Nurses' and students' perception of risk from medical practices

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ABSTRACT

Objectives: To determine the risk perceptions of a series of medical practices in non-expert (undergraduates) and expert (nurses) samples.

Methods: Four hundred and forty-seven nurses and 246 undergraduate students participated in this study. They all answered questionnaires about the risk dimensions and acceptance for medical practices.

Results: An exploratory factor analysis on participants’ answers to various dimensions of risk yielded a two-factor structure for risk perception in both samples: for nurses, the factors were “Unknown” and “Dread,” while for students, they were “Dread” and “Lack of Independence.” For both nurses and students, the factor scores of Dread negatively related to individual risk acceptance of medical practices. Furthermore, nurses tended to be more accepting of practices that they knew well (i.e., low unknown scale scores). For students, the subscale scores of the Lack of Independence factor negatively related to individual risk acceptance only for health examination practices. Nurses conceived risks more correctly and concretely compared to students. This was especially pronounced for practices related to medication use.

Conclusions: Although both nurses and students conceived various risk contents from medical practices, their conceptions still differed. Knowledge of these differences in the structure of risk perception and conceived risk contents of various medical practices between nurses and students could be utilized to improve risk communication in clinical practice.

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1. Introduction

Medical practices afford many benefits to individuals’ health. However, occasionally, they can be perceived negatively. Even putting aside people with particularly strong desires to avoid the doctor, people in general tend to avoid visiting doctors if they can or hesitate to accept medical treatments. This phenomenon can be interpreted as a problem of risk perception, which is one of the most important contributors to acceptance of the risks of medical practices.

1.1. Risk perception

Previous research on risk perception in both the general population and expert groups spans several decades. In general, non-experts and experts have consistently shown differences in risk perception for various hazardous events. This is no less true for risk related to medical practices, where experts would be considered medical professionals (e.g., physicians, nurses) and the non-experts would be those involved in non-medical occupations (e.g., university students). The rationale behind this line of research is that understanding the differences in risk perception between experts and non-experts can help with risk communication [1], which would be especially important in clinical practice.

The factor structure of risk perception has been investigated in the past. Perhaps the most well-known is the two-factor structure comprising “Dread” and “Unknown” [2,3]; however, other studies have obtained three-, four-, or even five-factor structures [4–6]. The underlying differences in factor structure may derive from the characteristics of the hazardous events in question (e.g., biotechnology or nuclear waste) and what dimensions of those hazard events are being assessed (e.g., old/new or fatal/not fatal). More specifically, Slovic [2] and Teigen et al. [3] covered a number of
hazards (e.g., football, swimming, nuclear power), whereas Sjöberg [5] and Sjöberg and Drottz-Sjöberg [6] targeted only nuclear waste. Further evidence comes from a study [4] targeting applications of biotechnology to food and medicine: for food applications, four factors—Harmful and Dread Applications, Useful Application, Science Knowledge, New Applications—were extracted, whereas for medical applications, they extracted five factors (Useful and Harmless Applications, Risk Exposure, New and Unknown Risk, Potential Damage to Environment, Observable and Voluntary). Unfortunately, risk acceptance was not examined in this study; however, they did ask about risk estimation using a single question. By looking at the impact of each factor on risk estimation, we can understand what factors are important for risk perception. They examined which extracted factors influenced risk estimation among laypeople and experts, and found that lay estimates of the risk of food applications were predicted by all four factors; in contrast, experts’ estimates were predicted only by the Harmful and Dread Applications and Useful Applications. For medical applications, lay estimates were predicted by Useful and Harmless Applications, while experts’ estimates were predicted by Useful and Harmless Application, Risk Exposure, and New and Unknown Risk. Given that a factor structure for risk perception has been obtained for various other types of hazard events, we expect that a unique factor structure will be observed for medical practices as well.

Furthermore, these unique factors will have specific relationships with risk acceptance. We aimed to determine which factors are related to risk acceptance. Risk perception has been found to be an important contributor to risk acceptance. Specifically, risk perception has been found to explain about 20% of the variance in risk acceptance—a rather high rate—depending on the measures used for both [5]. The factor structure of risk perception may also influence its explanatory contribution to risk acceptance. Thus, we sought to confirm the effect of risk perception about medical practices on individuals’ (both non-experts and experts) risk acceptance.

### 1.2. Conceived risks from medical practices

Assessment is influenced by recalled content. This has been supported by laboratory experiments [7,8]. For instance, Schwarz et al. [7] asked participants to describe examples of situations wherein they behaved assertively and felt at ease or situations wherein they had behaved unassertively and felt insecure. The number of examples that participants needed to describe was 6 (i.e., easy) or 12 (i.e., hard). After this recall task, subjects evaluated their assertiveness. The results showed that subjects rated themselves as more assertive after describing examples of assertive rather than unassertive behaviors if the recall task was easy. Caruso [8] had similar findings to Schwarz et al. for risk assessments of town safety. However, these studies did not discuss the details of the recalled content, which may influence their decisions. For instance, having knowledge of the worst damage caused by a tornado can influence individuals’ decisions about evacuation behavior [9]. As such, risk content is an interesting theme to investigate in relation to risk perception and acceptance.

