Childhood cancer near German nuclear power plants

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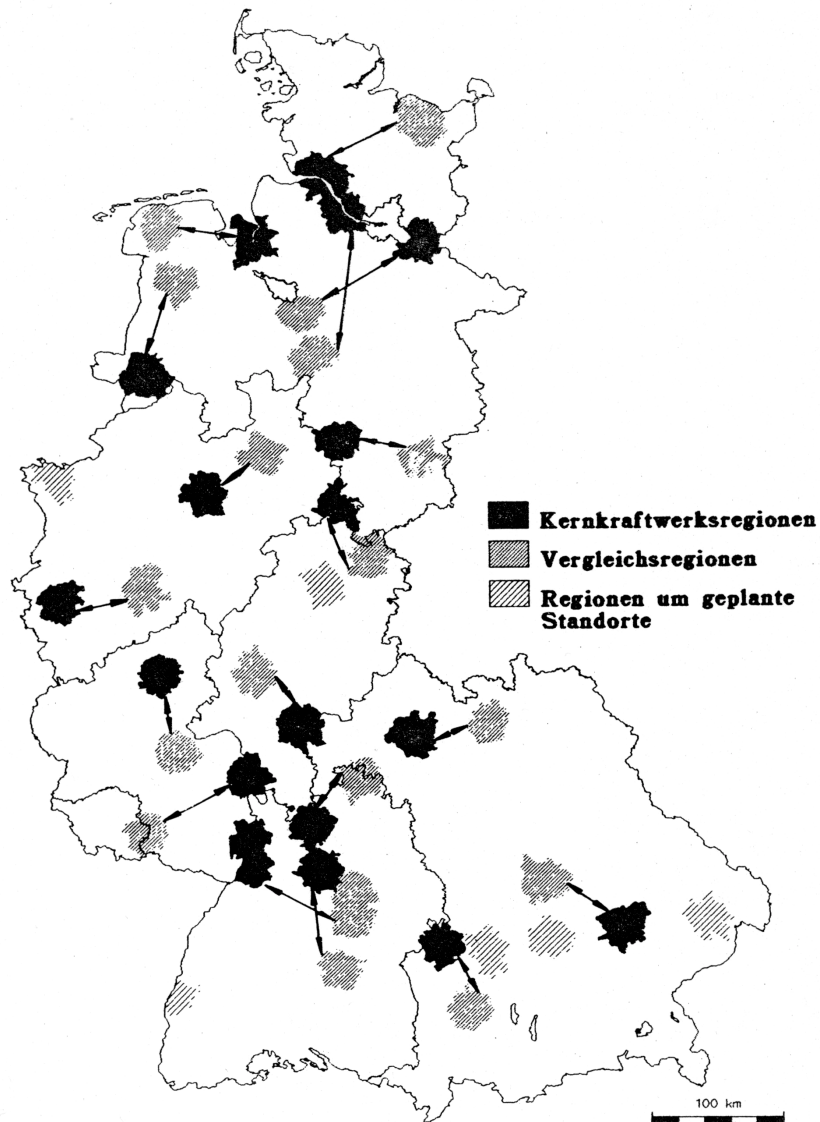
Official German study (IMSD study)

An official German study was published in 1997 by the
Institute of Medical Statistics and Documentation (IMSD),
University of Mainz (Germany)

The study was based on data from the German Childhood
Cancer Registry, 1980-1995

Study design

- Study type: ecological study

- Childhood cancers (all malignancies)

- Study area: 15-km zone around 20 nuclear installations

- Control area: To each site, an appropiately chosen control area (15 km radius) was selected

- Comparison of standardized incidence rates (SIR) in the study and control zone

- Pooled analysis of data from 20 sites and16 years (1980-1995)

Kernkraftwerksregionen
Vergleichsregionen
Regionen um geplante Standorte

Study regions around West
German nuclear sites
(black areas)
and control regions
(hatched areas)

