Correlation between Knowledge and Performance of Radiation Protection among Operating Room Nurses

Kyeong Weon Jeong[1], Hee Jung Jang[2†]

[1] *Kangdong Sacred Heart Hospital, Seoul, 05355, Korea*
[2] *Division of Nursing, Hallym University, Chuncheon 24252, Korea*
ysbslove@hanmail.net, hjjang@hallym.ac.kr

Abstract

This study investigated the correlation between knowledge and performance of radiation protection among operating room nurses. The research design was a descriptive survey. Data were collected by using a questionnaire from August 24 to September 7, 2015. The participants were 184 operating room nurses. The average score for radiation protection knowledge was 8.68(SD=2.65). The average score for the performance of radiation protection behaviors was 3.16(SD=0.67). There were no significant differences in knowledge of radiation protection according to general and occupational characteristics. However, there were significant differences in performance of radiation protection according to gender, age, education, and special health screening. Knowledge and performance of radiation protection had a significant positive correlation (r=.23, p<.01). This study concluded that educational programs are needed to improve performance of radiation protection among operating room nurses.

Keywords: Radiation protection, nurses, knowledge, performance

1 Introduction

Use of radiation has continuously increased along with advances in medicine and radiation technology, since the discovery of X-rays. In modern medicine, radiation is actively used in diagnosing and treating human diseases, and contributes to medical advances. In the process, exposure to radiation in healthcare workers increases daily, and opportunities for radiation exposure are likely to increase. Therefore, failure to reduce occupational exposure can potentially lead to cumulative radiation damage not only in radiology workers, but in all citizens, which can then lead to unfavorable outcomes in future generations [1]. Safety management is of interest to all who work with radiation. However, unnecessary exposure to radiation may result from carelessness due to lack of knowledge, overconfidence in working with radiation, and/or underestimation of potential dangers; in addition, systematic management that can detect such risks may be lacking [2]. Moreover, despite policies and regulations for radiation safety management, the frequency of radiation use in various fields is rapidly increasing, resulting in increased radiation exposure levels in all citizens [3].

In the operating room (OR), many procedures rely on use of radiation, and prolonged and continuous exposure can occur; most of the workers are females, and anxiety over occupational radiation exposure becomes much greater if they become pregnant. Therefore, because the risk of exposure to radiation is very high in doctors, nurses, and other OR workers, attention to radiation protection and safety management are needed. Radiologic imaging in the OR primarily utilizes a C-arm for fluoroscopy. When performing fluoroscopic imaging, the surgeon is at risk for increased exposure, compared to that in regular diagnostic use. Operations that use a C-arm create an environment that makes it

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†corresponding author e-mail: hjjang@hallym.ac.kr

difficult to avoid scattered rays, and radiologists need to reduce their exposure to unnecessary radiation by maintaining proper distance and shielding. Medical radiology has recently become more specialized; workers in interventional radiology, and angiography or the OR in particular, are at risk for prolonged, continuous exposure to radiation. However, the risk of such exposure has been shown to be very high due to lack of knowledge about radiation or awareness of protection [4].

Radiation protection refers to preventing non-stochastic effects and limiting the stochastic effects to an allowable level. Radiation protection involves appropriate use of radiation, and optimization based on the concept of using the lowest possible exposure dosage within reasonably achievable limits [5]. The International Commission on Radiological Protection has warned of the risks of occupational radiation exposure. No matter how low the dose, long-term exposure can increase the stochastic effects, such as cancer and leukemia, and can clearly affect skin lesions, alopecia, leukopenia, infertility, cataracts, and the fetus. Therefore, occupational exposure in radiologists, proper awareness of safety management of radiation emitting equipment, and radiation safety management in general are urgently needed for prevention of harmful effects of radiation and proper medical care.

Radiologists and other physicians with significant exposure to radiation wear meters to systematically evaluate and manage the level of exposure; however, radiation management in surgeons and nurses exposed during operations using a C-arm is not implemented properly, hence requiring action to address the issue.

Studies on radiation protection have involved investigation of protection-related knowledge, awareness, and behavior in radiology workers at medical institutions [1]; radiation protection awareness surveys of diagnostic radiologists [2]; radiation protection-related knowledge, attitudes, and behavior in dental workers [6]; and radiation protection behavior-related awareness and performance in OR nurses [7, 8]. However, there are few such studies.

Accordingly, the present study aimed to identify the correlation between knowledge and performance of radiation protection.

