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Relationship between Risk Perceptions of Radiation and Grade Level in Nursing School Students

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The aim of this study was to clarify the risk perception of radiation among nursing students and the relationship between risk perception of radiation and student grade level.

A questionnaire survey was administered to 341 nursing students, from freshmen to seniors, at X University. Students learn about radiation risk starting from their sophomore year through lessons on radiotherapy, radiological examinations, and nursing for radiotherapy. We then measured responses to questions regarding risk perception and factors influencing risk perception, including fear of radiation (fear), difficulty understanding radiation (difficulty), understanding the effects of radiation on the human body (understanding), and interest in radiation (interest). Data were collected and analyzed during April and July 2010.

A total of 292 nursing students (33 men, 259 women) completed the survey. Information about radiation was obtained primarily from lectures at school (n = 240) and from television (n = 203). Significantly more freshmen students than students in other grades obtained information from television.

Risk perception on radiation didn't change greatly and understanding level increased as grade went upward, but interest to radiation decreased after learning basic knowledge about radiation.

It is important to examine an educational content and the method for the continuance of the interest to radiation after learning basic knowledge of radiation.

Key words: risk perception, nursing, education, radiation

1. Introduction

Concerns and acceptance perceptions regarding medical radiation among the public are relatively high, because the benefit of medical exposure to radiation are clear[1]. Gonzalez and Darby[2] reported that many people felt anxiety about the affects of radiation or the risk of radiation exposure during examinations that required radiation. In addition, medical staff also express anxiety about radiation exposure[3]. Fear of radiation is highly communicable and can negatively affect patient care[4-6]. Therefore, systematic education regarding the effects of medical radiation is needed to alleviate any unnecessary anxiety.

Medical staff play an important role in risk communication and in sympathizing with, and dealing with, a patient's anxiety about radiation. In particular, nurses that routinely interact with patients might be expected to help patients deal with their concerns[7]. Today, the subject of radiation

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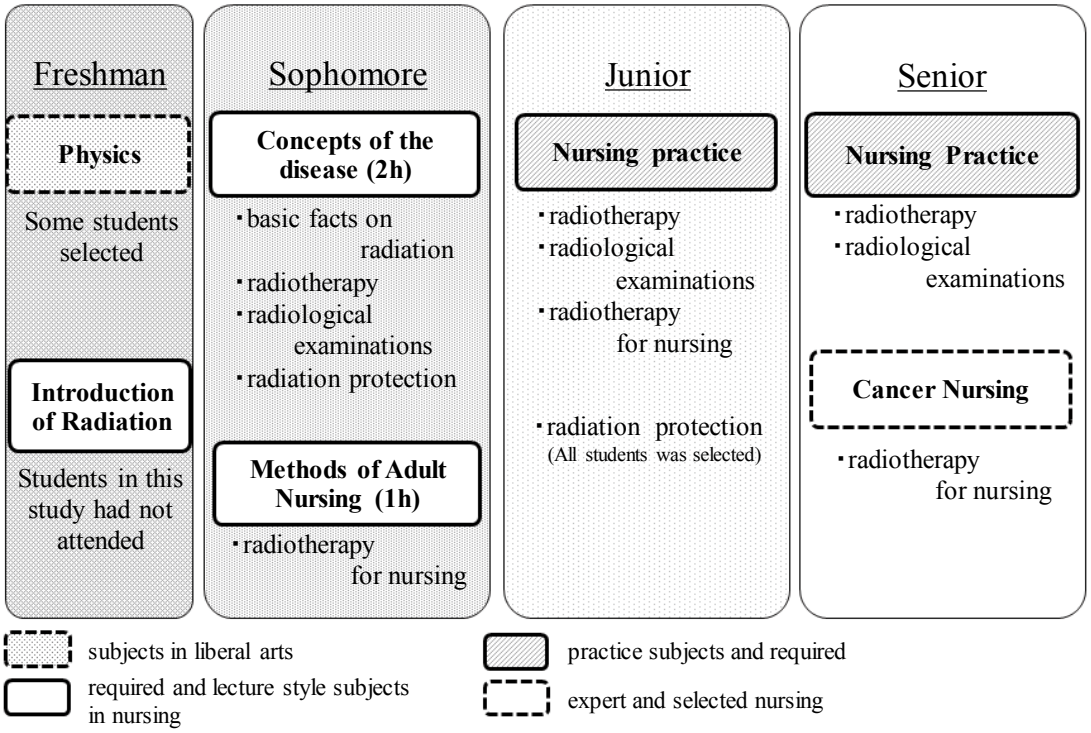