The contents of the risk of various hazard events are likely to be imagined in a concrete fashion, according to one study [10] wherein participants wrote negative and positive outcomes for various risk behaviors (e.g., taking drugs, smoking, drinking alcohol). This tendency for participants to describe negative outcomes in a more concrete fashion will likely be viewed for medical practices. Additionally, medical professionals’ conceptions of risks may or may not correspond with those of non-medical occupations. This is important to understand, given that, if they communicate to each other with the assumption of different risks in mind, it can interfere with constructive relationships in clinical settings. Thus, for a deeper understanding of risk perception and risk acceptance regarding medical practices, it would be valuable to understand the risk contents conceived from medical practices in both experts and non-experts.

### 1.3. Aims

First, we aimed to determine the differences in the factor structure of risk perception for medical practices between nurses (who served as an expert group) and undergraduate students (who served as a non-expert group). Second, we examined the effect of risk perception on individual risk acceptance in both nurses and students. Finally, we described the risk contents of medical practices as conceived by nurses and students.

### 2. Method

#### 2.1. Participants

A total of 693 individuals—447 nurses and 246 undergraduate students—participated in this study. Nurses worked at three hospitals in Japan. We sent questionnaires to nurses via the hospital management. Answering the questionnaire was entirely voluntary, and only those who agreed to cooperate completed and returned it. Four hundred fourteen were female, 11 were male, and 22 were unknown, and their mean age was 38.2 years (standard deviation = 9.88; range 21–67). They had worked as nurses for an average of 14.4 years (standard deviation = 9.45; range <1–45 years). The undergraduate students had no specific training in medical sciences, and were recruited from a university in Japan. Although we should have included students from different universities, this was not possible. One hundred were female, 134 were male, and 12 were unknown, and their mean age was 18.6 years (standard deviation = 0.85; range 18–23).

#### 2.2. Questionnaire

Seventeen relatively well-known medical practices were used to generate our questionnaire (see Table 1). All of the medical practices and questions concerning them were written in Japanese. All of the questionnaire items are displayed in the Appendix.

The first question determined whether participants had heard of the medical practices (see question (a) in the Appendix). Participants answered the remaining questions only for those medical practices that they had heard about. They then rated medical practices in terms of nine risk dimensions on a 7-point scale to determine the characteristics of risk perception of medical practices (see questions b and d in Appendix).

Before answering the fifth risk dimension question, participants wrote about the risks inherent within each medical practice via a free description. Multiple risks could be given for each practice (see question c in Appendix). We had two purposes in using the free description format. One was to help participants answer the dimensions of risk perception following it, and the other was to determine the differences in risk contents of each medical practice between nurses and students. To determine these differences, we classified respondents according to whether they described medical practices as “dangerous,” “not dangerous,” and “neither (I do not know).” We then calculated the correct answer rates (i.e., descriptions were distinguished between correct or incorrect) and concrete answer rate (i.e., descriptions were distinguished as abstract or concrete), and grouped risk descriptions into categories. To ensure that we distinguished participants’ answers as no risk, unknown risk, and non-response, we instructed participants to write
3. Results

3.1. Awareness

Table 1 shows the percentage of participants who were aware of each medical practice. The medical practices were ranked in descending order of awareness. Among nurses, awareness of all seventeen medical practices exceeded 99%, whereas the rates ranged between 40% and 100% among students. Nurses’ mean awareness of all 17 medical practices was 99%, which was higher than that of students (86%). Two-sample chi-square tests were performed to determine the differences in awareness between nurses and students for each medical practice. Table 1 also shows the p-values (P) and phi (ϕ; effect sizes). According to Cohen[11], ϕ coefficients of 0.10, 0.30, and 0.50 correspond to small, medium, and large effects, respectively. We noted significant differences between nurses and students in the mean awareness of the 17 practices. Non-significant differences in awareness were found for medical practices ranging from protective vaccinations to anticancer drugs.

3.2. Factor structure of risk perception for medical practice

To determine the factor structures of risk perception in both samples, we performed exploratory factor analyses on the risk dimensions. The means of each risk dimension for every medical practice were used in the analysis. In other words, each of the 17 medical practices were evaluated in terms of 9 risk dimensions, and we explored the potential factors of risk perception behind these dimensions. An unweighted least-squares extraction with a promax rotation was used. Items were regarded as loading onto a factor when the absolute value of their factor loadings exceeded 0.35 on only one factor. The number of extracted factors was determined using the eigenvalue criterion (i.e., an eigenvalue for the last extracted factor of greater than 1.0).

Table 2 shows the factor loadings (>0.35) and Cronbach’s α for the factor analysis of nurses, while Table 3 shows those for students.

For the factor analysis among nurses, two factors were ultimately extracted. Four dimensions loaded onto Factor 1, including “lack of personal knowledge,” “lack of scientific basis,” “new,” and “lack of control.” Because this factor seemed to reflect qualities of being uncertain or perplexed, we labeled it “Unknown.” Five dimensions loaded onto Factor 2, including “immediate,” “future impact,” “dread,” “lack of control possibility,” and “lack of personal knowledge.” Factor 1 was labeled “Unknown,” whereas Factor 2 was labeled “Dread.” The factor loadings of factor 1 ranged from 0.15 to 0.70, whereas the factor loadings of factor 2 ranged from 0.15 to 0.55.

