study including written context, pictures, diagrams, and educational videos, and all collected from the radiation hazard and radiation protection textbooks and international guidelines (Jindal, 2015; Algohani, Aldahhasi, Algarni, Amrain, & Marouf, 2018).

Post educational week

The questionnaire was sent to the participants after the education in order to evaluate the improvements in the medical staff knowledge about ionizing radiation, their short and long-term effects, and radiation protection.

Data analysis

We calculated the number and percentage for categorical variables. A Chi-square test was used to evaluate the differences between groups. P <0.05 was considered statistically significant.

Results

160 people from all specialties except diagnostic radiology field in all hospitals and health centers in Najran of all ages and different gender were subjected to develop their knowledge and awareness of the risks of radiation and protection, and the result was distributed as follows:

- Section 1:consists of 5 questions about assessing the awareness and knowledge of the medical staff about the risk of ionizing radiation and associated biological effect (Table 1).

Table 1. Assessing the awareness and knowledge of the medical staff about the risk of ionizing radiation and associated biological effect.

		Pre-test	Post-test
	Answer	Frequency (%)	Frequency (%)
Q 1: How important is knowledge of ionizing radiation doses for radiological examinations for you?	Not Important	59 (36.9%)	18(11.3%)
	Not Important at all	25 (15.6%)	8(5%)
	Moderately Important	45(28.1%)	40(25%)
	Very Important	31(19.4%)	94(58.8%)
Q 2: Are you confident in your knowledge about radiation doses of general diagnostic imaging?	No idea about ionizing radiation	85 (53.1%)	22 (13.8%)
	Very confident	17 (10.6%)	105(65.6%)
	Moderately confident	32 (20%)	27 (16.9%)
	Not confident	26 (16.2%)	6 (3.7%)
Q 3: Do not exposure to radiation protect greatly from biological effects?	Yes it protect me	52 (32.5%)	119 (74,4%
	No not protect me	58 (36.3%)	5 (3.1%)
	Partially protects me	29 (18.1%)	32 (20%
	Protect me very little	21 (13.1%)	4 (2.5%)
Q 4: How does radiation affect human health?	Exposure to very high levels of radiation	70 (43.8%)	147 (91.9%)
	When you follow the means of protection	24 (15%)	6 (3.7%)
	Does not affect human health	45 (28.1%)	6 (3.7%)
	Exposure to low radiation levels of radiation	21 (13.1%)	1 (0.6%)
Q 5: Are all kinds of ionizing radiation harmful Human health?	Harmful	35 (21.9%)	62 (38,8%)
	Not harmful	76 (47.5%)	9 (5.6%)
	Partially harmful	38 (23.7%)	40 (25%)
	Very harmful	11 (6.9%)	49 (30.6%)

- Section 2:consists of 5 questions about assessing the knowledge and awareness of medical staff about radiation protection and its importance in minimizing radiation effect (Table 2).

Table 2. Assessing the knowledge and awareness of medical staff about radiation protection and its importance in minimizing radiation effect.

		Pre-test	Post-test
	Answer	Frequency (%)	Frequency (%)
Q 6: Is radiation protection limited to radiological staff only?	yes	88 55%	25 15.6%
	no	72 45%	135 84.4%
Q 7: Do you know what is meant by the principle of ALARA/	yes	31 19.4%	124 77.5%
	no	129 80.6%	36 22.5%
Q 8: In your opinion, what are the golden rules that we use to reduce radiation damage?	Time and distance	34 21.3%	38 23.8%
	Time and wash your hands well	44 27.5%	8 5%
	Use some medicines and leave enough distance between you and the device	38 23.8%	5 3.1%
	Time, Shielding and distance	44 27.5%	109 68.1%
Q 9: Which category should protect them self most from radiation?	Doctors	38 23.8%	6 3.8%
	Nurses	30 18.8%	5 3.1%
	Radiological staff	50 31.3%	108 67.5%
	All those in the Hospital	42 26.2%	41 25.6%
Q 10: Does protection differ according to the radiology department?	yes	45 28.1%	83 51.9%
	no	62 38.7%	11 6.9%
	often	24 15%	54 33.8%
	sometimes	29 18.1%	12 7.5%

- Section 3: consists7 questions about an awareness assessment of pregnant medical professionals about exposure to radiation (Table 3).

Table 3. Assessment of pregnant medical professionals about exposure to radiation.

