



Effectiveness of a Basic Education Program on Radiation-Related Health Concerns for Nurses of Public Health and School Health in Japan

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Abstract

Background: After the Japanese nuclear power plant disaster in 2011, many residents became concerned about health effects of radiation. We aimed to evaluate the effectiveness of a training program for public health and school health nurses to improve their skills and expertise for better support to residents and students.

Methods: This was a quasi-experimental study using single-group and pre-post comparison in 2016 in Hiroshima, Kagoshima and Hyogo prefectures of Japan. The educational evaluation was conducted through each sub-item of Bloom's attainment goals. The evaluation of effectiveness was surveyed among 61 participants before and immediately after the workshop, and at 1-week and 1-month later. The analysis compared initial scores obtained before the workshop with subsequent responses. Where a significant difference was observed among three-group or more in the Friedman test, the Wilcoxon signed-rank test was used for two-group comparisons across the time periods. The significance level was set at $P < 0.05$.

Results: Data of 54 participants were analyzed. The knowledge based on Bloom's taxonomy was increased as the number of correct responses increased significantly after the workshop ($P < 0.001$). Cognitive domain was significantly increased after 1-week and 1-month ($P < 0.001$). Affective and psychomotor performances were also increased compared with prior. Participants increased vocabulary related to radiation and developed confidence in radiation disaster recovery measures.

Conclusion: Each sub-item of the Bloom's attainment (goal, cognitive, affective, psychomotor) has almost been reached and the effect was maintained even after 1-month. By learning concrete words, they could explain accurately. Participants improved their confidence after receiving the training to respond and clarify the radiation anxieties to the community people.

Keywords: Nuclear disaster; Health anxiety; Nurses

Introduction

Nuclear power plant disaster increases the level of anxiety globally (1). Since 1953, peaceful use of nuclear energy has been pursued (2), recently there have been 438 nuclear power plants in operation to meet rising energy demands around the world (3). More than 440 radiation accidents have

been occurred during the last seven decades related to radiation devices and minor effects of radioisotopes (4). In the past, five major nuclear accidents have occurred including Fukushima Daiichi accident, Japan.

The effects of these nuclear accidents on indi-

viduals and communities are diverse and ranging from short-term to long-term health effects including major psychological effects. The incidence of cancer might increase at the later stage of life due to inadequate protection from radiation exposure (4). Stigma is also another issue leading to distress. Some people have a negative view of the effects of radiation on future pregnancy or genetic inheritance among young women in Fukushima (5).

It is necessary to develop the countermeasures to prevent further stigmatizing of the affected people. Risk communication is challenging after a nuclear accident, information scarcity about radiation made risk assessment difficult; therefore, doctors and nurses need to provide scientific information to community people (6). Healthcare providers including nurses need to understand and properly address the wide range of health issues after nuclear accidents.

After the Fukushima nuclear power plant disaster following the Great East Japan earthquake and tsunami in 2011, consequently, many residents of Fukushima and surroundings were affected. The worries about radiation effects on health were growing attention internationally, which even restricted and withdrew imports from Japan (7). This experience suggests the importance of taking measures to deal with health concerns in normal times before disaster (8). Careful management of information dissemination is essential in dealing with rumors (9). Proper dissemination of information prevents discrimination and takes the highest activity at the national level (10). In Japan, PHNs have primary responsibility for communicating health information to the community, and they are gatekeepers of community health services (11). During disaster events, the demand for nurses is much higher than other healthcare professionals (12). Nurses of public health and school health have a great role in maintaining and improving health communication (13). Preparation and delivery of information are needed for both disaster and non-crisis areas in risk management (14).

