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Report

Experience in Individual Dose Estimation after the Fukushima Nuclear Accident Using Self-administered Questionnaires — Activities to Encourage Responses to the Questionnaires and Resulting Response Rate —

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Following the Fukushima Daiichi Nuclear Power Plant accident, individual external doses have been estimated by obtaining information on people's behavior at an initial stage after the accident and combining it with ambient dose rate maps. Residents in Fukushima Prefecture were asked to fill in their behaviors on self-administered questionnaires. The rate of response to the questionnaires was in the 20% range several months after sending out the questionnaire by mail. However, the rate did not subsequently increase by much after that, so various activities were taken to raise the response rate. Major activities were (1) creating a questionnaire that was simpler to fill out, (2) approaching Fukushima residents directly at various venues to help them fill out questionnaires, and (3) using the mass media to encourage people to submit questionnaires. While these activities, carried out primarily from FY2012 to FY2015, helped increase the number of responses, the response rate for the entire prefecture did not increase by much, and was at 27.6% as of March 31, 2018. However, rates exceeded 50% in most municipalities of the Soso region, where the damaged nuclear power plant is located. It appears that the response rate roughly reflected the ambient dose rate level.

Key words: Fukushima accident, individual external dose, behavior survey, self-administered questionnaire, response rate

1. Introduction

How to estimate radiation exposure to residents in Fukushima Prefecture was one of the issues immediately after the Fukushima Daiichi Nuclear Power Plant accident, because personal dosimeters, monitoring posts, and other measurement devices were not widespread. Thus, it was planned to estimate individual external doses by obtaining information on people's behavior after the accident and combining this with ambient dose rate maps[1]. At first the "Basic Survey", one of the components of the "Fukushima Health Management Survey (FHMS)" was started. FHMS is being conducted by Fukushima Medical University (FMU) as commissioned work from the Fukushima Prefectural government. The Basic Survey aimed at evaluating the individual external doses in the first 4 months after the accident (March 12 to

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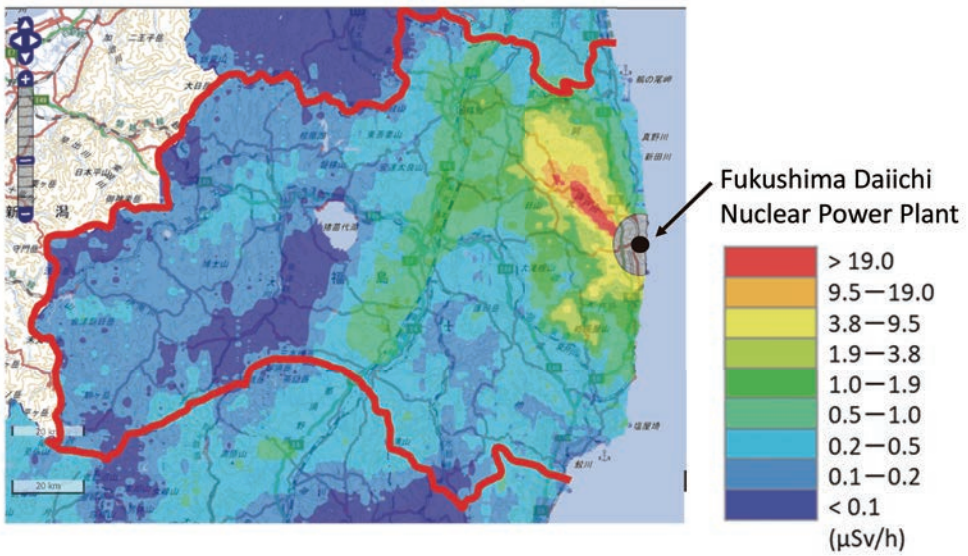

Fig. 1. Ambient dose rate map of Fukushima Prefecture. Dose rate was converted as of September 12, 2011. The map was modified by using PowerPoint® and Adobe Reader® software, from a map obtained by airborne monitoring survey. (Extension Site of Distribution Map of Radiation Dose, etc./GSI Maps)

July 11, 2011), notifying people of their dose estimates, and in general, grasping the level of external dose for Fukushima residents. The subjects of the Basic Survey are people who were registered residents of Fukushima Prefecture from March 11 to July 1, 2011[2]. The Basic survey was approved by the ethical review committee of Fukushima Medical University.

