

## **Implications of a Recent Authoritative Study of Childhood Cancers near Sixteen German Nuclear Power Plants**

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It is known that ionizing radiation poses a risk of childhood leukemia, therefore, radioactive emissions were suspected 20 years ago as a causal agent for a leukemia cluster near the nuclear plant Krümmel near Hamburg, Germany. Under continuous citizens' pressures, that country's government recently contracted a case-control study of childhood malignancies (acronym KiKK) in the areas around all German nuclear plants, with participation and review by a 12 member external committee of epidemiologists, pediatricians, statisticians and physicists.

Residential distance from the exhaust chimney served as surrogate variable for radiation exposure. Within 41 counties near Germany's 16 nuclear power plants, addresses of all children under the age of 5 at the time of diagnosis of malignancy during 1980 – 2003 (1592 cases) were compared with those of 3 times as many randomly selected 4735 healthy controls of same age and sex, residing in the same region, but > 70 km from these plants. Uncertainty in distances was about 25 m.

The investigators' choice of the <5 year age group of children reflects the known high radiation sensitivity from conception through fetal and embryonic development to infancy (Doll and Wakeford 1997; Gilman et al. 1988). However, on the basis of the plant operators' estimates of population doses, combined with commonly adopted radiation risk factors, the KiKK investigators were confident that radioactive releases would have to be at least 1,000 times higher to explain the observed detriment.

Contradicting expectations, the KiKK data show with high statistical power a strongly increasing risk for childhood malignancies with residential proximity to any of the 16 German nuclear plants. The steepest rise in risk occurs within 5 km, but significantly elevated risk extends to 50 km. Tests for plausible confounders found none, nor is chance a plausible explanation.

In case-control studies the odds ratio (OR) is used as an approximation to relative risk. For KiKK cases who resided < 5 km from the plant OR = 2.27 (i.e. children < 5 years that lived

within 5 km are 2.27 times more likely to develop leukemia than children living > 70 km from a nuclear plant). The OR falls to 1.09 for the area 5 to < 10 km. The external review panel concluded from the KiKK data that over the 24 year study period between 121 and 275 excess childhood cancers are attributable to residence within a radius of 50 km from 16 nuclear power plants.

Without questioning the validity of the official emission data and radiation risk factors, the KiKK investigators declared their findings as “unexplainable,” a scientifically and logically unsatisfactory conclusion (Kaatsch et al 2008; Spix et al. 2008).

The external review panel, however, applied Sir Austin Bradford Hill’s causality criteria for environmental epidemiology and concluded from the KiKK data and their consistency with several other epidemiological studies around nuclear installations worldwide, that there exists no plausible alternative hypothesis to a causal relationship between radioactive emissions and excess childhood cancer risk around German reactors.

The dissonance between unquestioned assumptions and unassailable evidence is illustrated by a statement to the press (12.12.2007) by the institute director of the KiKK team: “On the one hand, the results of the KiKK study surprised us, because on the basis of the current state of radiobiological knowledge, the increase in childhood cancer that we established, cannot be explained and we found no evidence for other possible causes. On the other hand, the results could be expected since about 2/3 of the cases in the new study had already been included in the earlier [ecological] studies and [their findings] gave rise to the present investigation” [author’s translation].

The KiKK team’s conclusions were immediately challenged in the literature by studies in the UK and France that “found no evidence” for the cancer – residential proximity association. However, none of these studies had sufficient statistical power to invalidate the KiKK findings. According to a fundamental rule in epidemiology: Absence of evidence of an effect does not constitute evidence of absence of that effect, inconclusive results like these should not misleadingly be called “negative” (Altman and Bland 1995).

The KiKK study’s indisputable findings require a critical re-examination of reactor emission dosimetry, and of flawed radio-biological models on which internationally accepted adult radiation risk factors, here inappropriately applied to young children, are based. The KiKK results also underscore the urgency for a public policy debate regarding the desirability of constructing additional nuclear power plants.

**References**

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