ORIGINAL ARTICLE

A STUDY OF STUDENT AWARENESS OF RADIATION PROTECTION SKILLS AT JAZAN UNIVERSITY

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ABSTRACT

Objectives: To evaluate radiology students' awareness of ionising radiation exposure and its related risks during common diagnostic imaging procedures, to evaluate students' radiation protection knowledge for assessment of educational processes and clinical training. ***Materials & Methods:*** A total of 200 senior students at the Diagnostic Radiology Department were requested to complete a questionnaire consisting of 26 questions. The data were analysed using the statistical package for social sciences software (SPSS). ***Results:*** The response rate was 90.5% (181 students). Awareness level depended on student grade point average (GPA), age, and relevant courses attended in radiation. Gender and marital status did not predict awareness of radiation protection standards. ***Conclusion:*** Our results showed a general lack of knowledge regarding radiation protection for fourth level students, which slightly improved in the subsequent levels. Including specific courses of radiation protection for medical and dental students is highly recommended. Such courses will improve skills specific to professional handling of radioactivity as well as radiation awareness.

Keywords Radiation Awareness, Radiation Dose, Dose Limits, Radiology Students.

INTRODUCTION

In recent years, there has been increasing concern regarding the amount of radiation exposure to the general population from man-made sources. Technological advancements in diagnostic radiology systems have led to a massive increase in exposure of ionising radiation to patients, especially with use of computed tomography (CT), accounting for about 50% of overall medical exposures.[1] It was estimated that approximately 15% of future cancers could be related to radiation exposure from CT in the United States [1]

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The continuous rise of exposure in ionising radiation has been reported in some studies.[2,3] Desmond et al.,[2] reported that the average cumulative effective dose having risen steadily from 7.9 to 25 mSv over a five-year period, with 85% of the radiation exposure occurring in the year 2008 alone, attributed to CT exams. What is even more worrying is that a high percentage (16%) of patients received cumulative effective doses greater than 75.0 mSv, possibly increasing the cancer risk. It is a matter of concern given that CT contributes 50% of the radiation dose to patients, yet it accounts for only 6% of the diagnostic procedures.[3]

There have been recent efforts to reduce the amount of exposure to radiation and educate patients and users regarding the importance of radiological protection; these efforts come from a wide range of stakeholders, including protection bodies, vendors, and institutions of education[4,5]. Inadequate knowledge and inaccurate information regarding radiation protection and dose limits among radiology professionals have been blamed for radiation protection-related issues.[6,7,8,9] Inadequate knowledge regarding the risks associated with high dose radiation presents a biological risk for patients seeking radiology services. This is particularly true for younger patients who are at a higher risk of radiation hazards, up to 4 times that of adults.[10]

Diagnostic reference level (DRL) is used to monitor practice and to ensure that patients are not exposed to unnecessary radiation. The annual limit for radiation workers, used only for occupational exposure, is 20 mSv and not higher than 100 mSv over 5 years[10]. For example, studies have found that paediatric examinations usually entail the same magnitude as that of adults, resulting in unnecessarily high radiation doses.[8,11,12,13] Therefore, we welcome efforts that increase knowledge of awareness protection, such as the European Council Directive 2013/59/EURATOM, providing basic safety standards for protection against the dangers of exposure to ionising radiation as well as guidelines on radiation protection education and training of medical professionals in the European Union.[13] In Saudi Arabia, the health care level is ranked 26th globally, and the frequency of radiological examinations is increasing[14]. The average number of procedures performed at diagnostic radiologic departments exceed 14.3 million procedures annually.[15] Therefore, protection of patients and personnel from unnecessary radiation is crucial. Furthermore, assessment of student awareness is recommended in order to ensure that their training level complies within international standards of patient safety and protection.[16, 17]

The Centres for Disease Control and Prevention[22] recommended that, although the embryo or foetus is protected in the uterus and receives lower doses than does the mother for most radiation exposure events, embryos and foetuses are particularly sensitive to ionising radiation. Severe exposure to ionisation in unborn children is likely to cause malformations, growth retardation, impaired brain function, and cancer.

