Overview of health consequences after the Fukushima Daiichi nuclear accident

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WHO/UNSCEAR health risk assessment

- Public
  - Doses lower than the thresholds for deterministic effects
  - No discernible increase in cancer risk

- Workers
  - Possibility of Hypothyroidism for those with the highest thyroid exposure
  - No discernible increase in cancer risk
Today’s topics

- **Public**
  - Thyroid exposure of children
  - Health conditions of people in Fukushima Prefecture

- **Workers**
  - Epidemiological study

- **Summary**
Dosimetric facts

- Estimated external dose during the first 4 months is $< 2$ mSv for $94\%$ of $\sim 450,000$ residents of Fukushima Prefecture.

- Internal dose from Cs-134 and 137 is $< 1$ mSv for $99.8\%$ of $\sim 15,000$ whole body counting in Fukushima Prefecture.

- Concentration of radioactive cesium in foodstuffs is kept low.
# Thyroid monitoring

<table>
<thead>
<tr>
<th>Municipality</th>
<th>Date</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iwaki</td>
<td>26–27 March, 2011</td>
<td>134</td>
</tr>
<tr>
<td>Kawamata</td>
<td>28–30 March, 2011</td>
<td>647</td>
</tr>
<tr>
<td>Iitate</td>
<td>30 March, 2011</td>
<td>299</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>1,080</strong></td>
</tr>
</tbody>
</table>
Outline of thyroid monitoring

- Children of 0–15 years old
- NaI scintillator survey meter (Aloka TCS-161, 171, 172)
- Background $\leq 0.2 \, \mu$Sv/h
- Neck wiped with clean wet towel
- Mean of 3 readings
Result of thyroid monitoring

Screening level: 0.2
(~100 mGy for 1y infant)
Thyroid examination (Initial screening)

- Target
  Residents of Fukushima Prefecture born between 2 April 1992 and 1 April 2011

- Methods
  Primary examination
  - Ultrasonography
  Confirmatory examination
  - Further ultrasonography
  - Blood test, Urine test
  - Fine-needle aspiration cytology (FNAC)
# Diagnostic criteria of primary exam

<table>
<thead>
<tr>
<th>Classification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>No nodules / cysts</td>
</tr>
<tr>
<td>A2</td>
<td>Nodules &lt;5.0mm or cysts &lt;20.0mm</td>
</tr>
<tr>
<td>B</td>
<td>Nodules &gt;5.1mm or cysts &gt;20.1mm</td>
</tr>
<tr>
<td>C</td>
<td>Immediate need for confirmatory examination</td>
</tr>
</tbody>
</table>

B and C are advised to take the confirmatory examination.
Thyroid examination in uncontaminated prefectures

- Aomori
- Nagasaki
- Fukushima
- Yamanashi
## Result of primary examination

(As of 31 October 2014)

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Fukushima Prefecture</th>
<th>Other prefectures*</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>152,633 (51.5%)</td>
<td>1,853 (42.5%)</td>
</tr>
<tr>
<td>A2</td>
<td>141,379 (47.7%)</td>
<td>2,468 (56.5%)</td>
</tr>
<tr>
<td>B</td>
<td>2,240 (0.8%)</td>
<td>44 (1.0%)</td>
</tr>
<tr>
<td>C</td>
<td>1 (0.0%)</td>
<td>0 (0.0%)</td>
</tr>
<tr>
<td>Total</td>
<td>296,253 (100.0%)</td>
<td>4,365 (100.0%)</td>
</tr>
</tbody>
</table>

* Aomori, Yamanashi and Nagasaki
Result of FNAC

(As of 31 October 2014)

- 519 participants underwent FNAC
- 24 suspicious and 84 malignant cases
- 81 papillary thyroid carcinoma out of 85 surgical cases
- Tumor size: $14.1 \pm 7.3$ mm
Age distribution of suspicious/malignant cases

Age as of 11 March 2011

Age as the date of confirmatory examination
Thyroid examination (Full-scale screening)

- Target
  - Those for initial screening
  - Residents of Fukushima Prefecture born between 2 April 2011 and 1 April 2012

- Examination frequency
  - Every 2 years until the age of 20
  - Every 5 years afterwards