Thus, individual residents were asked to fill out questionnaires about their behaviors in the 4 months after the accident and to send their replies back to FMU. These behavior records were digitalized, and individual estimates of external doses were made based on ambient dose rate maps using a computer program[3].

Questionnaires were distributed to residents of the initially surveyed areas beginning on June 30, 2011. The initial survey covered areas in Fukushima Prefecture where individual external dose levels were considered to be relatively high (Fig. 1 and 2). Starting in late August, questionnaires were sent to the remaining residents of Fukushima Prefecture by mail. In the end, about 2.06 million questionnaires were distributed.

A few months after questionnaires were sent out to all Fukushima residents, the number of responses being sent back peaked at about 8,000 per day. The response rate based on Fukushima residents voluntarily sending back the questionnaires at the end of 2011 was in the 20% range.[1] However, the rate did not increase by much thereafter. Various activities for raising the response rate were started in fiscal year 2011 (FY2011; the Japanese fiscal year begins April 1 and continues to the following March 31) and continued until FY 2015. This report aims at summarizing those activities, together with changes in the response rate over time and its regional distributions.

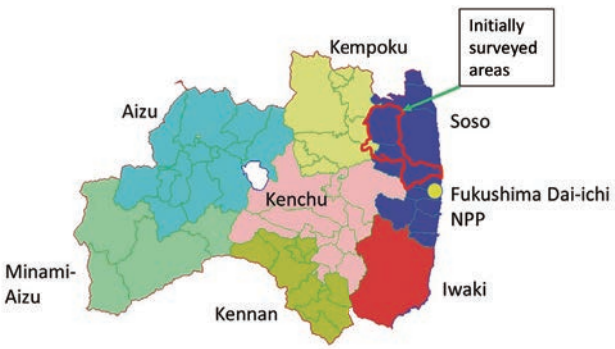

Fig. 2. The seven regions of Fukushima Prefecture and the initially surveyed areas of the Basic Survey (Namie Town and Iitate Village in the Soso region and Yamakiya district of Kawamata Town in the Kempoku region). The map was created by Haku-chizu KenMap software (http://www5b.biglobe.ne.jp/t-kamada/CBuilder/kenmap.htm, freeware approved by Geospatial Information Authority of Japan with approval No. 149 in 2002). The white unnamed area in the center is Lake Inawashiro.

Behavior surveys could be an effective tool for estimating external doses individually in an initial stage after a nuclear accident. This report will provide a resource for such public dose estimation, should another occur in the future.

2. Outline of the Basic Survey questionnaires

The questionnaire that was initially used for the Basic Survey (original questionnaire) asked respondents to

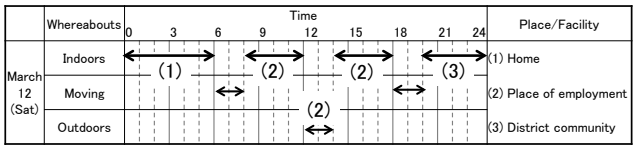

Fig. 3. A portion of the original questionnaire showing the entry of behavior on one day during the first 2 weeks after the accident.

record their behavior by the hour during a period of about 2 weeks after the accident (Fig. 3)[4]. The format for filling out behaviors then became simpler up to July 11, with respondents asked to provide information such as their whereabouts, mean time spent outside per day, and regular outings (to work or school).

