EDITORIAL

Summary of discussions at the symposium focusing on problems resulting from the nuclear accident at the Fukushima Daiichi nuclear power plant

To cite this article: Suminori Akiba et al 2013 J. Radiol. Prot. 33 E1

View the article online for updates and enhancements.

Related content

- Epidemiological studies of Fukushima residents exposed to ionising radiation from the Fukushima Daiichi Nuclear Power Plant prefecture—a preliminary review of current plans
  Suminori Akiba

- Radiological protection issues arising during and after the Fukushima nuclear reactor accident
  Abel J González, Makoto Akashi, John D Boice Jr et al.

- Joint research towards a better radiation protection—highlights of the Fifth MELODI Workshop
  A M Aerts, N R E N Impens, S Baatout et al.

Recent citations

- Estimation of internal exposure of the thyroid to 131I on the basis of 134Cs accumulated in the body among evacuees of the Fukushima Daiichi Nuclear Power Station accident
  Masahiro Hosoda et al
EDITORIAL

Summary of discussions at the symposium focusing on problems resulting from the nuclear accident at the Fukushima Daiichi nuclear power plant

Suminori Akiba¹, Shinji Tokonami² and Masahiro Hosoda³

1 Department of Epidemiology and Preventive Medicine, Kagoshima University Graduate School of Medical and Dental Sciences, Kagoshima City, Kagoshima 890-8544, Japan
2 Department of Radiation Physics, Institute of Radiation Emergency Medicine, Hirosaki University, Hirosaki City, Aomori 036-8564, Japan
3 Department of Radiological Life Sciences, Graduate School of Health Sciences, Hirosaki University, Hirosaki City, Aomori 036-8564, Japan

E-mail: akiba@m.kufm.kagoshima-u.ac.jp

Received 11 December 2012, accepted for publication 11 December 2012
Published 7 January 2013
Online at stacks.iop.org/JRP/33/E1

1. Introduction

Hirosaki University Institute of Radiation Medicine and the Research Center for Biomedical Sciences held an international symposium on natural radiation exposure and low-dose radiation epidemiological studies from 29 February to 3 March 2012. The symposium was held in Hirosaki, Japan, in cooperation with the National Institute of Radiological Sciences (NIRS) in Chiba, Japan, and the Japan Science and Technology Agency (JST) in Tokyo. The symposium, chaired by Professor Shinji Tokonami of Hirosaki University, covered the following main topics.

(i) Health risks and psychological problems relating to natural radiation exposure and low-dose radiation exposure, including that from the Fukushima Daiichi Nuclear Power Plant (NPP) accident.
(ii) Biological mechanisms and health risks relating to natural and low-dose radiation exposures.
(iii) Measurements of natural radiation from various radionuclides, including radon/thoron and their decay products, and factors relating to those measurements in various countries and settings.

The current issue of the journal includes important papers presented at the symposium relating to the first and second topics. Papers on the third topic will be published mainly in Radiation Protection and Dosimetry. In this editorial, symposium papers on the problems resulting from the nuclear accident at the Fukushima Daiichi NPP will be briefly introduced, and some discussion will be included.
2. Health risks and psychological problems resulting from the nuclear accident in Fukushima

2.1. Exposure of residents

Tokonami of Hirosaki University, Hirosaki, Japan, gave a presentation on the radiological impact of the accident at the Fukushima Daiichi NPP, which was run by the Tokyo Electric Power Company (TEPCO). After the accident, the Japanese Government, with the help of various institutions, conducted screening tests using Geiger–Müller survey meters to measure the level of radioactive contamination of residents and evacuees. Hirosaki University dispatched support teams to Fukushima that surveyed more than 5000 people between 15 March and 20 June 2011. Individual doses for all support team members were recorded. One staff member who was in Fukushima from 15 to 20 March had a cumulative dose of nearly 100 µSv (Monzen et al 2011).