The main objective of this study was to evaluate the knowledge and skills level of radiology students in radiation protection.
So that the importance of this study was to introduce the radiation protection awareness as a field culture among the radiology students, workers, radiographers as well as the radiologists.

MATERIALS AND METHODS

The study population included senior students of the Diagnostic Radiology Department at Jazan University, Saudi Arabia. A purposive sampling technique was used to develop the selection criteria. The 3rd and 4th year students were selected as the study group. A well-designed two-part questionnaire (provided appendix 1) was used for data collection. The first part included student demographics such as gender, age and marital status, while the second part was designed on a Likert scale scoring system to assess the prior knowledge of the students in the radiation protection field.

Two hundred (200) students were targeted. One hundred eighty-one (181) completed the questionnaires successfully, representing a response rate of 90.5%. SPSS version 20 was used for statistical analysis.

RESULTS

A total of 181 questionnaires were analysed to evaluate the effects of student characteristics on radiation protection awareness together with its dimensions i.e., general knowledge of radiation protection, determinants of radiation, radiation monitoring, and the As Low As Reasonably Achievable (ALARA) principle. Questions regarding radiation dosimetry quantities and units as well as dose limits were included to assess knowledge of radiation protection in diagnostic radiology. Most of the respondents were female (53.3%). The participants were evenly distributed across various undergraduate levels, with 6th grade being slightly more represented (26.9%). A total of 91.8% of the respondents were single and a clear majority (77%) had a grade point average (GPA) of 2.5–3 to 3.5–4. Most students (53.3%) were between 22 and 24 years old.

Ethical issues regarding the approval, consent, privacy and confidentiality were considered under responsibility and supervision of the deanship of scientific research in Jazan University .

The effect of student characteristics on general knowledge of radiation protection

Regression analysis showed that student background was a significant predictor of general knowledge (p = 0.03). Further exploratory data analysis (Fig. 1) showed a proportional relationship between GPA and general knowledge; i.e., general knowledge increased as the GPAs increased.

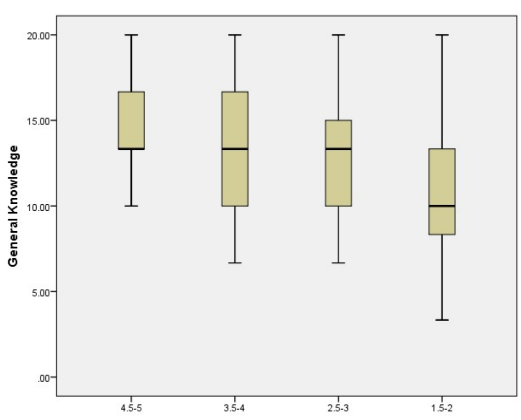

Figure 1. Level of general knowledge versus GPA

The effect of student characteristics on knowledge of radiation determinants

Multiple regression analysis to determine those student characteristics that predicted knowledge of radiation determinants showed that marital status and undergraduate level were significant predictors.

Figure 2 shows that awareness of radiation determinants were higher amongst married participants than among those who were single. Figure 3 illustrates clearly that levels of knowledge of this dimension increased with grade level.