The original questionnaire needs to fill out the behavior records on an hourly basis for about 2 weeks after the accident. It was thought that hourly behavior records were necessary to estimate doses for people who lived in evacuation areas and had complex behaviors after the accident, such as people whose whereabouts changed multiple times after leaving their houses in the evacuation areas. However, it was also expected that somewhat rough behavior records would not affect precision of dose estimation for people who did not evacuate, move, or otherwise change their whereabouts. Thus, a questionnaire that was simpler to fill out (simplified questionnaire) was created and preliminary survey was conducted to confirm the expectation[5].

As a result of the preliminary survey on cross-checking between the individual doses estimated with the original and simplified questionnaires, no significant difference was seen for those who had moved their residence or workplace one time or less in the 4 months after the accident[5, 6]. Thus, the simplified questionnaire was introduced, targeting people who meet this criteria. Figure 4 shows part of the simplified questionnaire.

	Place of residence during this term: XX City, YY ward, ZZ
	Time spent outdoors per day during this term in the area surrounding your place of residence: XX hours
2011/3/11	**Place of regular outing 1** (place of employment or education):
⇩	Facility name:
	Location:
2011/MM/DD	Time spent indoors at the place for outing:
	Time spent indoors at the place for outing:
	Place of regular outing 2 (place of employment or education):
	.....
	Place of residence during this term: XX City, YY street, ZZ
	Time spent outdoors per day during this term in the area surrounding your place of residence: XX hours
2011/MM/DD	**Place of regular outing 1** (place of employment or education):
⇩	Facility name:
	Location:
2011/7/11	Time spent indoors at the place for outing:
	Time spent indoors at the place for outing:
	Place of regular outing 2 (place of employment or education):
	.....

Fig. 4. Part of the simplified questionnaire.

3. Activities to raise the response rate

When the number of original questionnaires sent out to all Fukushima residents failed to increase by much, activities described below were carried out to raise the response rate.

3.1. Sending the simplified questionnaire

The simplified questionnaire was sent to people who had not submitted the original questionnaire and were eligible for thyroid examinations (about 250,000 people), as it was thought they would easily understand the significance of radiation dose estimation. In principle, people eligible for thyroid examinations were Fukushima residents who were 18 years old or younger at the time of the accident (further details below)[1]. The 13 municipalities that were designated for evacuation were thought to have few people who would meet the aforementioned criteria for the simplified questionnaire, as their evacuation behaviors were probably complex. Therefore, people who were eligible for thyroid ultrasound examinations and lived in an evacuation area when the accident occurred were sent a flyer encouraging them to submit a questionnaire, instead of the simplified questionnaire. This flyer was sent out in late November and December 2013[7].

In addition, about 6 months after sending out the simplified questionnaire (end of May 2014), reminder cards were sent to people who had not yet submitted one (about 200,000 people), encouraging them to respond. Subsequently, the simplified questionnaire was used widely in activities that provided support in filling out the questionnaire (described below). In some cases, however, those who had wished to use the simplified questionnaire did not meet the aforementioned criteria (the number of move(s) of their residence or workplace was one time or less in the 4 months after the accident). Such people were asked to fill out the original questionnaire instead.

3.2. Support for filling out questionnaires at thyroid ultrasound examination venues

After introducing the simplified questionnaire, people who changed their residence multiple times after the accident such as people living in evacuation areas, still needed to fill out the original questionnaire if they did not meet the conditions for the simplified questionnaire (changed their residence or workplace one time or less in the 4 months after the disaster). As described above, for the

(A) (B)

Fig. 5. Examples of how support was given. Support staff wearing green vests (A) approached Fukushima residents and (B) provided assistance to those who wanted to submit questionnaires.

original questionnaire respondents needed to fill in their behavior by the hour. According to the survey for the need for support filling out the questionnaire, one-third of respondents said they needed help understanding how to fill out the questionnaire. Thus, temporary counters with staff to provide support for filling out questionnaires were set up in places where Fukushima residents gathered.