- Methods
  - Same as initial screening
Preliminary result of primary exam
(As of 31 October 2014)

Full-scale screening

Number

0 5000 10000 15000 20000 25000

A1 A2 B C

Initial screening

Not participated
Preliminary result of FNAC
(As of 31 October 2014)

- 155 participants completed confirmatory test
- 11 of them underwent FNAC
- 4 suspicious cases
- Age: 10(M), 13(M), 19(F), 20(M)
- Tumor size: 7.0–17.3 mm
Today’s topics

- **Public**
  - Thyroid exposure of children
  - Health conditions of people in Fukushima Prefecture

- **Workers**
  - Epidemiological study

- **Summary**
Pregnancy outcome

<table>
<thead>
<tr>
<th>Pregnancy Outcome</th>
<th>FY 2011</th>
<th>FY 2012</th>
<th>FY 2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Miscarriage</td>
<td>0%</td>
<td>1%</td>
<td>2%</td>
</tr>
<tr>
<td>Preterm birth</td>
<td>3%</td>
<td>5%</td>
<td>6%</td>
</tr>
<tr>
<td>Congenital anomalies</td>
<td>7%</td>
<td>6%</td>
<td>5%</td>
</tr>
</tbody>
</table>
Mothers’ mental health

Mothers with tendency for depression

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Fiscal year</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>30%</td>
</tr>
<tr>
<td>2012</td>
<td>20%</td>
</tr>
<tr>
<td>2013</td>
<td>10%</td>
</tr>
</tbody>
</table>

Estimated ratio of postpartum depression based on EPDS

13%

(National average 9.0%)
Weight gain of evacuees

Distribution of BMI in 1,032 adults from Iitate Village (mean age 65) before and after the accident

2008–2010

- ≥ 30 (Obesity)
- 18.5– < 25 (Normal weight)
- 25– < 30 (Overweight)
- < 18.5 (Underweight)

2011–2012

- ≥ 30 (Obesity)
- 18.5– < 25 (Normal weight)
- 25– < 30 (Overweight)
- < 18.5 (Underweight)
Mental health of evacuees

Children (SDQ ≥ 16)

- 2011: 20%
- 2012: 15%
- 2013: 10%

Adult (K6 ≥ 13)

- 2011: 15%
- 2012: 10%
- 2013: 5%
Perception of radiation risk

How much health disorders (for example, cancer) do you think will occur in the future due to the current radiation exposure?

How much health disorders do you think will occur in future generations (children or grandchildren) due to the current radiation exposure?

Possibility

Very low

Very high
Psychological effect?

Imagine what they experienced!
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- **Summary**
Exposure of emergency workers

- A total of 19,346 workers engaged in emergency work.
- Effective doses to 174 workers exceeded 100 mSv.
- Six of them exceeded 250 mSv.
- Highest effective dose was 678.8 mSv.
- No acute radiation effect was observed.
Epidemiological study of emergency workers

- Expert meeting set up to make plans
- Report compiled in June 2014
- RERF appointed as the controlling research institute
- Multiple institutions to be engaged
- Baseline studies conducted in FY 2014
- Full-scale study starts in FY 2015
Outline of study plan (1)

- **Target**
  - ~20,000 emergency workers

- **Study design**
  - Prospective cohort (nested case-control)
  - Lifetime follow-up

- **Exposure assessment**
  - Realistic assessment of cumulative dose
  - Consideration on exposure condition
  - Chromosome assay (> 100 mSv)
Outline of study plan (2)

- **Endpoints**
  - Solid cancer
  - Leukemia
  - Non-cancerous disease
  - Psychological effects

- **Others**
  - Collection of biological samples (blood)
  - Ascertainment of medical exposure
  - Questionnaire on confounding factors
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- Summary
Summary

- Thyroid cancer cases observed so far are attributed to intensive screening.
- Evacuation has changed people’s lifestyle and could affect their health conditions.
- Mental health is an issue of concern especially for evacuees and young mothers.
- Epidemiological study of emergency workers has started, but discernible increase in cancer is unlikely.
For more information

- Fukushima Radiation and Health
  http://www.fmu.ac.jp/radiationhealth

- In Focus: Radiation Protection at Works Relating to TEPCO's Fukushima Daiichi Nuclear Power Plant Accident (IRPW)