

Research Paper

The Effectiveness of a Radiation Safety Training Program in Increasing the Radiation Safety Knowledge of Physicians: A Pilot Study



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ABSTRACT

Background Ionizing and non-ionizing radiation are widely used in the diagnosis and treatment of diseases. Considering the potential risks of radiation, radiation safety training courses are important for medical staff.

Objective The aim of this study was to investigate the effectiveness of one-day radiation safety training program in increasing the radiation safety knowledge of physicians.

Methods In this descriptive-analytical study, subjects were 12 physicians (6 general practitioners and 6 non-radiologist specialists) participated in the training program organized by Qazvin University of Medical Sciences in 2018. A researcher-made questionnaire was used for surveying physicians before and after the training. The mean and standard deviation of the scores were first calculated. Then, the pre- and post-test scores were compared using Wilcoxon signed-rank test, and the correlation of these scores with their age, gender, expertise area, and work experience was examined by Spearman's correlation test.

Findings The mean total scores of the physicians before and after training were 7.00 ± 2.56 (ranged 3-11) and 11.92 ± 2.31 (ranged 8-15) out of 18, respectively. The radiation safety knowledge of physicians significantly increased after training ($P < 0.001$). No significant relationship was found between their scores and their age, gender, expertise area and work experience.

Conclusion The radiation safety training program was effective in increasing the radiation safety knowledge of physicians and it can be used for a larger community of physicians.

Extended Abstract

1. Introduction

Ionizing and non-ionizing radiation are widely used in the diagnosis and treatment of diseases. There are many concerns about the negative biological effects of radiation on the living organ-

isms. Ionizing radiation including X-rays and gamma rays, has destructive effects on the body. These effects can be deterministic or stochastic. Deterministic effects of ionizing radiation, which occur at high doses of radiation with a certain threshold dose value, include cataracts, infertility, miscarriage, skin erythema and death. They may occur in imaging and therapeutic modalities that transmit a large amount of doses (energy absorbed per mass) to the patient,

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or during atomic explosions. In contrast, the threshold is not mentioned for the stochastic effects, and includes the range of energy used in conventional imaging. Stochastic effects of ionizing radiation include cancer and genetic disorders [1]. In case of exposure to non-ionizing radiation including ultraviolet, infrared, microwave and radiofrequency, adverse effects are: changes in blood, affected nervous systems and removal of antioxidants, abortion, premature birth and skin cancer [3-6].

Considering the potential risks of radiation used in imaging and treatment, and efforts in reducing the exposure of patients, some guidelines have been proposed by the international organizations for radiation protection, recommending the lowest exposure to radiation [8, 12]. Since physicians are responsible for imaging and treatment modalities, they need to be aware of the benefits and risks of these tests. Moreover, due to the relationship between parameters such as patient age, pregnancy, duration of radiation exposure, and severity of radiation damage, the physicians' lack of sufficient knowledge in this field can negatively affect the health of patients. Studies have shown that the physicians and medical students' knowledge of adverse effects of radiation used in clinical trials is very limited [14, 16, 17]. This indicates the importance of radiation safety training courses for medical staff. By evaluating the effectiveness of these training courses, the strengths and weaknesses of educational programs can be identified. Many researchers have studied the effectiveness of educational interventions in various fields, but there are few studies on the effectiveness of radiation safety training. Therefore, the aim of this study is to investigate the effectiveness of a 1-day radiation safety training program on increasing the radiation safety knowledge of physicians.

2. Materials and Methods

Participants were 12 physicians (6 general practitioners and 6 non-radiologist specialists) participated in a conference organized by Qazvin University of Medical Sciences in 2018. This one-day training program was presented in three sessions, each for 90 minutes, in the form of physician retraining program. The conference topics focused on the introduction of ionizing and non-ionizing radiation, their application in clinical trials and how to protect against them. A researcher-made questionnaire with 22 items was used for survey before and after the training. The questionnaire consisted of three sections; the first section assesses the demographic information of the participants. It was also a question whether they have ever participated in a radiation protection course or not.