These activities started in earnest in FY2012, when assistance counters at thyroid ultrasound examination venues became one of the main forms of support for filling out questionnaires[1]. The photos of Figure 5 show what these counters looked like. Thyroid ultrasound examinations have been conducted as part of FHMS, mostly for Fukushima residents who were age 18 or younger when the accident occurred[2]. Due to concerns that people's thyroid glands were exposed to radioactive iodine released during the nuclear accident, a system was created so those eligible could undergo regular thyroid examinations (once every few years). These examinations are often held at schools or hospitals, but are sometimes held at public facilities to serve preschool children and others. These public facilities are relatively spacious, so whenever possible counters have been set up to help people fill out questionnaires. After the thyroid ultrasound examination ended, staff approach the people being examined or their guardians (Fig. 5 (A)), and people who want to submit questionnaires are given explanations and assistance in filling them out (Fig. 5 (B)).

The first of these counters was set up in June 2012. A total of 41 sessions were held in Fukushima City in FY2012[8]. In FY2013 the area was expanded, and a total of 140 sessions were held in 38 municipalities[9]. In FY2014, thyroid ultrasound examinations began being performed outside the prefecture (for people who were Fukushima residents when the accident occurred, but had since moved away for school, work, or other reasons). Including sessions held outside Fukushima, 101 sessions were held that year[10]. The same number was held in FY2015[11].

3.3. Directly approaching subjects (at other places than thyroid ultrasound examination venues)

Besides thyroid ultrasound examination venues, support for filling out questionnaires was provided at the following locations. Similar to the scenario shown in Figure 5, residents were approached and those who wanted to submit questionnaires were given explanations and assistance in filling them out.

3.3.1. City halls, other government buildings

Support was provided in the main cities (Fukushima, Koriyama, Aizuwakamatsu, Iwaki, Shirakawa, Minami-Aizu, and Kitakata) of Fukushima Prefecture's seven regions (see Fig. 2). Visitors to city halls were approached and given assistance filling out questionnaires, if they wished. In June and July 2014, a total of 267 sessions were held in these seven regions[10].

3.3.2. Health check venues

Support counters were set up at venues for health checks conducted by municipalities. People were approached after finishing their health checks, and those who wanted to submit questionnaires were given explanations and assistance in filling them out. From June to November 2015, 119 sessions were held in eight cities in the prefecture's six regions except for Minami-Aizu (see Fig. 2)[11].

3.3.3. Visits to temporary housing facilities

Some people, such as those living in evacuation areas when the accident occurred, moved to temporary

housing facilities set up in various locations in Fukushima Prefecture. Starting in FY2012, mainly student volunteers began visiting temporary housing sites to help residents fill out questionnaires. From January to March 2013, a large-scale project with visits to temporary housing sites was conducted by a company commissioned from FMU. Visits were made to 107 temporary housing sites (about 12,000 people) in six of the prefecture's regions (excluding Minami-Aizu region, see Fig. 2) to provide support to residents who had yet to submit questionnaires[8].

3.3.4. Hospitals, health centers

In FY2012, a counter to provide support for filling out questionnaires was temporarily set up in the lobby of Fukushima Medical University Hospital several times. In addition, ten support sessions were held in other hospitals in Fukushima City in FY2014[10]. However, there was not much space for counters and little time was available for visitors to the hospitals. Thus, the support at hospitals was discontinued.

3.3.5 Other places where Fukushima residents gathered

Places where people who evacuated due to the accident could obtain information on the towns they left and exchange information among themselves were set up at supermarkets and other such locations. In FY2012, a total of 30 sessions to help people fill out questionnaires were held at these places in Fukushima and Koriyama Cities[8].

In addition, temporary counters to help people fill out questionnaires were also set up at event venues, such as health- or welfare-related festivals.

3.4. Visits to explain how to fill out the questionnaires

Explanatory sessions on thyroid ultrasound examinations are held for guardians and teachers at schools with students who are eligible for the examinations. After the explanatory sessions, a short introduction on the Basic Survey is made and submitting of questionnaires is encouraged. This was done at each of 88 meetings at kindergartens, daycares, primary schools, and middle schools in FY2013, at 17 meetings in FY2014, and at 15 meetings in FY2015[9-11]. In addition to thyroid ultrasound examination meetings, staff members were dispatched to hold explanatory meetings for introducing the Basic Survey, if requested.

