Commentary

Risk Communication on Health Effects of Low-dose Ionizing Radiation

−Practice of Community-Based Risk Communication−

Former faculty member, University of Fukui, **Naoki Yamano**

A new methodology of community-based risk communication was developed in cooperation with the local community by targeting the risks associated with the health effects of exposure to low-dose radiation after the Fukushima Daiichi Nuclear Accident. Before and after the study sessions that were conducted for three years as a joint pilot program with the citizens of Tsuruga, attitude surveys were conducted to analyze changes in the participants' knowledge, risk perceptions, and attitudes with respect to radiation, thereby validating the effectiveness of the methodology used for community-based risk communication. This commentary examines community-based risk communication with reference to the matters discussed in the public forum on the health effects of exposure to low-dose radiation that was held in Ookayama in March 2016.

KEYWORDS: Risk communication, low-dose ionizing radiation, nuclear consensus building, public participation, health effects, community-based, social implementation

I. Introduction

The most pressing and long-standing issue that continues to stand in the way of the recovery and reconstruction efforts conducted since the Fukushima Daiichi Nuclear Accident is the health effects of exposure to low-dose radiation. We will not be able to overcome any possible future obstacles and restore public trust unless a greater understanding of radiation is fostered among the public.

The importance and urgency of risk communication were also pointed out in Chapter VI of the final report [1)] published by the Government's Investigation Committee on the Accident at the Fukushima Nuclear Power Plant of Tokyo Electric Power Company.

After the accident, risk communication was conducted by the Ministry of the Environment (MOE), the Ministry of Education, Culture, Sports, Science and Technology (MEXT), the Consumer Affairs Agency (CAA), and numerous research institutes, learned societies, and other associations. Many briefing sessions and lecture meetings have already been held, and

DOI : 10.15669/fukushimainsights.Vol.3.220

Originally published in Journal of the Atomic Energy Society of Japan (ISSN 1882−2606), Vol. 58, No. 8, p. 499−503 (2016) in Japanese. (Japanese version accepted: May 30, 2016)

many materials on risk communication are available. In addition to lecture meetings for large audiences, interactive meetings are also held for relatively small groups. Research institutes, learned societies, and associations are also conducting training to produce radiation communicators.

Nonetheless, as indicated by the results from the latest attitude survey conducted by the CAA [2], public concern over the health effects of exposure to low-dose radiation has yet to be dispelled. Why is this?

Conventional communication about nuclear did not postulate a major disaster like the one that occurred in Fukushima. This method was developed with the aim of promoting public understanding of nuclear and gaining public acceptance in ordinary times based on the fundamental assumption that nuclear safety was assured. However, the method seems to have been employed in risk communication even after the Fukushima Daiichi Nuclear Accident.

The health effects of exposure to low-dose radiation can be roughly divided into the following: probabilistic effects and psychosocial effects.

To provide scientific evidence of the probabilistic effects, quantitative evaluations have been conducted by the ICRP and UNSCEAR to assess the risks associated with exposure to a dose of 100 mSv or more as well as in many other epidemiological studies. The psychosocial effects stem from the following factors: uncertainty concerning the abovementioned evaluations of the risks posed by low-dose exposure; a deterioration in the living, cultural, educational, and economic environments along with a fragmentation of the community following the evacuation; and public mistrust and anxiety due to a reduced level of trust toward the government and experts. Fear and anxiety concerning the radioactive contamination of food typically induce aversive behavior. It must be remembered that, for some people, this may progress even further and develop into radiophobia and a constant fear of a negative turn of events.

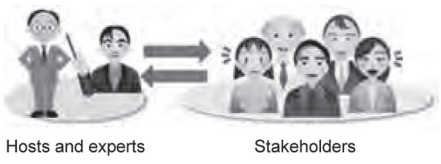
So, how can we communicate risk-related information in a scientifically sound manner? How can we handle uncertainties that cannot be validated exclusively by scientific means? How should psychosocial effects be taken into account? To address these questions, the author and his colleagues have developed a new methodology of community-based risk communication by working together with the local communities. The effectiveness of this methodology was validated in a pilot program conducted using study groups over the course of three years in Tsuruga, Fukui Prefecture, since it is the host municipality of a nuclear power plant. This commentary discusses how community-based risk communication can be practiced effectively in society while referring to the outcomes of the pilot program.

II. Community-Based Risk Communication

1. Definition of Community-Based Risk Communication

Community-based risk communication differs from conventional dialogues between the hosts and experts on one hand and the participants and other stakeholders on the other (**Figure 1** (a)). Instead, such communication is conducted among the stakeholders of a community in tandem with experts (Figure 1 (b)). In this context, a community consists of groups of local residents.

