

Regular Article

Changes in Nurses' Impression of Radiation after Attending Educational Seminars on Radiation

Mayumi Urushizaka^{1*}, Yuka Noto², Noriko Ogura³, Maiko Kitajima¹,
Yoshiko Nishizawa¹, Tomoko Ichinohe¹ and Hideaki Yamabe¹

¹Department of Health Promotion, Division of Health Sciences, Hiroasaki University Graduate School of Health Sciences,
66-1 Hon-cho, Hiroasaki, Aomori 036-8564, Japan

²Department of Disability and Health, Division of Health Sciences, Hiroasaki University Graduate School of Health Sciences,

³Department of Development and Aging, Division of Health Sciences, Hiroasaki University Graduate School of Health Sciences,

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The aims of this study were to investigate the changes in nurses' impressions of radiation after they attended seminars about radiation, to discuss the educational effect and the impact of seminars on the impression of radiation and to obtain suggestions for the content of radiological education. Subjects included 27 nurses who had attended the seminars on radiation held in 2011 and 2012. To assess each subject's background parameters and pre- and post-seminar impression of radiation, we distributed questionnaires before and after the seminar. A scale to rate their impressions of radiation consisted of 17 items classified into the following 3 factors: affectivity, usefulness, and certainty. The number of valid responses for the questionnaire was 19 (70.4%). No significant differences between the seminar participants in 2011 and those in 2012 were observed for age, nursing experience, frequency of attending seminars about radiation, familiarity with radiation, and work experience in working at a radiology department. In addition, when we compared the subjects' impressions of radiation before and after they attended the seminars, the impression scores did not show any significant differences. We compared the impressions of radiation of 19 nurses who participated in the seminars in 2011 and 2012 before and after the seminars. The post-seminar scores were significantly higher than the pre-seminar scores for 9 items of affectivity. Both usefulness and certainty showed no significant differences between before and after seminars. Even if the subjects understand that radiation is useful when it is used in the medical field safely and correctly, they do not always accept it. We suggest that radiological education and seminars may increase nurses' understanding with regard to radiation and encourage nurses to have positive impressions related to affectivity

Key words: impression of radiation, radiation emergency medicine, radiation impression scale, seminar on radiation, nurse training

1. Introduction

The Fukushima Daiichi Nuclear Power Plant accident in the wake of the Great East Japan Earthquake in 2011 increased awareness toward the significance in the need for the reinforcement of the radiation

*Mayumi Urushizaka: Hiroasaki University Graduate School of Health Sciences,
66-1 Honcho, Hiroasaki, Aomori 036-8564, Japan
E-mail: urushima@cc.hirosaki-u.ac.jp

emergency medicine system and the role of healthcare professionals¹⁻⁴). In particular, nurses are required to have specialized knowledge and skills of radiation emergency medicine because they take care of radiation accident victims for a long time immediately after the radiation accident. Due to the rareness of radiation emergency medicine events, however, nurses have insufficient hands-on training and experience in this field⁵). Nurses' lack of knowledge about radiation and radiation emergency medicine has been pointed out as a matter of concern, which indicates the necessity of providing systematic and continuous education of radiation and radiation emergency medicine⁶⁻¹⁰). However, few nursing schools or hospitals adopt radiation emergency medicine and nursing care of radiation accident victims in their curriculum of basic nursing education or continues education in the clinical settings.

In general, people of Japan, the only country attacked by atomic bombings, tend to be hypersensitive to and feel negative about radiation. Nurses are no exception to this; previous studies revealed that they had anxiety about and negative emotions toward radiation and radiation exposure¹¹⁻¹³). It has been pointed out that negative emotions toward radiation and radiation exposure, in addition to little knowledge of radiation and radiation emergency medicine, compromise the quality of nursing services. Research on nursing students' affectivities to radiation include a study of words related to radiation to characterize the image of radiation¹⁴) and a risk cognition study that suggested a necessity of rightly determining risks and benefits of radiation through appropriate education¹⁵).

