



Domestic radon exposure and the risk of childhood cancer

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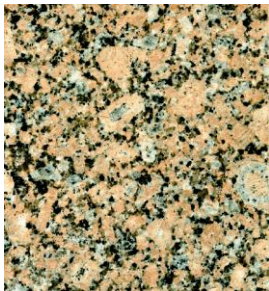
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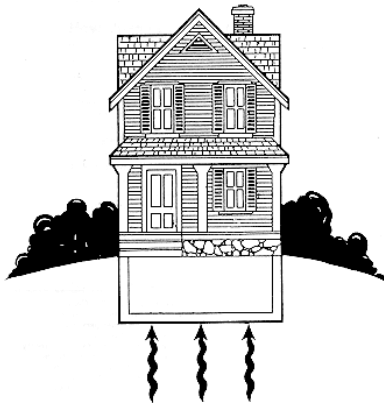
Radon

- originates from uranium = naturally occurring element in granitic and metamorphic rocks



Western Earth Surface team, http://geomaps.wr.usgs.gov/archive/socal/geology/transverse_ranges/index.html

- emanates from soils and concentrates inside of buildings



United States Environmental Protection Agency, <http://www.epa.gov/region1/eco/radon/test.html>



Radon doses

Irradiation due to radon inhalation

- respiratory tract

➔ evidence for association between radon exposure and lung cancer in adults e.g. Darby et. al. (2005)

- other organs

➔ irradiation by radon and its decay products as well (Kendall 2002, 2005)

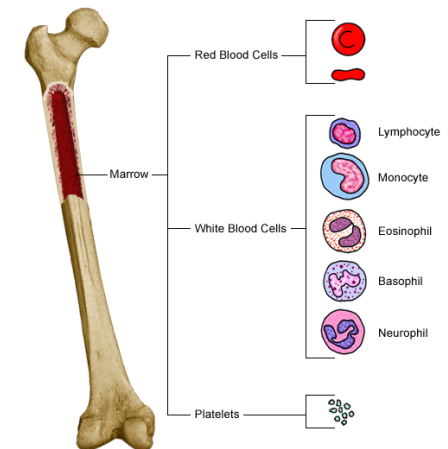
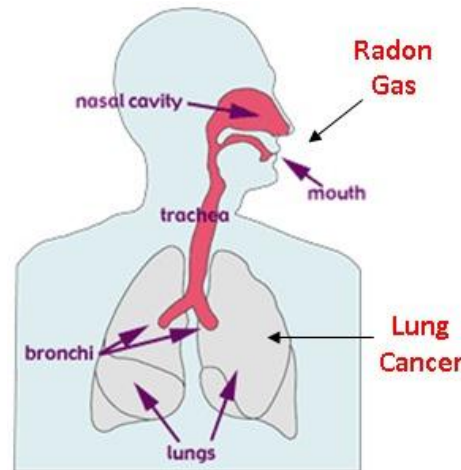
Radon doses

Radon: responsible for 60% (3.6 mSV) of total ionizing radiation dose of Swiss population (6 mSV)

Annual doses to different organs at 100 Bq/m³ adults (based on Kendall et al. 2002, 2005):

radon gas and decay products (mSv):

- lung: 18.6
- red bone marrow: 0.47
- brain: 0.11



Radon Center, Ireland, <http://www.radon.ie/>

<http://www.chxa.com/bone-marrow/>



Backgorund

so far:

- ecological studies
 - most ecologic studies found increased risk
(eg. Collman et al., 1991, Evrard et al. 2005, Henshaw et al., 1990)
- case-control studies: inconsistent results:
 - no association between residential radon and leukaemias
(eg. Kendall et al. 2012, Kaletsch et al., 1999, Steinbuch et al., 1999)
 - association between residential radon and leukaemias
(eg. Raaschou-Nielsen et al., 2008, Maged et al., 2000)
- no cohort studies so far



Aims

- census based cohort study on national level

Assessment of association between residential radon concentration and childhood cancer:

- childhood cancer in general

in particular:

- leukaemia
 - acute lymphoblastic leukaemia (ALL)
- central nervous system tumour (CNS-tumour)



Study design

- census based cohort study on national level

period of observation



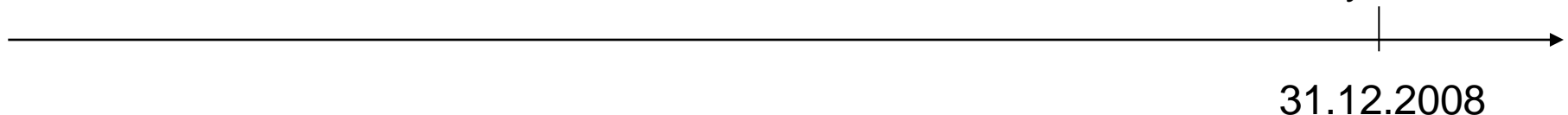
→ time of diagnosis

→ time of death

→ child becoming 16 years old

→ time of emigration

no event until end of year 2008





Study design

Inclusion criteria

- children between 0 to 15 years of age at date of census 2000
- cancer cases, diagnosed between the date of census 2000 and end of year 2008