In addition to these activities, Tokonami's research group conducted car-borne surveys in March and April 2011 to measure dose rates in the air in the region northwest of the Fukushima Daiichi NPP and on the expressway between Fukushima City and Hirosaki City, which is located 355 km north of Fukushima City. The results obtained by the car-borne surveys showed a similar distribution of radiation doses to the map published by the Ministry of Education, Culture, Sports, Science and Technology of Japan (MEXT) and by the United States Department of Energy (US DOE), although the measurement techniques were different. Interestingly, however, the study of Tokonami and his colleagues established that in situ gamma spectra measured on 25 April had much higher counts of caesium-134 and caesium-137 than those measured on 19 March. This implies that there were some additional releases of radionuclides from the Fukushima Daiichi NPP (Hosoda et al 2011).

At the symposium, Mikhail Balonov of the Institute of Radiation Hygiene, St Petersburg, Russia, described the various lessons that Japanese people can learn from the Chernobyl accident. He pointed out that a primary health concern among residents and evacuees in affected areas immediately after the nuclear accident was the internal exposure of the thyroid to radioiodine, particularly iodine-131 (I-131), and the subsequent risk of thyroid cancer. The deposition of I-131 was confined to the first two months after the Chernobyl accident because of I-131 decay. This radioiodine is rapidly absorbed into milk, leading to significant thyroid doses in people consuming cow’s milk, especially children, in Belarus, Russia and Ukraine. Fortunately, in the case of Fukushima, radionuclide-contaminated milk did not enter the supply chain. However, the radioactive plume from Fukushima hit many areas, including Namie-machi, Iitate-mura and Iwaki city. From 28 to 30 March, local health authorities measured the thyroid radiation doses of 1149 children aged from 0 to 15 years in Iitate-mura (population ≈ 7000), Yamakiya district of Kawamata-machi (population ≈ 1200) and Iwaki city (population ≈ 340 000), all of which are areas with relatively high radiation dose rates (The Local Nuclear Emergency Response Headquarters 2011). Measurements were taken using a NaI(Tl) scintillation survey meter placed on the throat. Further surveys were not conducted, although more precise measurements were needed to improve the precision and accuracy of the measurements and to examine a much larger number of children in different areas.

From 12 to 16 April 2011, Tokonami and his colleagues measured I-131 levels in the thyroid by placing a 3 in × 3 in NaI(Tl) scintillation spectrometer on the neck of 62 examinees in the areas northwest of the Fukushima Daiichi NPP and of evacuees from those areas. The median thyroid equivalent dose was estimated to be 4.2 mSv and 3.5 mSv for children and adults, respectively, which are much smaller than the mean thyroid dose resulting from the Chernobyl accident (490 mSv in evacuees). The maximum thyroid doses in children and adults were 23 and 33 mSv, respectively (Tokonami et al 2012). Currently, an important
Summary of discussions at the symposium focusing on problems resulting from the nuclear accident at the Fukushima Daiichi nuclear power plant

The task is to reconstruct the early internal thyroid doses of I-131 and other radionuclides with short half-lives. This reconstruction will be based on the internal exposure levels of Cs-137 and Cs-134 (which were measured by whole-body counters (WBCs) several months after the accident) using the ratios between radionuclides with short and long half-lives such as I-131/Cs-137.

At the symposium, Richard Wakeford of the Dalton Nuclear Institute, The University of Manchester, UK, beautifully summarised the leukaemia risk in relation to low-dose radiation during childhood. In the case of Fukushima, unless the radiation doses received are much higher than is currently estimated, the increase in cases of leukaemia and thyroid cancer is unlikely to be detected. Note that the Basic Survey of Fukushima Residents, which was conducted by the Prefectural Government to estimate radiation doses from external exposure, showed that the maximum cumulative dose of among residents (excluding radiation workers) between March 2011 and July 2011 was 3.9 mSv. Regarding internal exposure, the WBC survey of 54,126 residents conducted between June 2011 and June 2012 showed that the maximum internal exposure level was less than 4 mSv (Fukushima Prefectural Government 2012). A recent publication on the increased leukaemia and brain-cancer risk among children who have undergone several head CT examinations (Pearce et al 2012) has raised public concerns regarding the childhood cancer risk associated with low-dose radiation exposure. To evaluate the possible cancer risk of childhood radiation exposure, including not only the exposure from the nuclear accident at Fukushima but also diagnostic radiation exposure, a nationwide childhood cancer registry and, ideally, a nationwide cancer registry system should be established.