Note. The values below each dimension are the means and standard deviations of the seventeen medical practices. Factor 1—Unknown and Factor 2—Dread. Higher factor loadings between the factors are in bold type.
dimensions loaded onto Factor 2, including “fatal,” “dread,” “future impact,” “involuntary,” and “immediate.” As these characteristics related to looming fears, pressure, or evoked harm, Factor 2 was labeled “Dread.” The reliability of the two factors was assessed using Cronbach’s $\alpha$. The $\alpha$s for the Unknown and Dread factors were 0.848 and 0.862, respectively; both values, as can be seen, exceeded the recommended value of 0.70, indicating good internal consistency. These factors showed a strong positive correlation (Pearson’s $r = 0.848$ and 0.862, respectively; both values, as can be seen, exceeded the midpoint (“neither”).

For the factor analysis among students, two factors were again extracted. Three dimensions loaded significantly onto Factor 1, including “lack of scientific basis,” “dread,” and “fatal.” Given its qualities, we labeled this factor as Dread. In contrast, four dimensions loaded onto Factor 2, including “lack of personal knowledge,” “involuntary,” “immediate,” and “lack of control.” Because the dimensions appeared to reflect qualities of poor proactive involvement and low autonomy, this factor was labeled “Lack of Independence.” Notably, the dimensions of “new” and “future impact” did not load onto either factor, and thus were excluded. The Cronbach’s $\alpha$s for the Dread and Lack of Independence factors were 0.906 and 0.629, respectively; as the latter value was below 0.70, it was deemed to have poor internal consistency. Furthermore, the factors showed a relatively weak positive correlation (Pearson’s $r = 0.162$).

3.3. Relationships between risk perception factors and individual risk acceptance

To determine the relationships between the risk perception factors and participants’ personal acceptance, we plotted the degree of personal acceptance for various medical practices onto factor spaces (Fig. 1 depicts the results for nurses and Fig. 2 those for students). The factors extracted via the factor analysis were set as the axes (Factor 1 for the horizontal axis and Factor 2 for the vertical axis) in both figures. Medical practices were located on the factor space according to their factor scores (i.e., the mean value of the dimensions comprising each factor). We used exponential transforms for personal acceptance to depict the differences between medical practices clearly. In both figures, we drew a solid line at 4 on each axis because dimensions were rated on a scale ranging from 1 (“strongly agree”) to 7 (“strongly disagree”), with 4 as the midpoint (“neither”).

For nurses, all medical practices scored below 4.0 on the Unknown factor, except for Lasik eye surgery, indicating that nurses knew these practices well. Dread scores were spread between 3.5 and 5.2, suggesting that dread varied with the medical practice.

Similar results were found for students (Dread score range 2.6–4.9). In contrast, all Lack of Independence scores were above 4.0.

The means of personal acceptance ranged from 3.9 to 6.0 in nurses and 3.1 to 5.4 in students. Among nurses, the large circles (indicating high personal acceptance) tended to cluster around the lower left space of Fig. 1, which suggests that they are well known and have low dread. In contrast, among students, the large circles tended to cluster around the left of Fig. 2, which suggests low dread.

To confirm whether the risk perception factors in fact predict personal acceptance, we ran multiple linear regression analyses for each medical practice. The factor scores were used as independent variables and the degree of personal acceptance was used as the dependent variable. Figs. 3 and 4 show the results for nurses and students, respectively. In these analyses, $p$-values of less than 0.05 were significant.

In nurses, the adjusted coefficients of determination (adjusted $R^2$) for all 17 medical practices were significant ($P = 0.000–0.032$) and ranged from 0.012 to 0.145. For the Unknown factor, standard partial regression coefficients ($\beta$) were significant for most of items except barium examinations, automated external defibrillators, and tracheostomies and ventilators ($P = 0.000–0.026$), and ranged from −0.269 to −0.108. For the Dread factor, the $\beta$ values were significant for all items excepted laparoscopic surgery ($P = 0.000–0.041$) and ranged from −0.328 to −0.103. In summary, although the adjusted $R^2$ values were low, they were all significant. The results suggested that nurses were more likely to accept well-known and low-dread medical practices. In particular, Dread accounted for a significant amount of variance in personal accept ance for 16 of the total 17 medical practices.

Among students, all 17 medical practices had significant

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Table 3

| Dimensions                      | Factor 1 | Factor 2 |
|---------------------------------|----------|----------|
| Dread                           | 0.956    | −0.135   |
| Lack of independence            | 0.941    | 0.089    |
| Lack of personal knowledge      | 0.836    | −0.03    |

Note. “New” (4.15 ± 1.47) and “Future impact” (4.69 ± 1.83) were excluded. Factor 1 = Dread and Factor 2 = Lack of independence. Higher |factor loadings| between the factors are in bold type.
For Dread, the shows the response rates and chi-square test results (description in the free description question for that practice. Table 4 the number of participants out of the total who answered positively. We analyzed participants’ answers to the free description question. Regarding their conceptions of the risk contents of medical practice, 3.4.1. Response rate

3.4.2. Answer patterns

3.4.3. Correctness of risks

Among respondents who described medical practices as “dangerous,” we tallied the number of risks mentioned in each medical practice. Each nurse wrote a mean of 1.40 risks, while each student wrote a mean of 1.05 risks. Risks were counted regardless of their potential duplication—in other words, when two participants wrote the same risk, we counted it as two risks rather than one. Among the 17 medical practices, the highest number of risks for a single medical practice was 629, while the smallest number was 177. To examine the proportion of correct answers among nurses and students, a medical doctor determined the correctness of the descriptions. Incorrect descriptions were those that used incorrect terminology even if the meaning was apparent, or that provided vague answers such as “side effects,” “complication,” “shock,” and “uneasiness.” Table 6 shows the percentage of correct descriptions and the group analysis of differences (using chi-square tests). The mean and rates of fourteen practices were found to significantly differ in terms of correct answer rate, with nurses responding correctly significantly more often compared to students. For protective vaccination, blood transfusion, and oxygen inhalation through a mask, we observed low correct answer rates among nurses, such that they did not significantly differ from those of students.

