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Original Article

Assessment of Knowledge, Awareness, and Practice of Procedures for Protecting Operating Room Personnel From Ionizing Radiation: A Cross-sectional Investigation Using a Questionnaire

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Abstract

Background: This study aimed to look into operating room staff members' knowledge, attitudes, and practices related to radiation safety. We identified the relationship between their demographic variables and knowledge, attitudes, and practices.

Methods: A questionnaire was filled out by 210 employees who worked in the operating rooms of the public hospitals in Birjand between August 2022 and March 2023. Scores on knowledge, attitudes, behaviors, and demographic data were gathered, and the data were analyzed using SPSS, version 22.0. Statistical analyses were completed utilizing descriptive statistics tests, including the independent t-test, the one-way ANOVA with a significant level ($P<0.05$), and a Chi-square test.

Results: The results demonstrated no statistically significant difference ($P>0.05$) in the knowledge level of operating room personnel towards radiation protection for both genders, age, and type of employment, but work experience and academic degree represented significant differences ($P<0.05$).

Conclusion: The results revealed the operating room staff's ignorance of the dangers of radiation exposure. Most of them failed to take the appropriate safety measures to reduce their radiation exposure. The findings enable healthcare educators to design and create relevant educational programs that could support businesses in creating a safe work environment and teach healthcare personnel the value of taking personal responsibility for adhering to radiation protection regulations.

Keywords: Knowledge, Awareness, Practice, Operating room, Radiation protection

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Introduction

Using X-rays for diagnosis in medical centers and units such as radiology and surgery is widely growing. Despite useful applications and practical benefits, X-rays would cause serious, irreversible, and harmful effects on people who deal with radiation if recommended radiation protection protocols were neglected and not performed. Ionizing radiation such as X-rays raises the possibility of damaging DNA and cancer risk in nurses and others who are in contact with radiation during surgery in the operating room (1).

One of the imaging methods in the operating room is fluoroscopy or C-ARM device utilized in numerous surgical procedures, including angiography, neurosurgery, urology, and orthopedics (2). Radiation is generated and scattered in the operating room environment due to sequential exposure during surgery. It is necessary to observe specific radiation safety guidelines while working with operating room nurses. According to previous studies conducted in the field of radiation protection, the lack of knowledge of the personnel about the radiation and protection against the possible effects has irreparable consequences and can cause life and financial losses for the personnel, the patient, and the hospital (3-8). Many of the harmful effects of radiation can be minimized by increasing the level of knowledge, attitude, and practice of personnel (9).

Based on the literature review, few studies have been conducted to evaluate the knowledge, attitude, and practice of operating room personnel about radiation protection. Therefore, a comprehensive evaluation of all aspects of radiation protection in the operating room

personnel could be useful in planning to prevent and reduce the possible risks of ionizing radiation. This cross-sectional descriptive study was designed and implemented with the aim of investigating the knowledge, attitude, and practices of operating room personnel in Birjand in the field of radiation protection in terms of economic, health, human, and ethical considerations.

