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Childhood Cancer in the Vicinity of Nuclear Power Plants: The 2007 KiKK Study

(KiKK = Epidemiologische Studie zu Kinderkrebs in der Umgebung von Kernkraftwerken
Epidemiological Study of Childhood Cancer in the Vicinity of Nuclear Power Plants)

IPPNW Physicians Issue Warning: *"Young children develop cancer more frequently when they live near nuclear power plants (NPP). It must now be assumed that radioactive emissions from NPP are indeed not as harmless as previously believed. Now it is time to act."*

- Young children living near German nuclear reactors develop cancer and leukaemia more frequently than children living further away.
- 60% increased rate of cancer and approximately 120% increased rate of leukaemia.

These are the two main findings of the "Epidemiological Study of Childhood Cancer in the Vicinity of Nuclear Power Plants" (KiKK Study), commissioned by the German Federal Office for Radiation Protection (BfS), the equivalent of the UK's HPA. Although the design of the study, carried out by the Mainz Cancer Registry, is generally held to be correct, the interpretation of the study's findings is vigorously disputed by the authors1.

Indications of an increase in the incidence of childhood cancer near nuclear power plants have been found for over 20 years [2], but they have not as yet been taken sufficiently seriously. The correlation has been unequivocally confirmed by the KiKK study. Now it is time to act.

Background to the 2007 KiKK Study

The KiKK Study was called for in 2001 by IPPNW and the Ulm Physician's Initiative in a large-scale public relations campaign [3], because of several studies carried out by Dr. Alfred Koerblein of the Munich Environmental Institute [4] (including a study on NPPs in the Bavarian region initiated by the German IPPNW), had shown a significantly higher incidence of childhood cancer in the proximity of nuclear power plants. Only after massive pressure and over 10,000 letters of protest to the authorities and ministries did the Federal Office for Radiation Protection (BfS) accept the necessity for further studies5. In 2003, the BfS commissioned the Mainz Cancer Registry [6] to carry out the study.

There had already been reports of significant increases in the levels of leukaemia around English nuclear installations in the 1980s. There were also sharp increases in rates of leukaemia around the nuclear reprocessing plants at Sellafield and La Hague. An increased incidence of leukaemia found close to the Krummel nuclear power plant in Germany caused much concern from the beginning of the 1990s onwards. Few studies on the subject were known, however, and most of those that existed showed nothing conspicuous in the vicinity of nuclear power plants - at least in the official versions: 1997 and 1998.

These were two studies by the Mainz Cancer Registry (Director: Prof. Michaelis, Institute for Statistics and Documentation of the University of Mainz (IMSD)), covered the periods of 1980 to 1990 and 1980 to 1995 respectively. The childhood cancer rates in the vicinity of the 20 German nuclear installations (of which three were decommissioned nuclear power plants and two were research reactors) were examined. Main finding - nothing conspicuous [9].

The "Michaelis" study has been consistently criticised since 1992 by Prof. Roland Scholz in numerous IPPNW [10, 11] and other publications [12, 13]. A renewed analysis of the data in the IMSD studies in 1998 by Dr. Koerblein and Prof. Hoffmann [14] showed that there was a significant increase in the rate of childhood cancer within a radius of 5 kilometres. The increase was to be found only when operational nuclear power plants were taken into account, not the decommissioned plants, nor the research reactors. The increase was only found amongst infants under 5 years old.

Methodology and Findings of the KiKK Study

The results of the KiKK study were published in December 2007 in the European Journal of Cancer[15] and in the International Journal of Cancer[16]. The study covered all 16 large reactor locations where the 20 nuclear power plants in Germany were in operation during this period of time (period of study: 24 years, 1980 - 2003). Since the Lingen and Emsland locations are only two kilometers apart, they were combined into one study region. In the first part of the study a total of 1,592 under-fives with cancer were compared to a control group of 4,735 children. The distance between the children's homes and the power plants was precisely determined to within 25 meters. The main questions posed by the study were: "Do children under five years old more frequently develop cancer when living near a nuclear power plant?" and "is there an inverse relationship with distance?" (i.e. does the risk increase the nearer one lives to the plant?) The results showed not only a 60% increase in the cancer rate and a 117% increase in leukaemia in infants within the 5 kilometre radius, but also a significant increase in the risk of cancer and leukaemia the closer one lived to the nuclear power plant.