Fig. 1. Study Curriculum on radiation in nursing course.

is not a required part of the nursing curriculum provided for basic nursing education in Japan. Instead, knowledge about radiation related to treatment and examinations is studied in the expert nursing subject only[8-9]. In the past 30 years, there have been few chances to learn about radiation in elementary education in Japan[10], although starting in 2012, a course about radiation will be added to the junior high school science curriculum. Overall, however, there are few opportunities for nursing students in medical and health sciences schools, other than students in medical and radiological technology courses, to receive systematic education on radiation[8-9]. In addition, no study has examined how the risk perception of radiation changes with continual learning on the topic.

The present study aimed to clarify the risk perception of radiation in nursing students and the relationship between risk perception of radiation and the grade level of nursing students. We also examined ways to educate nurses about the appropriate level of risk perception regarding radiation.

2. Methods

2.1. Participants and Procedures

Participants were freshman to senior nursing students of the health sciences school at X University of Aomori Prefecture. A questionnaire survey was administered to 341 students, including 80 freshmen, 81 sophomores, 89 juniors, and 91 seniors. All students were asked to participate. Overall, 292 completed questionnaires were received (participation rate, 86%). Data collection and analysis were conducted between April and July 2010.

Participants were given a brief explanation outlining the purposes of the study after class, and were informed that they had the right to withdraw at any time. Participants took approximately 15 min to complete the questionnaire packet. We considered that a completed questionnaire represented consent to participate in the study.

2.2. Study Curriculum

The nursing education at X University regarding radiation is shown in Figure 1. There is no single subject that focuses on radiation in the nursing curriculum. The topic of radiation is only covered in various expert-level course. Most courses taken by freshmen are in liberal arts, although some students choose to take physics and chemistry classes.

Then, 'Introduction of Basic Radiation' to learn basic knowledge of radiation protection and radiation emergency medicine is going to start a course to freshmen by Co-medical Education Program in Radiation Emergency Medicine from 2010.

Students learn about radiation starting from their sophomore year through lessons on radiotherapy, radiological examinations, and nursing for radiotherapy patients. Sophomore students learn about the basics of radiology, radiological examinations, and treatments for 2 hours in required subjects about disease (Concepts of disease II). They also spend 2 hours learning about providing care during radiological treatment in a required subject about adult nursing care. Additionally, they have their first practical nursing experience to understand the

Table. 1. Question sheets (1)

Question 1 What comes mind when you hear the word "radiation" ? Please circle all number of the items that comes to mind. (There is no limit on number of choices.)

① X-ray and CT applications ② Hiroshima, Nagasaki (Nuclear Weapons) ③ Madam Curie ④ Food irradiation
⑤ Chernobyl ⑥ Cancer Treatment ⑦ Exposure ⑧ Leukemia ⑨ Waste ⑩ Breed improvement (agricultural produce)
⑪ Nuclear power generation ⑫ Other ( )

Question 2 What would you like to know more about as regards "radiation" ? Please circle three numbers corresponding to three choices. (Please limit your choices to three.)