3.5. Visits to companies

While the target population for the support sessions at thyroid ultrasound examination venues was children, visits to companies were conducted aiming at working adults. FMU staff visited companies in Fukushima Prefecture and asked persons in charge to encourage submitting the questionnaire among their company workers, such as through companywide emails, and morning meetings. Such visits to companies were done 495 times in FY2012[8].

3.6. Use of the mass media

The following activities were conducted to publicize the Basic Survey through the mass media. Articles encouraging submission of the Basic Survey questionnaire were published in prefectural and municipal bulletins, newspapers, and other media, and advertisements were run on television, radio, and elsewhere. A DVD on how to fill out the questionnaire was shown at municipal facilities in the prefecture, and this video was posted on the FMU homepage. Before sending out the simplified questionnaire at the end of November 2013, an explanatory session was held for members of the media and other efforts were made to notify Fukushima residents about the simplified questionnaire.

3.7. Including a pamphlet about the Basic Survey in informing people about other surveys of FHMS

FHMS includes four surveys in addition to the Basic Survey (thyroid ultrasound examination, comprehensive health check, Pregnancy and Birth Survey, Mental Health and Lifestyle Survey). When information on these surveys was mailed out to residents, a pamphlet was included which asked if the Basic Survey questionnaire had been submitted and if not, residents were asked to do so.

3.8. Supplying municipal offices with questionnaires

Questionnaires were sent to all Fukushima residents in 2011, but after a few years it was possible that some people had lost their questionnaires. Therefore, simplified questionnaires were placed at municipal offices so residents could take them if they wished. Fukushima Prefecture has a total of 59 municipalities. The 13 municipalities that were designated for evacuation were thought to have few people who would meet the aforementioned criteria for the simplified questionnaire. The original questionnaire was considered too difficult to fill out without assistance, so only the simplified questionnaire was provided at 46 municipal offices, excluding the 13 municipalities designated as evacuation areas. To facilitate this, FMU staff visited 46 municipal offices to ask for cooperation in placing the questionnaires and attending to residents.

3.9. Creating questionnaires for foreigners

Questionnaires in English, Chinese, Korean, and Tagalog were made for foreigners who were living in Fukushima Prefecture when the accident occurred. Descriptions of FHMS and examples of completed questionnaires were also translated into these languages, posted on websites, and make available for download[12].

3.10. Questionnaire requests, inquiries via website, call center

The Radiation Medical Science Center of FMU, which conducts FHMS, provided services whereby people could request questionnaires and answer questions through a website or call center[13].

4. Resulting response rate

The activities described above were not performed separately. Multiple activities were carried out simultaneously. Also, some people did not have time to fill out the questionnaires at the counters set up to provide assistance, so they would take home questionnaires from the counters and submit them later. In addition, of the questionnaires sent out to all Fukushima residents in August 2011, some people responded voluntarily a year or more later. These voluntary responses were not always kept separate from those filled out after a person received assistance. Therefore, when FMU received a questionnaire, it was not always able to distinguish whether it was a voluntary response or a response that had received assistance. It is thus impossible to discuss in detail how many questionnaires were received due to individual activities aimed at raising the response rate. Below, response rates over time are described. An increase of responses after the beginning of 2012 could be mainly due to those activities.

About 14,105 responses (about 2.4% of the total responses) were incomplete or the respondent expressed a desire not to participate in the survey, as of March 31, 2018.[14] However, these were included when calculating response rates. In some of the other questionnaires, behavior records were provided but for less than 4 months. These were also included in the number of responses.