3.4.4. Concreteness of risks

Two researchers independently divided all descriptions into “abstract” and “concrete” categories for each medical practice. The agreement rate between these raters—measured by counting the number of agreements, dividing by the total number of responses rated, and multiplying by 100—was 85.9%. Cases of non-agreement were discussed until a decision was reached. Table 7 shows the percentage of concrete descriptions and the group difference test results (chi-square test). The mean and seven medical practices...
showed significant group differences, with nurses tending to provide more concrete descriptions than students. All medical practices involving drug administration (i.e., anticancer drug, antibiotic drugs, steroid drug, morphine, and barium examination) were involved in this difference. Notably, for blood transfusion, Lasik eye surgery, and use of tracheostomy and ventilator, a significantly greater number of students responded concretely.

3.4.5. Detailed classification

Descriptions of the risks were then grouped into categories by the same two researchers who performed the analysis of concreteness. Researchers independently collected similar risks for each medical practice, and then discussed them with the aim of achieving consensus on a manageable set of categories. The number of risk categories for each of the 17 medical practices ranged from 7 to 18.

Among nurses, we noted numerous descriptions of psychosomatic symptoms such as “fever” (for protective vaccination) or “rash or itch” (for blood transfusion). We also observed many risks regarding secondary effects occurring after receiving the medical practice, such as “having low immunity or infection” (anticancer drugs) or “complicating diseases or sequelae” (Lasik eye surgery). In contrast, students primarily reported simple emotional descriptions, such as “pain” (protective vaccination) or “bad impression,” “vague fear,” and “looks bad for the health” (anticancer drugs). Students reported descriptions related to appearance changes, such as “changing eye shape,” as well as extreme notions such as “death” (automated external defibrillators: AED).

The descriptions of psychosomatic symptoms for barium examinations indicated that nurses took particular note of the throat, given categories such as “retching or vomiting” or “aspiration.” Students, by contrast, focused on the abdominal area, as per the category of “digestive symptoms.” Likewise, for oxygen inhalation through a mask, nurses conceived a number of risks across the entire body, such as “buildup of carbon dioxide,” “difficulty breathing, spitting, or a decline in lung function,” or “skin problems such as pressure ulcers.” Students, however, focused their attention on the contact site of the mask, such as “pain or discomfort of a mask.” Thus, nurses and students focused on different body parts, with students paying attention to body sites directly linked to the medical practice. Additionally, although both nurses and students conceived risks relating to the medical practice itself and their surrounding environment—such as “medical errors” (x-ray test) in nurses and “error of drug companies, medical staff, or patient” (protective vaccination) in students—nurses provided such descriptions particularly for x-ray tests, MRI/fMRI, tracheostomies and ventilators, oxygen inhalation through a mask, and AED, wherein the practices required dedicated equipment.

4. Discussion

4.1. Awareness and risk dimensions

We examined nurses and students’ perception of risk related to medical practices. Although previous research, such as Teigen et al. [3], dealt with medical practices such as diagnostic x-rays and aspirin in their study on risk perception, these were merely part of a larger set of hazardous events. As noted in section 1, the results of risk perception studies targeting particular domains such as biotechnology or radiation technology can be helpful for improving risk communication about the hazards.

We determined the participants’ awareness of the studied medical practices and their various risk dimensions. Almost all nurses were aware of all 17 medical practices, whereas students’ awareness rates varied from 40% to 100%. Importantly, students’ awareness of these medical practices was unbalanced across the practices. Because one of the duties of medical staff is to explain medical procedures to their patients, understanding what patients do and do not know is useful. For the risk dimensions, both nurses and students rated the medical practices as established scientifically and believed that the risks involved in these practices were beyond their control. To answer the former point, we can refer to Japan’s highly proficient medical care system. Indeed, according to the World Health Report of the World Health Organization [12], the health care system of Japan was ranked first among the World Health Organization’s 191 member states. For example, the 5-year relative survival rate of colorectal cancer was highest among all Organisation for Economic Co-operation and Development member countries between 1998 and 2003, and Japan had the highest number of hospital beds, MRI units, and CT scanners per capita [13]. Nurses are considered to know, at least to some extent, about the quality of Japan’s medical care. Furthermore, Japan has both a
universal healthcare system and a free access system (i.e., people can choose their hospitals freely), giving people widespread access to high-quality medical care. This also means that people are highly concerned about choosing a good hospital. This situation may lead both nurses and students’ subjective estimation of practices being established scientifically to be consistent with the objectively high quality of Japanese medical care. The lack of ability to control risk reported by all participants may be because of the fact that uncertainty (e.g., about the possibility of side effects) is inherent in medical care. However, this possibly suggests the necessity of trying to communicate about what patients can do to limit risk, such as volunteering their own names to reduce medical errors, taking greater care after surgery, engaging in rehabilitation, and using medicines to reduce side effects.