2.2. Exposure of workers

In the early phases of the nuclear accident at Fukushima, employees of TEPCO and its contractors, policemen, firefighters and members of the Self-Defence Forces were involved in various emergency activities not only at the site of Fukushima Daiichi NPP but also in the surrounding areas. On 14 March 2011, the Japanese government tentatively increased the dose limit of emergency nuclear workers from 100 to 250 mSv on the basis of ICRP 1990, which recommended a dose limit of 500 mSv for emergency workers (ICRP 1991).

On 24 March 2011, three TEPCO employees were reportedly exposed to approximately 173–180 mSv while laying electrical cables in the first floor and basement of Fukushima Daiichi No. 3 reactor. Two of the three were taken to the hospital with ‘possible’ radiation burns on their feet. On 21 November 2011, TEPCO reported the distribution and numbers of internal exposure doses (in eight dose categories) determined by WBC. Cumulative doses of external and internal exposures were also shown in eight dose categories in that report. According to the report, six workers received effective doses of 250 mSv or higher. REMnet, a network for radiation emergency medicine practitioners in Japan established after the JCO criticality accident in Tokai-mura in 1999, points out the importance of examining chromosome aberrations of lymphocytes to evaluate the radiation dose at the time of the emergency. In Japan, a network of cytologists capable of examining chromosome aberrations has been established to deal with this kind of situation. Whether chromosome analysis of workers who were suspected of exposure to relatively high doses at Fukushima Daiichi NPP was conducted has not been made public.

Shinji Yoshinaga of the National Institute of Radiological Sciences, Chiba, Japan, noted that, according to a TEPCO report, the maximum and average cumulative doses up to 30 November 2011 among TEPCO workers and its contract workers were about 680 and 12 mSv, respectively. He pointed out that these doses are much lower than those reported for the workers involved in Chernobyl recovery operations. It should be noted that not even the numbers of...
policemen, firefighters and members of the Self-Defence Forces with recorded radiation doses have been made public, let alone the radiation doses received. However, the median doses they received are unlikely to be higher than those of TEPCO workers. Workers of electric utility companies other than TEPCO were also involved in the response activities to the nuclear accident. The radiation doses received by those workers are considered to be low because their activities within the 20 km exclusion zone were limited.

The Ministry of Health Labour and Welfare (MHLW) plans to establish a long-term health-care programme of those workers. According to its plan, workers who have received a dose of 50 mSv or larger will be asked to undergo slit-lamp examinations to determine lens opacity. Workers who have received doses of 100 mSv or larger will additionally undergo the following examinations: (i) annual screening for cancers of the thyroid, stomach, colon and lung; (ii) thyroid function testing; (iii) blood counts. It is not clear whether MHLW plans to conduct long-term follow-up of those workers to determine cancer incidence rates and cause-specific mortality rates (MHLW 2011).

The NIRS is currently considering a study design for the follow-up of workers involved in emergency and clean-up activities at the Fukushima Daiichi NPP and surrounding areas after the accident. To evaluate the health effects of radiation exposure among these emergency and clean-up workers, it is necessary to conduct scientific evaluations of radiation doses received by all such workers. The mortality follow-up system of these workers and, ideally, a system to identify the incidence of cancer cases even after their retirement should also be established. For a long-term follow-up study, baseline surveys of factors possibly affecting health outcomes should also be carried out. It is also advisable to conduct routine medical examinations for lens opacity, thyroid abnormalities and other radiation-related medical conditions even after these workers retire. The minimum requirement for items that should be examined at annual health check-ups should be discussed and stipulated. Then, all the information should be accommodated in a database to evaluate health risk in association with radiation doses, taking risk factors other than radiation into account. Although it is unlikely that some risk evaluations will have sufficient statistical power, we think that it is necessary to conduct such a project to avoid possible misconceptions regarding the health risks of these workers. Scientifically, such research is not easy. Non-scientific factors may well make it even more difficult. Note that different ministries hold jurisdiction over various emergency workers. For example, the MHLW, the Ministry of Defence and the Ministry of General Affairs are responsible, respectively, for the health-care programmes of TEPCO workers, Self-Defence Forces and firefighters who were engaged in the emergency activities. In a country where the Ministries often put their own interests above the national interest, we cannot be too optimistic about the likelihood of close cooperation among different ministries to share information, let alone to establish a long-term follow-up system led by NIRS, which was established by MEXT.