Distance zones around NPP Philippsburg
(0-5, 5-10, 10-15 km)

Legend:
- 5 km Zone
- 10 km Zone
- 15 km Zone

Map labels: SCHIFFERSTADT, STADT · SCHWETZINGEN, STADT · BOEHL-IGGELHEIM · OTTERSTADT · KETSCH · DUDENHOFEN · SPEYER, STADT · HOCKENHEIM, STADT · HANHOFEN · ALTLUSSHEIM · WALLDORF, STADT · HARTHAUSEN · REILINGEN · GOMMERSHEIM · NEULUSSHEIM · BOEBINGEN · ROEMERBERG · FREISBACH · SCHWEGENHEIM · SANKT LEON-ROT · WEINGARTEN (PFALZ) · OBERHAUSEN-RHEINHAUSEN · LINGENFELD · LUSTADT · WAGHAEUSEL, STADT · WESTHEIM (PFALZ) · KRONAU · ZEISKAM · PHILIPPSBURG, STADT · GERMERSHEIM, STADT · KNITTELSHEIM · HAMBRUECKEN · BELLHEIM · DETTENHEIM · HOERDT · FORST · GRABEN-NEUDORF · KUHARDT · KARLSDORF-NEUTHARD · LINKENHEIM-HOCHSTETTEN

Definitions

Relative Risk (RR) = SIR(NPP) / SIR(CTL)

SIR(NPP) = OBS(NPP) / EXP (NPP)
SIR(CTL) = OBS(CTL) / EXP (CTL)

OBS = observed cases
EXP = expected cases (calculated with average rate)
NPP = study area near nuclear power plant
CTL = control area far (> 30 km) from NPP

Results

No increased risk of childhood cancer in the vicinity of nuclear installations

Relative risk: RR=0.99 in 0-15 km zone
and RR=1.10 in 0-5 km zone.

IMSD study revisited (1998)

Modified study design:

- Restriction to 15 sites of operating nuclear power plants (IMSD-study included 3 sites of decommissioned NPPs and 2 small research reactors)

- Immediate vicinity (5-km zone)

- one-sided test, i.e., test for a possible increase only (IMSD-study: 2-sided test, i.e. increase **or** decrease)

Test method

Comparison of two Poisson distributions
(one-sided binomial test)