Table 5
Answer patterns for risks conceived in each medical practice.

| Medical practices          | Respondent | Nurse | Student | Cramer’s V | P     |
|----------------------------|------------|-------|---------|------------|-------|
| Protective vaccination     | danger     | 97.0a | 85.3b   | 0.218      | 0.000 |
|                            | no danger  | 1.7b  | 6.2a    |            |       |
|                            | neither    | 1.3b  | 8.5a    |            |       |
| Blood transfusion          | danger     | 98.3a | 89.7b   | 0.190      | 0.001 |
|                            | no danger  | 0.7c  | 3.8d    |            |       |
|                            | neither    | 1.0b  | 6.4a    |            |       |
| Anticancer drug            | danger     | 97.9a | 88.8b   | 0.203      | 0.000 |
|                            | no danger  | 0.7c  | 1.3     |            |       |
|                            | neither    | 1.4c  | 10.0a   |            |       |
| Antibiotic drug            | danger     | 93.6a | 68.8b   | 0.362      | 0.000 |
|                            | no danger  | 3.9   | 6.3     |            |       |
|                            | neither    | 2.5b  | 25.0a   |            |       |
| Steroid drug               | danger     | 96.7a | 64.6b   | 0.442      | 0.000 |
|                            | no danger  | 0.7c  | 3.5d    |            |       |
|                            | neither    | 2.5b  | 31.9a   |            |       |
| Morphine                   | danger     | 93.7a | 64.9b   | 0.427      | 0.000 |
|                            | no danger  | 3.0b  | 0.0f    |            |       |
|                            | neither    | 3.3b  | 35.1a   |            |       |
| Barium examination         | danger     | 88.5a | 52.8g   | 0.402      | 0.000 |
|                            | no danger  | 4.2b  | 19.4f   |            |       |
|                            | neither    | 7.2b  | 27.8g   |            |       |
| Gastric camera             | danger     | 86.5a | 63.8b   | 0.267      | 0.000 |
|                            | no danger  | 6.7b  | 16.1f   |            |       |
|                            | neither    | 6.7b  | 20.1f   |            |       |
| Blood test                 | danger     | 86.9a | 74.0e   | 0.181      | 0.001 |
|                            | no danger  | 9.2   | 13.3    |            |       |
|                            | neither    | 4.0b  | 12.7g   |            |       |
| Lasik eye surgery          | danger     | 88.4a | 89.1    | 0.032      | 0.822 |
|                            | no danger  | 1.3   | 0.6     |            |       |
|                            | neither    | 10.3  | 10.3    |            |       |
| X-ray test                 | danger     | 82.8a | 67.7g   | 0.180      | 0.002 |
|                            | no danger  | 12.6c | 21.1f   |            |       |
|                            | neither    | 4.6a  | 11.2g   |            |       |
| Laparoscopic surgery       | danger     | 86.1a | 42.6e   | 0.412      | 0.000 |
|                            | no danger  | 3.0b  | 11.1f   |            |       |
|                            | neither    | 10.8b | 46.3g   |            |       |
| Cataract surgery           | danger     | 76.1a | 63.2b   | 0.140      | 0.033 |
|                            | no danger  | 5.6   | 7.4     |            |       |
|                            | neither    | 18.3c | 29.4g   |            |       |
| Magnetic resonance imaging (MRI)/Functional magnetic resonance imaging (fMRI) | danger | 69.7a | 42.7g   | 0.271      | 0.000 |
|                            | no danger  | 14.1  | 22.6    |            |       |
|                            | neither    | 16.2b | 34.7h   |            |       |
| Tracheostomy and ventilator| danger     | 88.9a | 57.1b   | 0.361      | 0.000 |
|                            | no danger  | 3.5   | 9.1     |            |       |
|                            | neither    | 7.6b  | 33.8g   |            |       |
| Oxygen inhalation through a mask | danger | 70.0a | 25.2b   | 0.435      | 0.000 |
|                            | no danger  | 12.4a | 29.1a   |            |       |
|                            | neither    | 17.6b | 45.6g   |            |       |
| Automated external defibrillator (AED) | danger | 56.0a | 53.1    | 0.029      | 0.885 |
|                            | no danger  | 16.9  | 18.0    |            |       |
|                            | neither    | 27.1  | 28.9    |            |       |

Note. Superscript *a, b, c and d indicate the results of a residual analysis; *a more at P < 0.01, b less at P < 0.01, c less P < 0.05 and d more P < 0.05.