Methods

Personnel employed in operating rooms of hospitals affiliated with Birjand University of Medical Sciences (Imam Reza, Valiasr, and Razi) were the subjects of this study from August 2022 to March 2023. The size of the entire community in this research was extremely large. For this reason, using Cochran's formula, the minimum sample size was determined by considering the standard deviation of 0.05 and the error of 0.5. The implementation stages of the work began after obtaining permission from the Ethics Committee of our university. A questionnaire was used to measure knowledge, attitude, and practice. To evaluate the validity of the questionnaire, quantitative and qualitative contents were tested using content validity index and content validity ratio approaches. Its validity was confirmed by consulting with 6 experts in the fields of medical physics, radiation health, and operating rooms. To check the reliability, using the test-by-test method, the questionnaire was given to 10 employees in a preliminary study. This work was repeated two weeks later, and when Pearson's correlation coefficient was calculated, the final questionnaire version's overall reliability was found to be high ($r=0.81$, $P<0.001$). After checking the reliability and validity, the questionnaire was divided into the surgery departments of Imam Reza, Valiasr, and Razi Hospitals in Birjand. To comply with the principles of ethics, the questionnaire was designed anonymously. The questionnaire included 41 questions, the first part of which consisted of demographic information questions, including age, gender, level of education, employment status, and work experience, as well as a section on general radiation protection that discusses the as low as reasonably available (ALARA), film badges, dose limitations for occupational exposure, and the wearing of lead aprons during exams principle. There were 10, 16, and 14 questions pertaining to knowledge, attitude, and practice, respectively. After collecting the data, the necessary control actions were taken on the answers (including errors in completing the questionnaire or not recording the answers). The collected information was entered into and analyzed using SPSS software (version 22), with descriptive statistics tests, including an independent t-test, a one-way analysis of variance with a significant level ($P<0.05$), and a chi-square test.

Results

Overall, 210 people participated in answering the questionnaire questions, and five questionnaires were removed from the collected data due to incomplete answers. The results showed that about 64.9% of the participants were females. The majority of them had a bachelor's degree (84.4%) and work experience above 10 years (52.7%), and their employment status was unofficial (54.1%). Most of the participants (64.4%) were in the age group of 30-40 years. The demographic information for this study is provided in Table 1. The frequency distribution of operating room personnel in the studied hospitals is illustrated in Figure 1, and the highest frequency is related

Table 1. Characteristics of the Study Participants' Demographics

Variable	Subgroup	Frequency	%
Age	Under 30 years	52	25.4
	30-40 years	132	64.4
	Above 40 years	21	10.2
Gender	Male	72	35.1
	Female	133	64.9
Work experience	Under 10 years	97	47.3
	Above 10 years	108	52.7
Degree	Associate	11	5.4
	Bachelor	173	84.4
	Master's degree and physician	21	10.2
Type of employment	Official	94	45.9
	Unofficial	111	54.1

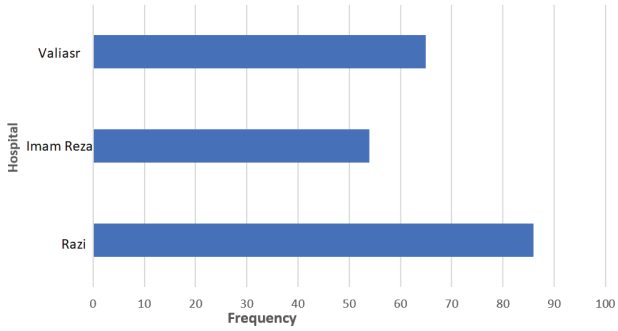

Figure 1. Frequency Distribution of Data in the Investigated Teaching Hospitals

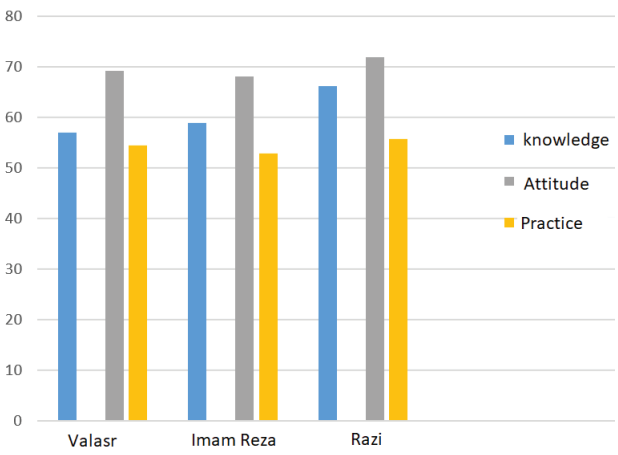

Figure 2. Comparison of Knowledge, Attitude, and Practice of Operating Room Personnel Regarding Compliance With the Principles of Radiation Protection in Hospitals

to Razi Hospital with 86 questionnaires.