① Amount of radiation not causing any harm ② How to control safety ③ Actions to be taken in the case of radiation accidents
④ Facilities utilizing radiation ⑤ How radiation is utilized in food ⑥ Breed improvement for agricultural produce
⑦ How radiation is utilized in industry ⑧ How radiation is utilized in medical science ⑨ Governmentalregulations
⑩ State-of-the-art research fields ⑪ Nothing in particular

Question 3 Of the following health hazards caused by radiation exposure, please select up to three items that concern you the most. Please circle the number of your choices.(Please limit your choices to three.)

① lifertility ② Cataracts ③ Ulcers, skin disorders, hair loss ④ life shortening
⑤ Effects on children (miscarriage, deformation, brain disorders)
⑥ Cancer and leukemia ⑦ Effects on descendents (genetic disorders) ⑧ Other ( )

Question 4 Please arrange the following ten items in order of your concern in terms of health risks. For example, if you think that riding a motorcycle is the most risky, please "1" in the relevant box. Similarly, please rank all the ten items by placing your corresponding numbers in the spaces provided.

☐ Riding a motorcycle	☐ Smoking (cigarettes)	☐ Drinking (alcoholoc beverages)	☐ Antibiotics
☐ HIV	☐ O-157	☐ Surgery	☐ Hepatic fever
☐ X-ray, CT applications	☐ Obesity (overweight)		

Question 5 We are constantly exposured to radiation in our daily life. Of the fellowing sources of radiation, how dengerous do you feel on your health by radiation or radioactive substances? Please evaluate items between zero (no dengerous) and ten (dangerous) respectively.

	Not dangerous 0 — 10 dangerous
1. Rocks & Soils	
2. Cosmic rays	
3. Radon spring	
4. Chest X-ray	
5. CT	
6. Radiation Therapy	
7. Airport baggage inspection	
8. Air travel	
9. Nuclear testing	
10. Living near nuclear power plant	

role of a nurse in September of their sophomore year for 2 days. During that time, some students learn about radiological treatments and examinations. Junior students attend some nursing practice that involves adult nursing, as well as Maternity Nursing and Pediatric Nursing. In addition, "Radiation Protection," a lecture subject, is taught for 1 hour at the beginning of nursing practice in the junior year.

Senior students also attend some nursing practice related to Gerontological Nursing. During nursing these practices, nursing students may learn about radiation through self-study. The experiences and learning differ depending on the respective patients. Some students attend "Cancer Nursing" as an elective subject and receive 1 hour of education on radiological treatment and care for patients. Although sophomores attend a lecture about radiology, other grade students in this study had not attended that lecture before the period of this survey.

2.3. Questionnaire (Table 1)

We asked questions about demographics as well as the risk perception of radiation. Demographics assessed included age, sex, elective science subjects in high school, knowing a family person who underwent radiotherapy, knowing a family person who has a job related to radiation, having a nuclear power plant in the prefecture where they grew up, and how to get information on radiation. Questions on risk perception of radiation were based on the study of Kanda[11] and covered some items, including the word reminded by "radiation", things that students would like to know about radiation, and "risk of damage to one's health by radiation or radioactive substances" (health risk of radiation). The

Table 1. Question sheets (2)

Question 6 How do you fear the radiation?.
1. Not at all 2. Slightly 3. Moderate 4. Strong

Question 7 How difficult is the knowledge of radiation?
1. Not at all 2. Slightly 3. Moderate 4. Strong

Question 8 How much influence on the human body of the radiation do you know?
1. Not at all 2. Slightly 3. Moderate 4. Strong

Question 9 How much are you interested about radiation?
1. Not at all 2. Slightly 3. Moderate 4. Strong

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To conclude this questionnaire, please provide the following personal information below. Please circle the appropriate number.