		Pre test	Post test
	Answer	Frequency (%)	Frequency (%)
Q 11: Do you have sufficient knowledge of the effect of radiation exposure on a pregnant health worker?	100%	40 (25%)	87 (55.6%)
	75%	19 (11.9%)	43 (26.9%)
	50%	42 (26.9%)	18 (11.9%)
	25%	58 (36.3%)	10 (5.6%)
Q 12: Are you aware of the health and preventive precaution for a pregnant health worker inside the radiology department?	Yes	34 (19.4%)	94 (68.85%)
	No	53 (34.4%)	30 (9.4%)
	To some extent	43 (26.9%)	35 (18.8%)
	I do not know	31 (19.4%)	5 (3.1%)
Q 13: Does a pregnant health worker perform her job normally in the radiology department?	Yes	53 (31.1%)	23 (15.6%)
	No	46 (28.1%)	84 (50.6%)
	Often	63 (38.7%)	53 (33.8%)
Q 14: Do you know the guideline established by health organizations for pregnant health workers?	Yes	23 (15%)	88 (60%)
	To some extent	44 (27.5%)	41 (26.9%)
	I do not now	90 (57.5%)	21 (13.1%)
Q 15: Are all types of radiation harmful to a pregnant health worker?	Yes	61 (38.1%)	40 (25%)
	No	39 (25%)	102 (63.1%)
	Significantly	26 (15%)	14 (8.8%)
	Slightly	36 (21.9%)	5 (3.1%)
Q 16: What is the radiation that is not harmful to a pregnant health worker?	X-ray	50 (31.3%)	18 (8.1%)
	CT	44 (29.4%)	7 (4.4%)
	US	40 (26.2%)	133 (83.1%)
	NM	21 (13.1%)	7 (4.4%)
Q 17: In your opinion what harm is caused to a fetus while exposed to radiation?	Abortion	19 (12.5%)	44 (22.5%)
	Fetal malformation	66 (41.9%)	119 (74.4%)
	Fetal death in the womb	23 (15.6%)	1 (0.6%)
	There is no harm to fetus	50 (30%)	4 (2.5%)

Discussion

In this study, we evaluated the Najran medical staff awareness about radiation hazards and protective measures against these hazards. We also assessed the effects of a one-week education plan in increasing the medical staff awareness about radiation hazards and related protective measures. At baseline, before providing educational materials to the participants, the awareness of radiation risks and radiation protection was considerably low, and there were serious deficits in medical staff knowledge about this topic. However, using scientific flyers and educational videos with sufficient and practical information on the mentioned topic, including risks of exposure to radiation and protection from ionizing radiation, dramatically increased the medical staff knowledge across age groups and genders. The educational course successfully increased the knowledge in 90% of participants, which indicates the effectiveness of such an educational program, which can be used in large-scale education plans. This calculation was done based on the comparison between pre and post-tests scores related to correct answers.

Soye and Paterson (2008), did a survey among 200 junior doctors and their findings showed that training does increase awareness about radiation dose and their findings were in line with our findings (Soye & Paterson, 2008). After it in 2016, Paolicchi et al. (2016), in their findings showed that it is necessary to improve the level of kn is a substantial need for radiographers to improve their awareness about radiation protection issues (Paolicchi et al., 2016). Following those researches, in 2018, Algohani, Aldahhasi, Algarni, Amrain, & Marouf (2018), showed similar findings and concluded that the amount of knowledge and awareness among health care professionals are not enough and there is a need to improve it.

It is necessary to find the best methods, plans, and more studies are required to determine the best way to improve awareness and knowledge of the risks of radiation and their protection. This initial study indicates the usefulness of training and an educational program in enhancing the medical staff knowledge. Such programs and continuing medical education programs on the risks associated with exposure to radiation and protection methods; can be directed to all medical personnel working in each field.

As this study was conducted during the COVID-19 pandemics, we could not hold face-to-face classes and educational programs, which is the main limitation of this study, as in-person classed may be more effective in enhancing the knowledge. Future studies, after the COVID-19 pandemic, using in-person classes and educational programs are indicated for better evaluation of the effectiveness of such programs.

Conclusion

The study was just to measure the knowledge and awareness of the medical staff about their appropriate exposure to ionizing radiation during common radiological examinations and their awareness of radiation protection in Najran hospitals. Online classes and educational courses can effectively enhance the medical staff's knowledge about the radiation risks and protection against it and can be utilized in this regard.

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