4.1. Responses to the simplified questionnaire

Figure 6 shows changes in the total number of responses to the simplified questionnaire. Progress in the Basic Survey including the number of responses and response rates is subject to reporting at meetings of the Prefectural Oversight Committee for FHMS, which are held almost quarterly. Hence, the number of responses has been totaled about once every 3 months, in line with these meetings. These totals are plotted in Figure 6. In FY2017, however, the frequency of reporting to the Oversight Committee was changed to once per year. Thus, only one value is shown in each of FY2017 and FY2018.

In the first few months after the simplified questionnaire was sent out, a large number of responses were received. Starting in 2015, about a year after questionnaires were sent out, growth in the total number of responses slowed considerably. It is thought these later

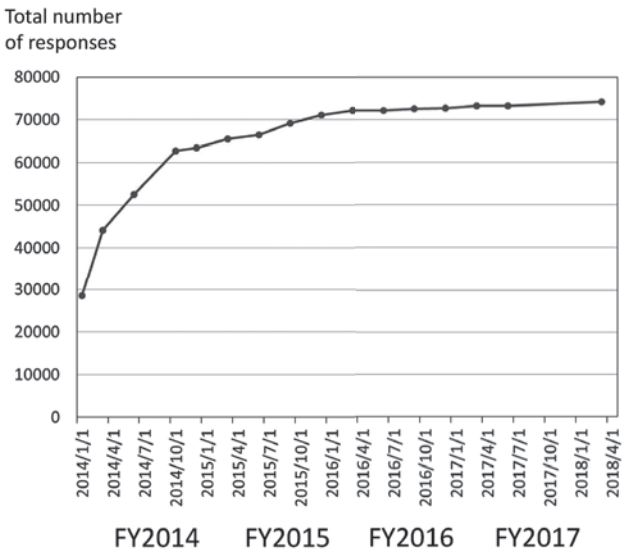

Fig. 6. Total number of responses to the simplified questionnaire.

responses were primarily simplified questionnaires that were filled out as part of support activities. As of March 31, 2018, a total of 74,100 people had responded to the simplified questionnaire[14].

4.2. Response rates by region

Because time-related changes in the response rate for the whole prefecture are described elsewhere[1], those by region are discussed below. Figure 7 shows how the response rates in the seven regions of Fukushima Prefecture (see Fig. 2) changed over time. These response rates are the rates for the simplified and original questionnaires together. The data in Figure 7 were plotted about every 3 months, in line with the aforementioned meetings of the Prefectural Oversight Committee for FHMS. The response rate for each region remained almost the same after FY2016. Thus, the data until FY2016 are plotted in Figure 7.

Figure 7 indicates the time at which the simplified questionnaire was sent out. This appears to have been somewhat effective, as seen in the fact that the response rates for Kennan, Aizu, and Minami-Aizu regions rose to the 20% range. Moreover, the response rate for the Soso region, where the nuclear power plant is located, rose above 45%. The evacuation behaviors of people in the Soso region were often complex, meaning that few people there met the criteria for the simplified questionnaire (people who moved their residence or workplace one time or less in the 4 months after the accident. Therefore, the response rate did not rise markedly in the Soso region after the simplified questionnaire was introduced.

Questionnaires were distributed to areas in the initially surveyed areas in the Soso and Kempoku regions before

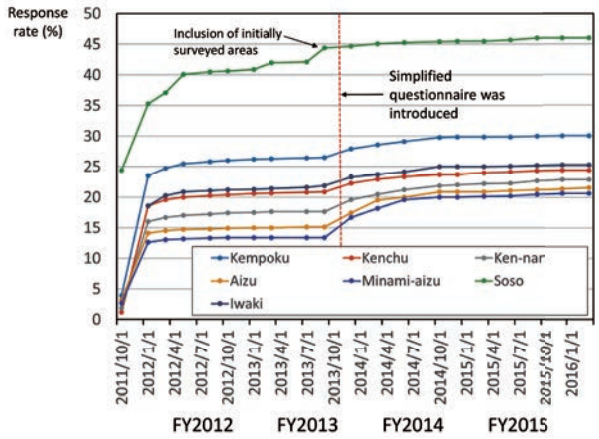

Fig. 7. Response rates in the seven regions over time.