* Sex 1. Male 2. Female
* Age ( ) years old
* Grade 1. Freshman 2. Sophomore 3. Junior 4. Senior
* Which did you take elective Subjects of Science in high school?
1. Physics 2. Chemistry 3. Biology 4. Geography

* Have any of your family members undergone radiological treatment? 1. Yes 2. No
* Have any of your family members engaged in occupation related to radiation? 1. Yes 2. No
* Did you grow up in the prefecture where the nuclear plant existed ? 1. Yes 2. No
* What is your resourse about radiation? There is no limit on number of choices.
1. lecture at School 2. family acquaintance 3.public relations facilities for nuclear power
4.newspaper magazine 5. Television 6.Internet

word reminded by "radiation and things that students would like to know about radiation were limited to three items. The questions about health risk of radiation were evaluated using an 11-point scale, standing for 0 and 10. Higher scores indicate a greater risk perception of radiation. Survey questions also assessed what factors influenced risk perception, including fear of radiation (fear), difficulty understanding radiation (difficulty), understanding the effect of radiation on the human body (understanding), and interest in radiation (interest). These items were assessed using a 4-point Likert scale ranging from no impact at all to strong impact .

2.4. Statistical Analysis

Differences in demographic data, the word reminded by "radiation"and among grade levels were assessed using the chi-square test. Correlations between risk perception and factors influencing risk perception of radiation were assessed using Pearson's correlation coefficient. Difference in health risk of radiation, fear, difficulty, interest, and understanding among grade level were assessed using one-way analysis of variance and Bonferroni test for multiple comparisons. Data were analysed using SPSS (version 11.5) for Windows (SPSS Inc., Chicago, IL). Statistical significance was defined as $p<0.05$.

2.5. Ethical issues

All study protocols were approved by the Committee for Medical Ethics of the X University (reference number 2010—025), and returning the questionnaire was regarded that their informed consent was obtained.

3. Results

3.1. Demographics

A total of 292 nursing students (33 men, 259 women) completed the survey. Backgrounds of the participants are shown in Table 2. The mean age of participants was 20 years (±1.9; range, 18 to 32 years); 89% were female. The ratio of elective subjects of science in high school was physics (30.8%), chemistry (95.2%), biology (75.3%), and physical geography (0.3%). Among participants, 20% knew someone who had undergone radiotherapy. Significantly more seniors knew someone who had undergone radiotherapy compared with other students ($p < 0.001$); the number of freshman who did not know anyone who had undergone radiotherapy was significantly higher than in the other grades ($p < 0.001$). Fifteen percent of participants knew someone in an occupation related to radiation, and more than half (55%) were born in a prefecture in which there was a nuclear power plant. There were no significant differences among grade levels in these two variables.

Information about radiation was obtained from lectures at school (82.2%), television (69.5%), newspapers and magazines (28.8%), public relations facilities for nuclear power plants (19.2%), the Internet (15.1%), and family or acquaintances (12%). The number of freshman obtaining information from a lecture at school was significantly lower

Table 2. Demographic data of particpants (n=292)

		Freshman (n=75)	Sophomore (n=64)	Junior (n=86)	Senior (n=67)	Total (n=292)	χ^2	p
sex	male	11	4	11	7	33	2.7	n.s.
	female	64	60	75	60	259		
Elective subjects of science in high school	Physics*2	22	20	23	25	90	2.1	n.s.
	Chemistry	74	63	79	62	278	6.6	p<0.1
	Biology*3	55	50	70	45	220	4.5	n.s.
	Geography	0	0	0	1	1	3.4	n.s.
A familiar person received the radiotherapy	exist	12	12	18	21	63	24.5	p<0.001
	not exist	34	39	55	38	166		
	unknown	29	13	10	8	60		
Familiar person who has occupation related to radiation	exist	9	13	13	10	45	8.5	n.s.
	not exist	66	50	64	55	235		
	unknown	0	1	6	2	9		
Nuclear power plant in prefecture grew up	exist	48	36	40	41	165	5.5	n.s.
	not exist	27	25	46	26	124		
	uncertain	0	2	1	0	3		
Resource of knowledge concerning radiation	lecture at school	35	63	77	65	240	80.4	p<0.001
	family acquaintance	13	8	9	5	35	3.5	n.s.
	public relations facilities for nuclear power	15	11	15	15	56	0.8	n.s.
	nuclear power magazine	26	15	24	19	84	2.2	n.s.
	Television	63	45	50	45	203	12.8	p<0.01
	Internet	6	8	18	12	44	6.0	n.s.

