Fukushima Radiation-Related Concerns. Public Health Implications

Ali Hamade
Environmental Public Health Program
Alaska Section of Epidemiology
Concerns over Fukushima radiation releases

- Radiation exposure concerns from
  - Seafood, Water, Migrating birds
- Media reports and analyses not necessarily informed
- Some publicized published studies modeled elevated risks of morbidity and mortality from Fukushima-related radiation
- Fukushima incident-related National Poison Data System calls (3/11/11 – 4/18/11)*
  - 400 calls
    - 340 information requests
    - 60 exposures (None classified as probable exposures)

*Law et al., 2013
State and Federal Response

- **Alaska**
  - Land animals, fish, marine mammals, shellfish, and seaweed safe to eat.

- **California**
  - Samples fish, water, and air. No health and safety concerns to California residents.

- **Oregon**
  - Coastal water monitoring suspended in 11/2011 because there were no findings above naturally occurring background radiation levels.

- **Washington**
  - Radioactivity found in tuna in 2011 and 2012 off Japan and California coasts far below what would pose a health risk.

- **EPA, FDA, and NOAA joint release**
  - No radiation levels of concern in water, sediment, or seafood (measured or expected).
FDA Derived Intervention Levels

• For radionuclides expected in the entire diet during the first year following accidental releases of radionuclides
• Presumed contamination would occur in 30% of dietary intake (Exception for I-131 in babies – 60 days)
• 03/2011 – 06/2012, FDA tested 1313 samples from Japan (199 seafood or seafood products)
  – 1312 samples had no Iodine-131, Cesium-134, Cesium-137, or other gamma-ray emitting radionuclides of concern
  – 1 sample contained detectable levels of Cesium, but below Derived Intervention Level
Case Study: Pacific Bluefin Tuna Caught in California Waters
NOAA-funded research led by Stanford University
Caught Pacific Bluefin Tuna (PBFT) fish from California coastal waters
Pacific Bluefin Tuna
- Spawn in the western Pacific Ocean
- Juveniles forage in the waters around Japan then either remain in the western Pacific or migrate eastward to California waters
- Youngest tuna in California waters (approximately 1–1.5 years old) likely migrated from Japan within preceding year
- Larger, older tuna in California waters are primarily residents for >1 year

Madigan et al., 2012, 2013
Cesium Levels Declining in Tuna – California, 2011 to 2012

Madigan et al., 2013
Pacific Bluefin Tuna Radiation by Fish Length- CA 2012

Radio Cesium versus Size in Pacific Bluefin Tuna

Plotted from Madigan et al., 2013 by California Dept. of Health Radiologic Health Branch (DRAFT)
Is There Health Risk from Consuming These Tuna?

Table 1. Committed effective dose to humans from ingesting PBFT calculated on the basis of Fukushima-derived Cs concentrations and natural radionuclides in fish in San Diego, August 2011, or potentially present in Japan, April 2011

<table>
<thead>
<tr>
<th>Radionuclide</th>
<th>PBFT source</th>
<th>Mean (±SD)</th>
<th>DC (nSv-Bq⁻¹)</th>
<th>nSv (from 200 g)*</th>
<th>nSv (from 1 kg)</th>
<th>μSv (annual consumption)*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(Bq·kg⁻¹ dry)</td>
<td>(Bq·kg⁻¹ wet)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>¹³⁴Cs</td>
<td>United States, August 2011</td>
<td>4.0 (1.4)</td>
<td>1</td>
<td>19</td>
<td>3.7</td>
<td>18.5</td>
</tr>
<tr>
<td>¹³⁷Cs</td>
<td>August 2011</td>
<td>6.3 (1.5)</td>
<td>1.5</td>
<td>13</td>
<td>4.0</td>
<td>19.9</td>
</tr>
<tr>
<td>⁴⁰K</td>
<td></td>
<td>347 (49)</td>
<td>84.7</td>
<td>6.2</td>
<td>105</td>
<td>525</td>
</tr>
<tr>
<td>²¹⁰Po</td>
<td></td>
<td>79</td>
<td>19.3</td>
<td>1,200</td>
<td>4,632</td>
<td>23,160</td>
</tr>
<tr>
<td>¹³⁴Cs</td>
<td>Japan, April 2011</td>
<td>60.0</td>
<td>14.6</td>
<td>19</td>
<td>56</td>
<td>278</td>
</tr>
<tr>
<td>¹³⁷Cs</td>
<td></td>
<td>94.5</td>
<td>23.1</td>
<td>13</td>
<td>60</td>
<td>299</td>
</tr>
<tr>
<td>⁴⁰K</td>
<td></td>
<td>347 (49)</td>
<td>84.7</td>
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*Annual per capita consumption rates (24.1 and 56.6 kgy⁻¹ in the US and Japan, respectively) are for all types of finfish and shellfish combined, whereas the dose calculations conservatively assumed the entire consumption was solely of contaminated tuna.
Exposure and Cancer Risk Assumptions

- Consuming 12 ounce of tuna per day (95th percentile fish consumption rate among recreational fishermen) (conservative assumption)
- Consuming this tuna for 1 year (~273 pounds)
- Radiation Exposure = 2.8 milliSv (4.7 microSv from Cesium ~ 1/600 total)
  - Cesium dose
    - ~ 1 dental X-ray
    - ~ half the daily background dose received by the average person
    - ~ 12% dose from cosmic rays flying LA-NY
- Excess Cancer Risk (above background) = 2 cancers in each 10,000,000 people exposed
- This cancer risk is EXTREMELY LOW
Cancer Risk in Perspective

$\sim 1 \text{ in } 2 \text{ males}$ and $1 \text{ in } 3 \text{ females}$ will develop cancer in their lifetime in the U.S.

(SEER.cancer.gov)
Cesium in Arctic Marine Mammals pre-Fukushima

- Measured 137Cs in muscle of 12 polar bears, 15 ringed seals, 10 hooded seals, 7 bearded seals, 14 harp seals, one walrus, one white whale, and one blue whale (2000-2003) from Svalbard and the Barents and North Greenland Seas
- Mean concentration highest for polar bears (0.72 Bq/kg wet weight) and lowest for bearded seals (0.22 Bq/kg); below detection limit for the walrus.
- No age related patterns in Cs levels (polar bears and hooded seals)
- **Pacific bluefin tuna (1.5 Bq/kg)** caught off the California coast > arctic marine mammals pre-Fukushima

Possible Consequences of Misinformation on Radiation

• Not eating healthful and nutritious traditional foods
• Commercial losses
  – Jobs
  – Money
  – Livelihoods
• Undue stress
Contact Information:

ali.hamade@alaska.gov
907-269-8000
California Air Sampling Data from All Stations

Concentration of Radio Iodine versus Day Sample was Collected

WRONG
Same data with public health concern reference level

Looks unimpressive… and delivers RIGHT message especially after seeing the first graph…

Threshold of public health concern

… and this…

flattens to…

This!

Highest level below 1.6 pCi per m
Pacific Bluefins Caught in CA - 2011

The closer to California, the less radioactive the tuna

Madigan et al., 2012