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Development of an effective tool for risk communication about food safety issues after the Fukushima nuclear accident: What should be considered?

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ABSTRACT

Although the Fukushima nuclear accident (FNA) in 2011 led to strong public anxiety about radioactive contamination of foods, the most appropriate way to communicate this risk has been poorly researched. We sought to design, develop, evaluate, and optimize an effective risk communication (RC) tool for food consumers after the FNA. To design this tool, a classical systematic qualitative research framework that consisted of formative evaluation, development of a pilot RC tool, and outcome evaluation was applied. The formative evaluation consisted of focus group interview (FGI) with food consumers: its aim was to identify the major risk messages. Due to the low knowledge base of the food consumers and the absence of a credible existing information source, a pilot RC tool was developed. An educational book was selected as the most effective RC vehicle. The FGI results were reflected in the content of the book, which was presented in a 'frequently asked questions and answers' format. To ensure ready comprehensibility of the book, the scientific words were paraphrased and visual aids were employed. To ensure credibility of the RC, evidence supporting its statements was provided and it was made clear that the RC was a collaborative message from multiple risk communicators (consumer organizations, government bodies, and academia). Outcome evaluation with a consumer survey showed that the RC tool effectively increased the knowledge base of food consumers and relieved their anxieties. This study suggests that in the event of another nuclear accident, food safety RCs should meet the following key requirements: 1) the RC should send a clear message that reassures food consumers that the fatal risk is well controlled, which will reduce public fear and outrage; 2) the RC should improve the knowledge base of food consumers about food safety by providing appropriate education; and 3) the RC should be produced *via* multi-institutional cooperation so that the credibility of risk communicators is rebuilt. Our results may help the planning of an effective radiological RC strategy for food consumers, thereby preventing misunderstandings and relieving food consumers of unnecessarily severe anxiety.

1. Introduction

A food risk assessment is the process of identifying and analyzing the dangers posed throughout the overall food processing and delivery chains, and its growing importance has been continually reported in a food safety field (Aven, 2016). Most researchers of the food risk assessment have mainly focused on investigating presence, survival/fate, and alterations in characteristics of microbiological risks, including *Listeria monocytogenes*, toxin-producing *Staphylococcus aureus*, etc. in a variety of potentially hazardous foods (Barancelli et al., 2014; Carrascosa et al., 2016; Jesus et al., 2016; Lee, Kim, Choi, & Yoon, 2015). Although some researchers have tried to find efficient ways or systemic approaches to remove or control microbiological risks based on empirical results from scientific analyses (Cusato et al., 2013, 2014; Lee, Cappato, Corassin, Cruz, & Oliveira, 2016), researches on chemical risks are relatively scarce in a food safety field, particularly for radiological risks.

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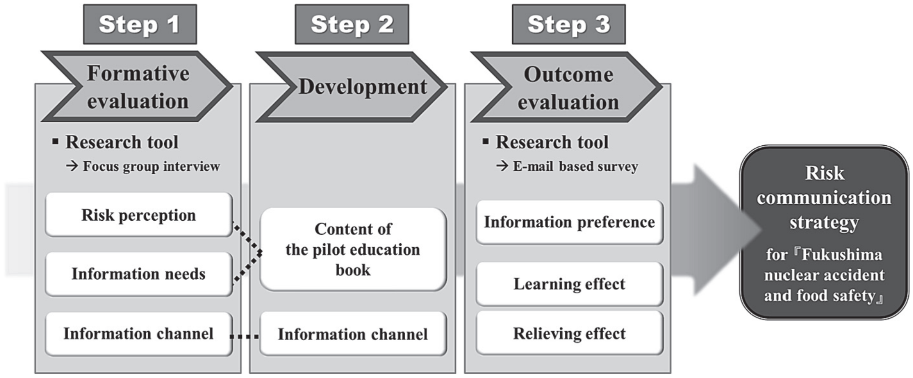

Fig. 1. Overall framework of this study.

On March 11, 2011, on the other hands, the Fukushima nuclear power plant in Japan was extensively damaged by a huge earthquake (magnitude: 9.0) that was accompanied by multiple tsunami waves. The damage led to radiation fallout (Thielen, 2012): the estimated total activity of the radionuclides released into the atmosphere was 5.2×10^{17} Bq (NERH, 2011; Steinhauser, Brandl, & Johnson, 2014), while the total radionuclide activity in the seawater near the nuclear plant exceeded 10^7 Bq/m^3 (Bailly du Bois et al., 2012).

