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Awareness Of Radiation Protection Measures Among Radiologists And Non-Radiologists

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Abstract:

Background: *More than 3,600 million radiology examinations are carried out every year worldwide. In spite of the great benefits of diagnostic and therapeutic radiations, they may result in some hazards if used inappropriately. However, these hazards can be prevented through raising the awareness of health care professionals about these hazards and the protective measures to be considered. Several guidelines and regulations were issued for this purpose including; the POPUMET regulations and ALARA principle and the WHO global initiative on radiation safety in health care settings.* ***Aim:*** *The current study aimed at assessing the level of radiation protection awareness among clinicians and radiologists in addition to exploring if radiation protection courses have a beneficial effect on the awareness level or not.* ***Methods:*** *This was a cross-sectional study where the level of radiation protection awareness was assessed using an anonymous questionnaire.* ***Results:*** *A total of 101 (100%) participants responded to the questionnaire. Of which; 49 (48.5%) were residents, 30 (29.7%) were specialists and 22 participants (21.8%) were consultants. Slightly less than half of the participants (48, 47.5%) have attended a radiation protection course before. The majority of participants who attended a course (68.8%) have heard about the POPUMET regulations ($p<0.001$). Participants were asked about the procedures with risk equivalent to 0.25 mSy of radiation estimated dose equivalent. And it was found that course attendance improved the knowledge about the risk of 3 (out of 4) procedures ($p<0.05$). On the other hand, course attendance didn't improve the knowledge about the approximated radiation doses of some procedures ($p>0.05$) or the degree of radio-sensitivity of different organs ($p>0.05$). The majority of the participants (96%) were not aware that there is no annual limit of radiation dose for patients. Around half of the participants (56.4%) were aware about w[1]hat the word "ALARA" stands for.* ***Conclusion:*** *Results of the current study suggested that the level of radiation protection awareness among health care professionals is not sufficient to ensure patients and workers' safety. And accordingly, we suggested that more efficient awareness programs for health care*

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professionals are conducted on regular basis with regular monitoring of awareness level to explore areas for improvement.

Keywords: *radiation, POPUMET, ALARA, awareness.*

Introduction:

According to the United Nations, more than 3,600 million radiology examinations are carried out every year to diagnose several diseases all over the world. In addition, 37 million procedures including nuclear medicine are carried out and 7.5 million treatments including radiotherapy are given every year[1].There is no doubt that therapeutic and diagnostic applications of ionizing radiation help millions of people all over the world every day. However, these benefits may be associated with unnecessary however preventable risks to patients, technicians and healthcare givers if radiation is not used appropriately. These risks are now minimized because of the development of advanced technologies that makes these applications safer[2]. Several regulations were released to raise the awareness about radiation hazards and the techniques to be followed for protection of patients undergoing medical treatment or examination. This includes; the POPUMET regulations, ALARA (as low as reasonably achievable) principle and the WHO global initiative on radiation safety in health care settings. These guidelines and principles integrate radiation protection with good medical practice to allow all stakeholders of healthcare services to comply with radiation safety standards. The main concepts of this initiative includes risk assessment, risk management and risk communication strategies [3].

It was reported in a study by **Kings, et al**. that physicians and other health professionals, need to be aware of radiation hazards and protection techniques in order to get the required benefits from radiation while minimizing the associated risks [4] **. Salih ,et al.** conducted a study in 2013 to assess the awareness and knowledge of Saudi medical students and doctors about hazards of ionizing radiation using a 20-item multiple choice questionnaire. It was revealed that almost all responders (98%) got low scores in all 98% had low scores in all items related to ionizing radiation hazards [5].

The current study aimed at assessing the level of radiation protection awareness among healthcare professionals in KSA in addition to exploring the effect of radiation protection courses on the level of awareness.

MATERIALS AND METHODS

Subjects

In this cross-sectional study, radiologists and physicians of different specialties in Makkah hospitals were asked to fill anonymous questionnaires about "radiation dose of radiological investigations" during the period from August 2022 to November 2022. Institutional review board approval was obtained before conducting any study-related procedures.

Data collected

A total of 10 questions were included in the questionnaire. This included questions about the medical degree, main interest, and specialty of the participating radiologists and physicians. In addition, radiologists and physicians were asked if they have ever attended a radiation protection course and if they have heard about POPUMET regulations before. Additional questions related to physician's knowledge about radiation risks, radiation doses of several examinations, radiation sensitivity of some organs, annual radiation dose limit for patients and the meaning of the word "ALARA".

The study was done after approval of ethical committee

Statistical analysis

Data were statistically described in terms of frequencies (number of cases) and percentages for categorical variables. Comparison of categorical data between subgroups was carried-out using Chi- square (c^2) test. One-sample t-test was used to compare the mean score of a certain question to a theoretical mean considering the null hypothesis. P values less than 0.05 were considered statistically significant. All statistical calculations were done using computer program IBM SPSS (Statistical Package for the Social Science; IBM Corp, Armonk, NY, USA) release 21 for Microsoft Windows.