Statistical analysis was used by Chi-Square test.
Statistical significance was defined as p<0.05. N.S was meaning of not siginificant.

than that of students in other grades ($p < 0.001$), whereas the number of freshman obtaining information from television was significantly higher than that of students in other grades($p < 0.01$).

3.2. The word reminded by "radiation" (up to three items) (Table 3)

In terms of the word reminded by "radiation," more than 80% of students reported "X-ray and CT examination," "radiation exposure," following "Hiroshima·Nagasaki" (77%), "Chernobyl" (67%), and "nuclear power plant" (66%).

The reminder of "Madam Curie" was significantly different among grades ($p < 0.01$). Significantly fewer freshman students selected it compared with other grades, whereas significantly more junior students selected it compared with other grades ($p < 0.05$). Juniors were significantly more likely to remind of "Breeding" and "food irradiation" than students in other grades ($p < 0.05$).

3.3. Things that students would like to know about radiation (up to three items)

Things that participants would like to know about radiation are shown in Table 4. The most common responses were "Actions to be taken in the case of radiation accidents" (71.6%), "How radiation is utilized in medical science" (58.2%), and "Amount of radiation that does not cause any harm" (40.4%). Sophomore students were significantly more likely to select "How to control safety" ($p < 0.001$) and "Amount of radiation that does not cause any harm" ($p < 0.01$) compared with students in other grades; freshman students were significantly less likely to choose these responses compared with students in other grades ($p < 0.001$).

Significantly more freshman students selected "How radiation is utilized in medical science" ($p < 0.001$) compared with students in other grades. Significantly more sophomores than freshmen were interested in radiation in terms of "State-of-the-art research fields" ($p < 0.05$).

3.4. Health risks of radiation

The survey contained questions associated with radiation itself and 10 questions on health risks of radiation. High-risk items were "living near a nuclear power plant," "nuclear testing," "cosmic rays," "radiation therapy," and "rocks and soil." "Airport baggage inspection" was perceived as being a significantly lower risk by freshmen than juniors ($p < 0.05$) (Fig. 2). There were no other significant differences in

Table 3. The word reminded by "radiation" (up to three items)

	freshman	sophomore	junior	senior	Total	%	χ^2	p
① X-ray/CT photogram	63	61	74	63	261	89.4	6.45	p<0.1
② Hiroshima/ Nagasaki	60	45	70	51	226	77.4	3.4	n.s.
③ Madam Curie	9	13	31	18	71	24.3	13.4	p<0.01
④ Food irradiation	3	0	9	4	16	5.5	8.2	p<0.05
⑤ Chernobyl	43	44	65	44	196	67.1	6.2	n.s.
⑥ Radiation Therapy	58	53	71	59	241	82.5	2.8	n.s.
⑦ Radiation Exposure	64	53	75	61	260	89.0	3.95	n.s.
⑧ Leukemia	25	24	36	21	106	36.3	2.19	n.s.
⑨ Nuclear Waste	24	21	33	33	111	38.0	5.48	n.s.
⑩ Breeding (agricultural produce)	1	0	8	4	13	4.5	9.82	p<0.05
⑪ Nuclear Power Plant	49	44	53	47	193	66.1	1.48	n.s.

Statistical analysis was used by Chi-Square test.
Statistical significance was defined as p<0.05.
N.S was meaning of not siginificant.

