

Cancer rates in children around Bavarian nuclear installations

Alfred Körblein, 26 June 2003

A November 1995 study by Bundesamt für Strahlenschutz (BfS) investigated cancer rates in children around Bavarian nuclear installationsⁱ. Cancer incidence in children in communities within a 15 km radius of the five nuclear installations combined, Isar, Gundremmingen, Grafenrheinfeld, Garching, and Kahl, was compared with the incidence in suitable control areas outside 15 km. The study yielded a non-significant 11% increase.

In my re-evaluation of this data I used the same method, a one-sided binomial test of the relative risks, but I differentiated between sites of operating nuclear power stations (NPS) and sites of research reactors. Now the result is a significant 35% increase in cancer rates near the three NPS sites (Gundremmingen, Isar, Grafenrheinfeld) combined ($P=0.0043$) whereas the cancer rates near the two research reactors (Garching, a small 4 MW research reactor, and Kahl, a 16 MW experimental reactor which ended operation in 1985) are lower than in the corresponding control areas.

Figure 1 shows the relative risks and 90% confidence intervals for the individual locations. There are significantly increased risks near Gundremmingen ($RR=1.56$) with two boiling water reactors (BWR) and near Isar ($RR=1.45$) with one BWR and one pressurized water reactor (PWR). No increase is found near Grafenrheinfeld with one PWR ($RR=0.95$). The relative risk is 1.50 near the two BWR sites combined ($P=0.0022$). The increase near the two BWR is effectively diluted by the other 3 sites so that the overall result is a non-significant 11% increase as reported by BfS ($P=0.132$). The table below shows the observed and the expected (based on the Bavarian average) case numbers in the study area and the control area. The relative risk (RR) is the ratio of OBS/EXP in the study area and OBS/EXP in the control area.

The BfS study also reports a significantly increased risk in so-called “planning regions”, i.e. regions in which nuclear installations were planned but not built. However, my analysis shows that the increased risk is driven by one location, namely Rehling, where 81 cases were observed when only 63.4 cases were expected. Because the cancer rate in the control area is lower than expected the calculated relative risk for Rehling is $RR=1.53$ ($P=0.014$, two-sided test) and for all planning regions combined $RR=1.20$ ($P=0.022$). Without Rehling the risk in the remaining planning regions is not significantly increased ($RR=1.08$, $P=0.448$). But Rehling lies about 30 km to the east, and therefore downwind of Gundremmingen, the NPS site with the highest increase of cancer risk.

The relative risks in the individual planning regions are shown in Figure 2.

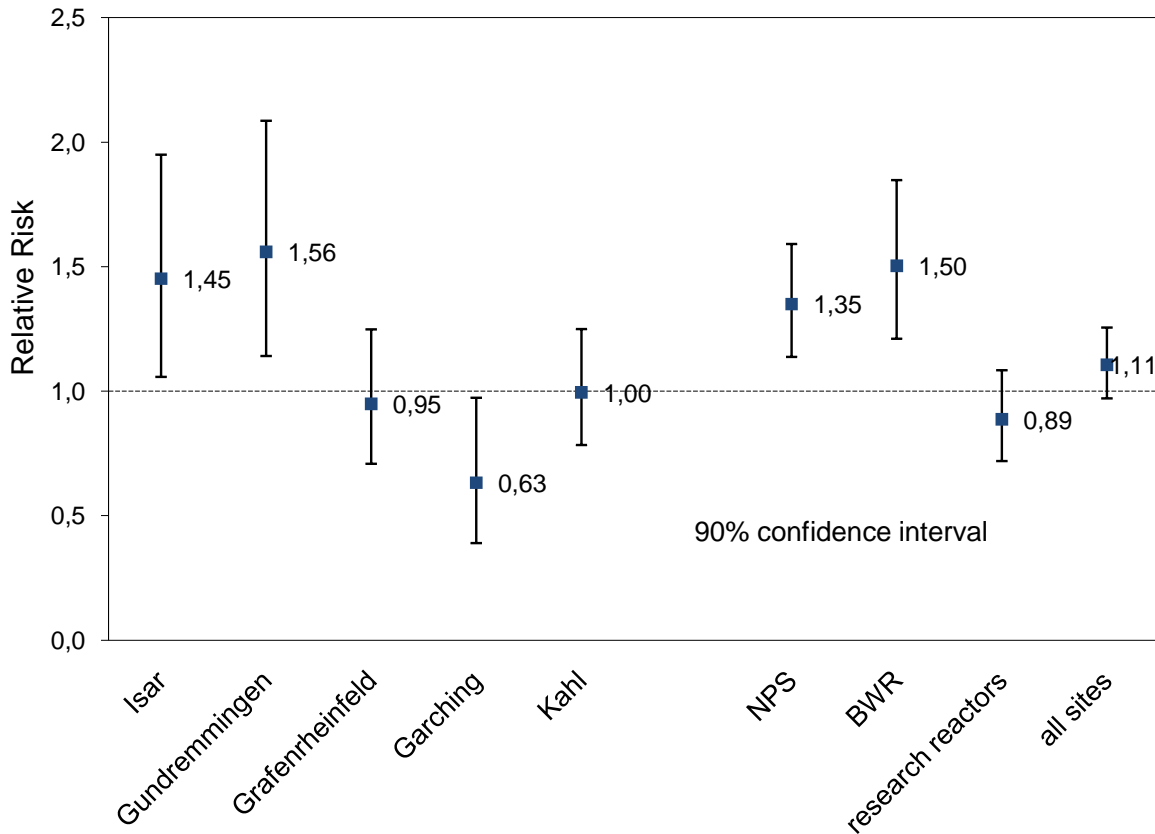


Figure 1: Relative cancer risk for children in the planning regions. Only at the location Rehling is the risk significantly increased. Rehling is about 30 km east of Gundremmingen.