From the concept of risk communication, we can understand the perspective of risk and benefit. It is said that if radiation is understood properly, there is no need to overestimate risk. However, only a few researches have been conducted so far, to qualitatively and quantitatively study the impression of radiation itself encompassing the affective component and not focusing only on risks and benefits. We focused on the emotional aspect of a person's impression towards radiation, because it is thought that a person's attitude towards radiation emergency medicine could be influenced by their emotional state.

Attitude is defined as a general, continuous, negative/positive emotion toward an object. Attitude contains 3 components: a behavioral component relating to the predisposition to act in a certain manner to an object such as access/avoidance, a cognitive component relating to thoughts and beliefs about the object, and an affective component relating to emotions such as comfort/discomfort. These components interact with one another, thereby collectively affecting attitude¹⁶). Negative emotions such as anxiety and fear may therefore influence behavioral and/or cognitive components.

Based on close relationships between attitude and action, nursing education needs to address not only knowledge and skills related to radiation emergency medicine but also emotions toward radiation and radiation emergency medicine so that nurses can, without insecure feelings, have contact with patients in need of radiation emergency medicine and take care of them with confidence.

We surveyed the nurses' impression of radiation and whether there was a change in their impression after they attended educational seminars about radiation. This was done by using a scale to rate their impression of radiation for evaluating the effect of seminars and the research content.

2. Methods

1. Subjects

Subjects included 27 nurses who had attended a seminar about radiation held in 2011 or 2012.

2. Investigative method

To assess each subject's background parameters and their pre- and post-seminar impression of radiation, we distributed questionnaires before and after the seminar about radiation. Age, gender, nursing experience, experience in working at a radiology department, experience in attending seminars on radiation, and familiarity with radiation were investigated. As for the impression of radiation, we used the radiation impression scale created by Noto *et al*¹⁷).

3. Radiation impression scale

In conducting the education of radiation emergency medicine, a radiation impression scale was created to measure quality and quantity of the impression of radiation as a factor affecting attitudes towards radiation emergency medicine. In creating the radiation impression scale, the semantic differential technique (SD method) was used for measuring the impression of radiation. The SD method is a theoretical method created by Osgood *et al*¹⁸). It is a valid tool to measure and describe the emotional state perceived by a person. This method clarifies the structure of the subjects' impression.

At first, in creating the scale, we selected pairs of opposite adjectives concerning radiation. We conducted a survey of first, second, and third year undergraduate nursing students. They were required to write three adjectives each concerning the 10 stimulus words related to radiation. Then, we selected 50 pairs of adjectives from the most frequent adjectives which also covered a number of concepts, and from previous research¹⁹). By using these pairs of adjectives, we conducted research on nurses' and nursing students' impression. The scale was made on seven steps (very, fairly, little, neither, little, fairly, very)

	←						→	
	very	fairly	little	neither	little	fairly	very	
Strong								Weak
Worrying								Not worrying
Destructive								Creative
Uncomfortable								Comfortable
Convenient								Inconvenient
Dangerous								Safe
Fearful								Not fearful
Necessary								Unnecessary
Effective								Ineffective
Usable								Unusable
Distressing								Not distressing
Dark								Light
Useful								Useless
Harmful								Harmless
Controllable								Uncontrollable
Good								Bad
Reliable								Unreliable

Fig. 1. The radiation impression scale: Figure 1. shows the radiation impression scale. Subjects mark the column of the closest adjective of their impression of radiation.

Table 1. Factors and items of the radiation impression scale

Factors	Items
"Affectivity"	Destructive - Creative Distressing - Notdistressing Worrying - Notworrying Fearful - Notfearful Harmful - Harmless Dangerous - Safe Uncomfortable - Comfortable Dark - Light Strong - Weak
"Usefulness"	Ineffective - Effective Unnecessary - Necessary Useless - Useful Unusable - Usable Inconvenient - Convenient
"Certainty"	Unreliable - Reliable Bad - Good Uncontrollable - Controllable