Table 4. Radiological knowledge that student wanted to learn

	freshman	sophomore	junior	senior	Total	%	χ^2	p
① Amount of radiation not causing any harm	40	14	36	28	118	40.4	14.5	p<0.01
② How to control safety	30	10	18	28	86	29.5	17.8	p<0.001
③Actions to be taken in the case of rasiation accidents	54	47	57	51	209	71.6	1.98	n.s.
④ Facilities utilizing radiation	8	11	18	14	51	17.5	3.67	n.s.
⑤ How radiation is utilized in food	4	19	25	12	60	20.5	18	p<0.001
⑥ Breed improvement for agricultural produce	2	7	9	6	24	8.2	4.31	n.s.
⑦ How radiation is utilized in industry	0	4	5	3	12	4.1	4.62	n.s.
⑧ How radiation is utilized in medical science	60	34	42	34	170	58.2	20	p<0.001
⑨ Government regulation	4	2	7	3	16	5.5	2	n.s.
⑩ State-of-art research fields	13	25	29	15	82	28.1	10.5	p<0.05

Statistical analysis was used by Chi-Square test.
Statistical significance was defined as p<0.05.
N.S was meaning of not siginificant.

perceptions of health risks for radiation.

3.5. Fear, Difficulty, Interest, and Understanding

Comparisons among grades of students for risk perceptions of radiation are shown in Figure 3. Freshman students had significantly greater "fear" than junior and senior students, whereas "difficulty" did not significantly differ among grades. "Understanding" was perceived as being significantly lower, and "interest" was perceived as being significantly higher by freshmen students than by other students.

The risk perception patterns were different between freshmen and other grades. Therefore, we analyzed correlations between risk perception and factors influencing risk perception after separating freshman from other grades (Table 5).

Except for freshmen, "fear" correlated significantly and positively with "difficulty" and significantly and negatively with "understanding." However, "fear" and other factors did not significantly correlate among freshmen.

4. Discussion

The aim of study was to clarify the risk perception of radiation among nursing students, relationships between risk perception of radiation and grade level of nursing students, to examine how risk perception of radiation is changed as the grade goes upward.

Participants were most likely to selection medical procedures such as X-ray, computed tomography, and radiotherapy as being associated with radiation. These results were similar to those in the study by Kanda[11] et al. In contrast, in Nakamura's investigation[12] of college students, items concerning war and energy were more likely to be associated with radiation than items concerning medical treatment. Results regarding medical procedures may be specific to medical students.

Furthermore, radiation reminded many people of radiation exposure. Radiation, atomic bombs, and atomic dust are all explained in textbooks in elementary and junior high schools in Japan[13]. In addition, Ota pointed out the possibility that anxiety and fears about radiation are formed based on insufficient and incorrect knowledge gained through television and other media[8].

In terms of things that students would like to know about radiation, the response to "Actions to be taken in the case of radiation accidents" may be involved in ongoing Co-medical Education Program in Radiation Emergency Medicine at X University. Responses to "How to control safety" were lower in our nursing students compared with another nursing

