

New French Study on Child Leukemias near NPPs

Dr Ian Fairlie
Consultant on Radiation in the Environment
London, United Kingdom
www.ianfairlie.org

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.

IJC International Journal of Cancer

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)

	Observed Number	Expected Number	% increase	p-value (one sided)
Germany	34	24.09	41%	0.0328
Great Britain	20	15.4	30%	0.1464
Switzerland	11	7.87	40%	0.1711
France	14	10.2	37%	0.1506

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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POOLED DATA	79	57.5	37%	0.0042

Other studies world-wide

(1) Laurier D et al (2008) Epidemiological studies of leukaemia in children and young adults around nuclear facilities: a critical review. Radiat Prot Dosimetry 132(2):182-90. **REVIEWED 26 MULTI-SITE STUDIES**

(2) Laurier D, Bard D (1999) Epidemiologic studies of leukemia among persons under 25 years of age living near nuclear sites. Epidemiol Rev 21(2):188-206.
LISTED 50 STUDIES (36 SINGLE AND 14 MULTI-SITE)

over 60 STUDIES

26 largest studies

Abstracted from table 1 of Laurier D et al (2008)

	Leukemia Increase observed	No increase observed	% of studies observed
Number of studies	19	7	73%
observed increases are greater than the one SD from the SIR	9	3	75%
observed increases are statistically significant at $p = 5\%$	6	1	85%

Conclusion: steady pattern of leukemia increases near NPPs

Possible Causes

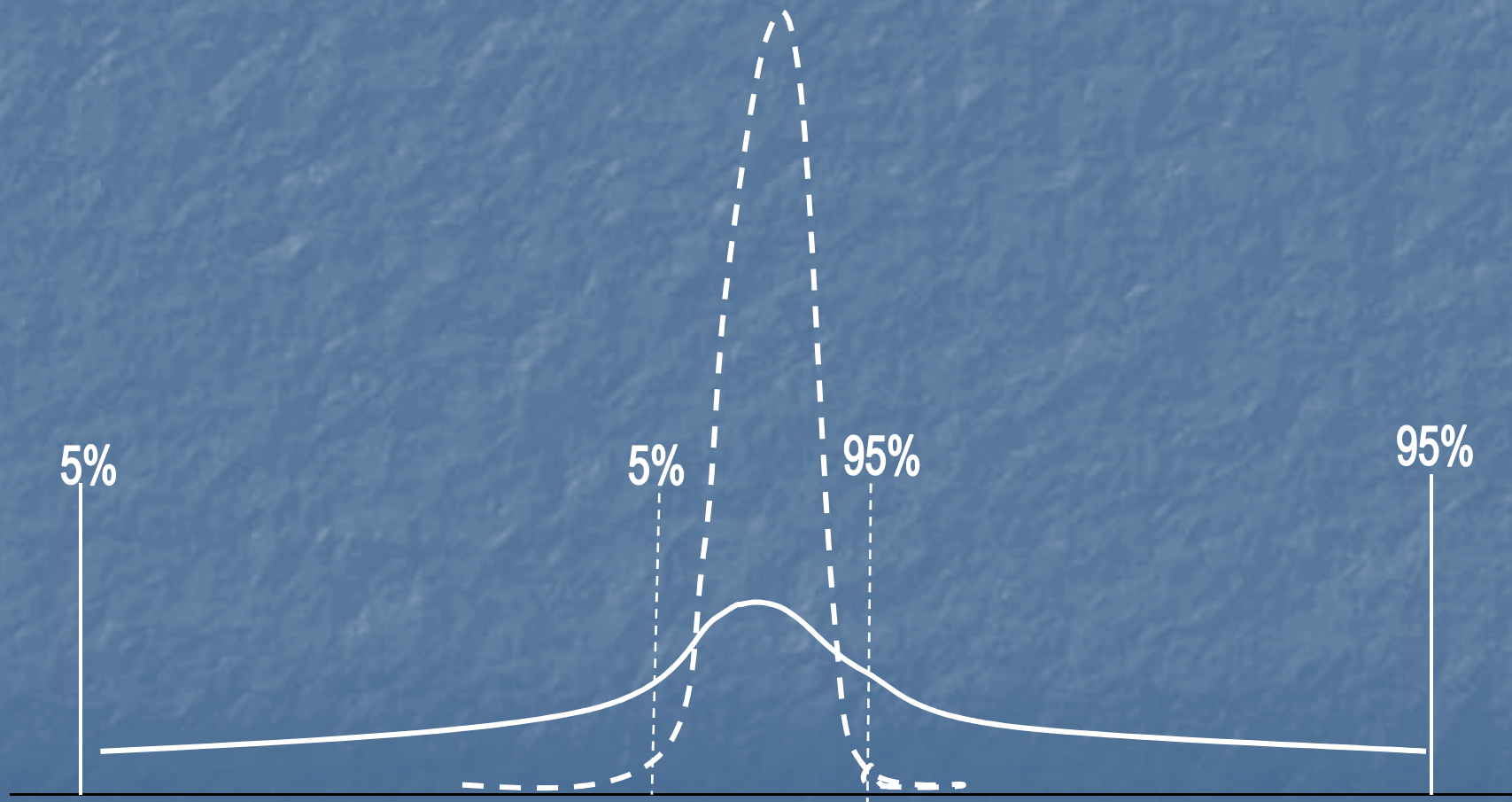
- Confounders X
- Coincidence X
- Population mixing X
- Exposure to chemicals X
- Exposure to viruses/fungi X
- Exposure to radiation ?