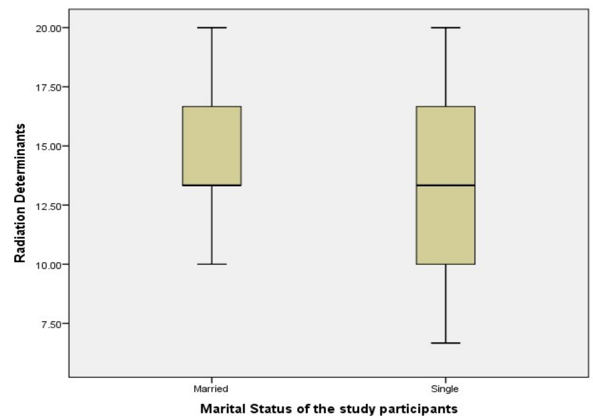

Figure 2. Radiation determinants vs. marital status

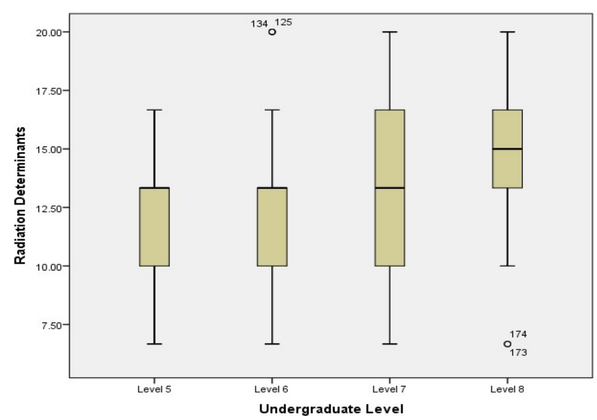

Figure 3. Radiation determinants vs. undergraduate level.