2.3. Risk communication

In the very early stages of the nuclear accident, central and local governments appeared to follow the traditional paternalistic attitude of ‘Let the people trust the government; do not give them any information’. However, as the nuclear accident worsened and the seriousness of the accident became apparent, the public and international institutions began to suspect the governments of covering up the truth. Further, the public began to doubt the credibility of mainstream researchers, whose statements are usually in line with the government’s policies. As pointed out at the symposium by Abel J González, Vice-President of the International Commission on Radiological Protection, one reason for public concern is the apparent lack of consensus among scientists on the actual health effects of exposure to low doses of ionising radiation. He also pointed out that ‘increasingly confused members of the public observe the
debate with scepticism and apprehension. These public worries are reproduced in the media and influence the pronouncements of politicians and other decision makers. As a result, the public began to doubt the competence and integrity of researchers, which are essential for good risk communication. After all, the Japanese scientific community seems to be one of the big losers in the aftermath of the nuclear accident in Fukushima. Indeed, the White Paper on Science and Technology reported that the proportion of people who think that knowledgeable experts should decide the directions of research and development for science and technology decreased from 85% in 2010 to 66% in 2012 (MEXT 2012).

At the symposium, Abel J González gave a presentation entitled ‘controlling exposure to low doses of ionising radiation: Fukushima exposure vis-à-vis background exposure’. He considered the following two different low-dose exposure scenarios: (i) exposure to residual artificial radioactive materials released during the Fukushima Daiichi NPP accident and (ii) exposure to the background radiation in the environment. As he indicated, although the levels of radiation exposure in both situations are similar (or are even higher for background radiation), exposure to natural radiation is generally not a worry to the public at large. He analysed this situation and proposed some suggestions for solutions. In addition, he made an important point regarding contamination. According to him, the word ‘contamination’ has an original meaning of making substances unholy by adding something. The Japanese word corresponding to contamination has a similar meaning, in a broad sense. In the traditional way of Japanese thinking, nature embodies God, and food is a sacred gift from heaven. That may be a factor involved in the strong response against ‘radionuclide-contaminated’ foods by the older people in addition to mothers with young children, who want to guard their children from contaminated foods. In addition, not a small number of Japanese people, particularly retiring baby boomers (who were the group that benefited most from Japan’s ‘miraculous’ economic success in the post-war period) seem to feel sinful for the fact that they implicitly supported the nuclear programme promoted by the Japanese government and the nuclear industries. If many Japanese people are trying to avoid unholy contamination or eliminate it from their daily lives, and to make up for their sins, it is not surprising that communications intended to educate the public on the magnitude of risk from radionuclides from the Fukushima accident were not successful.

The public seems to think that the government, TEPCO and the nuclear industries did not make suitable efforts to prevent the accident, and therefore, the party responsible for what happened should be identified and punished. However, that will not be a real solution to the problems faced by Japan. It is necessary to elucidate the causes of the Fukushima accident and to identify the problems involved in the systems of regulation and responsibility. The nuclear accident at Fukushima is considered to have been caused and exacerbated by several manmade factors. The National Diet of Japan Nuclear Accident Independent Investigation Commission (2012) pointed out that the regulatory authorities and the management of TEPCO made self-serving erroneous judgements and missed opportunities to take measures to prevent the nuclear accident. The commission also pointed out that the regulatory agencies suffered from ‘regulatory capture’, in which the regulatory authorities are dominated by the very industries they are intended to regulate. We think one of the factors involved in such a problem, and possibly in the cause of the nuclear accident, seems to have originated in the JCO accident, in which two workers were killed by a criticality accident at a nuclear fuel plant. After this accident, the central government established the Nuclear and Industrial Safety Agency (NISA). As a result, a large voice was given to NISA bureaucrats who lacked expert knowledge on nuclear safety and who were obsessed with a short-sighted outlook and a misguided sense of mission to promote nuclear energy programmes as smoothly as possible. This kind of bureaucracy-led regulatory system was probably a cause of the regulatory
capture mentioned above. The following episode exemplifies this problem. In 2006, the Nuclear Safety Commission of Japan (NSCJ), a government administrative body (made up of five scientists) under the Cabinet, was asked by NISA not to start discussions on revising the guidelines for nuclear disaster prevention and restoration on the basis of the IAEA publication on preparedness and response for a nuclear or radiological emergency (IAEA 2006). NISA is suspected to have been afraid that such discussions would result in a public outcry (The Bureau of the Secretariat NSCJ 2012). The fact that the NSCJ gave in to NISA and stopped the discussion exemplifies the power of NISA, which was dominated by bureaucrats.