Participatory approaches are taken either through consultative bodies that are operated to build consensus on community development plans and waste management plans [3] or through committees that are formed by learned experts and citizens [4]. Dialog forums [5] are held to facilitate communication regarding radioactive waste.



(a) Conventional risk communication

(b) Community-based risk communication

Figure 1 Modes of risk communication

The author and his colleagues investigated various risk communication activities that had been conducted in the past. These activities included risk communication conducted by the MOE to address health concerns about radiation, risk communication conducted by the CAA to address the issue of food and radioactivity, and a study session conducted by the Committee on Program for Responding to Fukushima Daiichi Nuclear Accident of the Japanese Radiation Research Society to address the health effects of radiation. A practical methodology of community-based risk communication was designed with reference to the investigation of these precedents and a survey conducted with the residents of Tsuruga to determine their attitudes towards radiation and risk [6].

2. Characteristics of Community-Based Risk Communication

Residents share common or similar local settings in the community where they live. For this reason, they can perceive the risks that affect their community as their own problems. In other words, community members can be assigned a common challenge of seeking a solution through their joint efforts.

As mentioned at the beginning of this commentary, the conventional approach to risk communication tends to suffer from the problems listed below, as this form of communication was intended to gain public acceptance of nuclear in ordinary times based on the fundamental assumption that nuclear safe was assured.

- A patronizing and paternalistic approach is taken to "educate" and convince the "ignorant public."
- Hosts tend to have the mistaken belief that the public can make proper judgements as long as the right information is provided (deficit model).
- Inappropriate risk messages are employed.
  A fear campaign and inappropriate comparisons with the risks of drinking, smoking, etc.
- Explanations of the impact of uncertainty, which forms the essence of risk, are inadequate.

For the above reasons, the following requirements were taken into account for community-based risk communication.

- Establish small study groups to facilitate the participation of local community members

Establish small groups of up to 15 members each to encourage local residents to play an active part in the discussions. Facilitate all participants to speak and share their thoughts. Encourage their continuous participation in at least five study sessions, because one to three sessions would not be sufficiently effective.

- Make arrangements to encourage voluntary participation

Even if people take an interest in the discussions, they will feel powerless if they are unaware that the outcomes of their sincere contributions to these discussions can make a difference. Accordingly, arrangements should be made to motivate them to participate in discussions repeatedly by appealing to their right to self-determination [i] and sense of self-efficacy [ii] in addition to their right to know.

In practice, learning materials for study groups are initially prepared by experts and then modified jointly with participants while incorporating input from stakeholders until they can genuinely accept the content. More specifically, residents are requested to engage in activities aimed at jointly creating a guidebook that is both acceptable to themselves and useful in providing explanations for residents in other communities.

- Explain the relevant logic in addition to providing information

Explain how people can make their own judgments on risks while also providing the relevant information. Risk literacy involves the transfer of risk-related information; it does not necessarily mean that people will voluntarily accept risks. Aside from providing the necessary evidence, answer questions related to values.

3. Research Method for Community-Based Risk Communication

The pilot program was conducted to develop and experimentally validate a methodology of community-based risk communication. As shown in **Figure 2**, a platform-style research forum was organized to allow the involvement of researchers in the fields of radiobiology, sociopsychology, risk communication, public participation, and social responsibility as well as their collaborators and local community members. A steering committee was established to conduct the pilot program.

The steering committee engaged in wide-ranging discussions to consider a method of validating community-based risk communication by analyzing issues such as the following: the memberships and methodologies of the study groups on community-based risk communication; the involvement of experts; the adequacy of the process for its practical application; and the methods for evaluating the group's achievements.

[i] "The right to make autonomous decisions about one's life and lifestyle free of any pressure from the authority or society" (translation of the definition provided in the Japanese dictionary *Daijirin*)

[ii] Recognition of the possibility of becoming successful or achieving a goal under certain circumstances through one's own ability.