Most participants (61.9%) had low awareness of the fundamentals of radiation protection, according to the results regarding their level of knowledge. The findings of this research concerning performance and attitude demonstrated that the majority of participants (58.5%) had an average performance related to compliance with the principles of radiation protection, but about 64.9% of the studied population had a weak attitude towards radiation protection laws (Table 2). The knowledge score of operating room personnel (mean ± standard deviation) at Razi hospital was calculated as 66 ± 14, which is the highest score among the studied hospitals. Figure 2 displays the average knowledge, attitude, and practice of operating room staff in different hospitals.

The level of knowledge of the operating room personnel regarding compliance with the principles of radiation safety is according to different parameters (Table 3), based on which there is a noteworthy correlation between the degree of knowledge of the operating room staff and the level of education ($P = 0.03$) and work experience ($P = 0.01$) observed separately. People who had a bachelor's degree in the operating room had a higher level of knowledge about the principles of radiation protection than people who had an associate's degree, and people who were employed in the last ten years had a high level of knowledge about radiation protection.

Table 4 presents the operating room staff's current performance status with regard to adhering to radiation protection principles. Based on the results, a significant relationship was observed between the performance of the operating room personnel and the level of education ($P = 0.04$), so that the senior experts working in the operating room with an average score of 14.4 performed better than the operating room associates with an average score of 5.72.

The attitude of the operating room personnel regarding compliance with radiation protection principles is provided in Table 5. The findings indicated that there was no statistically significant relationship between the

Table 2. Knowledge, Practice, and Attitude of Operating Room Staff Regarding Compliance With Radiation Safety

Variable	Level (%)	Frequency	%	Mean ± SD
Knowledge	Desirable (above 60)	35	17.1	8.7 ± 2.1
	Medium (40-60)	43	21	
	Weak (under 40)	127	61.9	
Practice	Desirable (above 60)	27	13.2	9.6 ± 2.6
	Medium (40-60)	120	58.5	
	Weak (under 40)	58	28.3	
Attitude	Desirable (above 60)	24	11.7	8.3 ± 2.1
	Medium (40-60)	48	23.4	
	Weak (under 40)	133	64.9	

Note. SD: Standard deviation.

Table 3. The Relationship Between Knowledge and Demographic Information

Variable	Subgroup	Mean Score (From 20)	Standard Deviation	*P* Value
Age	Under 30 years	6.75	±3.2	0.316
	30-40 years	11.2	±4.22	
	Above 40 years	10.9	±2.21	
Gender	Male	11.36	±3.04	0.214
	Female	8.96	±1.12	
Work experience	Under 10 years	6.63	±1.14	0.01*
	Above 10 years	11.07	±1.87	
Degree	Associate	5.32	±3.21	0.03*
	Bachelor	9.66	±2.23	
	Master degree and physician	16.4	±4.23	
Type of employment	Official	10.9	±2.1	0.18
	Unofficial	8.36	±2.04	

Note. * Significantly difference ($P < 0.05$).

Table 4. The Relationship Between Practice and Demographic Information

Variable	Subgroup	Mean Score (From 20)	Standard Deviation	*P* Value
Age	Under 30 years	6.43	±4.2	0.475
	30-40 years	10.2	±5.13	
	Above 40 years	12.9	±3.21	
Gender	Male	10.36	±4.17	0.304
	Female	6.96	±2.14	
Work experience	Under 10 years	5.71	±1.14	0.152
	Above 10 years	9.14	±1.87	
Degree	Associate	5.32	±2.21	0.04*
	Bachelor	3.26	±2.11	
	Master degree and physician	14.4	±3.10	
Type of employment	Official	12.9	±2.1	0.18
	Unofficial	6.36	±2.4	

