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Implications for effective food risk communication following the Fukushima nuclear accident based on a consumer survey

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ABSTRACT

Food consumers became more concerned about radioactive contamination of food after the Fukushima nuclear accident in 2011; thus, the present study aimed to survey food consumers to obtain their views on risk perception, general knowledge, confidence in existing information sources, and the information required to develop strategic risk communication plans. In total, we surveyed 1208 food consumers in the Republic of Korea, who were selected randomly for a multi-stage stratified systematic sampling process with a computer-aided telephone interview based on random digit dialing. A high number of consumers (77.2%) actually avoided purchasing Japanese foods because they perceived that there was a potential radiological risk. The consumers' levels of knowledge about radioactivity, environmental radiation, and health effects were relatively low, particularly the safe dosage limits for radiation and natural radioactive decay (recognition rate < 30.0%). A number of the respondents (56.1%) were seldom or never confident in the government's handling of food safety following the accident. Among the existing information sources, mass media (36.9%) were considered to be the most credible, followed by consumer organizations (26.6%), governmental institutions (12.5%), and food safety experts (7.7%). The subjects required a variety of information on food safety issues related to radioactive contaminations, but their actual search behaviors were highly passive. In relation to the socio-demographic characteristics, women and consumers with high involvement in food purchasing tended to be more sensitive about the potential risks for food produced in those areas affected by the nuclear accident. In relation to general knowledge, women, the elderly, and those with low educational attainment tended to have low awareness of radioactivity, environmental radiation, and the health effects of radiation exposure. These results provide a valuable resource for understanding consumers' general opinions about food safety issues following the Fukushima nuclear accident. In addition, they may facilitate the production of meaningful recommendations regarding appropriate risk communications and the education of consumers about the radiological safety of foods in the context of a potential nuclear emergency.

1. Introduction

On March 11 2011, a massive earthquake (magnitude 9.0) caused a major tsunami with waves as high as 40.5 m, which severely damaged the Fukushima Daiichi (Nos. 1 and 2) nuclear power plants (Hamada, Ogino, & Fujimichi, 2012). The accident released huge volumes of radioactive materials (total activity: 1.6×10^{17} Bq for ^{131}I and 1.5×10^{16} Bq for ^{137}Cs) into the atmosphere and marine environment, according to the Japanese Nuclear and Industrial Safety Agency (NERH, 2011). The radionuclides released into different environments can be transferred to drinking water and foods, and the ingestion of radioactively contaminated water and foods exposes the human body to internal radiation (IAEA, 2010). Radionuclide levels above the provisional regulatory values set by government of Japan (1–2000 Bq/kg, depending on the food type) were detected in foodstuffs, such as raw milk, vegetables, mushrooms, fruit, nuts, seaweed, marine invertebrates, coastal fish, freshwater fish, beef, wild animal meat, brown rice, wheat, and tea leaves, in various prefectures of Japan, and restrictions on the distribution and consumption of contaminated foods were implemented recently (Hamada et al., 2012).

Food consumers around the world were concerned about the safety of food from Japan due to radioactive contamination

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following the accident and some avoided purchasing all Japanese foods, regardless of whether they were actually contaminated (Hosono, Kumagai, & Sekizaki, 2013; Kimura, Bain, Ransom, & Higgins, 2013; McKendree, Ortega, Widmar, & Wang, 2013). The perceptions and attitudes of consumers regarding food quality and safety appear to influence the global food market because consumers only purchase foods if they perceive that both the quality and safety are sufficiently high to merit the price demanded (Grunert, 2005; Ortega, Wang, Wu, & Olynk, 2011). Thus, it is important to assess the risk perceptions and attitudes of food consumers with respect to the Fukushima nuclear accident in terms of different environments, foodstuffs, eating behaviors, risk communication, and the distribution of information.

To prevent consumers from being unnecessarily anxious about food safety issues following the accident, adequate risk communication should be provided based on investigations of: 1) the information that consumers are actually interested in receiving, 2) how to provide the correct information in an effective manner, 3) previous knowledge level of consumers about the issues to be communicated (Cope et al., 2010). Several researchers have studied the effects of the Fukushima accident, but they focused on the current status and the limitations of risk communication in a wide sense (Butler, Parkhill, & Pidgeon, 2011; Friedman, 2011; van Deventer, del Rosario Perez, Tritscher, Fukushima, & Carr, 2012), the responses of Japanese subjects or foreigners who stayed in Japan (Rubin, Amlôt, Wessely, & Greenberg, 2012; Tateno & Yokoyama, 2013), or changes in risk perception and trust with respect to nuclear power itself or related policy (He, Mol, Zhang, & Lu, 2012; Ho et al., 2013; Kim, Kim, & Kim, 2013; Visschers & Siegrist, 2012; Wittneben, 2012). It is important to investigate the risk perceptions and food purchasing behaviors of international consumers to gain insights into their knowledge of radioactive contamination of food from a safety perspective, but no specific studies of this subject were found in a review of the literature.

