marital, or socioeconomic status; or precise irradiation exposure, although irradiation symptoms were not reported.

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Internal Radiation Exposure After the Fukushima Nuclear Power Plant Disaster

To the Editor: On March 11, 2011, an earthquake and tsunami struck Japan and led to a meltdown of the reactors at the Fukushima Daiichi nuclear power plant. Release of radioactive material into the air, water, and soil raised concern about internal radiation exposure and the long-term risk of cancer in nearby residents.[1] However, radiation exposure has not been measured.

Methods. Minamisoma is located 23 km north of the Fukushima Daiichi nuclear plant. Many residents were evacuated, but by August 2011, approximately half had returned. A voluntary screening program for levels of cesium (^{134}Cs and ^{137}Cs), known to be representative of total internal radiation exposure,[2] was conducted between September 26, 2011, and March 31, 2012, for all residents aged 6 years or older using a whole-body counter (Fastscan Model 2250) shielded to background radiation. Detection limits were 210 Bq for ^{134}Cs and 250 Bq for ^{137}Cs with a 2-minute scan. Persons without radiation exposure would have a level of 0 Bq. Cesium exposure was measured as both total body exposure and concentration by body weight (Bq/kg) and is reported as median values with ranges (minimum to maximum). Total cesium exposure was converted into committed effective dose (sievert, Sv) based on the assumption of acute cesium inhalation immediately after the disaster in adults, and on that of chronic cesium ingestion after the disaster in children. Common dose-limit recommendations for the public are 1 mSv or less.[3] χ^2 Tests were used to compare proportions of adults and children exposed, with 2-sided $P < .05$ considered statistically significant. All statistical analyses were conducted using Stata/MP version 11 (StataCorp LP). The institutional review board of the Institute of Medical Science, University of Tokyo, approved the study with a waiver of informed consent.

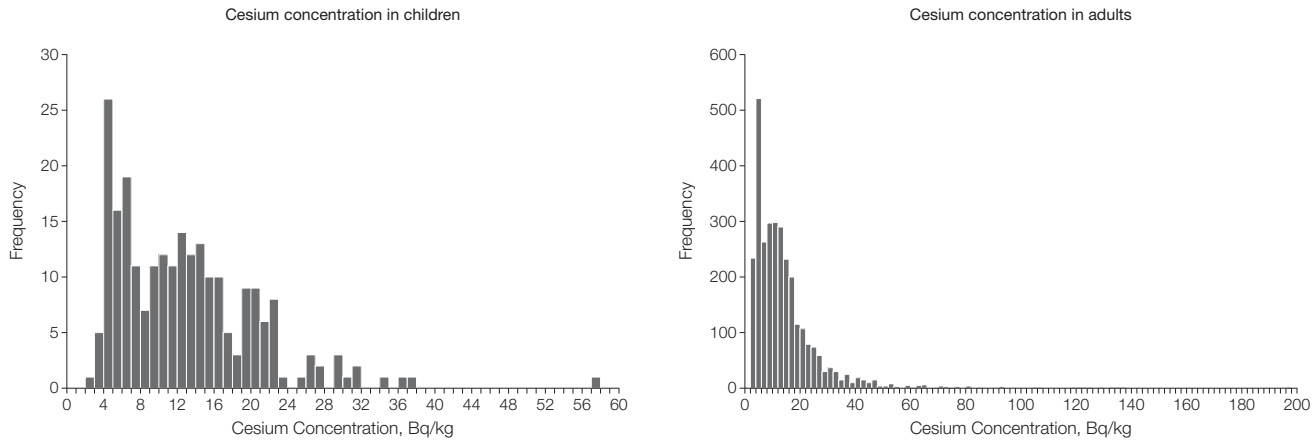
Results. A total of 9498 residents enrolled in the study, 24% of the registered population on August 15, 2011. The sample consisted of 1432 children (720 girls; median [range] age, 11 [6-15] years) and 8066 adults (4512 women; median [range] age, 44 [15-97] years).

A total of 3286 individuals (34.6%; 95% CI, 33.6%-35.6%) had detectable levels of cesium (FIGURE). Cesium was detected in 235 children (16.4%; 95% CI, 14.5%-18.3%), ranging from 210 to 2953 Bq (median, 590 Bq), with a concentration of 2.8 to 57.9 Bq/kg (median, 11.9 Bq/kg). In contrast, 3051 adults (37.8%; 95% CI, 36.8%-38.9%) had detectable levels of cesium, ranging from 210 to 12 771 Bq (median, 744 Bq), with a concentration of 2.3 to 196.5 Bq/kg (median, 11.4 Bq/kg). This difference in exposure risk between adults and children was statistically significant ($\chi^2 = 246.5$, $P < .001$).

Committed effective doses were less than 1 mSv in all but 1 resident (1.07 mSv).

Comment. To our knowledge, this is the first report on internal exposure to cesium radiation after the Fukushima Daiichi nuclear plant incident. In this sample, exposure levels were low in most adults and children tested and much lower than those reported in studies years after the Chernobyl incident (49 Bq/kg after 7-10 years).[4] Even the highest levels of contamination observed are below the thresh-

Figure. Histograms of Cesium Concentration (Bq/kg) in Exposed Children and Adults



Frequency of exposure measured in children in 1 Bq/kg increments and in adults in 2 Bq/kg increments. Nonexposed adults and children were excluded; therefore, the numbers of individuals included are 235 children and 3051 adults.

olds for the administration of Prussian blue.[3] Differences between children and adults may reflect differences in cesium metabolism[5] or greater attention to food and water consumption or changes in outdoor activity in children.

Because this screening program started 6 months after the nuclear power plant disaster, higher exposure levels might have been detected earlier; it is not possible to ascertain whether the low levels of exposure were due to low ongoing exposure or decay from high exposure values. No information on individual exposure to environmental contaminants was available. Because data were collected from volunteers, the results may not be representative of the entire population in contaminated areas. No case of acute health problems has been reported so far; however, assessments of the long-term effect of radiation requires ongoing monitoring of exposure and the health conditions of the affected communities.

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