Table 2. Program overview of radiation seminars for nurses

Day	Title of the lecture	Overview	Time
First day	"Fundamentals of radiation"	To learn about the basic knowledge of radiation units and its nature, and also radiation found in our surroundings.	60 minutes
	"Fundamentals of the biological effects of radiation"	To learn basic knowledge about the biological effects of radiation.	60 minutes
	"Fundamentals of radiation protection"	To learn the knowledge of basic radiation protection and radiation regulations.	60 minutes
	"Biological effects of radiation on humans"	To learn about the effects of radiation on the human body by external exposure, internal exposure.	90 minutes
	"Principles of Radiation Emergency Medicine"	To learn about the overview and the principle of Radiation Emergency Medicine.	60 minutes
Second day	"Nuclear power plant accident and radiation accident"	To learn about the actual outline of a nuclear power plant accident and actual radiation accident cases.	90 minutes
	"Mental health care in a nuclear power plant accident"	To learn about the impact on the mind in the event of an accident and mental health care.	60 minutes
	"The amount of radiation"	To practice being able to have an image of the amounts of radiation per unit.	60 minutes
	"Working with a survey meter"	To practice with and measure with a survey meter in the treatment of patients.	90 minutes
Third day	"Decontamination"	To practice the method of treatment of wounds that are contaminated with radioactive material.	70 minutes
	"Attach and detach of a protective suit"	To practice the method of attach and detach of a protective suit when accepting patients that were exposed.	20 minutes
	"Practice of the admission of patients associated with contamination and the exposure"	To practice the sequence of steps needed in admitting patients with external exposure, starting from the arrival by ambulance treatment at the ER and ends at the transfer to the general ward.	20 minutes

for each pair of adjectives concerning the impression of radiation. Scoring was based on positive adjectives as a high score (Fig. 1). As a result of factor analysis, the scale was composed of 17 items which included the following 3 subscales "affectivity," "usefulness," and "certainty" (Table 1). A correlation coefficient between each

subscales indicated 0.21–0.52, the alpha confidence coefficient of the entire scale was 0.68, and each subscale was in the range of 0.78–0.89. From the above results, we can consider reliability and validity was acquired through this measurement tool and was used in this survey.

Table 3. Characteristics of the subject

characteristics	total n=27	2011 n=15	2012 n=12	*p
Subjects				
male	8(29.6)	1(6.7)	7(58.3)	
female	19(70.4)	14(93.3)	5(41.7)	
Age	43.22 ± 8.23	43.47 ± 7.50	42.92 ± 9.40	n.s.
Nursing experience (years)	18.56 ± 8.95	18.07 ± 8.94	19.17 ± 9.31	n.s.
Experience in working at a radiology department				
yes	12(44.5)	6(40.1)	6(50.1)	
no	15(55.6)	9(60.0)	6(50.0)	n.s.
Experience in attending seminars on radiation				
yes	15(55.7)	5(33.4)	10(83.3)	
no	12(44.4)	10(66.7)	2(16.7)	n.s.
Do you feel familiarity with radiation?				
familiar	21(77.8)	10(66.7)	11(91.7)	
not familiar	2(7.4)	1(6.7)	1(8.3)	n.s.
neither	4(14.8)	4(26.7)	0(0)	

Values are the numbers of responses and values in brackets are percentages or values of mean and standard deviation.

Statistical analysis was used by the two sample t-test or Fisher's exact test.

Statistical significance was defined as $P < 0.05$. N.S. means not significant.

4. Overview of seminars on radiation

The seminars on radiation for nurses were held by the Hirosaki University Graduate School of Health Sciences in Hirosaki in 2011 and 2012. The seminars were conducted for 3 days.

The seminars held in 2011 and 2012 were not entirely the same but the main contents of the training were similar. The main training program is shown in Table 2.

5. Analysis

All data were analyzed using SPSS version 11.5 software. We analyzed the results by performing the two-sample t-test, paired t-test, or Fisher's exact test. A P value of less than 0.05 was considered significant.

6. Ethical considerations

This study was approved by the Ethics Committee of Hirosaki University Graduate School of Medicine. We explained the aim of this study as well as the anonymous and voluntary nature of their participation to the subjects. We explained that we will only use their questionnaire answers for this research and by their posting of the questionnaire, we received their consent for participating in this research.