4.2. Factor structures of risk perception

Two factors were obtained for both nurses (Unknown and Dread) and students (Dread and Lack of Independence). Both nurses and students had a Dread factor. Notably, however, while both Dread factors contained the dimensions of “dread” and “fatal,” they were otherwise composed of different dimensions. For example, among nurses, the Dread factor included dimensions of “future impact,” “involuntary,” and “immediate.” Furthermore, the Dread factor of nurses contained more dimensions than did that of students. An interesting quality of the Dream factor among nurses was its inclusion of the “immediate” dimension. In previous studies targeting hazards such as earthquakes, radiation, or air pollution, the Dream factor contained a dimension of “delayed.” In contrast, for medical practices, the quality of “immediate”
contributed. This is possibly because medical practices are perceived as more urgent and serious risks, such as the acute deterioration aspect of the “shock or allergy” category. Another interesting point is that the dimension of “lack of scientific basis” was found in the Unknown factor among nurses, but in the Dread factor among students. Among students, the Dread factor comprised the dimensions of “dread” and “fatal” (commonly found in the Dread factor) as well as “lack of scientific basis” (commonly found in the Unknown factor). In other words, students’ Dread factor was a mix of the typical Dread factor with elements of the Unknown factor. The Dread factor among students may have focused on aspects of risk unrelated to the self, whereas the Lack of Independence focused mainly on self-efficacy. Previous studies have shown that people have different judgments depending on whether the matter concerned themselves or not. For example, generally, people use sophisticated information processing when the matter is of considerable importance to them [14]. Going back to the description of Caruso’s [8] study above, Caruso thought that one reason for the findings was that people were more motivated to process information about the self than information about others. Caruso assumed that people initially judge whether information is related to the self or not, which then has considerable influence on subsequent information processing. It is likely that self-related information influences judgments about the risk dimensions of medical practices among students, although this must be studied in more depth in the future.

Notably, the two-factor structure involving Dread and Unknown among nurses accords with the two-factor structure found in previous studies [2,3]. In contrast, the two-factor structure among students (Dread and Lack of Independence) was somewhat unique—previous studies [4–6] rarely noted the Lack of Independence factor. Furthermore, the correlation between the factors among students, although positive, was rather weak.

4.3. Relationships between risk perception and individual risk acceptance

Our findings suggested that risk perception of medical practices influenced both experts’ and non-experts’ risk acceptance. Thus, although all of the hazardous events included in the study were medical practices, the effect of risk perception on individual risk acceptance might differ according to the practice. Despite the

| Medical practices                  | Nurses | Students | ϕ   | P       |
|-----------------------------------|--------|----------|-----|---------|
| Protective vaccination            | 40.05  | 35.15    | 0.034 | 0.434   |
| Blood transfusion                 | 56.41  | 66.22    | 0.070 | 0.122   |
| Anticancer drug                   | 59.41  | 37.80    | 0.147 | 0.000   |
| Antibiotic drug                   | 45.43  | 12.00    | 0.285 | 0.000   |
| Steroid drug                      | 51.00  | 15.38    | 0.262 | 0.000   |
| Morphine                          | 64.15  | 7.89     | 0.332 | 0.000   |
| Barium examination                | 50.34  | 27.85    | 0.179 | 0.001   |
| Gastric camera                    | 83.12  | 58.16    | 0.294 | 0.000   |
| Blood test                        | 87.87  | 48.72    | 0.424 | 0.000   |
| Lasik eye surgery                 | 63.06  | 52.94    | 0.108 | 0.028   |
| X-ray test                        | 58.82  | 21.82    | 0.365 | 0.000   |
| Laparoscopic surgery              | 70.28  | 11.11    | 0.341 | 0.000   |
| Cataract surgery                  | 71.09  | 55.17    | 0.158 | 0.007   |
| Magnetic resonance imaging (MRI)/Functional magnetic resonance imaging (fMRI) | 58.17 | 12.50 | 0.429 | 0.000 |
| Tracheostomy and ventilator       | 63.18  | 26.67    | 0.270 | 0.000   |
| Oxygen inhalation through a mask  | 33.13  | 46.43    | 0.103 | 0.163   |
| Automated external defibrillator (AED) | 63.30 | 35.29 | 0.273 | 0.000   |
| Mean                              | 60.88  | 37.80    | 0.191 | 0.000   |

| Medical practices                  | Nurses | Students | ϕ   | P       |
|-----------------------------------|--------|----------|-----|---------|
| Protective vaccination            | 52.79  | 53.33    | 0.005 | 0.906   |
| Blood transfusion                 | 35.20  | 58.11    | 0.167 | 0.000   |
| Anticancer drug                   | 65.08  | 39.02    | 0.180 | 0.000   |
| Antibiotic drug                   | 73.16  | 32.00    | 0.359 | 0.000   |
| Steroid drug                      | 59.95  | 35.90    | 0.176 | 0.000   |
| Morphine                          | 73.85  | 50.00    | 0.154 | 0.002   |
| Barium examination                | 80.07  | 59.49    | 0.196 | 0.000   |
| Gastric camera                    | 83.44  | 84.69    | 0.015 | 0.770   |
| Blood test                        | 87.87  | 85.47    | 0.032 | 0.509   |
| Lasik eye surgery                 | 62.69  | 74.51    | 0.121 | 0.013   |
| X-ray test                        | 15.20  | 16.36    | 0.015 | 0.786   |
| Laparoscopic surgery              | 69.23  | 29.63    | 0.234 | 0.000   |
| Cataract surgery                  | 64.93  | 71.26    | 0.061 | 0.291   |
| Magnetic resonance imaging (MRI)/Functional magnetic resonance imaging (fMRI)| 62.75 | 32.14 | 0.272 | 0.000 |
| Tracheostomy and ventilator       | 65.12  | 84.91    | 0.198 | 0.000   |
| Oxygen inhalation through a mask  | 81.60  | 92.86    | 0.107 | 0.140   |
| Automated external defibrillator (AED) | 82.57 | 83.82 | 0.016 | 0.829   |
| Mean                              | 64.68  | 59.00    | 0.049 | 0.000   |
variance in the Dread factor scores by medical practices in both nurses and students. Dread was negatively related to personal acceptance for 16 practices among nurses and all 17 among students. Among nurses, Unknown factor scores were negatively related to personal acceptance of medical practices except barium examinations, AED, and tracheostomies and ventilators. Thus, nurses tended to be more accepting of well-known and low-dread medical practices.

