Recent ecological studies in Great Britain\(^2\) and Germany\(^3\) also evaluated residence at diagnosis and found similar leukaemia risks in children <5 years of age living near (0–5 km) nuclear power stations (Table 1). The standardized incidence ratio (SIR) is 1.40 in Switzerland (CH), 1.36 in Great Britain (GB) and 1.41 in Germany (D). The relative risk (RR), defined by the ratio of SIR in the 5-km zone to SIR in the rest of the study region, is 1.46 in CH, 1.41 in GB and 1.45 in D. Each individual RR is not significant but a pooled analysis of the data yields RR = 1.44 that is significant on the 1% level (P = 0.007). So the Swiss data confirm the excess of leukaemia found in young children living near German and British NPPs.

### Table 1  SIR and RR near Swiss, British and German nuclear power stations

<table>
<thead>
<tr>
<th>Data set</th>
<th>O</th>
<th>E</th>
<th>SIR</th>
<th>(P)-value(^*)</th>
<th>RR</th>
<th>(P)-value(^**)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switzerland (CH)</td>
<td>0–5 km</td>
<td>11</td>
<td>7.87</td>
<td>1.40</td>
<td>0.3431</td>
<td>1.46</td>
</tr>
<tr>
<td></td>
<td>5–15 km</td>
<td>54</td>
<td>56.40</td>
<td>0.96</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Great Britain (GB)</td>
<td>&lt;5 km</td>
<td>20</td>
<td>14.74</td>
<td>1.36</td>
<td>0.2216</td>
<td>1.41</td>
</tr>
<tr>
<td></td>
<td>&gt;5 km</td>
<td>1579</td>
<td>1640.44</td>
<td>0.96</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Germany (D)</td>
<td>&lt;5 km</td>
<td>34</td>
<td>24.09</td>
<td>1.41</td>
<td>0.0656</td>
<td>1.45</td>
</tr>
<tr>
<td></td>
<td>&gt;5 km</td>
<td>585</td>
<td>599.58</td>
<td>0.98</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CH + GB + D</td>
<td>&lt;5 km</td>
<td>65</td>
<td>46.70</td>
<td>1.39</td>
<td>0.0130</td>
<td>1.44</td>
</tr>
<tr>
<td></td>
<td>&gt;5 km</td>
<td>2218</td>
<td>2296.42</td>
<td>0.97</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^*\)\(P\)-value (Poisson distribution).

\(^**\)\(P\)-value (Binomial distribution).

### Spike radiations near nuclear power plants may be the culprit

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Spycher \textit{et al.},\(^1\) in their nationwide cohort study, found ‘little evidence’ of an association between residence near nuclear power plants (NPPs) and the risk of leukaemia or any childhood cancer. In their discussion about potential causes of this small evidence the authors state that the exposure to radioactivity set free by the nuclear facilities is unlikely to explain an excess in cancer risk in their vicinity and that the NPPs are responsible for less than 1/500 of the total radiation received yearly by people living near NPPs. Indeed, estimated yearly radiation doses are invariably very low. However, each model derives a range of results log normally distributed from which only the median value is normally used. This means that, although the real value could be larger or smaller than the median value, in practice some high values could result.\(^2,\(^3\)\) The cumulative uncertainty in dose estimates could be very large as recognized by the report of the UK Government’s CERRIE Committee.\(^4\) This does not mean that official dose estimates from

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### References


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NPP releases are always incorrect, but it does mean that they contain unquantified uncertainties that could be large and which could render them unreliable where evidence exists that at least in some countries there may be an increased risk of cancer near NPPs. Spikes in the emissions of radioactive carbon and hydrogen (as carbon dioxide and water vapour) occur at nuclear power reactors mainly when their pressure vessels are opened to replace nuclear fuel. These spikes in releases from nuclear power stations may result in the labelling of the embryos and fetuses of pregnant women living nearby. These concentrations could be long-lived in high doses and accumulate in radiosensitive tissues that could result in subsequent cancers. In Germany, spikes of radiation emissions from most nuclear plants (confirmed by the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization) have been well demonstrated (Figure 1).

Spikes in the emissions could also be the cause of human sex problems. Similar to shifts of sex odds observed after the Chernobyl accident, the human sex odds at birth have been observed to be distorted in the vicinity of 28 nuclear reactors and nuclear storage or processing facilities in Germany and in Switzerland.6,7

When other causes of radiation emissions are not evident, the difference in cancer rate near power plants in the same or in different countries could represent the difference between numbers and/or intensity of these spikes would occur.

Would a worse NPP management cause cancer in people living nearby?

References
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Authors’ response to: Childhood cancer and nuclear power plants in Switzerland: a census-based cohort study

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We thank Jürg Schädelin, Alfred Körblein and Giovanni Ghirga for their comments on the CANUPIS study (Childhood Cancer and Nuclear Power Plants in Switzerland).1 Schädelin is surprised that ‘a virtually identical result was obtained’ in the Swiss and in the German KiKK study (Kinderkrebs in der Umgebung von Kernkraftwerken)2 in the regression analyses of the inverse distance to the nearest nuclear power plant (NPP). He misinterprets numerically similar results that were reported on different scales: the results given on page 31 of our web appendix 2 are incidence rate ratios (IRRs) and not comparable to the KiKK study, which reported the untransformed regression coefficients. The regression coefficient in our study was 0.55 [95% confidence interval (CI) −1.22 to 2.32] in the resident cohort and −0.29 (−2.36 to 1.79) in the birth cohort; clearly different from the 1.75 (95% lower confidence bound 0.65) in the German study. Schädelin also sees a discrepancy between our results for the resident cohort (using address of residence at diagnosis and showing a slight decrease of risk closer to NPPs) and the birth cohort (using address at birth and showing a slight increase of risk), but ignores the wide confidence intervals (which both include the null). We agree with Schädelin that the 1/distance model makes strong assumptions about the relation between distance and risk. Due to the sharp increase of the function as distances approach zero, the few cases in close proximity to the NPPs will strongly influence regression parameters. Whereas the assumption that potential effects of radioactive emissions are limited to their immediate proximity is plausible, the precise functional form between distance and cancer incidence is unknown.

Körblein pooled our data with results from two studies from Germany and the United Kingdom to suggest that our study ‘confirms the excess of leukaemia’ observed in the latter studies. Given the large number of previous studies, the three studies included by Körblein represent a highly selected subset. For example, it is unclear why the French study by Laurier3 was not included. This study reported a standardized incidence ratio (SIR) for the 0- to 5-km zone around NPPs of 0.96 (95% CI 0.31–2.24).

Figure 1 Sampling distribution of IRRs in the Swiss study assuming a true IRR of 2.2 as estimated in the German KiKK study. IRRs are for childhood leukaemia in 0- to 4-year olds comparing the 0- to 5-km zone with the >15-km zone around NPPs. The distribution is based on 106 random draws from Poisson distributions of numbers of cases in each zone using the person-years and baseline incidence rate (in >15-km zone) from the Swiss study. The dotted and dashed lines represent the estimated IRR in the Swiss study (birth cohort) and the assumed true IRR respectively.