

Purpose

- To provide knowledge on the levels of radiation exposure due to the nuclear accident, and the associated effects and risks to human health and the effects on non-human biota
- To present estimates of radiation doses and discuss implications for health for different population groups inside Japan, as well as in some neighboring countries, in light of the UNSCEAR's previous scientific assessments
- To identify gaps in knowledge for possible future follow-up and research

1. The assessment was based on measurement data as far as possible.
2. Doses that the public received for the first one year after the accident were assessed, targeting 20-year-old adults, 10-year-old children and 1-year-old infants.
3. Projections were also made of doses to be received over the first 10 years and up to age 80 years.
4. Models were used, with realistic assumptions, to provide an objective evaluation of the situation.
5. Protective actions taken during the first year were considered and the doses averted by them were estimated.

Used measurement values, etc.

1. Internal exposure through inhalation and external exposure

- (i) Deposition densities of radioactive materials on the ground surface measured on earth and from aircraft
- (ii) Radioactivity concentrations in the air and on the ground surface estimated based on types and estimated amount of radioactive materials released from the reactor and through diffusion simulation

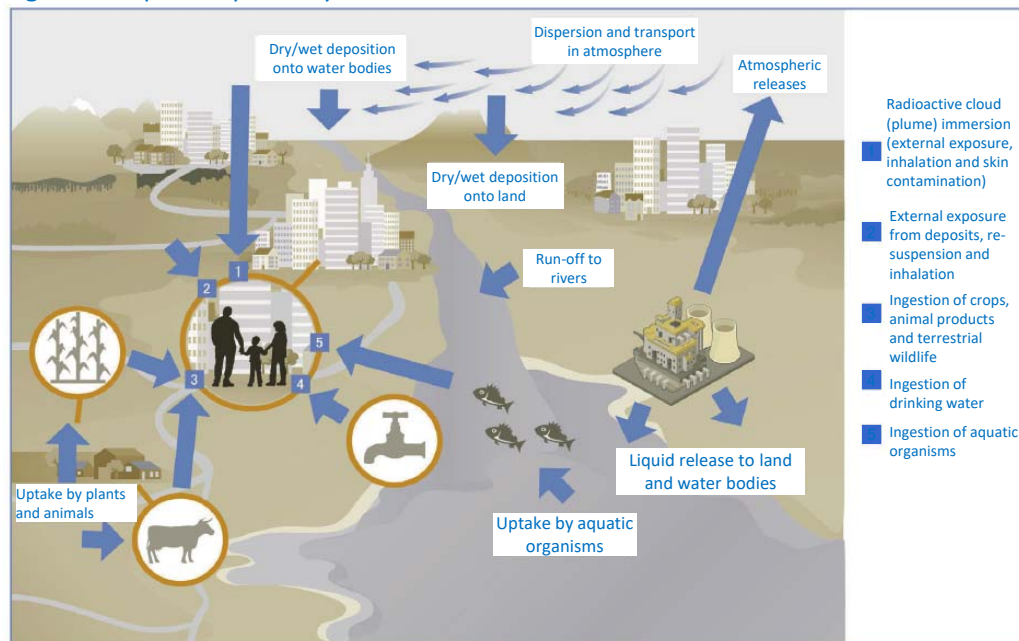
2. Internal exposure through ingestion

- Radioactivity concentrations in foods and drinking water
 - (i) First year: Measurement data for concentrations of radionuclides in distributing foods and drinking water
 - (ii) Second year onward: Radioactivity concentrations in foods estimated through simulation based on soil contamination data; For marine products, radioactivity concentrations in seawater estimated based on measurement data in the sea area off Fukushima Prefecture and through diffusion simulation of radionuclides
- Japanese people's food intake (based on the National Health and Nutrition Survey)

