



UNSCEAR

United Nations Scientific Committee
on the Effects of Atomic Radiation

A photograph showing a worker in a white hard hat and blue uniform standing on the deck of a boat, looking out at a large industrial facility, likely the Fukushima Daiichi Nuclear Power Plant, situated on a coastline under a blue sky with scattered clouds. The water is a deep blue, and the plant's complex structure of towers and cranes is visible in the distance.

UNSCEAR 2020 Report on Radiological Consequences from the Fukushima Accident 10 years later

The United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) is a committee of the United Nations established by the General Assembly in 1955. It is composed of scientific experts nominated by 31 Member States.

The Committee's mandate is to assess and report on the levels, effects and risks of exposure of people and their environment to ionizing radiation. Governments and organizations throughout the world use the Committee's findings as the scientific basis for deciding on protective measures for the public and the environment. Its reviews are relevant to scientists, users of ionizing radiation and policymakers.

The Committee's programme of work is endorsed by the General Assembly. The Committee compiles relevant data submitted by United Nations Member States, international

organizations and non-governmental organizations, as well as peer-reviewed scientific literature, and engages specialists to analyse those data, to study relevant scientific topics and to produce scientific evaluations. After approval by the Committee, these authoritative reviews are published as scientific annexes to the Committee's report to the General Assembly.

“The independent scientific evaluations of the Scientific Committee remain widely recognized and highly regarded as the basis of radiation safety worldwide.”

UN Secretary General António Guterres

They provide the scientific basis for national and international recommendations and standards for the protection of people and the environment.



2012 -
2019

data timeframe



1,600+

peer-reviewed
publications



500

references



30+

experts



13

critical
reviewers



200+

Committee's
experts review

The UNSCEAR 2020 Report

On 11 March 2011, at 14:46 local time, a 9.0-magnitude earthquake occurred near Honshu, Japan, creating a devastating tsunami that left a trail of death and destruction in its wake. The earthquake and subsequent tsunami, which flooded over 500 km² of land, resulted in the loss of more than 20,000 lives and destroyed property, infrastructure and natural resources.

They also led to the worst civil nuclear accident since the one in Chernobyl in 1986. The loss of off-site and on-site electrical power and compromised safety systems at the Fukushima Daiichi nuclear power station (FDNPS) led to severe core damage to three of the six nuclear reactors on the site; this resulted in the release, over a prolonged period, of radioactive material into the environment.

In May 2011, the Committee embarked upon a two-year assessment of the levels and effects of radiation exposure from the FDNPS accident. It reported its findings to the General Assembly in October 2013 (A/68/46) and with a detailed Annex A “Levels and effects of radiation exposure due to the nuclear accident after the 2011 great east-Japan earthquake and tsunami” with the supporting scientific data and evaluation. The report was published in April 2014.

The Committee maintained an awareness of new information that became available subsequently (reviewed in White Papers published in 2015, 2016 and 2017) and in 2018 decided to prepare an update to its assessment. The UNSCEAR 2020 Report uses the most recent detailed information and analyses available a decade after the accident to validate and, where necessary, revise the estimates of doses to the public and workers.

While self-standing, this report is intended to be read in conjunction with the UNSCEAR 2013 Report and the subsequent White Papers and does not repeat all the information available in these publications. All reports can be downloaded at www.unscear.org.

Main Objectives

- **Summarize** all of the information available since 2012 and assess its implications for the UNSCEAR 2013 Report.
- **Validate and revise** estimates of doses to the public, based on more detailed analyses of the available information.
- **Set out** an improved appraisal of the uncertainties.
- **Better address** issues and objectives not fully addressed in the UNSCEAR 2013 Report.

Doses to the Public

The previous UNSCEAR report was based on data until October 2012, while the 2020 Report made use of new information from measurements made on people and in the environment to make more realistic and validated estimates of levels of exposure of the public.

New data also enabled more realistic external exposure models to be used, quantitative assessments to be made of the uncertainties in the estimated levels of exposure and of the ranges of exposure levels in the population groups considered.