For students, the Lack of Independence factor scores were negatively related to personal acceptance of the health examination items, including gastric cameras, barium examinations, blood tests, and MRJ/MRI, along with protective vaccination. Thus, students appear to be more accepting of these practices so long as they are able to be proactively involved in them or have autonomy in making decisions regarding them. Other studies have also noted that, along with risk perception, easy access to and greater knowledge of screening services (specifically cancer screening) positively relates to consultation behavior for these services [15]. This makes this finding particularly useful, given that many countries are seeking to improve medical check-up rates. The Ministry of Health, Labour and Welfare in Japan also has the goal of improving the medical check-up rate [16,17]. In the future, in addition to existing strategies such as improving service delivery by healthcare providers or community demand for and access to cancer screening services [18], it may be helpful to address the Lack of Independence factor of risk perception among non-experts, such as telling what patients can do to reduce the risks inherent in various medical practices. This may improve acceptance of these practices (both cancer screening and medical check-ups) among students.

4.4. Conceived risks

Finally, we attempted to grasp the conceived risk contents for each studied medical practice among both nurses and students. We also looked at the response rate for this portion of the survey, the correctness and concreteness of participants' answers, and their answer patterns (i.e., whether they regarded a practice as dangerous or not). Students had significantly higher response rates than did nurses on average. This suggests that they were more comfortable in answering and were not as concerned with making errors. Nurses, in contrast, tended to respond more correctly and concretely. Nurses likely responded more correctly because of their greater knowledge about medical practices. The greater concreteness, particularly for medical practices involving drugs, was perhaps because they had to often explain the risks inherent in a given drug in an easy-to-understand way to patients, such as by citing concrete examples of risks.

Regarding the answer patterns, while the “danger” category was the largest in absolute terms for both students and nurses, more nurses were in the danger category than were students, whereas more students were in the “no danger” and “neither” categories than were nurses. Students' likelihood of responding with “neither” is reasonable because they had less knowledge about medical practices than did nurses. However, it was interesting that students also responded with “no danger” more often, given that no act is without some risk. This is also in contrast to the detailed classification of students' free descriptions, where students tended to include more extreme risks such as “death.” These findings may be the result of type I thinking, which is characterized by fast, automatic, emotional, and low-load thoughts [19]. Furthermore, younger individuals tend to have lower risk perception, which in turn lead to higher risk-taking behavior [20]. Overall, students' mention of “no danger” may have been led by their type I thinking habits, which contribute to low risk perception in adolescence.

Finally, the results regarding risk categories supported our thought that both experts and non-experts will report various conceived risk contents for medical practices. We noted several differing categories of risks specific to either nurses or students. Characteristically, nurses reported numerous descriptions of psychosomatic symptoms or secondary effects. In contrast, students had descriptions containing more emotion, that concerned their appearance, and that were extreme (e.g., relating to “death”). This coincides with earlier findings that, although younger individuals may underestimate the degree of risk, they also overestimate the probability of sudden death compared to adults [21]. Furthermore, nurses and students both focused on different body parts, with students paying specific attention to the body sites directly linked to medical practice, and nurses’ attention to the entire body. Although both nurses and students conceived risks derived from the current situation and surrounding environment, nurses mainly referred to such risk for medical practices with dedicated equipment. We believe that the differences in risk contents of medical practices between nurses and students found in this study can be utilized for better risk communications in clinical practice.

4.5. Future issues

We examined the factor structure of risk perception from medical practices in non-expert and expert samples. In both samples, a two-factor structure was yielded: nurses exhibited “Unknown” and “Dread,” while students exhibited “Dread” and “Lack of Independence.” Although the degree of influence differed by medical practice, both sets of factors of risk perception influenced risk acceptance. Furthermore, experts and non-experts conceived various risk contents for medical practices and described them slightly differently. Overall, these findings will help in improving risk communication between medical experts and patients.

It must be noted that our data suggest no possible explanations for these findings. Thus, the underlying mechanisms for our results should be investigated in future studies. Furthermore, although we focused on examining the effect of risk perception on individual risk acceptance in this study, adding factors other than risk perception and applying the Artificial Neural Network Model will enable us to better explain individual risk acceptance. Finally, although we used nurses as the expert sample, medical experts would also include physicians and pharmacists. Thus, grasping the differences among different occupations might add further understanding of how to smoothen communication in team medical care.

Author contributions

Adachi conceived the study, designed the trial, and obtained research funding. Adachi collected the data, while Adachi and Kikuchi analyzed them. Adachi drafted the manuscript, and both authors contributed to its revision. Adachi takes responsibility for the paper as a whole.