The second part of the study, which covered a shorter period of time and a selection of diagnoses (leukaemia, lymphomas and tumours of the central nervous system), tested whether other risk factors (confounders) could have had any appreciable effect on the main result of the study - the negative distance trend. This proved not to be the case for any of the studied risk factors. The proximity of residence to the nuclear power plant remains the only plausible influencing factor.

Discussion on the "small number" of cases

After the findings of the study were published in December 2007, the authors emphasised that the study basically "only" dealt with a small number of cases of cancer: 37 cases were observed where 17 would have been expected statistically. This means that in a period of 24 years there was less than one additional leukaemia case a year. The 20 additional cases were only to be found within the 5 kilometre radius and were all cases of leukaemia. The reciprocal distance rule implicit in the study, however, adds up to a total of 121 additional cases amongst infants for the whole region under study.

Moreover, it can be assumed that such effects do not confine themselves to small children. Older children and adults could also be affected. However, the rates of cancer development amongst these groups have not yet been the subject of a comparable systematic study anywhere in the world.

It is significant that the KiKK study, in its methods and the questions it posed, was not set up to determine the exact number of additional cases of cancer at all. One can always find larger or smaller numbers of ill children according to the random selection of the size of the study area and using different distance rules. The latest KiKK study has a methodological strength, however, in testing the distance trend (the main question posed by the study). This overcame the disadvantage of classically dividing the area into circular sections. But the KiKK study is

inappropriate for determining the absolute number of cases. The authors' reference to the small number of cases is obviously meant to soften the highly charged controversy over the results of the study. In any case, the study proves that there is an increased risk that correlates to the proximity to nuclear installations. That the absolute number of additional cancer cases is low is in part due to the fact that the area around nuclear power plants is thinly populated.

The authors of the study were at first surprised by their results. They quickly pointed out however that the raised levels of childhood cancer and leukaemia in the vicinity of nuclear power plants could not be explained by radioactive emissions. They claimed that the radiation doses from radioactivity near the nuclear power plants were more than a factor of 1000 below the average dose from natural background radioactivity. Since this is not compatible with current radiobiological thinking, they raised the possibility of coincidence as an explanation.

The KiKK study invalidates the conclusions of the previous studies by the Mainz Cancer Registry (IMSD 1992 and 1997). This should not really be a surprise, since Koerblein had already pointed this out many times, as had Koerblein and Hoffmann in their reanalysis of the IMSD study in 1998. For this reason, Koerblein was strongly attacked by the Mainz Cancer Registry and accused of "data dredging" [17]. However, the KiKK study completely confirms the Koerblein and Hoffmann reanalysis of 1998. In the meantime, the Mainz Cancer Registry authors have now admitted that their earlier studies had shown an increased cancer and leukaemia risk for infants living in close proximity to German nuclear power plants.

What is the cause?

Coincidence already has a long and sad tradition as an ultimate and helpless interpretation in radiological causality research. In the 1980s, many attempts were made to explain the raised levels of childhood leukaemia in the area near the Krummel power plant and Geesthacht nuclear research centre. Previous inexplicable clusters were given as the explanation for another inexplicable cluster. Are the KIKK findings once again simply coincidence? No. Coincidence as an explanatory model was held to be improbable by the External Expert group commissioned by the German Government's Bundesamt fur Strahlenschutz (BfS) the equivalent of the UK's HPA to supervise the drafting, the execution and evaluation of the KiKK study [18]. In referring to coincidence above, the Mainz authors were ignoring the current state of research.