An example of the results from the 2020 Report is shown in the figures 1 and 2. This shows estimates of the average effective doses in the first year after the accident to infants in municipalities that were not evacuated and average annual doses in 2021. For perspective, the annual average dose in Japan from natural radiation is 2.2 mSv. The updated, more realistic estimates of doses to members of the public have generally either decreased or are broadly comparable with the Committee's previous estimates. The contribution of ingestion of food and water is much less than previously estimated, and the contribution of external exposure is larger.

For those who were evacuated, the estimated average effective doses to infants in the first year for the different evacuation groups ranged from about 0.2 mSv to about 8 mSv. The evacuation of municipalities averted or significantly reduced the exposure of the affected population. High doses did not occur because of the evacuation (but also due to other non-human factors, mainly the wind blowing to the ocean during the first two days of the accident).

Doses have reduced since the accident. In 2021, the estimated average annual effective doses were less than 0.5 mSv in parts of Fukushima Prefecture that were not evacuated and below 0.1 mSv elsewhere in Japan. In the evacuated communities where evacuation orders have been lifted, estimated annual average effective doses in 2021, taking account of remediation work, were generally less than 1 mSv.

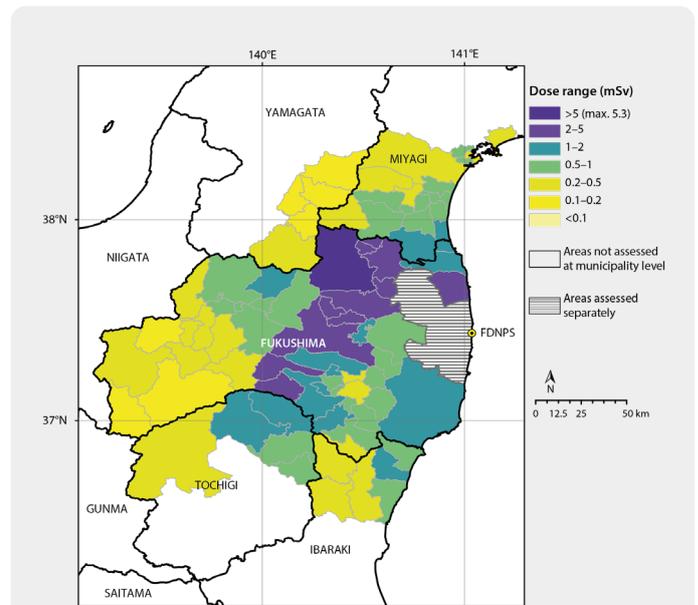


Fig 1

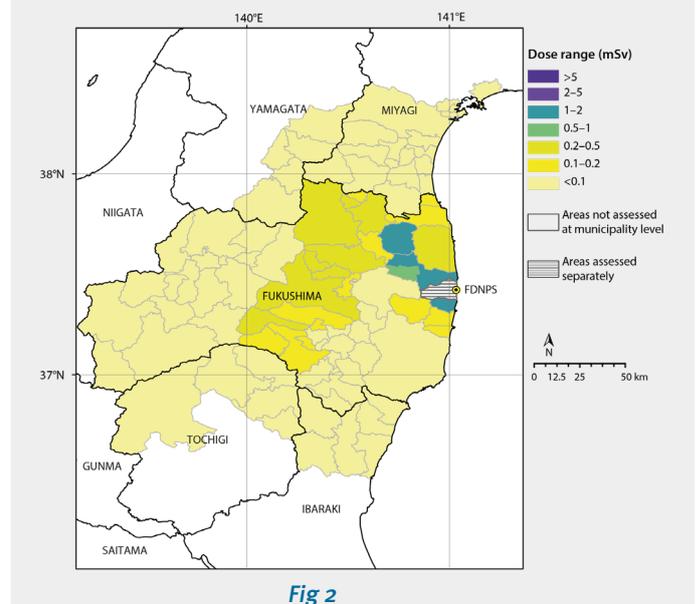


Fig 2

In addition to the average doses to defined groups of members of the public, which were the focus of the Committee's previous report, the Committee has also estimated the ranges of doses to individuals in the population groups, taking account of uncertainties and variabilities. Typically, nine out of ten people in each population group were estimated to have received doses in the range of three times lower than the average dose to three times higher than the average.