p = 1- BINOMDIST(OBS-1; OBS(NPP)/(OBS(NPP)+OBS(CTL));
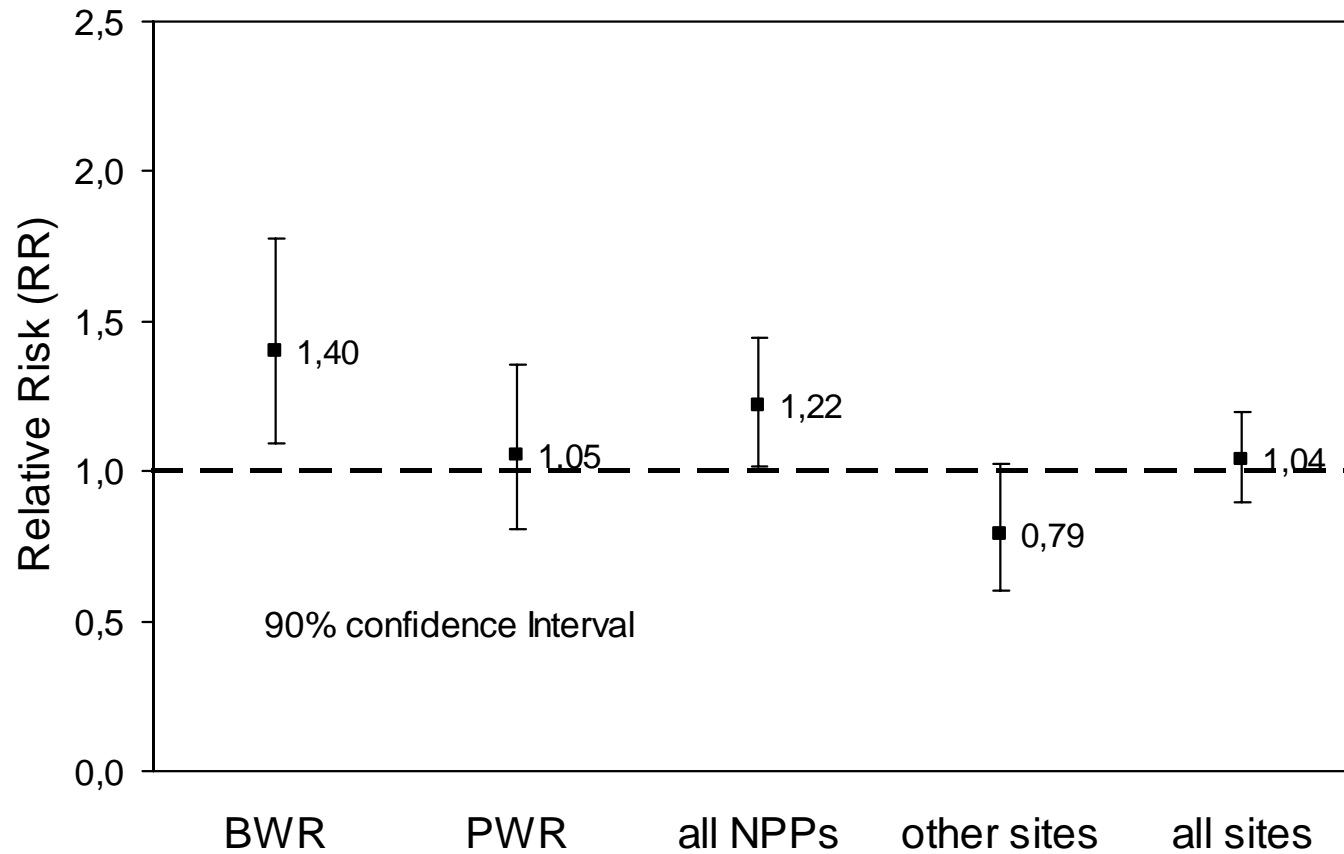   EXP(NPP)/(EXP(NPP)+EXP(CTL));1)