Location	OBS (study area)	EXP (study area)	OBS (control area)	EXP (control area)	RR	P
Isar	32	23.7	143	153.9	1.45	0.0372
Gundremmingen	33	22.6	263	281.5	1.56	0.0137
Grafenheinfeld	37	31.1	84	67.0	0.95	0.6367
Garching	15	25.8	30	32.7	0.63	0.9481
Kahl	54	55.7	57	58.6	1.00	0.5466
PWR	102	77.5	490	502.4	1.35	0.0043
BWR	65	46.4	406	435.4	1.50	0.0022
Research reactors	69	81.5	87	91.2	0.89	0.7945
all locations	171	159.0	577	593.6	1.11	0.1324

Abbreviations:

- NPS Nuclear power stations
- PWR Pressure Water Reactors
- BWR Boiling Water Reactors
- OBS Number of observed cases
- EXP Number of expected cases
- RR Relative Risk
- P one-sided P value from a binomial test (comparison of two Poisson distributions)

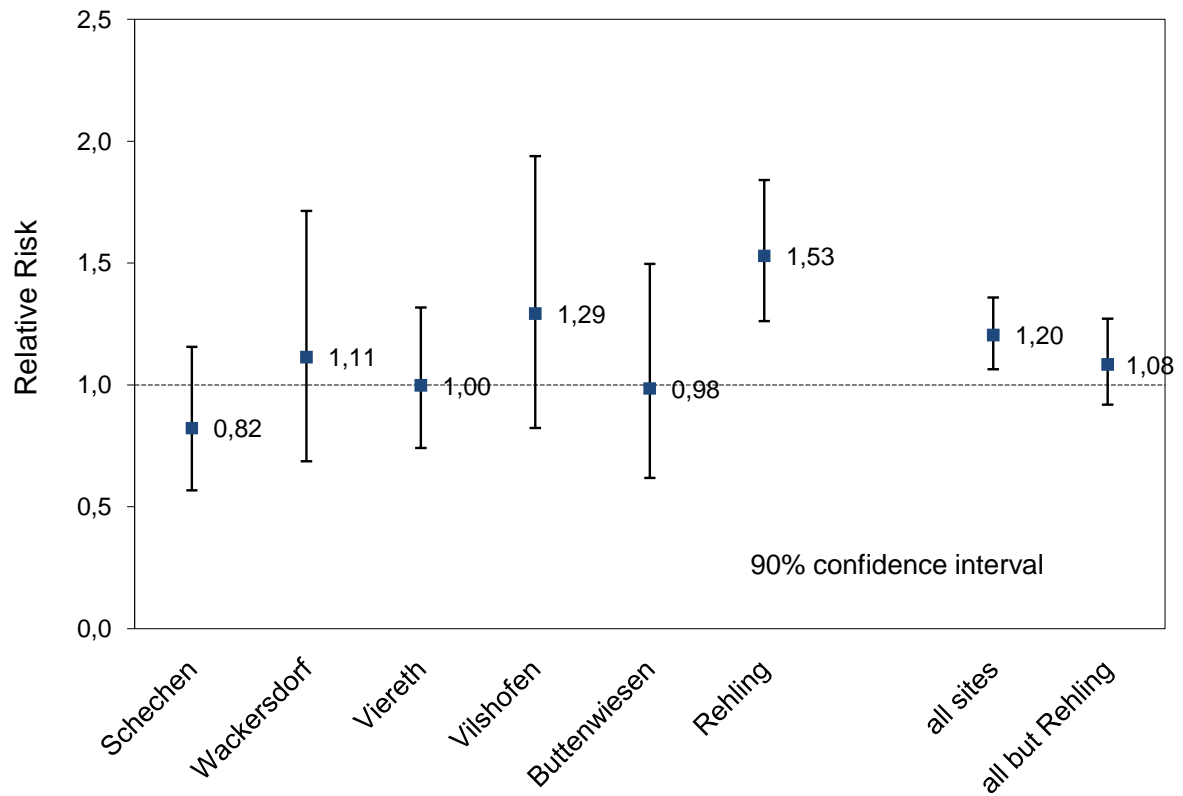


Fig.2: Relative cancer risk in children in the planning regions. Only at the location Rehling is the risk significantly increased. Rehling is about 30 km east of Gundremmingen.

ⁱ van Santen F, Irl C, Grosche B, Schoetzau A. Investigation of the frequency of childhood cancer and congenital malformations in the environs of Bavarian nuclear installations. Report of the Bundesamt für Strahlenschutz, November 1995