In particular, the Republic of Korea is a neighbor of Japan, thus investigating the risk perception and food purchasing behavior of consumers in the Republic of Korea would be helpful for predicting the trends among food consumers in response to the Fukushima nuclear accident. Therefore, the present survey aimed to assess the anxiety of consumers regarding the potential radioactive contamination of foodstuffs following the Fukushima nuclear accident by exploring: 1) the risk perceptions of the subjects regarding the nuclear accident and its effects on food safety; 2) the knowledge of subjects regarding radioactivity, environmental radiation, and the health effects of radiation exposure; 3) confidence in existing information sources related to food safety; and 4) the requirements of consumers in relation to food safety information and education.

2. Methods

2.1. Survey population and sample allocation

This survey targeted adult consumers (>18 years old) from the Republic of Korea. Before the survey, samples ($n = 1200$) were pre-allocated according to population data from the statistical yearbook of Republic of Korea during August 2012 (MOSPA, 2012) using the multi-stage stratified systematic sampling method (Barnett, 2003). The sampling fraction used for each stratum (gender, age, and geographic location) was proportional to the total population.

2.2. Research instrument

The questionnaire used as a survey instrument to assess consumer perceptions of food safety following the Fukushima nuclear accident was developed by a consulting committee that comprised experts from different institutions (Government: Food Contaminants Division at the National Institute of Food and Drug Safety Evaluation; experts in food safety: Department of Food Bioscience and Technology at Korea University; experts in risk communication: School of Communication at Sogang University; and experts in consumer surveys: Consumers Union of Korea). The committee members participated in the development of the draft instrument and the revision of the final questionnaire. Finally, Gallup Korea (Seoul, Republic of Korea) confirmed the clarity and validity of the survey instrument.

The instrument comprised 22 questions in total, including sub-questions (each with three to seven reply options, including the option “I don't know” or “others”), and it was divided into five sections: 1) perceptions of Japanese foods following the Fukushima accident; 2) perception of the risk of potential nuclear accidents in surrounding countries; 3) knowledge of the concepts of radioactivity, environmental radiation, and the health effects of radiation exposure; 4) confidence in existing information sources related to food safety; and 5) requirements for food safety information and related search behaviors after the accident (Table 1). In Section 3 of the questionnaire, six questions were designed to test the respondents' ability to identify the correct answers, which were determined by reference to the USEPA (2012) and Korea Nuclear Safety and Security Commission (NSSC, 2012), where the reply options comprised “true”, “false”, or “I don't know”.

In general, the perceptions and attitudes of consumers regarding food safety vary according to demographic and socio-economic factors such as gender, age, education level, and economic status (Wilcock, Pun, Khanona, & Aung, 2004). Thus, questions related to the socio-demographic characteristics of individuals were also included in the questionnaire, including gender, age, location, education level, and family income. In addition, involvement in food purchasing was also considered to be a variable that determines a consumer's sensitivity and their perception of the potential risk of radioactive contamination in foods.

The research instrument was pre-tested by consumers ($n = 30$) and expert researchers ($n = 15$). The target consumers for the pre-test were selected randomly, although their gender and age were considered. The pre-test consumers were asked to respond to the following questions: 1) How much time did it take to complete the questionnaire? 2) Did the questionnaire contain expressions that were unclear or difficult to interpret? 3) Did you clearly understand the terminology used? 4) Do any of the terms need to be clarified? 5) Did you feel displeasure, negative feelings, or resistance when you completed the questionnaire? 6) Did you have any opinions that differed from the existing response options? The researchers checked that the responses provided by the pre-test consumers were consistent and they modified the questionnaire according to the reviewers' comments. The answers provided by the pre-test consumers were not included in the survey results.

2.3. Data collection

Trained professional interviewers from Gallup Korea (Seoul, Republic of Korea) conducted the survey using the computer-assisted telephone interview methodology during October 2012. We used random digit dialing samples of telephone numbers and panel members because surveys that use probability-based sampling have been shown to be more representative of a nation than non-probabilistic Internet-based sampling (Chang & Krosnick, 2009). In total, 1208 samples were collected from the telephone interviews (sampling error: ±2.8% at 95% confidence level) and sample weighting was used to correct for the unequal sample inclusion probabilities for the pre-allocated samples based on the