

Session 2.4

Thyroid Equivalent Doses Due to Radioiodine (I-131) Intake for Evacuees Caused by the Nuclear Accident in Fukushima

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A primary health concern among residents and evacuees in affected areas immediately after a nuclear accident is the internal exposure of the thyroid to radioiodine, particularly I-131, and subsequent thyroid cancer risk. Japan, the natural disasters of the earthquake and tsunami in March 2011 destroyed an important function of the Fukushima Daiichi Nuclear Power Plant (F1-NPP) and a large amount of radioactive material was released to the environment. We conducted I-131 activity measurements in the thyroid of residents in Namie town and evacuees from coastal areas during the period from April 11th to 16th, placing a 3-inch × 3-inch NaI(Tl) scintillation spectrometer at the neck of examinees. In total, 62 people aged from 0 to 83 years old (of which accurate information on age was unavailable for eight people) underwent the measurement with informed consent. We found detectable I-131 activity in 39 of the 45 people evacuated from coastal areas, and in 7 of the 17 residents in Tsushima District, Namie Town. Net thyroid and background count rates were determined from the detected gamma spectra measured for the most conservative dose assessment, we used thyroid equivalent dose coefficients for iodine in elemental form, as given by ICRP Publication 71, and the thyroid uptake factor equal to 0.3. Thyroid equivalent doses by inhalation ranged from none detected (*N.D.*) to 33 mSv. The median thyroid equivalent dose was estimated to be 4.2 mSv and 3.5 mSv for children and adults, respectively, much smaller than the mean thyroid dose in the Chernobyl accident (490 mSv in evacuees). Maximum thyroid doses for children and adults were 23 mSv and 33 mSv, respectively. As the most conservative scenario, we estimated the thyroid dose to children, using the atmospheric I-131 concentration assessed from the thyroid measurements of adults. We considered that the rainfall on March 15th resulted in deposition of ambient radioactive materials on the ground and subsequent less possibilities to inhale them. The maximum I-131 activity detected in the thyroid of an adult was 1.5 kBq. Assuming the inhalation exposure took place for 4 hours on the afternoon of March 15th, we estimated that this person could inhale as much as 85 kBq of I-131. Using the thyroid activity and breathing rate, the maximum atmospheric I-131 concentration was estimated to be 23 kBq m⁻³. Using the maximum atmospheric concentration, the thyroid dose for different age groups from inhalation of I-131 was calculated for children. In this estimation the dose for 1-, 5- and 10-year-old children could exceed 50 mSv. If children in this age range remained in Tsushima District after the radioactive plume arrived in the afternoon of March 15th, they might have experienced further exposure to I-131. Since the maximum I-131 concentration was obtained from an adult's activity, inhaled activity by infants could be less because they usually stay indoors in cold

winter weather.

Thyroid equivalent dose for residents who lived in Namie Town well known as heavily contaminated area was estimated using a result of whole body counting examination which was carried out by Japan Atomic Energy Agency a few months after the Fukushima Daiichi Nuclear Power Station accident. Photon peaks by I-131 and Cs-134 were observed by our previous study using a NaI(Tl) scintillation spectrometer and I-131/Cs-134 activity ratio was estimated in this study. The maximum values of I-131/Cs-134 activity ratio corresponding to thyroid uptake factor of 0.3, 0.1 and 0.03 were evaluated to be 0.9, 2.6 and 8.7, respectively. The maximum value of I-131/Cs-134 activity ratio was used for the most conservative thyroid dose estimation. Maximum internal exposure of the thyroid to I-131 on the basis of Cs-134 accumulated in the body measured by whole body counter was estimated to be 18 mSv. This value was much smaller than 50 mSv, which is the recommended dose taking a stable iodine tablet by the International Atomic Energy Agency.