with
OBS observed, EXP expected no. of cases
NPP study area, CTR control area
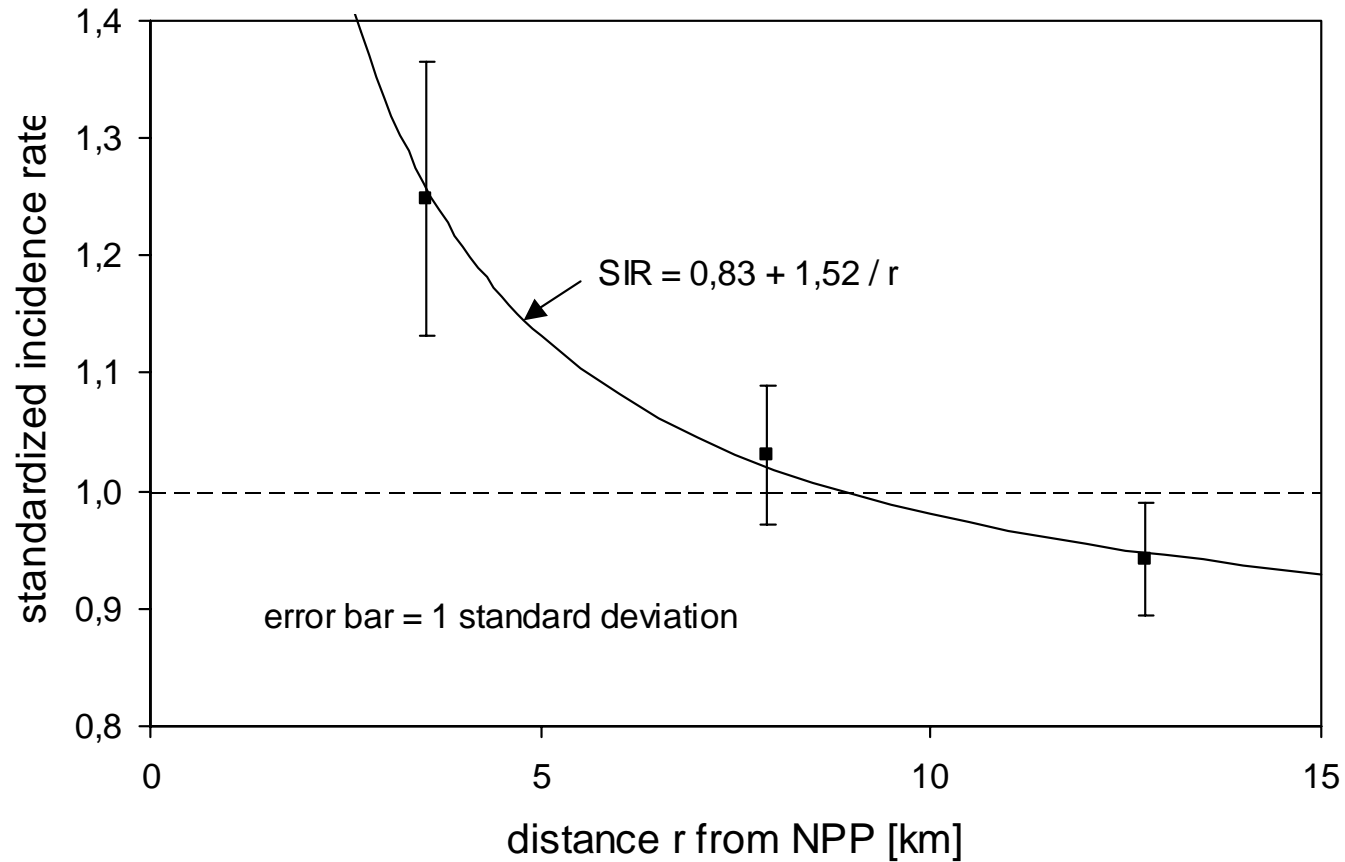one sided p-value

Childhood cancers (< 5 km)

Results

	O(NPP)	E(NPP)	O(CTR)	E(CTR)	RR	p-value
BWR	49	35,5	307	311,3	1,40	0,0205
PWR	44	39,4	271	255,5	1,05	0,4029
NPP sites	93	74,9	578	566,8	1,22	0,0470
other sites	42	49,4	514	479,7	0,79	0,9394
all sites	135	124,4	1092	1046,5	1,04	0,3453
BWR = boiling water reactor						
PWR = pressurized water reactor						

Significant 22% increase of childhood cancer rates near (0-5 km) all NPPs (**p=0.047**), 40% increase near BWR-sites