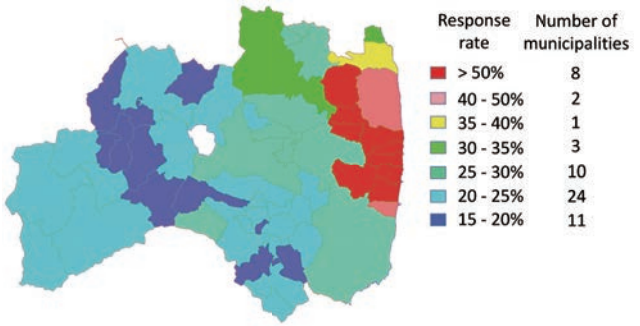

Fig. 8. Map showing response rates by municipality (As of March 31, 2018). The map was created by Haku-chizu KenMap software (http://www5b.biglobe.ne.jp/t-kamada/CBuilder/kenmap.htm).

the other regions (Fig. 2). Responses before July 31, 2013, were totaled separately for the initially surveyed areas, the Soso region minus the initially surveyed areas, and the Kempoku region minus the initially surveyed areas; but starting September 30, 2013, responses from the initially surveyed areas were included in totals for the Soso and Kempoku regions. Therefore, while the response rate for the Soso region appears to increase suddenly with the total for July 31 to September 30, 2013, this is not due to an increase in the response rate but due to a change in the totalization method.

Figure 8 shows the response rates for 59 Fukushima municipalities as of March 31, 2018[14]. The overall trend is of low response rates in regions where ambient dose rates were relatively low (Aizu, Minami-Aizu, Kennan), while the Soso region with relatively high ambient dose rates has the highest response rate. Regions with intermediate ambient dose rates (Kenchu, Kempoku) tended to have response rates that were between that of Soso and those of Aizu, Minami-Aizu, and Kennan. While the response rate Fukushima Prefecture overall was about 27.6%, response rates in the eight municipalities in the Soso region, where the nuclear power plant is located, were mostly 50% or higher, highlighting the regional differences.

4.3. Response rates by age group

Table 1 shows response rates for different age groups (age when the accident occurred was used as the standard) published in Proceedings of the Prefectural Oversight Committee Meetings[14, 15]. Between October 31, 2012 and June 30, 2015, the response rate for the age 0-9 group increased by about 17 percentage points and the rate for the age 10-19 group increased by about 16 points (Table 1). As a result, the response rate for people age 19 and younger was almost 40%. Sending simplified questionnaires (November and December 2013) to people eligible for thyroid ultrasound examinations (age 18 or younger when the accident occurred) and providing support for filling out questionnaires at thyroid ultrasound examination venues (FY2012 to FY2015) are thought to have contributed to the increase in response rate for this age group.

5. Discussion

Multiple activities for raising the response rate were carried out simultaneously, which makes it difficult to identify their individual effect. That said, the most effective activities appear to have been creating a simplified questionnaire and sending it to people eligible for thyroid ultrasound examinations.

The Basic Survey has covered the entire population of Fukushima Prefecture—about 2.06 million people. Because this includes regions with relatively low ambient dose rates (e.g., Aizu, Minami-Aizu), raising the response rate for the prefecture as a whole was difficult. Also, the questionnaire of the Basic Survey was sent by mail and the residents were asked to mail them back. If an interview-style survey was adopted, the response rate could have been higher. In that case, however, enormous costs are involving when visiting each resident. While activities to raise the response rate carried out primarily from FY2012 to FY2015 helped increase the number of responses, the response rate for the entire prefecture did not increase by much, being 27.6% as of March 31, 2018.