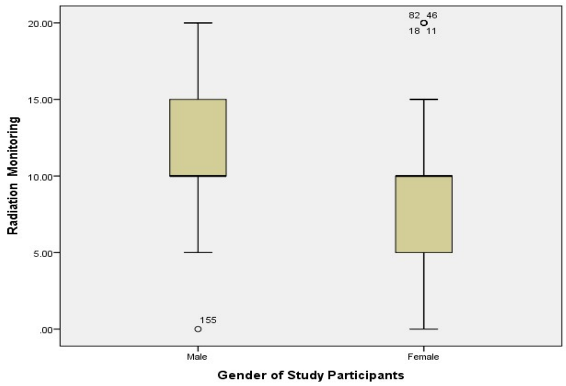

Figure 4. Radiation monitoring vs. gender

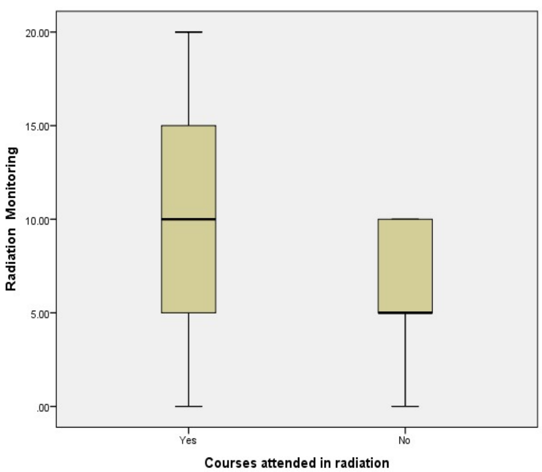

Figure 5. Radiation monitoring vs. radiation courses attended

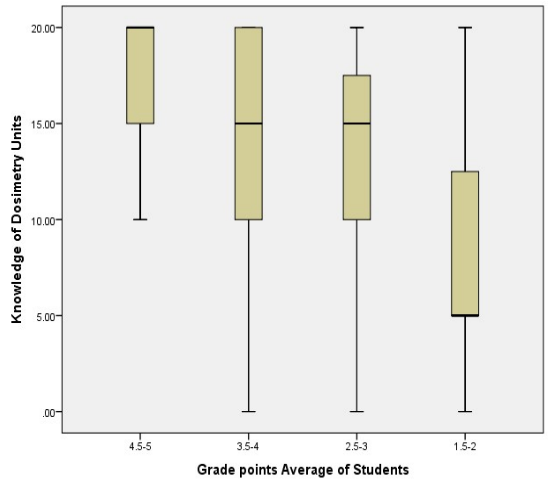

Figure 6. Knowledge of dosimetry units vs. GPA

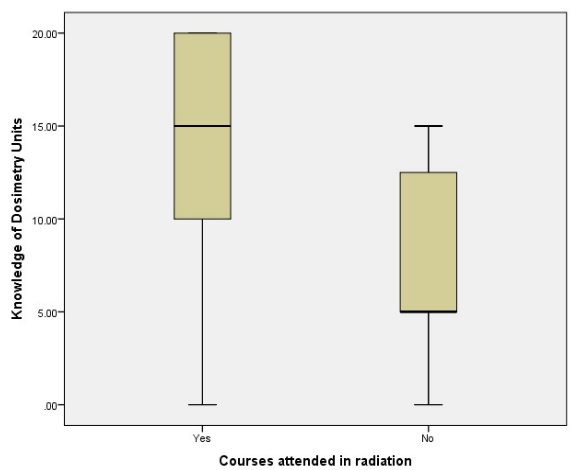

Figure 7. Knowledge of dosimetry units vs. radiation courses attended

The effect of student characteristics on knowledge of ALARA principles

The effect of student characteristics on knowledge of dose units and dose limits

A regression analysis was conducted to determine the effect of student characteristics on the awareness of dosimetry units and dose limits. Grade point average in radiation courses and undergraduate level were significant predictors of knowledge of dose units and dose limits.

The level of knowledge of dosimetry units and dose limits increased with GPA scores (Fig. 7) and increasing undergraduate level (Fig. 8). In addition, the level of knowledge of dosimetry units and dose limits was highest among students who had attended courses in radiation (Fig. 9).

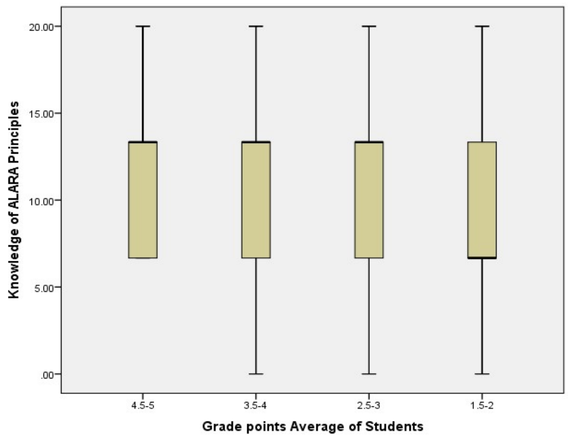

Figure 8. Knowledge of ALARA principles versus GPA scores

The effect of student characteristics on radiation awareness

A regression analysis was conducted to determine the effects of demographic aspects on their level of knowledge on radiation protection. We found that demographic factors collectively (i.e., courses attended in radiation, grade point average, age, marital status, gender, and undergraduate level) significantly predicted the level of knowledge of radiation protection (F (6, 175) = 13.26, p = 0.00, $R^2 = 0.31$).

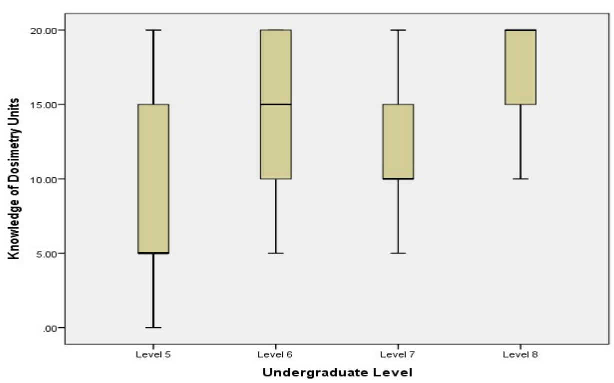

Figure 9. Knowledge of dosimetry units vs. undergraduate level

This may reflect the fact that undergraduate level had a significant influence on level of radiation protection knowledge (p = 0.00). This was also the case for age, courses attended in radiation related items and GPA. Gender and marital status were less significant predictors of the level of radiation protection knowledge. Further exploratory data analysis showed that radiation awareness among students increased as GPA increased (Fig. 10) and as undergraduate level increased (Fig. 11). In addition, radiation awareness was high if the student attended a course on radiation and was higher in older students than in younger students. These data make sense because older students are also generally at higher undergraduate levels, where they would have taken more courses on radiation protection.