Area classification for dose assessment

Group	Area	Spatial resolution for public dose assessment
1	Settlements in Fukushima Prefecture where people were evacuated in the days to months after the accident	Representative locations were used for each settlement identified in 18 evacuation scenarios
2	Districts of Fukushima Prefecture not evacuated	District level for external and inhalation pathways, based on the estimates for each of the 1-km-grid points, averaged over the district Prefecture level for ingestion pathway
3	Selected prefectures in eastern Japan that were neighboring (prefectures of Miyagi, Tochigi, Gunma and Ibaraki) or nearby (prefectures of Iwate and Chiba) to Fukushima Prefecture	District level for external and inhalation pathways, based on the estimates for each of the 1-km-grid points, averaged over the district Estimated dose due to ingestion for Iwate Prefecture same as for Group 4; for other five prefectures was based on average for the five prefectures
4	All remaining prefectures of Japan	Prefecture level for external and inhalation pathways Average for rest of Japan for ingestion pathway

Figure V. Exposure pathways from releases of radioactive material to the environment



1. Move of radioactive plumes in the air
 - ✓ External exposure
 - ✓ Internal exposure (inhalation)
2. Deposition on the ground surface
 - ✓ External exposure
 - ✓ Internal exposure (re-suspension, inhalation)
3. Deposition on the ground surface, etc.
 - ✓ Internal exposure (transfer to foods and drinks)

Major exposure pathways to be assessed

- (i) External exposure from radioactive materials in plumes and internal exposure through inhalation thereof
- (ii) External exposure from radioactive materials deposited on the ground surface and internal exposure through ingestion of radionuclides that have transferred into foods and drinks
- (iii) Internal exposure through ingestion of radioactive materials that have transferred into marine products

Table 1. Estimated average effective doses and absorbed doses to the thyroid by area for the first one year after the accident*¹

Evacuated settlements					
Group		Effective dose (mSv)		Absorbed dose to the thyroid (mGv)	
		20-year-old (Adults)* ²	1-year old (Infants)	20-year-old (Adults)* ²	1-year old (Infants)
1 ^a	Precautionary Evacuation Areas ^b	1.1-5.7	1.6-9.3	7.2-34	15-82
	Deliberate Evacuation Areas ^c	4.8-9.3	7.1-13	16-35	47-83
Non-evacuated areas					
2	Fukushima Prefecture (other than evacuated settlements)	1.0-4.3	2.0-7.5	7.8-17	33-52
3	Neighboring prefectures ^d	0.2-1.4	0.3-2.5	0.6-5.1	2.7-15
4	Rest of Japan	0.1-0.3	0.2-0.5	0.5-0.9	2.6-3.3
^a Estimate evacuees' doses using 18 evacuation scenarios					
^b Settlements where evacuation was ordered from March 12 to 15, 2011, as emergency protective measures to prevent high-level exposure					
^c Settlements where evacuation was ordered from the end of March to June 2011					
^d Iwate, Miyagi, Ibaraki, Tochigi, Gunma and Chiba Prefectures					

*1: Estimation of doses for typical residents of evacuated settlements and other areas in Japan mSv: millisieverts mGy: milligrays

*2: Estimated doses for 10-year-old children are omitted here.

Reference: Estimation of the public doses in neighboring countries and the rest of the world: The UNSCEAR concluded that the average effective dose for people residing outside Japan for the first one year after the accident was lower than 0.01 mSv.

- It is not likely that any significant changes attributable to radiation exposure due to the accident would arise in future cancer statistics.
- There is the possibility that thyroid cancer risks may theoretically increase among the group of children whose estimated exposure doses were at the highest level. Therefore, their situations need to be closely followed up and assessed.
- Congenital abnormalities and hereditary effects are not detected.

1. Measurement levels of short-half-life radionuclides deposited on the ground surface and their spatial distribution by area
2. Changes in release rates of radionuclides over time and weather information at the time of their release
3. Particle sizes and chemical forms of radioactive iodine
4. Assumption of radioactivity concentrations in foods
5. Japanese people's thyroid iodine uptake rate

Comparison with Direct Measurements

Two sets of measurement information of radionuclides served as information sources for assessing public exposure doses.

- (i) Measured values of I-131 in the thyroid, especially in the thyroid of children
- (ii) Results of the whole-body monitoring of Cs-134 and Cs-137

1. The UNSCEAR's estimates of settlement-average absorbed doses to the thyroid from internal exposure were up to about five times higher than the corresponding values derived from direct monitoring of this group.
2. The results of the whole-body counting of more than 106,000 residents of Fukushima Prefecture were substantially lower than the UNSCEAR's estimates of average effective doses through inhalation and ingestion of Cs-134 and Cs-137.