New French Study on Child Leukemias near NPPs

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French GEOCAP Study

Childhood leukemia around French nuclear power plants – the Geocap study, 2002-2007.

Int J of Cancer January 2012. DOI: 10.1002/ijc.27425

Claire Sermage-Faure, Dominique Laurier, Stéphanie Goujon-Bellec, Michel Chartier, Aurélie Guyot-Goubin, Jérémie Rudant, Denis Hémon, Jacqueline Clavel.
French GEOCAP Study

- Statistically significant increase in leukaemia in children (2002-2007) within 5 km of 19 French NPPs
- Persuasive findings because the increase was found via two different methods
  (a) huge nationwide *case-control* study, and
  (b) conventional *incidence* study
Other European Studies

- In fact, GEOCAP is the fourth recent European study with this result.
- After the shocking findings of the KiKK study in 2008, further studies in Germany, Great Britain, Switzerland, and France.
- All have very similar findings.
## 4 recent European studies

All Acute Leukemias in Four Countries (under-fives, 0-5 km)

<table>
<thead>
<tr>
<th>Country</th>
<th>Observed Number</th>
<th>Expected Number</th>
<th>% Increase</th>
<th>p-value (one sided)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>34</td>
<td>24.09</td>
<td>41%</td>
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</tr>
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French authors: combine the available data

“Overall, the findings call for ... collaborative analysis of ... studies conducted in various countries”

But they did not do this themselves although it’s relatively straightforward

Dr Alfred Körblein and I did do it we found a 37% increase which is statistically significant.
## Combined Analysis

All Acute Leukemias (under-fives, 0-5 km of NPPs)

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<td>0.1506</td>
</tr>
<tr>
<td><strong>POOLED DATA</strong></td>
<td><strong>79</strong></td>
<td><strong>57.5</strong></td>
<td><strong>37%</strong></td>
<td><strong>0.0042</strong></td>
</tr>
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</table>
Other studies world-wide


over 60 STUDIES
26 largest studies


<table>
<thead>
<tr>
<th>Number of studies</th>
<th>Leukemia Increase observed</th>
<th>No increase observed</th>
<th>% of studies observed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>19</td>
<td>7</td>
<td>73%</td>
</tr>
<tr>
<td>observed increases are greater than the one SD from the SIR</td>
<td>9</td>
<td>3</td>
<td>75%</td>
</tr>
<tr>
<td>observed increases are statistically significant at p = 5%</td>
<td>6</td>
<td>1</td>
<td>85%</td>
</tr>
</tbody>
</table>

Conclusion: steady pattern of leukemia increases near NPPs
Possible Causes

- Confounders
- Coincidence
- Population mixing
- Exposure to chemicals
- Exposure to viruses/fungi
- Exposure to radiation
Large uncertainties in estimated doses near reactors

- Environmental models (behaviour of nuclides in environment)
- Biokinetic models (uptake and retention of nuclides in humans)
- Dosimetric models (convert Bq to mGy: mSv)
- Weighting factors (tissue $W_T$ and radiation $W_R$)

= OFFICIAL DOSE ESTIMATES HAVE LARGE UNCERTAINTIES - see CERRIE Report [www.cerrie.org](http://www.cerrie.org)
Uncertainty distributions in dose estimates
## Uncertainties in Dose Coefficients


<table>
<thead>
<tr>
<th>Nuclide</th>
<th>Intake</th>
<th>Organ</th>
<th>U Range = \left(\frac{\text{95th}}{\text{5th}}\right)\text{ percentiles}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cs-137</td>
<td>ingestion</td>
<td>red bone marrow</td>
<td>4</td>
</tr>
<tr>
<td>I-131</td>
<td>inhalation</td>
<td>thyroid</td>
<td>9</td>
</tr>
<tr>
<td>Sr-90</td>
<td>ingestion</td>
<td>red bone marrow</td>
<td>240</td>
</tr>
<tr>
<td>Pu-239</td>
<td>ingestion</td>
<td>red bone marrow</td>
<td>1,300</td>
</tr>
<tr>
<td>Sr-90</td>
<td>inhalation</td>
<td>lungs</td>
<td>5,300</td>
</tr>
<tr>
<td>Ce-144</td>
<td>inhalation</td>
<td>red bone marrow</td>
<td>8,500</td>
</tr>
<tr>
<td>Pu-239</td>
<td>ingestion</td>
<td>bone surface</td>
<td>20,000</td>
</tr>
</tbody>
</table>
So, radiation exposures to nearby people could be a cause
A hypothesis to explain findings

- episodic spikes in reactor releases
- high concentrations in pregnant women
- large doses to embryos/fetuses
- resulting babies are born pre-leukemic
- after 1-2 years develop full leukemia
“We conclude that there is strong evidence that low dose irradiation of the fetus *in utero*, particularly in the last trimester, causes an increased risk of cancer in childhood.”

Spikes at NPPs
Apply the Precautionary Principle

- if reasonable evidence, should take precautionary steps
- uncertainty no excuse for inaction
- eg health warnings near reactors?
- whatever the explanation, leukemia risk is still there
Thanks to

Dr Alfred Körblein
Professor Dillwyn Williams
Dr Keith Baverstock
IPPNW Germany