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

Uncertainty distributions in dose estimates



Uncertainties in Dose Coefficients

Goossens LHJ, Harper FT, Harrison JD, Hora SC, Kraan BCP, Cooke RM (1998) Probabilistic Accident Consequence Uncertainty Analysis: Uncertainty Assessment for Internal Dosimetry: Main Report. Prepared for U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, USA. And for Commission of the European Communities, DG XII and XI, B-1049 Brussels Belgium. NUREG/CR-6571 EUR 16773.

Nuclide	Intake	Organ	U Range = (ratio of 95 th /5 th percentiles)
Cs-137	ingestion	red bone marrow	4
I-131	inhalation	thyroid	9
Sr-90	ingestion	red bone marrow	240
Pu-239	ingestion	red bone marrow	1,300
Sr-90	inhalation	lungs	5,300
Ce-144	inhalation	red bone marrow	8,500
Pu-239	ingestion	bone surface	20,000

So, radiation exposures to nearby
people could be a cause

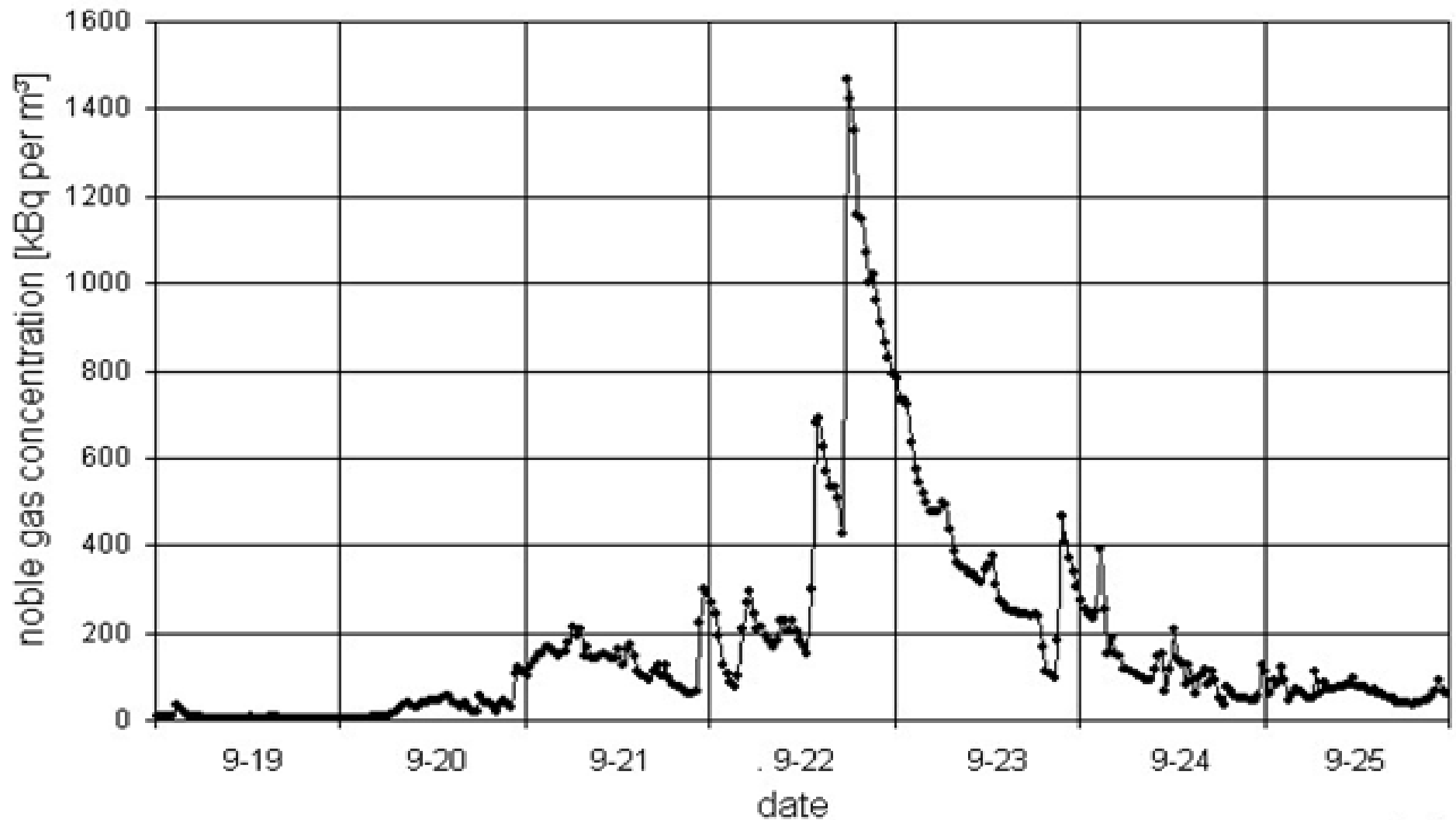
A hypothesis to explain findings

- 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.”

Doll R and Wakeford R (1997) Risk of childhood cancer from fetal irradiation. Br J Radiol; 70: 130-9

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