By identifying the relationship between the level of knowledge of radiation protection and performance of radiation protection behavior in OR nurses, who are directly and indirectly exposed to perioperative radiation, the present study further aimed to provide assistance in developing future programs to improve radiation safety management performance levels in medical workers.

1.1. Objectives

The main objective of the present study was to investigate the level of knowledge of radiation protection and performance of radiation protection behavior in OR nurses, with details as follows:

1) Identify the level of knowledge of radiation protection and performance of radiation protection behavior in OR nurses.
2) Analyze the differences in level of knowledge of radiation protection and performance of radiation protection behavior in OR nurses, according to their general and occupational characteristics.
3) Analyze the correlation between level of knowledge of radiation protection and performance of radiation protection behavior in OR nurses.

2. Methods

2.1 Research Design

The present study was designed as descriptive research to identify the level of knowledge of radiation protection and performance of radiation protection behavior in OR nurses.

2.2 Participants

1) Participants in the study comprised 200 OR nurses from 6 affiliated hospitals of H University Hospital, located in South Korea.

2) The sample included only OR nurses who work with radiation or are at risk for radiation exposure, and who understood the nature of the study and consented to participation. Those who did not consent to participation or were on sick leave or away at the time were excluded.

2.3 Data Collection

Data collection occurred between August 24 and September 7, 2015. After receiving approval from the K Hospital institutional review board (Approval No. 2015-07-016-002), 200 sets of questionnaires were mailed out, and all 200 sets were retrieved. Those with incomplete responses were excluded and a total of 184 sets were analyzed. The questionnaire was in a self-reporting format and the name of the participant on the questionnaire and consent form was removed to maintain privacy.

2.4 Measurements

The research tool used was a questionnaire on knowledge of radiation protection and performance of radiation protection behavior, which was developed by Kang[7]. The questionnaire was used after testing the validity of its content through consultation with a professor of nursing, an orthopedic physician, and a radiologist. In regards to the reliability of the tool, questions on knowledge related to radiation protection were processed as correct or incorrect answers, and the corresponding Kuder–Richardson Formula 20 value was .68, while performance for radiation protection behavior had a Cronbach alpha value of .88. At the time of development, Kang's [7] tool performance for radiation protection behavior had a Cronbach alpha value of .85.

2.5 Data Analysis

Data collected for the study were analyzed using SPSS WIN 21.0, and the details of the analytic techniques were as follows.

First, frequencies and percentages were derived for investigation of general and occupational characteristics of the participants.

Second, for investigation of current state of radiation protection, knowledge of radiation protection, performance on radiation protection behavior, and educational need for radiation protection in nurses, chi-square tests, frequency analysis, t-tests, and one-way analysis of variance (ANOVA) were performed.

Third, the relationship between radiation protection-related knowledge and performance of radiation protection behavior was analyzed using Pearson's correlation coefficient. Fourth, Duncan's post hoc test was performed.

3. Results

3.1 Knowledge of Radiation protection according to general and occupational characteristics

Results of investigation of radiation protection-related knowledge level according to general characteristics of nurses are shown in Table 1. Radiation protection-related

knowledge according to gender, age, marital status, clinical experience, education level, primary role, and average working hours did not show statistically significant differences.

Table 1. Knowledge of Radiation Protection According to General Characteristics

Characteristic		N	Mean	SD	t(F)	p
Gender	Male	13	7.92	3.15	-0.92	0.376
	Female	171	8.74	2.61		
Age (yrs)	≤25	47	8.85	2.31	1.14	0.334
	26～30	82	8.45	2.68		
	31～35	31	8.42	2.67		
	36≥	24	9.50	3.07		
Marital status	Married	49	8.80	2.89	0.32	0.747
	Unmarried	135	8.64	2.56		
Clinical experience	<3 years	60	8.68	2.33	1.24	0.298
	3~5 years	30	8.10	2.68		
	5~10 years	60	8.60	2.79		
	≥10 years	34	9.35	2.84		
Education level	Graduation from a 3-yr of college	80	8.34	2.97	-1.57	0.119
	Higher than graduation from a 4-yr university	104	8.95	2.35		
Primary role	Scrub & circulating nurse	141	8.77	2.58	0.77	0.443
	Anesthetic, recovery, assistant nurse	43	8.40	2.88		
Average working hours	< 9 hrs	82	9.06	2.40	1.77	0.079
	≥ 10 hrs	102	8.38	2.81		
Total		184	8.68	2.65		

As shown above, nurses did not show differences in radiation protection-related knowledge according to their general characteristics.