Table 5. The Relationship Between Attitude and Demographic Information

Variable	Subgroup	Mean Score (From 20)	Standard Deviation	*P* Value
Age	Under 30 years	8.75	±1.20	0.316
	30-40 years	10.2	±2.02	
	Above than 40 years	9.9	±2.34	
Gender	Male	9.36	±3.12	0.214
	Female	10.96	±1.40	
Work experience	Under 10 years	8.36	±1.14	0.412
	Above 10 years	10.07	±1.87	
Degree	Associate	7.72	±4.14	0.512
	Bachelor	7.66	±2.23	
	Master degree and physician	15.4	±4.23	
Type of employment	Official	8.75	±1.20	0.18
	Unofficial	10.2	±2.02	

attitude of the research units regarding compliance with the principles of radiation protection and age, gender, work experience, education level, and type of employment.

Discussion

The purpose of this study was to ascertain the radiation protection practices, attitudes, and knowledge of operating room staff employed by Birjand University of Medical Sciences affiliated hospitals. The results obtained in order to achieve data regarding the level of awareness and knowledge of operating room staff about the risks of radiation and compliance with radiation protection revealed that the majority of personnel in surgical departments of hospitals have a weak knowledge score about radiation protection.

The evaluation of the knowledge of operating room personnel about radiation protection demonstrated that the average knowledge score was higher in men than in women. Although gender did not have a significant effect on knowledge, the results showed that the knowledge score of male personnel in radiation protection was better than that of females. In a similar study conducted by Keshtkar et al, it was found that age, gender, and university degree have no significant impact on the knowledge and practice of radiographers and operating room personnel (9). In their study, Rassin et al found a lack of knowledge about the dangers of radiation (10). Dehghani et al reported that there is no significant difference between gender and awareness of radiation risks (11).

In this study, it was found that personnel with more than 10 years of work experience perform better on the principles of radiation protection, and the knowledge score of personnel with less than 10 years of work experience was lower. The findings of the present study showed a significant difference between the personnel's work experience and knowledge. The results further represented that the practice of staff in complying with the principles of radiation protection improves with increased work experience. In a study conducted by Chien et al in China, it was concluded that practice level increases with work experience, but no significant relationship was observed between the time elapsed since the graduation of operating room personnel and their practice level (12). However, their findings are consistent with the findings of this research in terms of the absence of a significant relationship between gender and the level of knowledge, attitude, and practice.

The existing studies in the field of knowledge, attitude, and practice evaluation for radiation protection have been performed on the radiologist community working in radiology departments (13-18). In most of these studies, no significant relationship between the level of knowledge and performance and the gender, age, and type of employment of people has been reported, but the relationship between knowledge and practice and their work experience represented a significant difference. Söylemez et al also found a significant relationship between the level of knowledge, attitude, and practice and the individual's work experience in the field of radiation protection (19). In another study, a significant difference was observed between the knowledge of young personnel (with under 3 years of work experience) and older personnel. The results of this research confirmed that scientific and experimental information together had a great impact on the performance of personnel in complying with the principles of radiation safety. The operating room personnel sometimes neglect to observe the principles of radiation protection and do not observe even the simplest actions, including the use of a shield apron (20). Totally, it is necessary to continuously train new operating room personnel and transfer the experiences of personnel with high work experience to them. The distinction between these studies is that in our study, a comprehensive questionnaire was designed to precisely assess the operating room staff's capacity for radiation protection.

Conclusion

The results of this study demonstrated that staff members' awareness of radiation safety in operating rooms is inadequate. Their behavior and attitude are impacted accordingly. The radiation safety equipment is not used extremely often. We propose making radiation safety lectures mandatory for all staff. Applying and giving the ALARA principle the weight it deserves is essential. In this context, having comprehensive training and radiation safety courses can be beneficial.

Competing Interests

The authors say they have no competing interests.

Data Availability Statement

The data supporting the study's conclusions will be made available upon request from the corresponding author.

Ethical Approval

This study was approved by the Ethics Committee of Birjand University of Medical Sciences (Ethics No. IR.BUMS.REC.1401.214)

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