In the second section, 4 questions rated on a Likert scale, measure the physician's information about radiation accidents and radiation exposure of a pregnant woman. The next section with 18 questions assesses the physicians' knowledge of ionizing and non-ionizing radiation (9 items) and the radiation safety (9 items). The number of correct answers was important. The Wilcoxon test was used to compare the pre-test and post-test data, and the Spearman correlation test to investigate the correlation of variables such as age, gender, work experience, and expertise area with the physicians' radiation knowledge.

3. Results

The mean age of the participants was 49.67 ± 9.80 years (ranged 30-70), and 16% of them were female. According to the results, only 8.3% of the participants had previously participated in a Radiation safety training course. Physicians performed well in informing patients about the harms of radiation, but they didn't know much about the law for pregnant women with ionizing radiation exposure. The overall percentage of subjects who answered correctly in the pre-test phase was 38.8% (ranged 8.3-91.7), while in the post-test phase, it was 66.21% (ranged 33.3-100), which shows their information had significantly increased after training. The range of total scores obtained by the physicians before and after the training were 3-11 (mean = 7.00 ± 2.56) and 8-15 (mean = 11.92 ± 2.31) out of 18, respectively.

The Wilcoxon test was used to statistically compare the pre-test and post-test results. Based on the Z test result which was significant at $P < 0.001$, it can be said that, statistically with 99% confidence, the radiation safety training course was effective. Results of Spearman correlation test showed no correlation of age, gender and work experience with the scores of participants ($P > 0.05$). The expertise area of the physicians (general or specialist) was effective in the pre-test and post-test scores, and specialists showed better scores, but this difference was not statistically significant ($P = 0.057$). Furthermore, it was found that the baseline information of the physicians about ionizing radiation was less than about non-ionizing radiation (40.25% vs. 66%). In analyzing the pre-test, post-test responses, it was observed that the relative changes in the post-test scores compared to the pre-test scores was more than 100% in 8 items. In 6 items related to the non-ionizing radiation, only 36.1% of the participants answered correctly at baseline, which doubled after training ($P < 0.001$). Therefore, in overall, it can be found out that the radiation safety training program was effective in increasing the radiation knowledge of the physicians.

4. Discussion

The pre-test knowledge and awareness about radiation safety was low in the physicians, which was consistent with other studies [18-20]. There are few studies on the effectiveness of radiation safety training. Yunus et al. [21] examined the effect of a radiation safety training program on increasing the awareness of 27 nurses in the nuclear medicine department. They observed a significant difference between pre-test and post-test responses which is in good agreement with our results. In another study in the United States [22], the effectiveness of a radiation safety training for oncology nurses was evaluated using a questionnaire. The results showed that the nurses' awareness relatively increased by 21.6%. In the present study, this relative was 70.06%, indicating that the training program was more effective in our study than in their study. In a study by George et al. [23], the effectiveness of a radiation protection training program was performed on interventional cardiologists, and the results showed that the radiation dose received by patients undergoing heart surgery and angiography was reduced by teaching simple and low-cost methods of dose reduction, without losing diagnostic information. All the above-mentioned studies emphasize the important role of radiation safety training in reducing the radiation exposure and its negative side effects.

5. Conclusion

We concluded that the radiation safety training program was effective in increasing the radiation safety awareness of physicians, and can be used for a larger community of physicians. It is recommended that the retraining programs be provided periodically by health care providers to update and increase the physicians' knowledge and awareness of the ionizing and non-ionizing radiation safety.

Ethical Considerations

Compliance with ethical guidelines

This study was approved by the Research Ethics Committee of Qazvin University of Medical Sciences (Code: IR.QUMS.REC.1397.348).

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Authors' contributions

Conceptualization, methodology and validation: Azam Janati Esfahani, Nematollah Gheibi, Reza Paydar; Data collection and analysis: Azam Janati Esfahani, Reihaneh Mehrabi, Masoome Aliakbari, Fateme Sadat Bagheri, Samane Heshmati, Elmira Mohammadi, Zahra Sadat Seyedi Gilavan, Mahla Gangi; Writing, editing & review, and Project administration: Azam Janati Esfahani.

Conflicts of interest

The authors declared no conflict of interest.