Dependency on distance

SIR = 0,83 + 1,52 / r

error bar = 1 standard deviation

standardized incidence rate
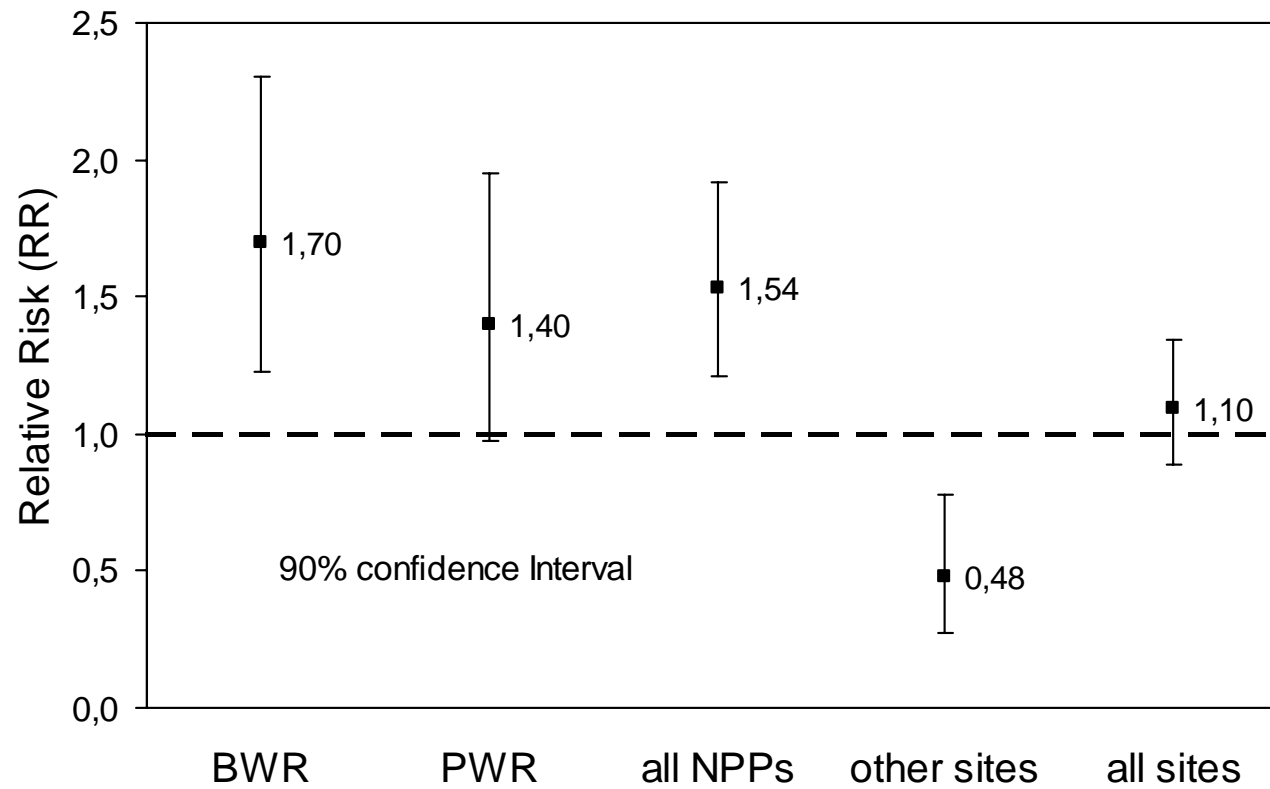
distance r from NPP [km]

Early Childhood Cancers (< 5 years)

Due to the high sensitivity in early childhood, a greater
radiation effect on cancer rates is expected

Therefore an **additional analysis** was conducted,
restricted to **early** childhood cancers

Early childhood cancers (< 5 km)

Results

	O(NPP)	E(NPP)	O(CTR)	E(CTR)	RR	p-value
BWR	30	17,1	156	151,5	1,70	0,0077
PWR	25	19,0	114	121,3	1,40	0,0850
NPP sites	55	36,2	270	272,7	1,54	0,0034
other sites	12	22,6	240	217,7	0,48	0,9979
all sites	67	58,8	510	490,4	1,10	0,2579
BWR = boiling water reactor						
PWR = pressurized water reactor						