The estimated municipality - and prefecture - average absorbed doses to the thyroid for infants in the first year are in the range of about 2 to 30 mGy for municipalities that were evacuated, about 1 to 20mGy for other municipalities in Fukushima Prefecture, about 0.6 to 6 mGy in neighbouring prefectures, and about 0.09 to 0.7 mGy for prefectures in the rest of Japan.

Doses to Workers

The average effective dose to the more than 20,000 emergency workers involved in mitigation and other activities at the FDNPS site from March 2011 to the end of March 2012 was about 13 mSv. About 36% received an effective dose more than 10 mSv, while 0.8% (174 workers) were assessed to have received more than 100 mSv in this period. Annual effective doses have been considerably lower since April 2012, with average annual effective doses declining from about 6 mSv in the year to the end of March

2013 to about 2.5 mSv in the year to the end of March 2020. No worker has received an annual effective dose of more than 50 mSv since April 2013.

Absorbed doses to the thyroid of a small number of emergency workers who received the highest doses had been reassessed, in particular using individual-specific measurements of thyroid size, and this had led to changes in the assessed doses to the thyroid of these individuals.

Health Effects

Since the UNSCEAR 2013 Report, no adverse health effects among Fukushima residents have been documented that could be directly attributed to radiation exposure from the accident.

Exposure to radiation could lead to an increased incidence of disease in the exposed population; however for example, with cancer, it is not generally possible to distinguish by observation or testing whether or not the disease of a specific patient has been caused by the radiation exposure. The Committee has therefore assessed the risks resulting from radiation exposure following the accident by estimating whether any increased incidence of a particular disease, calculated theoretically from the estimated doses, would be detectable compared to the normal statistical variability in the baseline incidence of the disease in that population. The Committee's conclusion is that its revised estimates of dose are such that future radiation-associated health effects are unlikely to be detectable.

Following the accident, the greatest concern was whether the exposure to radiation resulting from the accident would lead to an increase in rates of thyroid cancer in the population in Japan. Although a substantial number of thyroid cancers have been detected among exposed children, the Committee believes that, on the balance of available evidence, the (relative to expected) large increase in thyroid cancers is the result of ultrasensitive screening

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procedures that have revealed the prevalence of thyroid abnormalities in the population not previously recognized, and is not a result of radiation exposure. The Committee also concluded that no detectable excesses of other types of cancer that are sensitive to radiation, such as leukaemia or breast cancer, were likely because of the generally low levels of radiation exposure in the Fukushima Prefecture population.

There has been no credible evidence of excess birth defects, stillbirths, premature births or low birthweights related to radiation exposure. Increases in the incidence of cardiovascular and metabolic conditions have been observed among those evacuated following the accident but are probably associated with concomitant social and lifestyle changes and are not attributable to radiation exposure. Excess psychological distress also occurred in the aftermath of the combined earthquake, tsunami and FDNPS accident. However, the report does not address other health consequences, such as mental health or financial impacts, which are beyond the Committee's mandate.

In particular, an increase in the incidence of cancers is also unlikely to be detectable in workers for leukaemia, total solid cancers or thyroid cancer. The Committee has insufficient information to reach an informed judgement on the risk of cataracts.