The American Nurses Association and the Nursing Emergency Preparedness Education Coali-

tion mentioned that nurses needed to acquire a minimum level of disaster management knowledge and skills to ensure the safety and wellbeing of community people (15, 16). Since the Fukushima nuclear accident in 2011, various training initiatives have been carried out (17) such as, public health nurses were trained to measure radiation levels and school health nurses learned how to administer stable iodine to children immediately after an accident (3). In addition, public health nurses were assigned for mothers, young children, adults, and elderly people, while school health nurses were for school-going children. Both nurses experienced stress in dealing with the community having no knowledge of radiation (18). Education on radiation is insufficient in the nursing curriculum of public health and school health. Moreover, they are involved in various works with residents and children where the nuclear power plant does not exist, they cannot afford the time for radiation issues, and this purpose has the limited budget allocation (13).

During the disaster, trustworthy relationship with people is necessary for the preparation of information on a day-to-day basis (19). As professionals, local residents trust nurses of public health and school health. The role of nurses during the nuclear disaster is important, and preparatory education is crucial (20). Community and school health nurses also need to involve people in developing and providing information in times of non-crisis to support all residents (21). The previous findings demonstrated that nurses have no disaster nursing education or lack of emergency preparedness knowledge and skills (22-24). Although the demand for disaster preparedness has been recognized for many years, a significant knowledge gap still exists among our service providers.

We aimed to develop and evaluate a short-term basic radiation education program to acquire fundamental knowledge and applications.

Methods

Participants and design

This was a quasi-experimental study using single-group, and compared pre-post intervention from

July to September 2016. Study participants were 29 public health nurses and 25 school health nurses from Kagoshima, Hyogo, and Hiroshima of Japan. They attended a radiation training hosted by the cooperating organization.

The study was approved by the Epidemiological Research Ethics Review Committee of Hiroshima University (E-402). Participants provided written consent to participate in the study.

Intervention

Education program consisted of a workshop and self-study materials. The workshop has basic and applied context, where learning activity used face-to-face group discussion. Self-study materials' contents were installed on tablet devices in Japanese language to fit with local context. The objective was established based on the previous study (25), to develop an understanding of information grasping ability to support residents' decision-making during the non-crisis period.

Structure of the education program Dealing with individual concerns and health guidance in group settings

The situations devised for the workshop consisted of an individual resident asking participants for advice, and demonstration of group guidance for mothers who had infants. In this education program, the example of 'dealing with an individual's health concerns was presented as a movie on individual's tablet computer. The setting of the movie highlighted an individual resident stopping and consulting with the viewer. The setting was designed to provide a sense of relevance with works to those who do not feel the need to learn about radiation in normal times. Using the same example in the workshop as in the prior learning materials, learners by themselves was to compare changes in corresponding scenarios. The participants could confirm learning effects by perceiving changes visually.

Inclusion criteria

The area of residence was located at least 100 km from a nuclear power plant, and the area was not

subject to any special instructions such as evacuation information or measures.

Mothers, who were: 1) anxious about the safety of water used for preparing baby milk, 2) concerned that children were at risk of inhaling contaminated air at school during after-school activities and wanted to stop such activities, 3) thought their children could not attend baseball practice because of released radiation exposures, 4) wanted the nursery to cancel children's walking because of concerns about radiation levels in the neighborhood, and 5) middle-aged women being recommended to walk to reduce serum lipid levels, but could not walk because of hotspots were identified.

Participants had about 10 minutes to describe and submit their responses to the anxiety followed by 40 minutes lecture. The basic knowledge provided to participants covered radioactive cesium and time elapsed since nuclear accident, thyroid function, human metabolism, internal and external exposure, hotspots, and countermeasures. Next, the script for the role-play was described again, and conducted in pairs. The demonstration was conducted as 'model of group guidance for mothers covering basic knowledge of radiation and application' applied in cases 2 to 5, together with health guidance demonstration for junior-high-school students and mothers (effectiveness evaluation completed) were included in a CD-ROM, which was distributed after completion of training.