Results of investigation of radiation protection-related knowledge level according to occupational characteristics of nurses are shown in Table 2. Protection-related knowledge was shown to be high in the categories of number of exposures to radiation emitting equipment, anxiety over risk of radiation exposure, departmental transfer due to concern over radiation exposure, perceived effects on health due to radiation exposure, and special medical examination related to radiation exposure, but the differences were not significant. Therefore, it was determined that there were no differences in protection-related knowledge according to occupational characteristics of nurses.

Table 2. Knowledge of Radiation Protection According to Occupational Characteristics

Category		N	Mean	SD	t(F)	p
Number of exposures to radiation emitting equipment	1 type	89	8.66	2.67	-0.11	0.914
	≥2 types	95	8.71	2.64		
Anxiety over risk of radiation exposure	Anxious	160	8.71	2.65	0.36	0.718
	Not anxious	24	8.50	2.67		
Departmental transfer due to concern over radiation exposure	Yes	27	8.07	2.62	-1.31	0.198
	No	157	8.79	2.65		
Perceived effects on health due to radiation exposure	Affected	120	8.86	2.71	1.24	0.214
	Unaffected	64	8.36	2.51		
Special medical examination related to radiation exposure	Receiving	89	8.79	2.71	0.50	0.616
	Not receiving	95	8.59	2.60		
Total		184	8.68	2.65		

3.2 Performance of Radiation Protection According to General and Occupational Characteristics

Results of investigation of performance of radiation protection behavior according to general characteristics of nurses are shown in Table 3.

Male nurses showed higher performance of radiation protection behavior than female nurses (t=2.17, p<.05); higher performance of radiation protection behavior was also shown in older nurses (F=2.93, p<.05), nurses with ≥10 years in total clinical experience (F=8.08, p<.001), and nurses with education level higher than graduation from a 4-year university (t=-2.40, p<.05). The differences were statistically significant.

However, marital status, primary role in the OR, and average daily working hours did not show statistically significant differences in performance of radiation protection behavior.

Table 3. Performance of Radiation Protection According to General Characteristics

Category		N	Mean	SD	t(F)	p	Duncan
Gender	Male	13	3.54	0.65	2.17[*]	0.048	
	Female	171	3.13	0.66			
Age	≤25 years	47	3.04	0.58	2.93[*]	0.035	A
	26~30 years	82	3.08	0.63			A
	31~35 years	31	3.34	0.74			AB
	≥36 years	24	3.43	0.77			B
Marital	Married	49	3.24	0.84	1.01	0.314	

status	Single	135	3.13	0.59			
Total clinical experi-ence	<3 years	60	3.18	0.60	8.08***	0.000	B A AB C
	3~5 years	30	2.88	0.67			
	5~10 years	60	3.04	0.60			
	≥10 years	34	3.60	0.71			
Education level	Graduation from a 3-yr college	80	3.03	0.64	-2.40*	0.018	
	Higher than graduation from a 4-yr university	104	3.26	0.67			
Primary role in OR	Scrub & circu-lating nurse	141	3.15	0.67	-0.29	0.769	
	Anesthetic, recovery, assis-tant nurse	43	3.19	0.66			
Average daily working time	< 9 hrs	82	3.21	0.70	0.83	0.408	
	≥10 hrs	102	3.12	0.64			
Total		184	3.16	0.67			

* $p<.05$, *** $p<.001$

Results of investigation of performance of radiation protection behavior according to occupational characteristics of nurses are shown in Table 4.

Table 4. Performance of Radiation Protection According to Occupational Characteristics

Category		N	Mean	SD	t(F)	p
Number of exposures to radiation emit-ting equipment	1 type	89	3.12	0.71	-0.90	0.372
	≥2 types	95	3.20	0.62		
Anxiety over risk of radiation exposure	Anxious	160	3.13	0.66	-1.61	0.118
	Not anxious	24	3.37	0.67		
Departmental transfer due to concern over radiation expo-sure	Yes	27	3.04	0.85	-0.99	0.322
	No	157	3.18	0.63		
Perceived effects on health due to radiation expo-sure	Affected	120	3.11	0.68	-1.56	0.121
	Unaffected	64	3.26	0.64		
Special medical examination related to radia-tion exposure	Receiving	89	3.40	0.59	4.94***	0.000
	Not receiv-ing	95	2.94	0.67		
Total		184	3.16	0.67		

** $p<.01$, *** $p<.001$

Performance of radiation protection behavior according to number of exposures to radiation emitting equipment, anxiety over risk of radiation exposure, departmental transfer due to concern over radiation exposure, and perceived effects on health due to radiation exposure did not show significant differences.