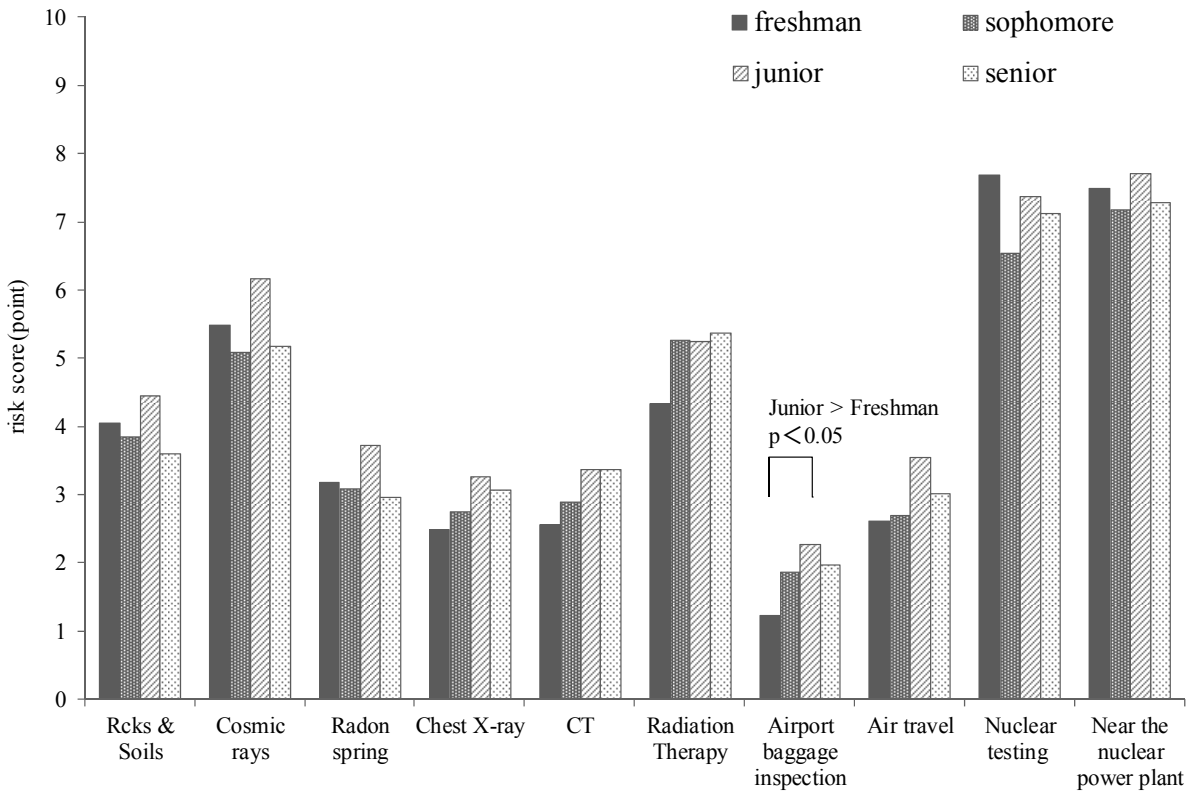


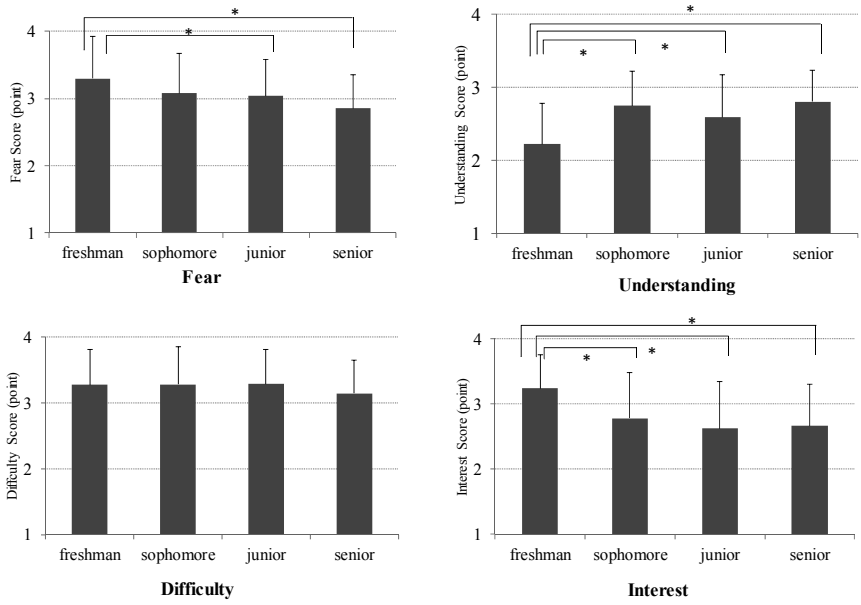
Fig. 2. Comparisons among grades of students on health risk of radiation.

investigation[11], but "How radiation is utilized in medical science" and "Amount of radiation that does not cause any harm" were high because these were new students learning about radiation for the first time. Nursing students tended to learn the knowledge required in medical staff as well as Nishi's research[14]. As compared with students excluding freshman, freshman students more likely to learn the basic radiation knowledge. Results showed that learning basic knowledge about radiation lead to attempts to obtain more advanced and new knowledge, such as radiation in the food or an industry field. This suggests that studying continually expanded students' interest in radiation.