3. Results

1. Subjects

Subjects were 8 males and 19 females of 27 subjects who attended radiation seminars. The mean age was 43.22 ± 8.23 years and the mean years of nursing experience was 18.56 ± 8.95 years. Twelve subjects had experience in working at a radiology department and fifteen subjects

had experience in attending seminars on radiation. For the question "Do you feel familiarity with radiation?", 21 subjects (77.8%) felt familiar, 1 did not (7.4%), and 4 felt neither (14.8%). Subject details are shown in Table 3.

2. Characteristics of subjects in 2011 compared with those in 2012

The characteristics of subjects in 2011 compared with those in 2012 had no significant difference on age, nursing experience, frequency of attending seminars on radiation, working experience at a radiology department, familiarity with radiation (Table 3). In addition, the results of radiation impression scores in 2011 and 2012 were compared before and after the seminar. At that time, a total of 19 valid questionnaire responses (70.4%) were obtained out of 27 responses. As a result, the impression scores collected during this period did not exhibit any significant differences between the 2 groups (Figure 2 and Figure 3). We determined that the group of participants in 2011 and that in 2012 were sufficiently similar to be combined for analysis, because there were no significant differences between the subject's background parameters and pre- and post-seminar impression of radiation in 2011 and 2012.

3. Change of radiation impression by radiation seminar

We compared the subjects' impression of radiation before and after the seminars with combined data of 2011 and 2012 (Figure 4). For affectivity, the post-seminar scores were significantly higher than the pre-seminar scores for all 9 items (worrying versus not worrying, dangerous versus safe, uncomfortable versus comfortable, dark versus light, $*P < 0.05$; destructive

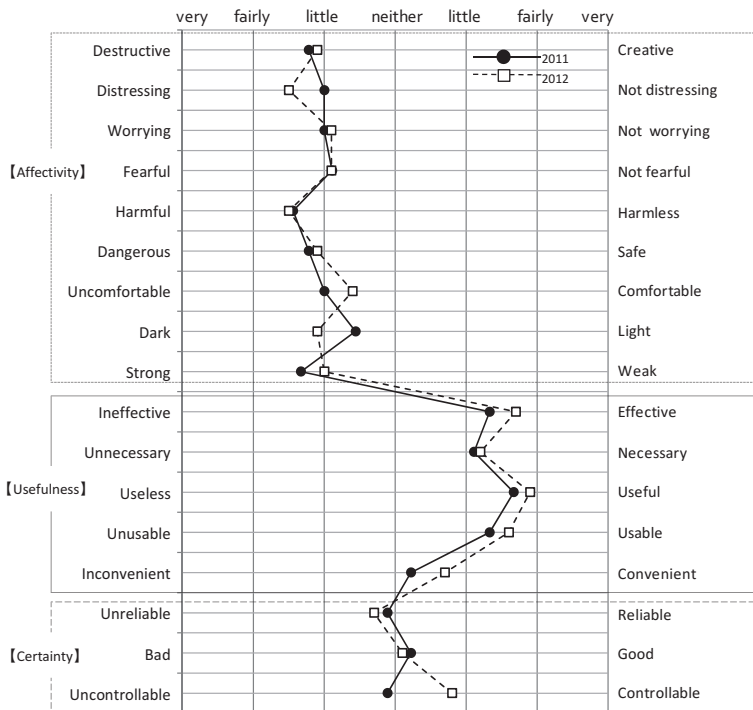


Fig. 2. Comparison between 2011 and 2012 at pre-seminar scores of the radiation impression scale: Statistical analysis was used by the two sample t-test. Statistical significance was defined as $P < 0.05$.