In the case of nuclear accidents, the primary route of human internal radiation exposure is *via* food consumption, namely, the transmission to food consumers of radioactive compounds in contaminated animals, plants, fresh water, and soil (Christodouleas et al., 2011; IAEA, 2010). Indeed, after the Fukushima nuclear accident (FNA), Hamada and Ogino (2012) and Hosono, Kumagai, and Sekizaki (2013) reported radioactive contamination in various foods (including milk, vegetables, seafood, meats, eggs, and cereals) and drinking water in Japan that exceeded the provisional regulation levels (1–2000 Bq/kg).

After the FNA, an enormous amount of information on the FNA spread rapidly all over the world due to the internet and they were far more than those during the Three Mile Island and Chernobyl nuclear accidents (Friedman, 2011). However, despite this global explosion of information about the FNA, there was little effective risk communication (RC) that was based on correct and scientific information. This was partly because of the dominance of several media outlets, which reported the accident and its after-effects in a sensationalist and fear-inducing manner that caused unnecessarily severe anxiety in the public about the effects of the FNA (Figueroa, 2013). Moreover, there was little research on RC strategies for food consumers after the FNA: the existing research on the FNA mainly focused on measuring the radionuclides that were released into the environment after the FNA (Bailly du Bois et al., 2012; Buesseler, Aoyama, & Fukasawa, 2011; Hirose, 2012; Steinhauser et al., 2014; Stohl et al., 2012), the effects of radiation exposure on human health (Christodouleas et al., 2011; Ten Hoeve & Jacobson, 2012; Tsubokura, Gilmour, Takahashi, Oikawa, & Kanazawa, 2012), and the degree of radioactive contamination in drinking water and foods in Japan (Chiu, Huang, Wuu, & Wang, 2013; Harada et al., 2013; Merz, Steinhauser, & Hamada, 2013; Nihei, 2013; Watabe, Ushio, & Ikeda, 2013; Yamada, 2013). Thus, a tool that adequately communicates the risk of food contamination after the FNA to the general public is needed.

The United States Environmental Protection Agency has emphasized in its "seven cardinal rules of RC" that the following two approaches are needed to develop an effective RC tool for environmental disasters: first, 'listen to the specific concerns of the public', and second, 'plan your tool carefully and evaluate your efforts' (Covello & Allen, 1992). In addition, several RC researchers suggested recently that RC tools should be developed by applying a classical systematic qualitative research framework that consists of the following three elements: formative research that defines the needs of the target group (step 1), development and implementation of the RC tool (step 2), and outcome evaluation that tests whether the tool can achieve its aims (step 3) (Noar, 2006; Tiozzo et al., 2011). Recently, we addressed the first requirement of the United States Environmental Protection Agency ('listen to the specific concerns of the public') with regard to developing a post-FNA RC tool, namely, we surveyed general food consumers to determine their risk perception, knowledge, confidence in existing information sources, and information needs after the FNA (Kim et al., 2015).

In the present study, a RC for food consumers in South Korea after the FNA was developed by performing steps 1–3 (Fig. 1). Step 1 consisted of focus group interview (FGI) to define the needs of South Korean food consumers, while in steps 2 and 3, a pilot RC tool was developed and evaluated for its effectiveness, respectively. Thus, the overall research objectives were 1) to identify which RC content is effective, 2) to develop and optimize a RC, and 3) to identify the key practical requirements needed to develop an effective RC for food consumers about FNA-related food safety issues.

2. Formative evaluation: focus group interviews

According to the hazard plus outrage approach taken in a classical RC study (Robertson & Pengilley, 2012; Sandman, 1987), any risk of radioactive contamination of foods is considered to be a substantial risk, namely, it associates with 'high hazard and high outrage'. This relates directly to the intrinsic characteristics of radioactive food contamination, namely, the involuntariness of possible exposure, the lack of personal control over such exposure, the lack of familiarity with nuclear accidents, the possibility that exposure can cause dreadful diseases, and the fact that the radionuclides can diffuse invisibly over time and space. The high outrage associated with radioactive food contamination is problematic for risk communicators because when the public are outraged, they may resist RCs or have difficulty in accepting any information in an RC even when the RC contains accurate information (Lundgren & McMakin, 2013). Thus, it was considered very important in this study to identify all of the FNA-related issues of South Korean food consumers.

In-depth investigation on the specific food consumers provides key information about the phenomenon of public perception and acceptance in the fields of food science (Poelman, Delahunty, & de Graaf, 2017). FGI is one of the qualitative research tools by using