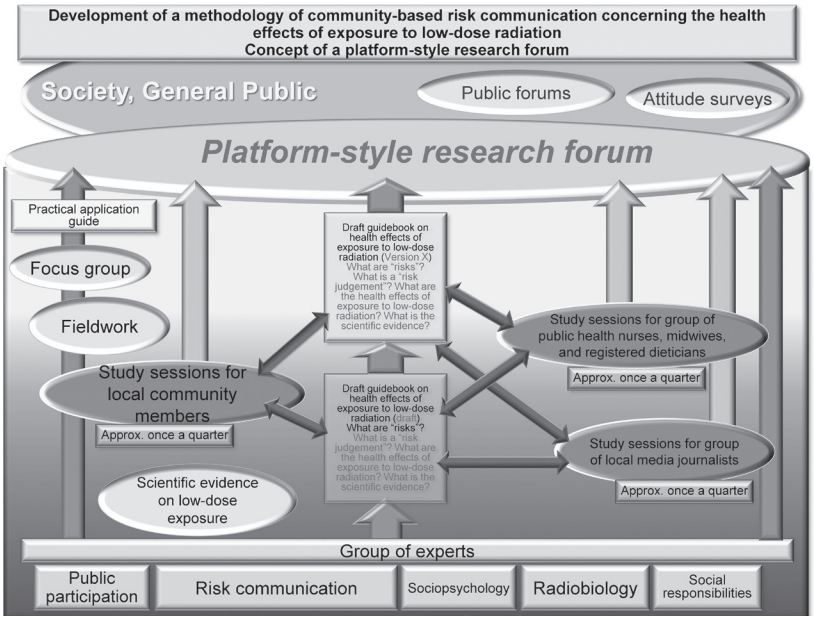


Figure 2 Concept of the platform-style research forum

III. Community-Based Risk Communication in Practice

1. Drafting a Guidebook for Solving Problems

As the first step in addressing impediments to public recognition of the risks associated with low-dose radiation and related challenges, mainly researchers led the drafting process for a guidebook on the health effects of low-dose radiation. This draft was discussed in a platform-style research forum to explore the desired risk communication collaboratively in accordance with local characteristics.

The draft took into account the following three factors.

- Scientific evidence on the health effects of low-dose radiation
- How uncertainties that cannot be validated exclusively by scientific means should be handled
- Psychosocial effects

Space limitations prevent us from going into detail, but the draft has a total of 46 pages and is structured as follows.

- Introduction
- Concept of risks
- Somatic effects of radiation
- What is a low dose?
- Health effects of low-dose radiation
- Conclusion
- Supplement and reference

The draft not only discussed the health effects of radiation in a scientifically sound manner, but also clarified the psychological effects of radiophobia as well as the risks and methods required to make the necessary judgements.

2. Study Sessions with the Local Community

A pilot program was conducted with study groups while using the draft guidebook on the health effects of exposure to low-dose radiation as a learning material.

(1) Study sessions conducted with the draft guidebook

The following three study groups were established to carry out a series of study sessions using the draft textbook.

(A) Group of women who live in Tsuruga (12 persons)
(A group of women interested in nuclear)
(B) Group of professionals from the health care center in Tsuruga (12 persons)
(Public health nurses, registered dieticians, midwives, and clinical psychotherapists)
(C) Group of media journalists (5 persons)
(Newspaper and network reporters from the Tsuruga press club)

Group C often failed to meet due to members having to cancel at the last minute. From fiscal 2014 onward, members of Group C began to join the meetings of Group A or B.

Lasting about two hours, each study session involved studying the draft to identify any points that were unclear, confusing, or incomprehensible and then rephrasing or modifying the text to make it clearer.

During the study sessions held in fiscal 2013, participants proposed the drafting of an introductory edition while taking into account inadequacies and improvement points that they had identified. In fiscal 2014, they began collaborating in the drafting of the introductory edition. The issues and necessary improvements that were identified are mentioned in a later section about revisions to the guidebook.

(2) Briefing exercises in groups

Exercises were conducted among Groups A and B to simulate briefings to local citizens and learn how best to communicate with them and provide explanations by using the introductory edition of the guidebook on the health effects of exposure to low-dose radiation, which had been jointly drafted with the members of the study groups. Graduate students from the University of Fukui played the roles of local citizens as the intended audience.

During the Q&A sessions held in the briefing exercises, participants exchanged opinions to clarify what they really understood and what they did not. At the same time, they clarified what matters would require particular attention and consideration when local citizens were invited to briefing sessions. These points were reflected in a guide for the practical implementation of the guidebook during actual briefings. **Figure 3** shows how study sessions and briefing exercises were conducted, while **Table 1** provides a record of the study sessions.

(3) Revisions to the guidebook

During study sessions conducted for the citizens of Tsuruga, the participants identified the following issues as requiring revision in the draft that had been prepared earlier by experts.