The dose distribution estimated on the basis of responses might be biased for two reasons: low response rate as a whole and the regional differences in response rate. First, it is possible that the low response rates in regions like Aizu, Minami-Aizu and Kennan lead to misunderstanding of dose distribution for the entire

Table 1. Response rates (%) by age group

Age group	0-9	10-19	20-29	30-39	40-49	50-59	60+	Total
Response rate (as of 2012/10/31)	28.4	19.4	16.6	21.9	19.9	21.6	27.0	23.0
Response rate (as of 2015/6/30)	45.8	35.2	17.8	24.3	22.1	22.7	27.6	27.2
Response rate (as of 2018/3/31)	46.6	36.0	18.2	24.8	22.5	23.0	27.9	27.6

population of these regions which includes persons who had not yet responded to the questionnaires. That is, if the level of external dose is different between respondents and non-respondents even in the same region, the dose distribution obtained from responses could be different from that for the entire population. Secondly, regional differences in response rate might cause misunderstanding of dose estimates for the whole population of the prefecture. Since the response rate is lower in areas with low gamma dose rate, distribution of doses for the whole prefecture could be biased in a higher direction.

Therefore, the dose distribution obtained from the Basic Survey was investigated as to whether it is representative of the residents of Fukushima Prefecture (survey of representativeness), and this have been described in detail in a separate report[16]. In this investigation, dose estimates were obtained from people who had not submitted questionnaires by visiting them at home, and these were compared to the doses of people from the same region who had submitted questionnaires for each region. As a result, no significant difference was found in estimated dose between respondents and non-respondents for each region. In addition, it was concluded that the dose distribution that had been obtained was representative of all Fukushima residents. Thus, activities to increase the response rate were essentially terminated in FY2015.

However, counters to help people fill out the questionnaire continued to be set up at thyroid ultrasound examination venues, not to increase the response rate but to help people who wanted to submit questionnaires. In FY2016, support counters were set up 45 times, mainly during the summer, winter, and spring vacations of students who are eligible for thyroid ultrasound examinations. The setting up of support counters has continued also in FY 2017 and 2018[14].

As for the effects of FHMS including the Basic Survey on subjective well-being and anxiety about radiation, an online survey targeting Fukushima residents (N = 1023) was conducted and reported elsewhere[17]. According to the survey results, participating in the Basic Survey was associated with significant increases in "satisfaction with life" and "self-rated health". Supporting people who wanted to submit questionnaires could be effective for their subjective well-being.

6. Summary

The Basic Survey aimed at evaluating the external doses for individuals in the first 4 months after the 2011 nuclear accident, notifying people of their dose estimates, and grasping the level of external dose for Fukushima residents. The survey was conducted by sending self-administered questionnaires to all Fukushima residents, who returned them by mail. About 6 months after sending out the questionnaires the response rate for the prefecture as a whole had not changed much, so various activities were taken to raise the response rate.

Major activities were (1) creating a questionnaire that was simpler to fill out, (2) approaching Fukushima residents directly at various venues to help them fill out questionnaires, and (3) using the mass media to encourage people to submit questionnaires. The first appeared to be the most effective, though in the prefecture overall only 74,100 simplified questionnaires were submitted, representing just 3.6% of the population at the time of the disaster.

People who wanted to submit questionnaires but did not understand how to fill them out, or who put off submitting one for lack of time likely received some benefit from the aforementioned activities to increase the response rate. That said, as time passes, it becomes more difficult for people to accurately recall their behavior after the accident. This may have also blunted growth in the response rate over time.

Looking at the response rates by region, it appears that the response rate roughly reflected how high the ambient dose rate was. While the response rate for the prefecture overall was about 27.6%, it mostly exceeded 50% in the Soso region, where the nuclear power plant is located. This likely reflects greater concern about radiation exposure from the accident.

The above suggests that should another such accident occur in the future and external dose need to be evaluated, it would be better to start using a questionnaire that is simple to fill out before residents' memories fade. In addition, the differences in response rates between

regions indicate it would also be effective to focus on regions where a high response rate can be expected. If the target population is small, interview-based surveys could be effective for obtaining a high response rate.

Conflict of Interest

The authors declare that they have no conflict of interest.

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