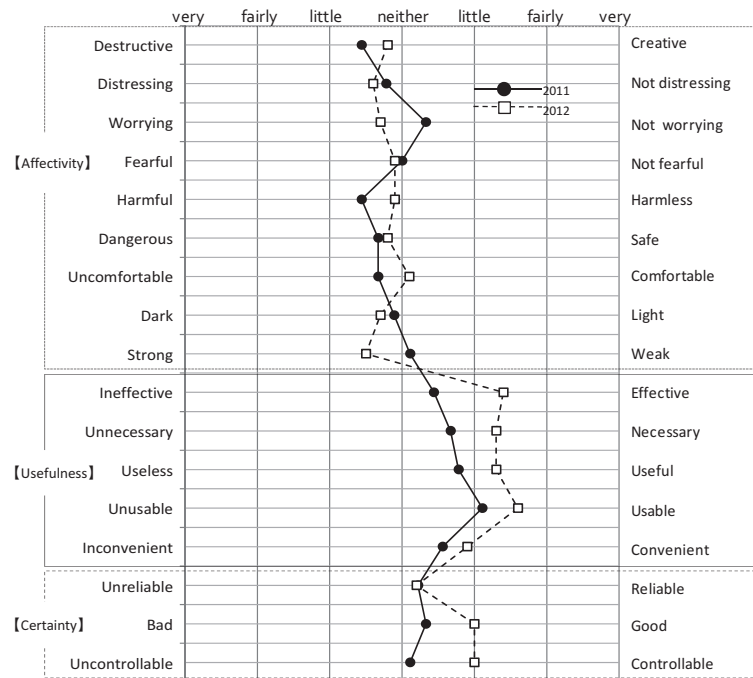


Fig. 3. Comparison between 2011 and 2012 at post-seminar scores of the radiation impression scale: Statistical analysis was used by the two sample t-test. Statistical significance was defined as $P < 0.05$.

versus creative, distressing versus not distressing, fearful versus not fearful, harmful versus harmless, strong versus weak, $**P < 0.01$). In affectivity, most pre-seminar responses were “little” on the negative side, but post-seminar responses came close to “neither”.

In terms of usefulness, there were no significant differences in all 5 items (ineffective versus effective, unnecessary versus necessary, unusable versus usable, inconvenient versus convenient) before and after seminars. Most scores of both before and after seminars

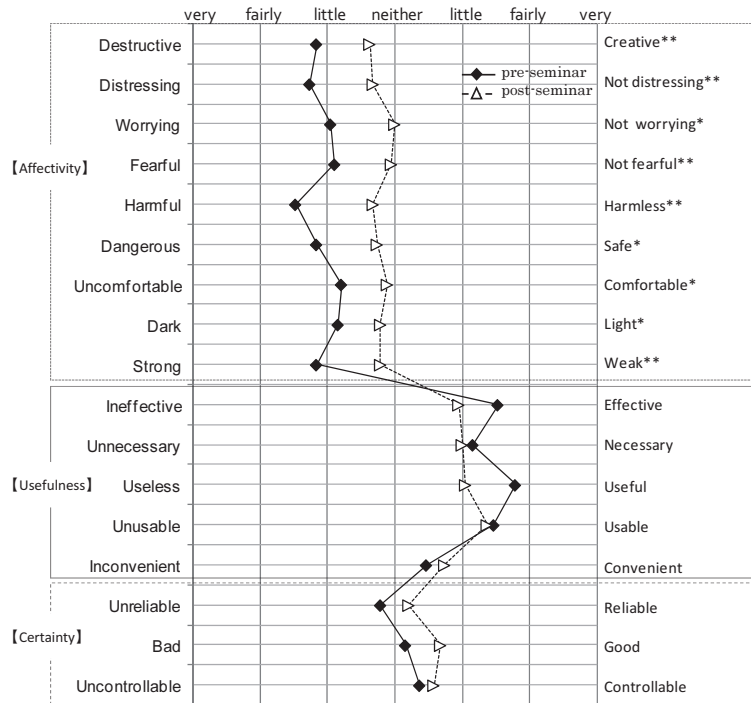


Fig. 4. Comparison of the radiation impression scale pre and post seminar combined 2011 and 2012: Statistical analysis was used by paired t-test. Statistical significance was defined as $P < 0.05$. * $P < 0.05$, ** $P < 0.01$

were “neither” or toward the positive side adjective of “fairly”.

In terms of certainty, there were no significant differences in all 3 items (unreliable versus reliable, bad versus good, uncontrollable versus controllable) before and after the seminars. Scores of both before and after the seminars were between the positive side adjective of “little” to the negative side adjective of “little.”