significant 54% increase of early childhood cancers in the vicinity (0-5 km) of German nuclear power plants (**p=0.0034**)
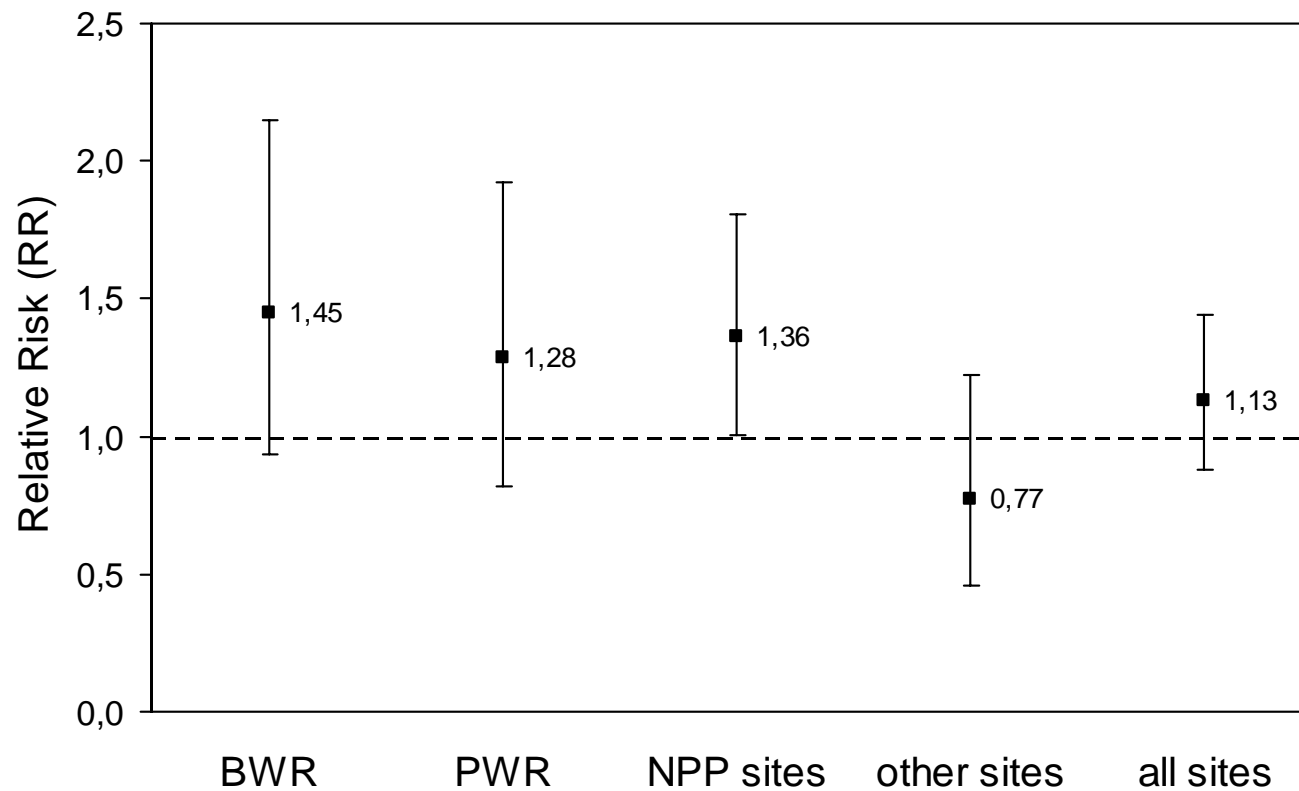
Childhood Leukemia (0-14 years)

A possible radiation origin of childhood leukemia is
widely recognized.