Nurses who received special medical examinations related to radiation exposure (t=-4.94, p<.001) showed higher performance of radiation protection behavior, with the differences being statistically significant.

3.3 Correlation between Knowledge and Performance of Radiation Protection

As shown in Table 5, knowledge of radiation protection showed a statistically significant positive correlation with performance of radiation protection behavior (r=.229, p<.01). Therefore, nurses with higher knowledge of radiation protection showed higher performance of radiation protection behavior.

Table 5. Correlation between Knowledge and Performance of Radiation Protection

Category	Performance of radiation protection behavior
Knowledge of radiation protection	0.229[**] (.002)

** p<.01

4. Discussion

The present study aimed to provide assistance for future development of programs for enhancement of radiation safety management practices in medical workers by investigating knowledge of radiation protection and performance of radiation protection behavior in nurses who work in the OR.

Nurses who perceived themselves as being anxious over risk of radiation exposure accounted for 87.0%, while those who were not anxious accounted for 13%. If awareness of radiation safety can be improved through education, then anxiety over uncertainties about exposure can be reduced.

Radiation protection-related knowledge level showed a mean score of 8.68 out of 16 possible points, demonstrating a moderate level. The nurses most often stated that "the amount of time exposed to radiation must be minimized."

Performance of radiation protection behavior showed a mean score of 3.16 out of 5 possible points, which corresponds to 63.2 points when converted to a 100-point scale, which was a moderate level. Although this score was higher than reported by by Kang & Lee [7], Lee [9], it was much lower than the radiation protection attitude score of 90.25 points reported by Yun [10].

Knowledge of radiation protection showed a statistically significant positive correlation with performance of radiation protection behavior (r=.229, p<.01), which was consistent with the results from the study by Kang & Lee [7], Lee [9], Kim [11], and Yoon & Yoon[12]. Therefore, nurses with greater knowledge of radiation protection showed higher performance of radiation protection behavior.

Nurses who did not receive a special medical examination for radiation exposure accounted for 37.5%, followed in order by "currently receiving," with 32.1%, "only those who qualify receive it," with 16.3%, and "I don't know," with 14.1%. Surgeons and nurs-

es in the OR, who are often exposed to mobile X-ray emitting equipment (C-arm), are not classified as radiology-related workers, and are not being managed properly.

According to the 2014 Radiation Safety Management Status, a report published by the Board of Audit and Inspection of Korea on radiology workers in 16 national hospitals, exposure management was being conducted on a total of 2,413 radiology workers; however, 1,374 surgeons and nurses exposed to radiation from C-arm use were not included as radiology workers, and concerns about their exposure safety management were pointed out. Therefore, improved radiation safety education and further studies can lead to improved levels of safety management in radiology workers. For the further research, it needs to develop a education model to discover evidence based knowledge of radiation protection among nurses as like developing a hybrid decision support model to take care of the elderly with depression [13].

5. Conclusion

The present study was conducted to identify knowledge of radiation protection and performance of radiation protection behavior in OR nurses. Level of knowledge according to general and occupational characteristics did not show significant differences; however, significant differences in performance were seen in nurses who were male, older, had higher education level, and received special medical examinations. Moreover, a statistically significant positive correlation was seen between knowledge and performance of radiation protection. Therefore, in order to enhance performance of radiation protection behavior, knowledge of radiation protection needs to be enhanced. Education on radiation protection is needed above all. Implementation of radiation protection-related education is suggested for continuing or general education of nurses. Future studies should investigate knowledge of radiation protection and performance of radiation protection behavior in non-OR nurses, such as those working in the general ward or specialized departments, and educational needs should also be studied to develop customized radiation protection education programs.

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Authors

Kyeong Weon Jeong, is a unit manager in Kangdong Sacred Heart Hospital. She received a master's degree from public health graduate school of Hallym University in 2011. Her research interest is perioperative nursing care.

Hee Jung Jang, is a professor in Division of Nursing, Hallym University since 1997. She received B.S, M.S, and Ph. D of Nursing in Ewha womans University. Her research interests are Middle aged health, medical- surgical Nursing including perioperative nursing care.