Measures

Knowledge comprised four items based on correct answers: 1) places likely to become hotspots and sites of information disclosure, 2) actions likely to cause internal exposure, 3) opinions on upper limits of radiation for ordinary people, and 4) number of days elapsed since a nuclear accident and change of radioactive material. Levels of achievement of the attainment goals of the education program were evaluated. Attainment goals were created in Bloom's cognitive, affective, and psychomotor domains (26).

Cognitive goals were to understand and share existing useful information for assuming the situ-

ation. Affective domain was stated, 'be able to imagine the health concerns of residents', and 'have interest in the information and techniques required to respond'. Psychomotor domain was evaluated based on participants thought whether they 'could respond to the health concerns expressed virtually'. Each goal was evaluated by following responses:

Cognitive

I know the place, which can acquire radiological information.

I know that the government has released the results of an investigation about radiation.

I feel the necessity for training to a nuclear disaster recovery response.

Affective

I can assume the anxieties of residents' health concretely.

I am interested in news and the report about radiation.

I have considered the meaning of the measured value released.

Psychomotor

I can respond to the example of anxieties, which the residents complain about.

This program was conducted by comparing pre and post workshop learning. Evaluation of effectiveness was done through the level of knowledge, and achievement of goals made by Bloom taxonomy.

Knowledge was assessed before and immediately after the workshop. The achievements of goals

were surveyed immediately after the workshop, and at 1-week and 1-month later. A five-point Likert scale and open-ended questions were used. The questionnaires were distributed and collected by post except for the survey immediately after the workshop.

Data analysis

The analysis compared initial scores obtained before the workshop with subsequent responses. The Wilcoxon signed-rank test was used to compare two-group, and the Friedman test was used to compare three-group or more. When a significant difference was observed on the Friedman test, the Wilcoxon signed-rank test was used for two-group comparisons across time periods. The significance level was set at $P < 0.05$. When conducting multiple tests in the same category, the significance level was divided by the number of tests. Open answers provided before and after were compared thematically and by the number of words. All data were anonymously maintained in accordance with the ethical guidelines for epidemiological research.

Overview of the participants' analysis

The analysis of the education program was conducted on 54 out of 61 participants who submitted survey forms (Table 1). Ten participants did not answer questions about the level of achievement. Therefore, the analysis of the level of achievement was used on 44 participants (Table 2).

Table 1: Respondents attribute in this study

<i>Variable</i>	<i>Category</i>	<i>n (54)</i>	<i>Percent</i>
Age (yr.)	Twenties	8	14.8
	Thirties	8	14.8
	40s	15	27.8
	50 years and over	23	42.6
Job category	Public Health Nurse	29	53.7
	School health Nurse	25	46.3
Have you ever been to support the disaster location?	Yes	23	42.6
	No	31	57.4

Table 2: Changes in response over time (n=44)

Variable	Investigation time	Mean	Friedman Test	P-value			
				Wilcoxon's signed-rank test		Before vs. One month	
				Before vs. Immediately	Before vs. One week	Before vs. One month	
Cognitive	I know the place which can acquire radiological information	Before	1.6	P<0.001	P<0.001	P<0.001	P<0.001
		After	2.8				
		Immediately	3.1				
		One week	3.3				
	I know that the government has released the results of an investigation about radiation	Before	1.9	P<0.001	P<0.001	P<0.001	P<0.001
		After	3.3				
I feel the necessity for training to a nuclear disaster	Before	2.9	P=0.028	ns	ns	ns	
	After	3.3					
Affective	I can assume the anxieties of residents' health concretely	Before	2.1	P<0.001	P<0.001	P<0.001	P<0.001
		After	3.2				
		Immediately	3.3				
		One week	3.3				
	I am interested in news and the report about radiation	Before	2.9	P=0.017	ns	P=0.007	P=0.012
		After	3.2				
I have considered the meaning of the measured value released	Before	2.3	P<0.001	P<0.001	P<0.001	P<0.001	
	After	3.3					
Psychomotor	I can respond to the anxieties of which the residents complain about	Before	1.6	P<0.001	P<0.001	P<0.001	P<0.001
		After	2.8				
		Immediately	2.9				
		One week	2.9				

Note: vs. = versus; ns = not significant; Each question is a maximum of 5 points; For comparison of three or more groups, groups having significant difference after Friedman's test were compared between groups by Wilcoxon signed-rank test

Results

Evaluation of knowledge

Responses to questions were judged to be correct if they were completely accurate. The number of correct responses was increased significantly after the workshop ($P<0.001$).