In the summer of 2007, a comprehensive meta-analysis by Baker et al. on leukaemia in children living near nuclear power plants [19] caused a sensation. They examined data contained in a total of 17 international studies carried out in Germany, Spain, France, Japan and North America during the period between 1984 and 1999. Epidemiologists at the University of South Carolina discovered an enhanced risk of between 14% and 21% of developing leukaemia for children under nine years of age, depending on distance. All of the people examined under the age of 25 had an increased morbidity probability of about 7%-10% and the rates of mortality were raised by 2%-18%.

Correlation between the rate of morbidity, emission measurements, calculation model for radiation exposure and the biological effects of radionuclides.

In Germany, children living near nuclear power plants develop cancer and leukaemia more frequently that those living further away. This has long been only a supposition, but has now been clearly proven and is now officially accepted [20]. If emissions have been correctly measured by monitoring the areas surrounding nuclear installations, as has been claimed by both the NPP operators and the regulatory authorities, then either the currently accepted calculation models for determining radiation doses of local residents are incorrect, or the biological effects of

incorporated radionuclides have been badly underestimated, at least for young children or embryos. Or both.

The results of the KiKK study compel us to critically review (i) the measurement of emissions by the operators (ii) the methods for estimating radiation doses and (iii) the models used for estimating risks. Any of these three steps could help solve the contradiction between the allegedly low doses and the severe effects referred to by the authors. [A separate inquiry into the boiling water reactor design type is also necessary. Boiling Water reactors (BWR) have only one cooling circuit in their design. Pressure water reactors (PWR) have two separate cooling circuits, which means that BWRs have one less barrier holding back radioactive material from the surrounding area. The weak point can be found in the turbine hall of the NPP where highly radioactive steam is carried out of the reactor to the turbines.]

In order to eliminate one individual location as the sole cause of the morbidity rate, the data in the study was assessed 16 times, each time excluding one location. In every case the exclusion did not change anything related to the main result of the study - an inverse distance trend. However it was not tested whether there was a difference in risk between BWR and PWR reactors. This question could be answered easily enough using the existing study data.

Nevertheless there is enough evidence to show that the BWRs in Germany (currently Brunsbüttel, Krümmel, Phillipsburg 1, Isar 1, Gundremmingen B + C; and, in the past, Würgassen) have higher levels of emissions. According to the annual reports of the government, environmental radioactivity and radiation exposure [21] of BWRs are appreciably higher than those of PWRs, though within the currently accepted limits. It is now time to act. The indications over many years that there are increased levels of morbidity near NPPs have now been scientifically proven by the KiKK study. No one can rule out the possibility of an increased risk for older children and adults living near NPPs. A systematic investigation of the KiKK type has still to be carried out for these groups.

The previous mode of measuring emissions and reporting them needs to be put to the test. We can no longer rely on the information given by the NPP operating company. There needs to be official monitoring without any gaps and measured values must be made public.

Previous assumptions about radiation risk, and the emission limits for radiation that are based on these, need to be critically re-examined and adapted to current international research findings. In addition, the data in the KiKK study should be separately assessed according to whether the location is a BWR or PWR. We should primarily think about the people affected - the precautionary principle is long overdue. Further cases of cancer near to NPPs have to be prevented. The only kind of reactor that does not present a cancer risk is a decommissioned reactor.

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(Slightly Amended to clarify some matters for UK readers by Dr Ian Fairlie, MEDACT)

Internet links (in German)
www.ippnw-ulm.de
www.ippnw.de
www.alfred-koerblein.de
www.bfs.de
www.umweltinstitut.org

www.kinderkrebsregister.de

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21 Annual reports of the Federal German Government, Umweltradioaktivität und Strahlenbelastung, published on the site http://dip.bundestag.de The report from 2001, 14/9995 http://dip.bundestag.de/btd/14/099/1409995.pdf for instance, shows four times the emissions from the Gundremmingen NPP with two BWR reactors compared to PWRs.