Freshman students had greater "fear" regarding radiation than junior and senior students. In addition, the number of freshman obtaining information from television was significantly higher than in other grades. Information from mass media about radiation is often exaggerated and extreme[15], which increases the public's anxiety. The fear reported by freshmen was not significantly associated with "interest" or "understanding," so it appears that mass media has a powerful influence on risk perception of radiation when basic facts about radiation are not known. We expected freshmen to have a higher risk perception of radiation than students at other levels due to the unknown nature of radiation and its effects on the human body. Except for freshmen, "fear" correlated significantly and positively with "difficulty," and significantly and negatively with "understanding." In a word, it means that the scarer about radiation person, the more difficult knowledge of the radiation and the more incomprehensibility person about the influence on the human body on radiation. It has been reported that people with poor knowledge about radiation have high anxiety[16-17]. Slovic reported that factors contributing to risk perception include dead risk and unknown risk[18]. Learning basic knowledge about radiation may decrease both factors, and could explain why the risk perception of radiation was reduced at the sophomore level and above.

Consequently, we suggest that correlations between amounts of knowledge and fear can be increased by providing systematic education about radiation. If systematic study is undertaken, it was clarified that the risk perception on radiation did not change even if they continually studied either[19]. Moreover, we clarified that knowledge about radiation increased gradually as grade level advanced, and interest in radiation decreased gradually. Providing accurate information on radiation to freshmen with a high interest in radiation is more effective so as to reduce unwarranted fears. Once risk perception is formed, it is not easily changed.

Knowledge gained via systematic education on radiation in a lecture style is not necessarily effective for clinical use[20]. The image of radiation is not understandable for nursing students. It is necessary to do practice which continually have an experience getting an image about radiation[8]. Continuous and practical education after graduate school,



Statistic analysis were assessed using one-way analysis of variance and Bonferroni test for multiple comparisons.
Statistical significance was defined as $p<0.05$. *$p<0.05$

Fig. 3. Comparisons among grades of students on the risk perception and factors influence on risk perception on radiation.

Table 5. Correlations with the risk perception and factors influence on risk perception on radiation

Freshman

	fear	difficulty	understanding	interest
fear	—			
difficulty	0.16	—		
understanding	0.12	-0.22 $^{\Delta}$	—	
interest	0.09	-0.04	0.43***	—

Sophomore Junior Senior

	fear	difficulty	understanding	interest
fear	—			
difficulty	0.23**	—		
understanding	-0.24***	-0.36***	—	
interest	-0.02	-0.17*	0.27***	—

Data analysis was used by Peason's correlation coefficient.
***$p<0.001$ **$p<0.01$ *$p<0.05$ $\Delta p<0.1$

with hands-on patient care, may lead to an appropriate level of risk perception of radiation.

This study was conducted before the radiation leak from Fukushima Daiichi Nuclear Power Plant following the Great East Japan Earthquake. The impact of this accident is still ongoing, although several months have passed. Many Japanese people do not have even basic knowledge about radiation, but they watched the news, which included daily references to difficult technical terms about radiation. Risk perception of radiation in Japanese people seemed to be increased by the disaster. People living in a country with more than 50 nuclear power plants should have basic knowledge regarding radiation. Thus, it is important to keep examining educational content and methods to reduce the risk perception of radiation to an appropriate level. We will continue to examine the education of medical staff to improve the public's anxiety and fears concerning radiation.

5. Conclusion

Risk perception of radiation didn't change grately and understanding level increased as grade went upward, but interest in radiation decreased after learning basic knowledge about radiation. It is important to carefvlly examine an educational content and the method for the continuance of the interest in radiation after learning basic knowledge of radiation.

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