Therefore an additional analysis is conducted
for childhood leukemia.
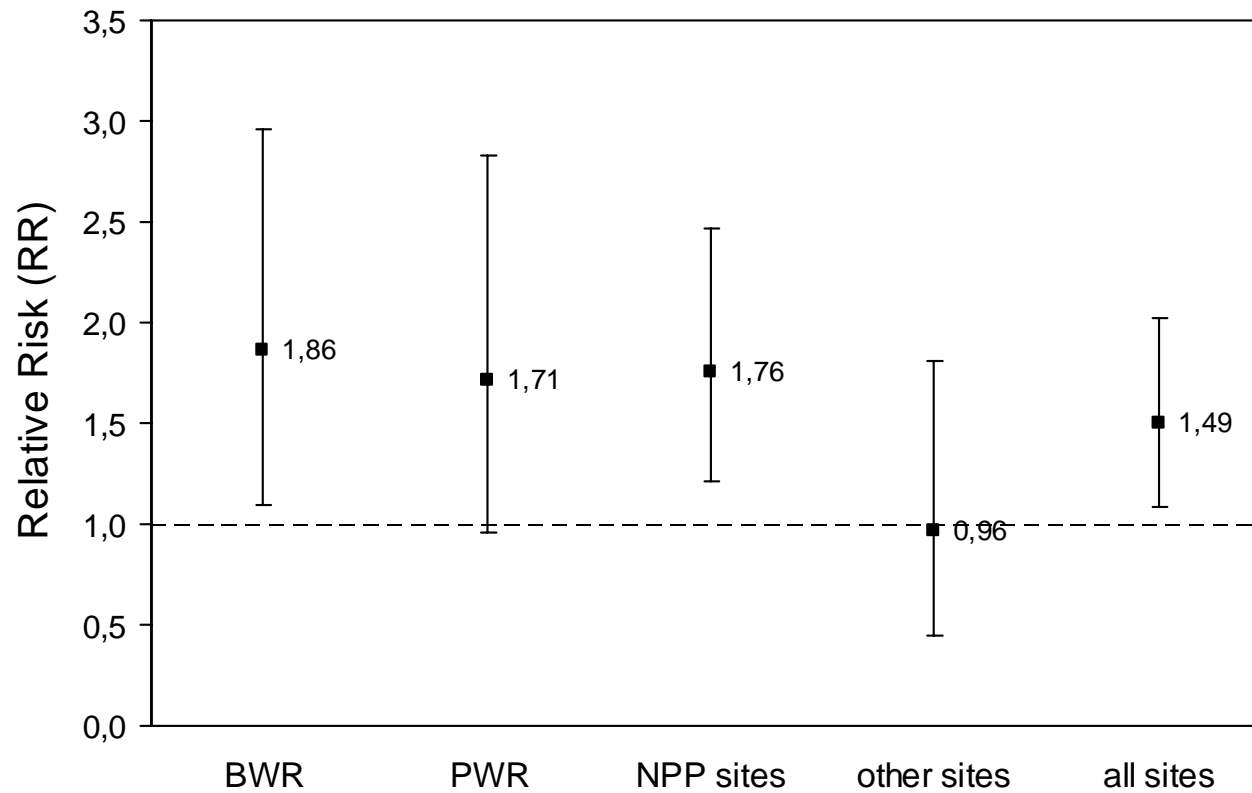
Childhood leukemia near NPP sites

Results

	O(NPP)	E(NPP)	O(CTR)	E(CTR)	RR	p-value
BWR	18	12,0	109	105,7	1,45	0,0960
PWR	17	13,0	89	87,4	1,28	0,2076
NPP sites	35	25,0	198	193,1	1,36	0,0592
other sites	13	16,9	164	164,0	0,77	0,8503
all sites	48	41,9	362	357,1	1,13	0,2329

36% increase of childhood cancer rates near (0-5 km)
all NPP sites (p=0.059), 45% increase near BWR sites

Early childhood leukemia near NPP sites

Results

	O(K)	E(K)	O(V)	E(V)	RR	p-value
BWR	13	6,3	62	55,4	1,86	0,0379
PWR	11	7,0	41	44,6	1,71	0,0869
NPP sites	24	13,3	103	100,0	1,76	0,0121
other sites	7	8,1	71	79,4	0,96	0,5938
all sites	31	21,4	174	179,4	1,49	0,0292