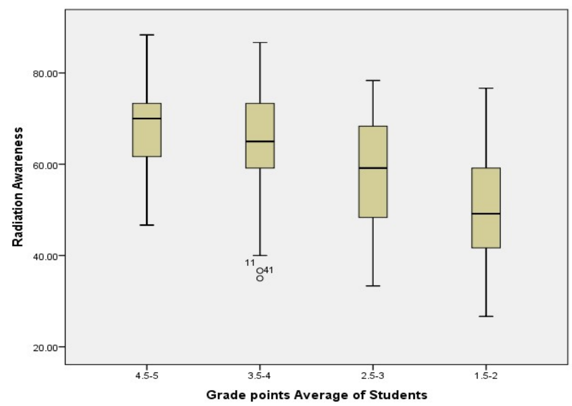

Figure 10: Radiation awareness vs. GPA

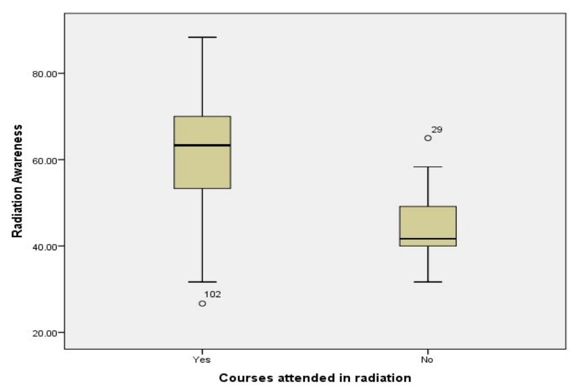

Figure 11. Radiation awareness vs. courses attended in radiation

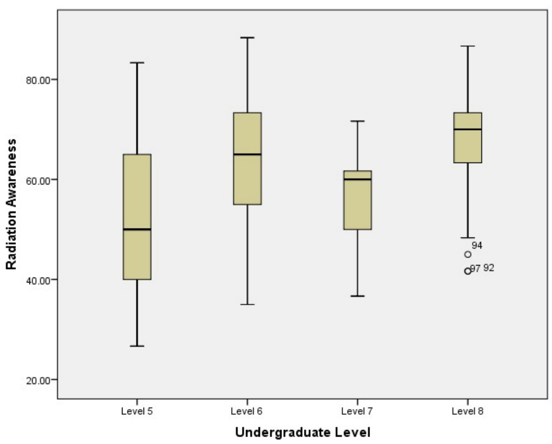

Figure 12. Radiation awareness vs. undergraduate level

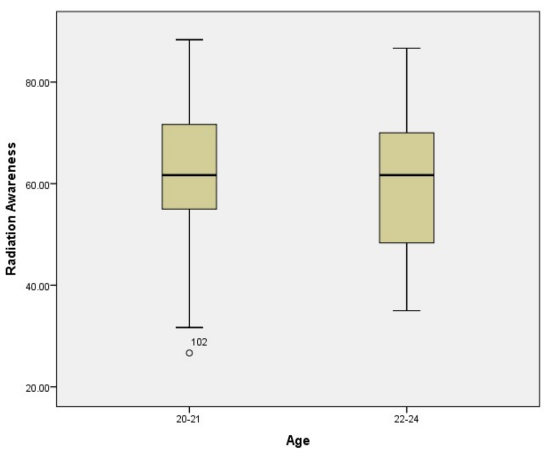

Figure 13. Radiation awareness vs. age

DISCUSSION

The aim of this study was to evaluate the knowledge of third and fourth year undergraduate diagnostic radiology students at Jazan University regarding their level of awareness of radiation protection. To the best of our knowledge, this is the first study of its kind to be conducted at Jazan University. The key finding of the study is that diagnostic radiology students' levels of knowledge increased with undergraduate level (Figs. 9 and 10). These results support the hypothesis that the level of knowledge of the radiation dose, associated risks, and radiation protection correlated with undergraduate level. However, the level of knowledge was generally low, consistent with findings of previous studies.[18, 19, 20, 21]