→ databases:

- Swiss National Cohort (SNC): data on mortality, emigration
- Swiss Childhood Cancer Registry (SCCR): data on cancer outcomes, time of diagnosis



Statistical analysis

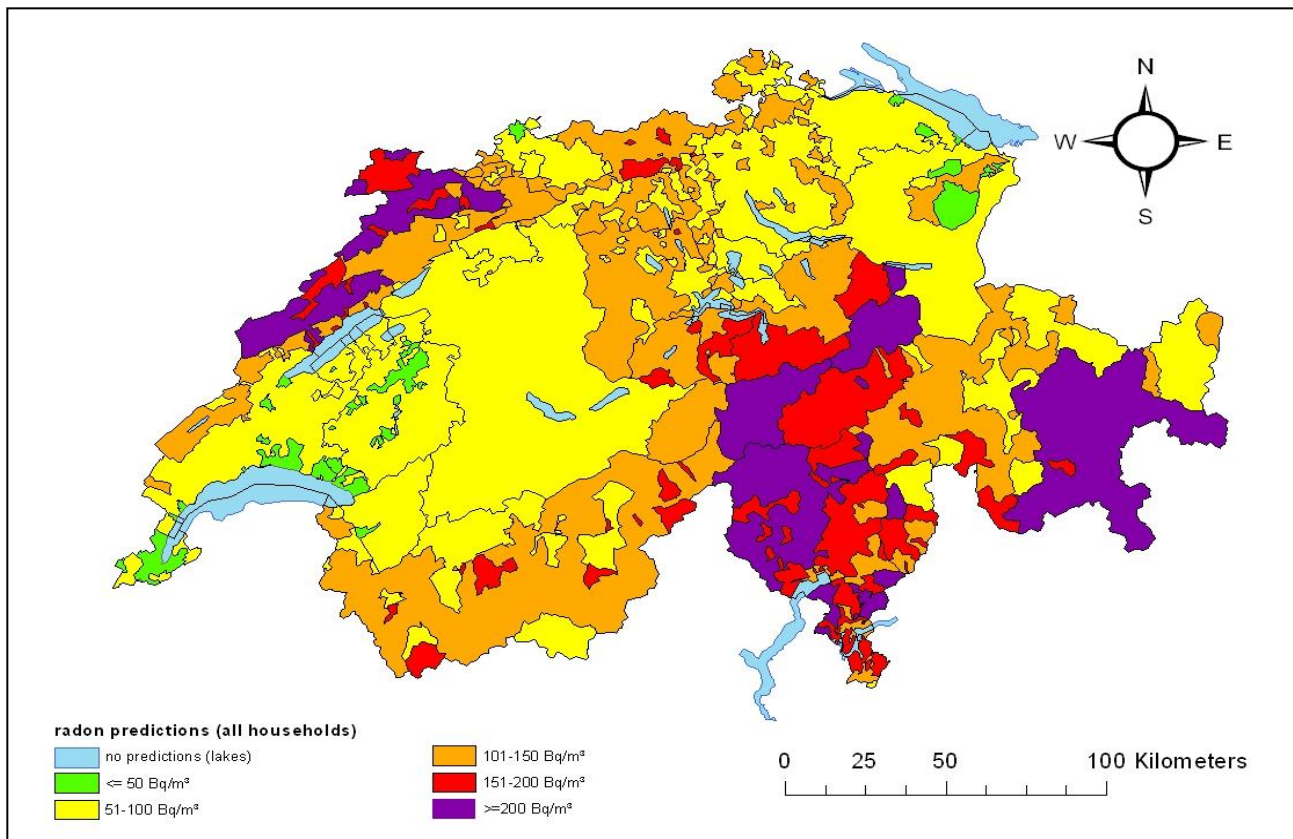
Cox regression model for time-to-event analysis

Considered predictors:

- residential radon concentration
- period effects
- environmental radiation exposure from external sources
- gender
- birth order within each household
- socio-economic status of the parents

Exposure assessment: residential radon concentration

- based on radon prediction model (R^2 : 20%)
(cf. Hauri et al. (2012))
- predictions for each household, each individual



Number of children considered for the analysis

Total number of children: 1,279,435

Cancer cases	All cancers	Leukaemia	Acute lymphoblastic leukaemia (ALL)	CNS tumours
	866	257	205	223