Significant 76% increase of early childhood leukemia in the vicinity (0-5 km) of German nuclear power plants (**p=0.012**)
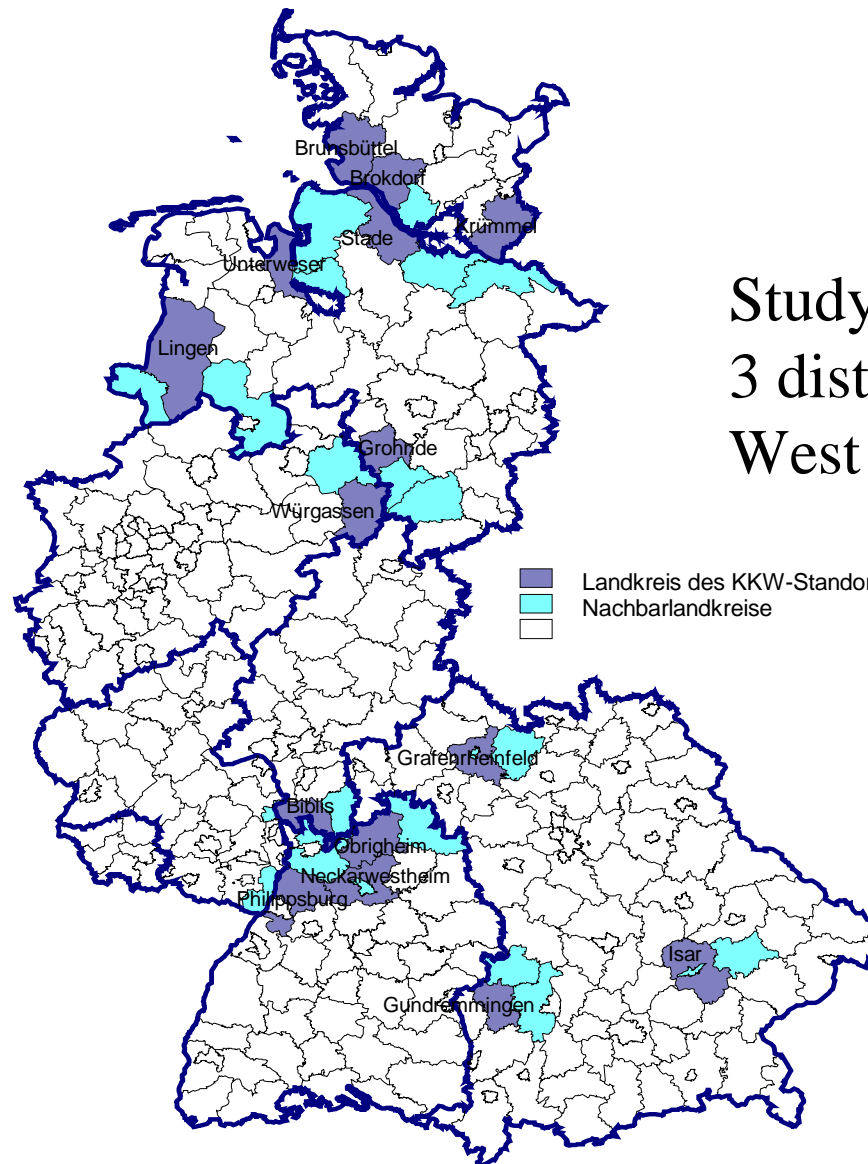
2003: Start of a case control study

- All malignancies

- All German nuclear power plants (NPP)

- Early childhood cancers only

- Distance from the NPP = proxy for exposure

- 3 controls per case

- All available German data (1980-2003)

- One-sided test

Epidemiologische Studie zu Kernkraftwerken, Kinderkrebs und Fehlbildungen

short title: <u>Ki</u>nder und <u>Kern</u>kraft (KiKK-Studie)

Deutsches Kinderkrebsregister
in cooperation with Mainzer Geburtenregister

Study region =
3 districts surrounding each
West German NPP site

Brunsbüttel
Brokdorf
Krümmel
Stade
Unterweser
Lingen
Grohnde
Würgassen

Landkreis des KKW-Standortes
Nachbarlandkreise

Grafenrheinfeld
Biblis
Obrigheim
Neckarwestheim
Philippsburg
Isar
Gundremmingen

Hypothesis to be tested:

„There is no increase of cancer rate with decreasing distance from NPP site"

Prospective end of the study
and presentation of the results:

end of 2007