Evaluation of level of achievement

For each question item, the maximum value of one question was 5-point. The points of cognitive, affective, and psychomotor items were examined by Friedman's test on the difference of 4-point in before workshop, immediately after, 1-week after, and 1-month later. A significant difference was observed in the group. Questions by region of Bloom taxonomy were examined using the Wilcoxon signed-rank test, the difference between the representative value of 44 people before training and just after the workshop. By the same method, the representative value of the

score before the training versus the score after 1-week, and the score before the training versus the score 1-month later were compared (Table 2).

Cognitive

We set the goal of Cognitive as follows, specifically investigated with three questions.

"I know the place which can acquire radiological information." As for the answer, the scoring average before training was 1.6, and immediately after training was 2.8 ($P<0.001$). The score was 3.1 before the training and 1-week later, and it increased significantly ($P<0.001$). It also increased after 1-month ($P<0.001$).

"I know that the government has released the results of an investigation about radiation." The same result was obtained for this question ($P<0.001$).

"I feel the necessity of training to response a nuclear disaster." Though there was a significant difference in the score ($P=0.028$) throughout the

period up to 1-month, no significant increase was observed compared to prior 2.9.

Affective

Affective's goal was to "be concerned about residents' health uncertainty" and "have an interest in information and technology necessary for response." There are three questions to judge that these have been achieved.

"I can assume the anxieties of residents' health concretely." The score of question at before workshop was 2.1. Immediately after, it increased significantly to 3.2 ($P<0.001$). After 1-week ($P<0.001$) and after 1-month ($P<0.001$), it did not decrease.

"I am interested in news and the report about radiation." Changes in the score throughout the period were significant. The score was 2.9 before workshop. Immediately after, it was 3.2, and no significant increase was observed. After 1-week, it became 3.3, which was significantly increased compared with before ($P=0.007$). After 1-month it remained 3.3 ($P=0.012$).

"I have considered the meaning of the measured value released." The score before workshop was 2.3. Immediately after, it was 3.3. ($P<0.001$). It did not decrease even after 1-week ($P<0.001$) and after 1-month ($P<0.001$).

Psychomotor

I can respond to the example of anxieties, which the residents complain about.

The average score before workshop was 1.6. Immediately thereafter it was 2.8 ($P<0.001$). After 1-week and 1-month, it was 2.9, and the average scores after 1-week and 1-month significantly increased compared with the average score before the training ($P<0.001$). We compared the worksheet describing the method of role play imitating the actual correspondence at the beginning and after the workshop (Table 3). Worksheets recording methods of role-play simulation of the actual situation from the beginning and after completion of the workshop were compared. Words used at least 10 times were extracted. There was a clear increase in words respond-

ing to the case recorded on the worksheets, as well as in the frequency (Table 3).

Discussion

Educational evaluation through Bloom's attainment goals was conducted for each sub-item. The key finding in the present study is that the workshop for nurses of public health and school health was successful in improving participants' cognition domain. Effective training programs require developing the desired knowledge, skills and abilities of the workforce that may also affect employee motivation and commitment (27). For the variable 'I know the place which can acquire radiological information' as measured during pre-test; significant gains made on them during post-test, 1-week and 1-month period. These findings suggest that nurses participated in the workshop retained and utilized knowledge learned during the training and successfully applied. While there were immediate post-training effects were on a decreasing trend for the variable 'I know that the government has released the results of an investigation about radiation', suggesting that follow-up training or supervision is required to sustain positive effects of the training program (28). It also indicates that participants had the foundation to engage in more specialized training after completing the education program. Therefore, it seems that the goals of 'understand existing information sources that can be used and methods for sharing information', and 'be able to understand training needs assuming the situation of those responsible' were attained.