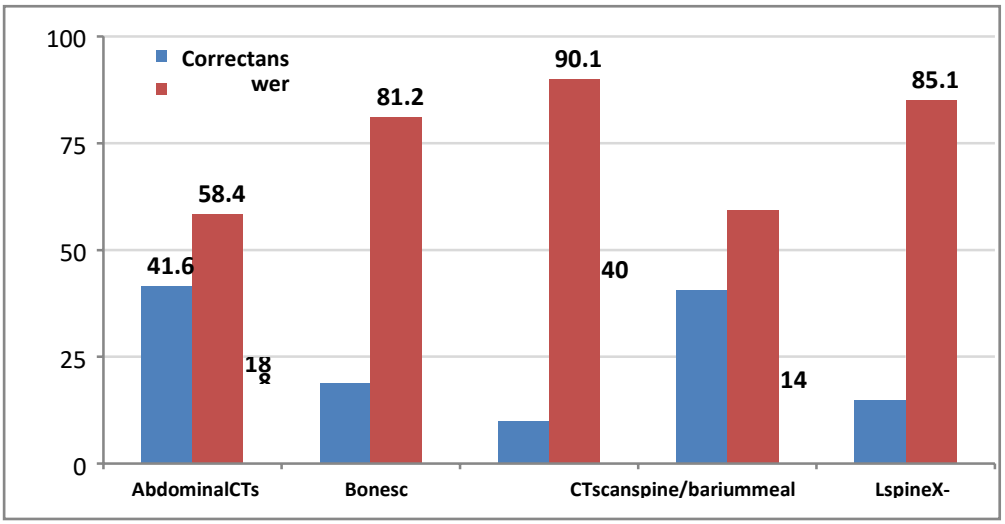
Results:

Participants' characteristics:

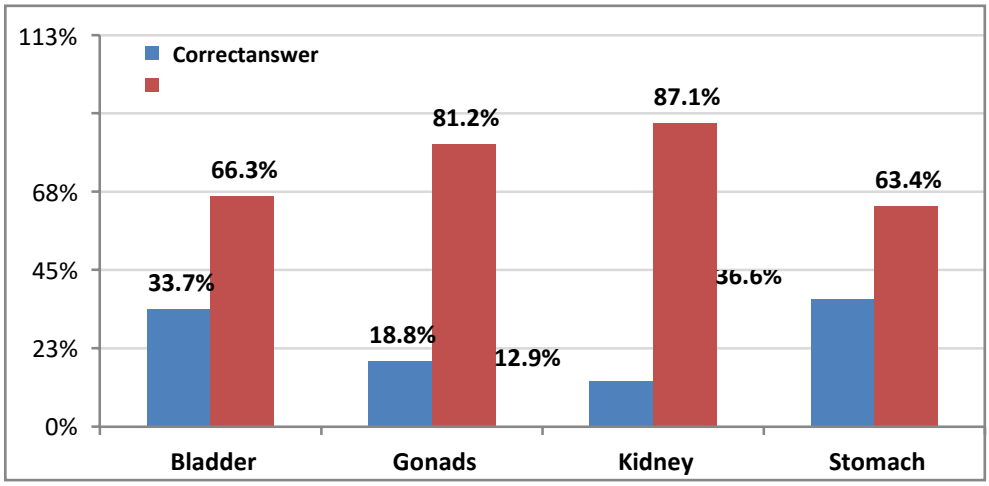
A total of 101 (100%) physicians responded to the questionnaire. This included 49 (48.5%) residents, 30 (29.7%) specialists and 22 (21.8%) consultants. Results showed that less than half of the participants (48, 47.5%) have attended a radiation protection course before while 53 (52.5%) have never attended a radiation protection course. When asked about their main interests, 65 (64.4%) participants said that they were interested in medicine while 36 (35.6%) chosen surgery as their main interest. The most frequent specialty among participants was internal medicine (17, 30.4%), followed by surgery (9, 16.1%), radiology (6, 10.7%) and anesthesia (5, 8.9%). The rate of radiation protection course attendance didn't differ significantly between the different specialties (p=0.427).

Specialty	Frequency	Valid Percent
Internal Medicine	17	30.4
Surgery	9	16.1
Radiology	6	10.7
Anesthesia	5	8.9
Dentistry	3	5.4
ENT	3	5.4
Obstetrics and gynecology	3	5.4
Pediatrics	3	5.4
Orthopedics	2	3.6
Cardiology	1	1.8
Dermatology	1	1.8
ER	1	1.8
Nephrology	1	1.8
Ophthalmology	1	1.8
Total	**56***	**100**
* 45 participants didn't answer this question		