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Appendix. Questionnaire

a. Awareness

Have you heard of the following medical practices? (never heard or have heard)
b. Risk dimensions I
1. Lack of scientific basis*: To what extent are the following medical practices established scientifically? (1 = not established scientifically to 7 = established scientifically)
2. Dread: Are following the medical practices intuitively frightening to you or not? (1 = not dread to 7 = dread)
3. Involuntary*: Do you believe that the following medical practices compel you to accept them or not? (1 = involuntary acceptance to 7 = voluntary acceptance)
4. New*: Are the following medical practices new or old? (1 = old to 7 = new)
NOTE. *Reverse scored
5. Lack of personal knowledge*: If you think that the following medical practices have risk, how precise is your personal knowledge of them? (1 = not known precisely to 7 = known precisely)
6. Fatal: If you think that the following medical practices have risk, how fatal do you believe is the harm from them? (1 fatal to 7 = neither)
7. Immediate: If you think the following medical practices have risk, how immediate do you believe the harm is? (1 = delayed effect to 7 = immediate effect)
8. Future impact: If you think the following medical practices have risk, to what extent do you believe that the medical practices would influence your future? (1 = effect would have no future impact; 7 = effect has an impact on the future)
9. Lack of control*: If you think that the following medical practices have risk, to what extent do you believe you can limit the harm they cause through your own efforts? (1 = cannot reduce; 7 = can reduce)
NOTE. *Reverse scored
c. Personal acceptance
Can you accept the following medical practices? (1 = unacceptable; 7 = acceptable)
NOTE. *Reverse scored

Appendix A. Supplementary data
Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.ijnss.2017.03.002.

References
[1] Austin LC, Fischhoff B. Injury prevention and risk communication: a mental models approach. Inj Prev 2012;18(2):124–9.
[2] Slovic P. Perception of risk. Science 1987;236(4799):280–5.
[3] Teigen KH, Burn W, Slovic P. Social risks as seen by a Norwegian public. J Behav Decis Mak 1988;1(2):111–30.
[4] Savadori L, Savio S, Nicolata E, Rumati F, Finscane M, Slovic P. Expert and public perception of risk from biotechnology. Risk Anal 2004;24(5):1289–99.
[5] Sjoberg L. Factors in risk perception. Risk Anal 2000;20(1):1–11.
[6] Sjoberg L, Drottz-Sjoberg BM. Risk perception by politicians and the publications. Energ Environ 2008;19(3–4):455–83.
[7] Schwarz N, Bless H, Strack F, Klumpp G, Rittenauer-Schatka H, Simons A. Ease of retrieval as information: another look at the availability heuristic. J Pers Soc Psychol 1991;61(2):195–202.
[8] Caruso EM. Use of experienced retrieval ease in self and social judgements. J Exp Soc Psychol 2008;44(1):148–55.
[9] Hansson S, Tietjed JD, Hansson PO. Natural disaster: long-range impact on human response to future disaster threats. Environ Behav 1979;11:268–84.
[10] Moore S, Gullone E. Predicting adolescent risk behavior using a personalized cost-benefit analysis. J Youth Adolesc 1996;25(3):343–59.
[11] Cohen J. Statistical power analysis for the behavioral sciences. second ed. Hillsdale, NJ: Lawrence Erlbaum; 1988.
[12] World Health Organization. The World Health Report 2000. Health Systems: improving performance. Geneva: World Health Organization; 2000.
[13] Organisation for Economic Co-operation and Development. Health at a glance 2015. Paris: OECD Publishing; 2015.
[14] Gilbert DT, Krull DS. Seeing less and knowing more: the benefits of perceptual ignorance. J Pers Soc Psychol 1988;54:193–202.
[15] Power E, Miles A, von Wagner C, Robb K, Wardle J. Uptake of colorectal cancer screening increased for breast, cervical, and colorectal cancers. Am J Prev Med 2007 [cited 2016 Aug 30]. Available from: http://www.mhlw.go.jp/shingi/2007/01/dl/d0615-f1.pdf.
[16] Ministry of Health, Labour and Welfare. Cancer control promotion basic plan. 2007 [cited 2016 Aug 30]. Available from: http://www.mhlw.go.jp/shingi/2007/06/dl/d0615-f1a.pdf.
[17] Ministry of Health, Labour and Welfare. Cancer Control Promotion Council; 2016 [cited 2016 Aug 30]. Available from: http://www.mhlw.go.jp/stf/shingi/shingi-gan.html?tid=128235.
[18] Breslow RA, Rimer BK, Baron RC, Coates RJ, Kerner J, Wilson KM, et al. Introducing the community guide’s reviews of evidence on interventions to increase screening for breast, cervical, and colorectal cancers. Am J Prev Med 2008;35(15):S14–20.
[19] Frankish K, Evans JS. BT. The duality of mind: an historical perspective. In: Evans JS, Frankish K, editors. In two minds: dual processes and beyond. Oxford, England: Oxford University Press; 2009. p. 1–30.
[20] Reniers RLEP, Murphy L, Lin A, Bartolome SP, Wood SJ. Risk perception and risk-taking behaviour during adolescence: the influence of personality and gender. PLoS ONE 2016;11(4):e0153842.
[21] Fischhoff B, Buine de Bruin W, Parker AM, Mullenberg SG, Halpern-Felsher B. Adolescents’ perceived risk of dying. J Adolesc Health 2010;46(3):265–9.