- Approach to risks: It is difficult to understand the definition, concept, trade-offs, probabilities, and uncertainties of risks.
- Somatic effects of radiation: Difficult terms are used, such as DNA damage and repair mechanisms, excessive absolute risks and excessive relative risks (EARs and ERRs), Sv, Bq, and Gy.
- What is a low dose?: The psychological consequences of the Chernobyl accident could be understood clearly.
- Health effects of low-dose radiation: It is difficult to understand the findings of

(a) A study session (Group A) (b) A briefing exercise (Group A)

(c) A study session (Group B) (b) A briefing exercise (Group B)

Figure 3 Views of study sessions and briefing exercises

Table 1 Record of study sessions

Study Group A	Study Group B	Study Group C
Jul. 12, 2013 16 persons	Nov. 12, 2013 13 persons	Jul. 31, 2013 7 persons
Nov. 8, 2013 12 persons	Jan. 17, 2014 16 persons	Nov. 11, 2013 3 persons
Jan. 17, 2014 10 persons	Mar. 17, 2014 16 persons	Jan. 23, 2014 1 person
Mar. 14, 2014 11 persons	Jun. 4, 2014 12 persons	Sep. 26, 2014 3 persons
May 16, 2014 10 persons	Jul. 30, 2014 12 persons	(These members later joined either Group A or B)
Jul. 11, 2014 12 persons	Sep. 24, 2014 10 persons	
Sep. 26, 2014 8 persons	Nov. 19, 2014 13 persons	
Nov. 7, 2014 12 persons	Mar. 12, 2015 13 persons	
Feb. 20, 2015 12 persons	Aug. 3, 2015 13 persons	
Aug. 21, 2015 8 persons	Oct. 7, 2015 20 persons	
Nov. 27, 2015 7 persons		

epidemiological studies on medical exposure, including the four models (LNT, etc.) and the computer tomography.

In general, these opinions can be roughly summarized as follows.

- Too much information makes it difficult to capture the overall picture.
- The structure and chapter breakdown should be modified.
- The content should be convincing for citizens and allow them to offer explanations to fellow citizens.
- Too many details are unnecessary for beginners. The introductory edition of the guidebook should be made shorter.

With these opinions in mind, revisions to the draft were begun in fiscal 2014. The introductory edition of the guidebook on the health effects of exposure to low-dose radiation was prepared after repeated revisions and modifications in collaboration with members of the study groups.

3. Preparation of a Practical Application Guide

During the study sessions and briefing exercises, it became quite clear that even a good guidebook cannot be fully understood simply by reading it or hearing a few explanations once or twice. A good guidebook can be made more effective if an appropriate method of putting it into practice is employed.

Given this, a guide was prepared to facilitate the practical application of the method used for community-based risk communication while taking into account the issues and challenges identified during the study sessions.

This guide facilitates the application of the guidebook on the health effects of exposure to low-dose radiation (introductory edition) in the practice of community-based risk communication in local communities. The guide was also summarized to produce a practical guide. The practical application guide and the practical guide have been made available on a website (www.cbriskcommunication.org), along with the guidebook on the health effects of exposure to low-dose radiation (introductory edition).

IV. Evaluation of Community-Based Risk Communication

Attitude surveys were conducted before and after the study sessions (November 2013 and November 2015) to examine how levels of understanding and attitudes among the participants had changed [7]. The questionnaire used for these surveys was similar to the one used in the attitude survey on radiation and risks conducted with the citizens of Tsuruga in September 2013. This similarity makes it possible for the attitudes of participants in the study sessions to be compared with those of other citizens in Tsuruga. The attributes of these participants can also be understood through factor analysis.

In the analysis of attitudes among the citizens of Tsuruga [6], the responses were classified into five groups, with three groups representing moderate opinions set between the most concerned group and the most accepting group at the two extremes. The 24 members of the study groups were mainly classified into the most concerned group together with the first and the third groups in the middle. Only three of the members were classified into the most accepting group. Thus, these participants represented a typical mixture of intermediate groups and the most concerned group.

In total, 44 questions were asked. Due to space limitations, **Figure 4** presents only some of the changes in attitudes among participants in the study sessions. The lightly shaded bars represent responses before the study sessions, while the heavily shaded bars represent responses after the study sessions. For comparison, the results of the earlier attitude survey conducted with the citizens of Tsuruga are also represented using solid lines.

After the study sessions, fewer people had negative views or fear toward radiation, and a larger number of people had a more positive attitude that radiation itself is neither good nor bad.

Figure 5 shows how perceptions of food from Fukushima and risks changed before and

after the study sessions. While 20% of the citizens of Tsuruga avoided food from Fukushima, the participants developed a notably stronger tendency to deny such an aversion after the study sessions. After the study sessions, the respondents had a better understanding of the methods used to determine risks.