Participants were asked if they have heard about the 1988 health and safety regulation concerning protection of persons undergoing medical examination or not. A total of 44 (43.6%) participants answered "Yes" while 57 (56.4%) answered "No". The percentage of participants who answered "Yes" was significantly higher ($p<0.001$) among the group who attended a radiation protection course (68.8%) compared to those who have not attended the course (20.8%). Another question was asking about the percentage of medical radiation to which the U.K population is exposed out of all radiations from various sources. A significantly higher ($p<0.001$) percentage of participants gave wrong answers (87.1%) while only (12.9%) answered this question correctly. Attendance of a radiation protection course was found to have no significant effect on participants' answers ($p=0.242$). In order to assess participants' level of awareness about risk of radiation, they were asked about the procedures with risk equivalent to 0.25 mSy of radiation estimated dose equivalent. Significantly high percentages ($p<0.001$) of participants gave correct answers for risk of having CXR (59.4%), risk of bone scan (62.4%) and risk of having a barium meal (65.3%) while for risk of smoking, the majority of participants (57.4%) gave wrong answers ($p<0.001$). Participants' knowledge about the approximated radiation doses of some investigational procedures was assessed. The majority gave wrong answers about the approximate dose of abdominal CT scan (58.4%), bone scan (81.2%), CT scan spine/barium meal (90.1%), barium enema/IVU (59.4%) and L spine X-ray (85.1%). The percentages of wrong answers were significantly higher ($p<0.001$) than correct answers for all procedures. Course attendance didn't improve the knowledge about the approximated radiation doses of any procedure ($p>0.05$).



The same as approximate radiation doses, course attendance didn't improve the knowledge about the degree of radio-sensitivity of different organs ($p>0.05$). The majority gave wrong answers about the radio- sensitivity of bladder (66.3%), gonads (81.2%), kidney (87.1%) and stomach (63.4%). The percentages of wrong answers were significantly higher ($p<0.001$) than correct answers for all procedures. The majority of the participants (96%) were not aware that there is no annual limit of radiation dose for patients ($p<0.001$). Radiation Protection course was found to have no significant impact on answers of this question ($p=0.653$). A significantly high ($p<0.001$) percentage of participants (56.4%) were aware about what the word "ALARA" stands for while (34.6%) were not aware of its meaning. And again radiation protection course was found to have no significant impact on participant's awareness of "ALARA" meaning ($p=0.286$).



Discussion:

Radiation is the type of energy that is released from atoms as electromagnetic waves or in the form of particles. Every day, we get exposed to low radiation doses of several sources that may be natural (e.g. soil, water and vegetation) or may be human-made sources (e.g. X-rays and other radiation-releasing medical devices[6].

There are several applications of ionizing radiation in several fields including the routine use across all branches of medicine which was initiated more than 100 years ago including several diagnostic and therapeutic techniques. However, radiation is associated with a potential health risk due to its effect on atoms of living cells. This may result in damage to living cells, tissues and DNA. Risk/ benefit assessment must be considered while taking the decision of exposing a patient to a certain procedure including radiation. This could not be achieved with medical knowledge alone as a good understanding of the radiation and its effects is needed [7,8].

This cross-sectional study was carried-out to assess the awareness level about radiation protection and radiation dose of different radiological investigations. A total of 101 physicians of different specialties were asked to fill-in an anonymous questionnaire. In general, the level of awareness among participating physicians was revealed to be very unsatisfactory. Moreover, when a similar study was conducted on radiology workers by **Ramanathan and Rayan** , the awareness about radiation doses and risks was found to be poor as well[9].

Results showed that a considerably low proportion of participating physicians (47.5%) have attended a radiation protection course before with no differences between course attendance rates among different specialties (p=0.427). Lower percentage (12.1%) of radiographers who attend radiation protection courses regularly was reported in the study by **Paolicchi ,et al .**[10].

Results of the study by **Quinn ,et al**. revealed that radiation protection course attendance can improve knowledge about the POPUMET regulations (p<0.0001) and the ALARA principle. In our study, the percentage of participants who were aware of POPUMET regulations was significantly higher among those who attended a radiation protection course (p<0.001) while the course was found to have no significant impact on participant's awareness of "ALARA" meaning (p=0.286) [11].

Knowledge about radiation doses of several procedures was assessed. Most of the participants gave wrong answers for each of the whole procedures. This is consistent with the results of the study by Ramanathan and Rayan (2014) where only 23% of the participants gave correct answers about the radiation dose of single-view and double-view chest X-ray [9] .

In a recent study conducted in Riyadh, Saudi Arabia by Alotaibi and Alnafea (2017), the awareness of radiology staff about the radiation dose in a chest X-ray (single-view) was found to be poor where 24.6% gave correct answers[12].

In the study by **Quinn ,et al.** most of the participants were not aware of the relative radio-sensitivity of some body organs. The same in our study, the majority gave wrong answers about the radio-sensitivity of bladder (66.3%), gonads (81.2%), kidney (87.1%) and stomach (63.4%)[11]

Conclusion:

Based on the discussed results of our study and other studies, we can conclude that the overall knowledge of physicians and radiologist about radiation is inadequate which may increase the radiation hazard to patients and radiology workers.

Extensive efforts should be made to provide more robust education and acquire greater knowledge. In addition, we suggest conducting regular training courses about radiation dose and associated risks.

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