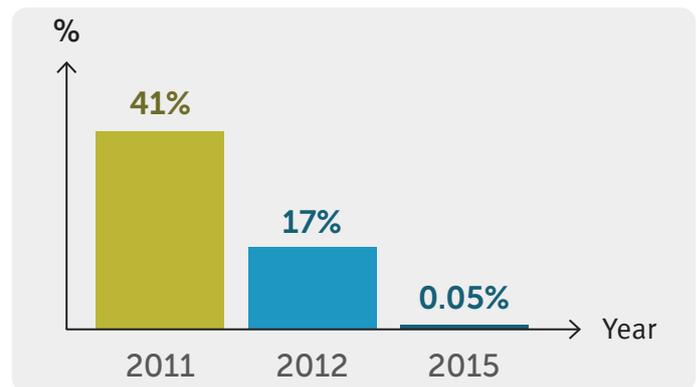


Thyroid (ultrasound) screening.

Marine Environment Impact

The Committee reviewed the movement of radioactive material released as a result of the accident into the marine environment. By 2012, the concentrations of ^{137}Cs , in the coastal waters off the FDNPS site, were little above the levels prevailing before the accident. Concentrations of ^{137}Cs in marine foods have declined rapidly: 41% of samples caught off the coast of Fukushima Prefecture in 2011 exceeded the long-term limit established by the Japanese Government, decreasing to 17% in 2012, and, from the beginning of 2015, to just four samples out of 9,000 (0.05%).

Decline of ^{137}Cs in Marine Foods



Terrestrial and Freshwater Environment Impact

A large body of Japan-specific information has been accumulated on the levels and transfer of radionuclides released to the atmosphere through terrestrial and freshwater environments. Monitoring programmes that began immediately after the accident enabled timely restrictions to be applied to prevent foodstuffs being marketed, where the radionuclide concentration exceeded regulation values and limits established by the Japanese Government. Radionuclide concentrations in most monitored foodstuffs declined rapidly following the accident.

Since 2015, no samples of livestock and crop products, and less than a few per cent of most monitored wild food and freshwater fish products, have exceeded the limit established by the Japanese Government. In addition, a small number of monitored agricultural food samples (less than a few per cent) exceeded the Codex Alimentarius guideline levels for international trade in 2011, and no samples have exceeded them from 2012 onwards.

The large-scale remediation projects implemented by the Japanese national Government and municipal administrations, as well as natural processes and radioactive decay, have further reduced concentrations of radiocaesium in terrestrial and freshwater environments.

No agricultural samples reported exceeded the guideline levels from 2012 onwards.



Rice monitoring.



Wildlife Impact

The Committee continues to consider that regional impacts on wildlife populations with a clear causal link to radiation exposure resulting from the FDNPS accident would have been unlikely, although detrimental effects on individual

organisms might have been possible, and some effects have been observed in plants and animals in the absence of any wide-scale group impacts.

Conclusions

The Committee's revised estimates of doses to the public and their associated uncertainties provide a more realistic assessment of the exposure of the public resulting from the accident at FDNPS compared with the UNSCEAR 2013 Report. While the uncertainties in the estimated doses

remain large, the Committee is of the view that further research is unlikely to reduce them significantly, or change the central estimates, other than in specific circumstances (e.g., to take account of further information on the efficacy of remediation).

Lessons for the Future

Timely monitoring (e.g., whole body counting, thyroid measurements, personal dosimetry) of representative groups of workers and the public at the earliest opportunity after an accident would greatly enhance the quality and informativeness of any assessment of doses to workers and the public following a radiological or nuclear accident. If appropriate human measurements are not made in the immediate aftermath of an accident, doses to people can only be assessed using models together with other measurements that may be available, for example, in the facility where the accident occurred and/or in the wider environment. Experience has shown that the use of such models often leads to conservative estimates of doses.

Care is needed over the widespread use and interpretation of sensitive ultrasound thyroid screening following radiation exposure as a result of events such as the FDNPS accident. There is compelling evidence that sensitive ultrasound screening detects many more cases of abnormalities and cancer in the thyroid than would be detected following the presentation of clinical symptoms. The consequential over-diagnosis of thyroid cancers, many of which may never result in clinical symptoms, has the potential to cause considerable anxiety among some of those screened and to lead to unnecessary treatment, the detrimental effects of which may outweigh those of the radiation exposure itself, especially if the thyroid doses are relatively low.

For further information:

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