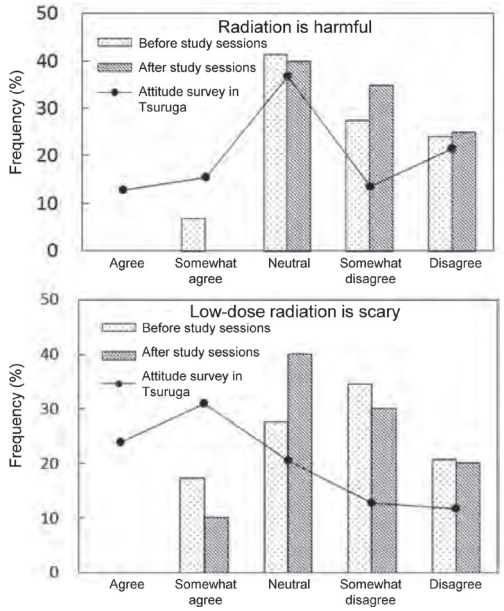


Figure 4 Changes in attitudes among participants in the study sessions

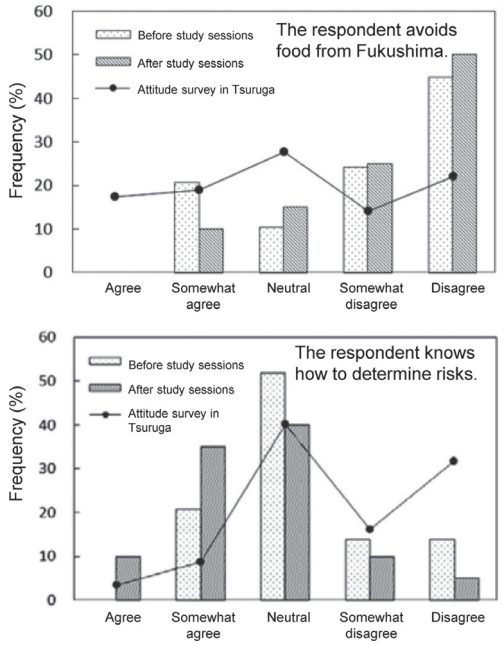


Figure 5 Changes in perceptions of food and risks among participants of study sessions

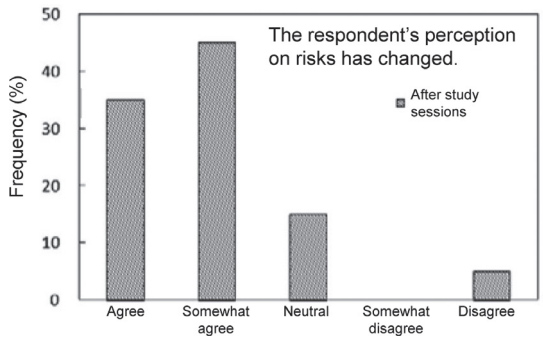


Figure 6 Changes in the perception of risks among participants in the study sessions

Furthermore, after the study sessions, many participants responded that these sessions had changed their attitudes (**Figure 6**).

In this manner, the pilot program verified that the study sessions had changed attitudes towards radiation health risks and validated the method adopted for community-based risk communication.

V. Perspectives for Community-Based Risk Communication

In March 2016, a public forum was held in Ookayama, Tokyo, to discuss the health effects of low-dose radiation. Opinions were exchanged among a total of 40 and some participants, including citizens interested in risk communication related to these health effects, practitioners of risk communication, and researchers in related fields.

Details concerning what was discussed at the public forum are saved for another time, but community-based risk communication is clearly a more useful method for allowing communities to discuss and address local challenges together.

The fact that there were only a few participants is often misinterpreted as reflecting a narrow scope of application. In fact, many insights can be obtained effectively by applying this method in many other communities.

Some people feel that this method is less effective and efficient than conventional large-scale briefing sessions and town meetings. However, it is highly doubtful that honest opinions and views can be heard at briefing sessions attended by a large number of participants.

Community-based risk communication can be scaled up to a global level by first having local community members visualize how global challenges affect their communities. After that, the targets can be expanded across multiple regions and many communities.

The pilot program demonstrated that the success or failure of risk communication depends on the quality of the guidebook and the method used to apply it in practice. The author hopes that local communities throughout Japan will lead the way in community-based risk communication to validate its effectiveness in resolving various challenges. The pilot program was financed by a JSPS Grant-in-Aid for Scientific Research (No. 25420902).

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