It is alarming that so many diagnostic radiology students did not correctly identify the type of radiation produced in the various most common medical imaging procedures. The students in the present study performed less well than those in previous studies.[18–21] This is concerning because the number of radiological examinations is increasing in Saudi Arabia.
It is encouraging and promising that 94% and 96.7% of the students correctly identified the risk of exposure of pregnant women to radiation and that the unborn children are more sensitive to radiation, respectively, in agreement with the findings in 2018 by the Centres for Disease Control and Prevention.[22]

Our results demonstrated only 48.4% of the students correctly identified bone marrow as the most sensitive tissue of the body and 32.4% identified lymphocytes as the immune system component that is most sensitive to radiation.

Concerning radiation monitoring, the diagnostic radiology students performed at an average level with respect to their knowledge of the devices used in measuring radiation (e.g., the thermoluminescence dosimeter (TLD) and how they are worn. Their knowledge of personal monitoring devices was also very limited. However, their considerable knowledge regarding the reasons for wearing a dosimeter is encouraging. The study revealed that diagnostic radiology students have average knowledge ALARA principles (Fig. 11). This was also mentioned by the ICRP in 2007.[10]

With respect to radiation dose units and the dose limit for radiation workers, 63.2% (n = 115) of students displayed sufficient awareness. This dose limit was recommended to prevent workers from tissue reactions (deterministic effects) and to reduce the probability of cancer effect (stochastic effect). Only 60% of the students were aware that the annual permissible radiation to the public is 1.0 mSv/y.

Regarding their confidence in their knowledge about radiation, 26.4% of the respondents answered that their knowledge level was either average or poor. Nevertheless, 91.2% of the students had attended courses in radiation sciences. It is expected that attendance of students in radiation courses would increase their confidence in the knowledge regarding radiation protection; nevertheless, this appears not to be the case. This is consistent with findings from Faggioni et al[21], who reported a negative relationship between the confidence level and knowledge related to radiation. Faggioni et al[21] also observed that students who reported moderate confidence achieved lower scores on objective tests.[21] This observation is corroborated by the findings in the present study demonstrating that radiation awareness was GPA-dependent. Factors that increase the level of awareness among diagnostic radiology students according to this study include undergraduate level, which is also associated with age, and radiation courses attended.

As the number of nuclear medicine and radioactive related applications increases, more student training will be needed in the field of radiation protection. In fact, the Council of the European Union[23] directed its member states to encourage the introduction of courses on radiation protection in medical and dental schools. The reason is to train more professionals who are knowledgeable and well-trained to create a positive safety culture in radiation protection. These courses to be included in the basic curriculum include basic knowledge on radiation protection i.e., the health effects of radiation, risk-benefit analysis, justifications for exposures, doses required, and general protection procedures.[23–27]

CONCLUSION

The evaluation of the knowledge on radiation protection in diagnostic radiology students was completed successfully. The study revealed relationships between undergraduate level, GPA, and age with radiation protection awareness. It also found correlations between confidence level and knowledge related to radiation. Low confidence was associated with poor awareness of radiation protection. Finally, moderate confidence scores correlated with grade point average. Radiation protection culture is not quite enough for students who will use a radiation in their daily life work.

RECOMMENDATIONS

Courses of radiation protection should be introduced for all medical and applied medical sciences students. Such courses with on-the-job training should be sustainable even after graduation and during the working life in hospitals and various health service centres. These courses to be included in the basic curriculum include basic knowledge on radiation protection, i.e., the health effects of radiation, risk-benefit analysis, justifications for exposures, DRL, and general protection procedures. This is important in the case of Saudi Arabia where there is increasing use of radiological procedures. Having homegrown professionals who are well-informed about protection against both background and medical radiation is important.

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