4. Discussion

Aomori Prefecture, located in the northern part of the main island of Honshu, has numerous nuclear-power-related facilities, and because of this, enrichment of human resources engaged in radiation emergency medicine is an important issue. Hirosaki University, located in Aomori Prefecture, initiated the cultivation of talent for radiation emergency medicine in 2007 and an educational program for nurses and radiation technologists in radiation emergency medicine in 2010. Nurses’ lack of knowledge of radiation and radiation emergency medicine is an issue to be addressed in the program; a vague sense of nurses’ anxiety and fear toward radiation and radiation emergency medicine is also an issue to be addressed¹¹⁻¹³. Some researchers attribute negative emotions toward radiation to inadequate basic radiology education in Japan.

Some also point out that in elementary education,

pupils initially learn about radiation associated with the atomic bombings in Hiroshima and Nagasaki and A-bomb victims, mainly in social studies and moral education classes and naturally have a fearful image of radiation^{20, 21}. Radiation education in the field of natural science is primarily provided in the subject of physics at high school. However, because physics is taught as an optional subject at some schools, not everyone takes this class and also the contents of radiation is not sufficient. The current radiation education leaves much to be desired²¹⁻²⁴. In summary, most Japanese people seem to have a not-so-correct and insufficient knowledge about radiation and nuclear power and feel negative (e.g., fear) about radiation.

The radiation impression scale used in the present survey was a tool to measure qualitatively and quantitatively the impression (affectivity, usefulness, and certainty) of radiation itself. Before educational seminars, nurses’ response to the affectivity-related impression of radiation was “little” on the negative side adjective, indicating that they had a negative impression of radiation. After seminars, however, their response to all 9 affectivity-related questions changed from a negative impression to an impression closer to “neither.” Ohta¹⁴ says that hands-on practice in addition to lecture-style education is instrumental in improving a negative impression and gaining appropriate knowledge. Ohta²⁵ also points out that learning of radiation protection

facilitates the acquisition of attitude that enables nurses to provide nursing services without having unnecessary anxiety. In seminars, nurses gained basic knowledge of radiation and learned about risks of radiation (including effects on the human body) as well as methods of radiation protection. More specifically, nurses actually used a survey meter to measure radiation, tried on protective clothing, and learned nursing skills based on the 3 principles of radiation protection. Through learning experience, nurses acquired the knowledge and skills for the appropriate handling of (protection against) radiation, thereby eliminating unnecessary fear or anxiety toward radiation and improving their affectivity-related impression.

The usefulness- and certainty-related impression of radiation did not change before and after seminars. Radiation is used daily for examinations and treatment in clinical practice. More than 70% of nurses surveyed, responded that radiation felt familiar. This suggests that nurses, who routinely witness diagnoses based on radiological examinations and tumor regression or disappearance by radiotherapy, consider radiation as an effective tool in medical care. This may explain why their responses to the usefulness-related questions were rather on the positive side adjectives. In clinical practice, radiation is controlled safely and used by specialists. All possible safety measures are required for radiation application, including meticulous attention paid to prevent occupational radiation exposure and research study conducted about necessity of in-house radiological education. Through educational efforts made in the clinical settings, nurses appear to understand that radiation can be safe or dangerous depending on how it is controlled or applied. This may be the reason why certainty-related nurses' impression of radiation turned out to be inconclusive, showing neither negative nor positive tendencies.

The results of the survey study suggest that an educational approach involving hands-on training provides nurses with opportunities to gain the knowledge and skills of radiation protection and thus acquire appropriate expertise without having unnecessary negative emotions toward radiation. Given the study limitation of a small sample size ($n = 19$), however, changes in nurses' impression of radiation after they attend seminars and the content of the seminars need further investigation.

5. Conclusion

The nurses developed a "neither" impression toward radiation through these seminars, reducing an excessive impression of negative adjectives with regard to radiation. This was possibly caused by the following: increased basic knowledge of radiation, gaining the ability to judge

the risk of radiation exposure through learning the risks of radiation, and practicing to reduce risk of radiation using the three principles of protection against radiation.

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