One of the main causes of the nuclear accident and the failure of risk communication after the accident seems to be the infallibilism of the national government and local authorities. Although no system is perfect, the Japanese government and local authorities tried to give the public the impression that the system to ensure nuclear safety was perfect. One of the reasons why the government could not admit the truth to the public is the fact that Japanese people tend avoid all forms of risk. In general, the Japanese are not risk takers. To make our nuclear programmes safer, it is necessary to evaluate continually their safety, effectiveness, efficiency, accessibility and quality. Any problems identified by such an evaluation should be disclosed to the public. At the same time, the public should understand that all policies and safeguards are imperfect. It is of note that the Declaration of Helsinki on Ethical Principles for Medical Research Involving Human Subjects (World Medical Association 2008) includes the following clause: ‘the primary purpose of medical research involving human subjects is to understand the causes, development and effects of diseases and improve preventive, diagnostic and therapeutic interventions (methods, procedures and treatments). Even the best current interventions must be evaluated continuously through research for their safety, effectiveness, efficiency, accessibility and quality’. The policy makers of nuclear programmes in many Asian countries, which are known for the strong power of their bureaucrats, should learn the lesson of what happened in Japan.

The Japanese government has decided to establish an education programme for junior-high-school students to increase their knowledge of radiation and its health risks. In the long run, this is the most effective measure to improve risk communication in Japan. Such education will not only increase the knowledge of the public at large but should eventually provide a large number of teachers with a good understanding of radiation and its associated risks who can serve as opinion leaders in various situations, including emergencies. To understand a complicated problem, it is necessary to look at it from different points of view. Although such an approach is advantageous in understanding the various aspects of the problem, the understanding itself may become superficial. More insightful understanding will be obtained by trying to penetrate deep into a problem from one certain aspect, although that approach may not be comprehensive. School teachers in Japan tend to spend more time imparting knowledge to children than teaching them the go-deep approach, thereby possibly depriving them of learning an approach that can elucidate the core of a problem. However, the possession of a large amount of knowledge does not ensure insightful understanding of a problem. To assure the quality of school education on radiation, graduate school programmes for school teachers should be established. Such training will give teachers a good opportunity to learn the scientific approach, which will be useful when addressing various health issues and social problems.

The public perception that some people are highly sensitive to radiation made risk communication more difficult. However, information on the genetic basis of radiosensitivity is still quite limited. At the symposium, Ikuo Kashiwakura of Hirosaki University, Hirosaki, Japan, gave a presentation on the radiosensitivity of human haematopoietic stem/progenitor cells. If at least some school teachers are given an opportunity to get involved in these
kinds of studies and more basic studies at graduate schools, that will be helpful not only for accumulating knowledge on radiation biology but also for risk communication.

Acknowledgment

The authors appreciate insightful comments and improvements to the English made by David Smallbones.

References


Monzen S et al 2011 Individual radiation exposure dose due to support activities at safe shelters in Fukushima Prefecture PLoS One 6 e27761


The Bureau of the Secretariat NSCJ 2012 The requests and comments made by NISA on the NSCJ’s initiative to revise the guidelines for nuclear disaster prevention and restoration, including PAZ

The Local Nuclear Emergency Response Headquarters 2011 The survey results of thyroid radiation dose among children in Fukushima prefecture Press Release 23 March


World Medical Association 2008 WMA Declaration of Helsinki—Ethical Principles for Medical Research Involving Human Subjects (Amended by the 59th WMA General Assembly (Seoul, Korea, October 2008)) (www.wma.net/en/30publications/10policies/b3/)