Another important finding of the study was significant increases were observed for all the variables of the affective domain. These findings suggest that individuals can learn through training on a task that improves decision-making control of effective material to subsequently "influence emotional information in other settings more successfully. Participants got better at engaging with goal-relevant affective material, while ignoring highly emotional material that is not pertinent or may distract from the target task" (29). Learn-

ing motivation among nursing staff is linked to the implementation of their own work (30, 31), therefore, showing concrete examples of residents' health concerns as specific professional cases seems to have raised learning motivation. They could learn that responding respectfully to

trivial concerns felt well by residents in their daily lives, as a consequence of their jobs would lead to trust. It seems that the goals, 'be able to imagine the health concerns of residents' and 'have interest in the information and techniques required to respond' were attained.

Table 3: Compare worksheets in case correspondence

<i>Extracted words</i>	<i>Start of training</i>		<i>End of training</i>	
		<i>Number of sentences</i>	<i>Extracted words</i>	<i>Number of sentences</i>
			Water	57
			Hotspot	42
			Worry	42
Water		30	Water supply	33
Worry		22	Cesium	31
Convey		21	Listen	27
Anxiety		21	Iodine	24
			Confirmation	24
			Radiation	22
			All right	21
Confirmation		19	Upstream	19
Listen		17	Halving	19
			Anxiety	18
			Material	17
			Radiation	17
Hotspot		16	Milk	16
All right		14	Drink	16
Water supply		13	Think	16
Information		12	Partner	15
A feeling		11	Migration	13
Correct		11	Beverage	13
Knowledge		11	A feeling	13
Drink		10	Region	13
Investigate		10	Soil	13
			Influence	12
			Soil	12
			Exposure	12
			Mineral water	11
			Convey	11
			Radioactivity	11
			Accident	10
			Know	10

Psychomotor scores increased as compared with before training. The goal is considered to have been achieved for the psychomotor domain. Psychomotor scores for public health and school

health nurses on radiation training were not increased over a certain level after the workshop. This might be an indication of the limitations of knowledge and case study as a learning method

of continuing professional development for nurses and once again reiterates the importance of follow-up training or supervision (28). The attitude of encouraging clients to take decisions and judgments while listening to their opinions and wishes has already been cultivated through continuing professional development (31). It is also due to confidence being developed and techniques being acquired through actual experience (32).

The participants did not possess the necessary knowledge and skills to respond to the post-nuclear disaster situation. After receiving the training participants increased their confidence level to overcome the difficulties of risk communication and to explain radiation protection to the community people. They also dramatically enriched terms and vocabularies related to radiation for communication with residents.

Limitations of the study

Participants in this study were Japanese public health and school health nurses. Public health nurses engage in similar kinds of work throughout the world, but school health nurses work within a unique teaching system in Japan. There was a limitation to examine the effectiveness with teachers who are not responsible for health maintenance and management in schools.

Conclusion

Examining new cases in workshops and usual engagement with self-study materials could be effective in providing explanations to residents for developing confidence in corresponding technology through face-to-face education. These can develop the confidence of answers about radiation and to explain self-learning materials to residents. These methods are suitable and appropriate way of conducting continued professional development in times of non-crisis. The materials developed in this study cover basic content related to radiation and could be used by nurses responsible for managing people's health in any country or region. The educational effect for

teachers who are not specializing in school healthcare needs to evaluate in the future.

Ethical considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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Conflict of interest

The authors declare that there is no conflict of interest.

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