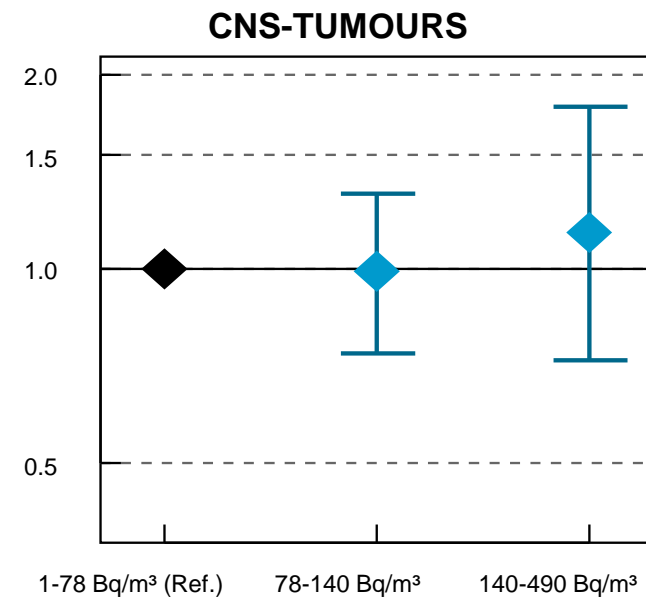
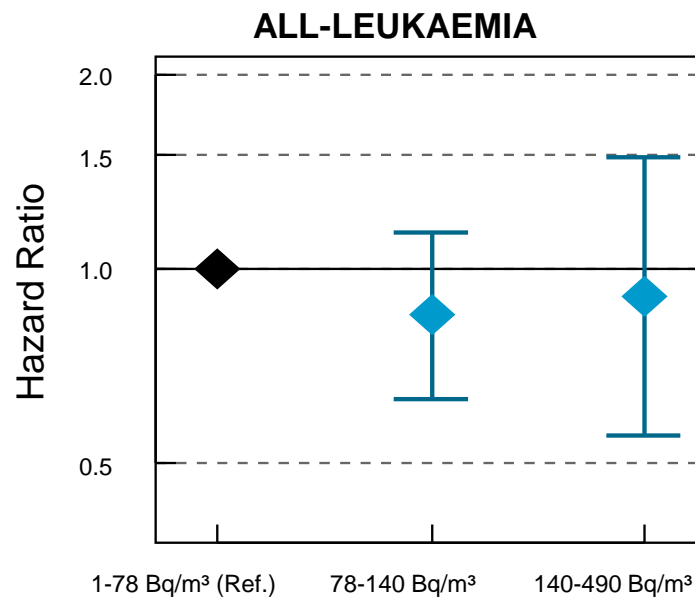
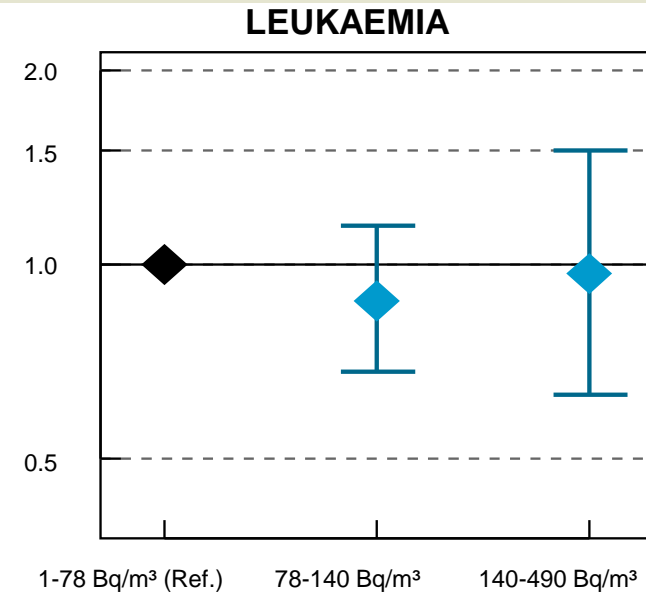
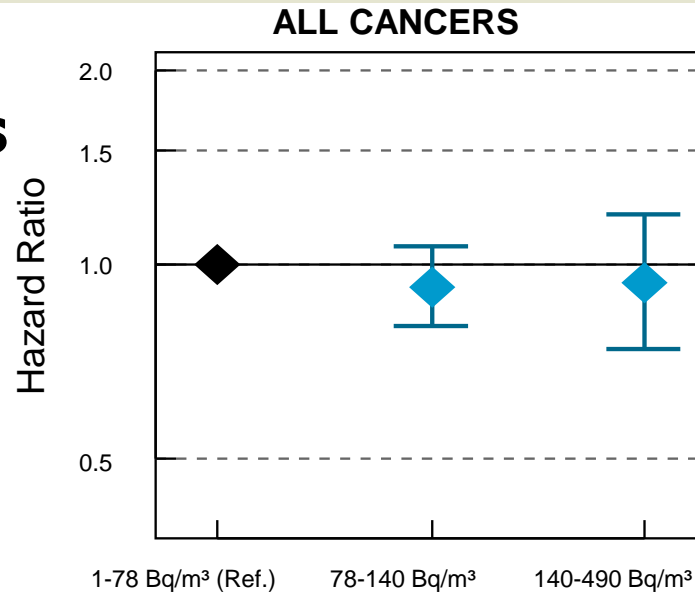
radon concentration: all children

μ : 86.0 Bq/m³

min: 1 Bq/m³ max: 490 Bq/m³

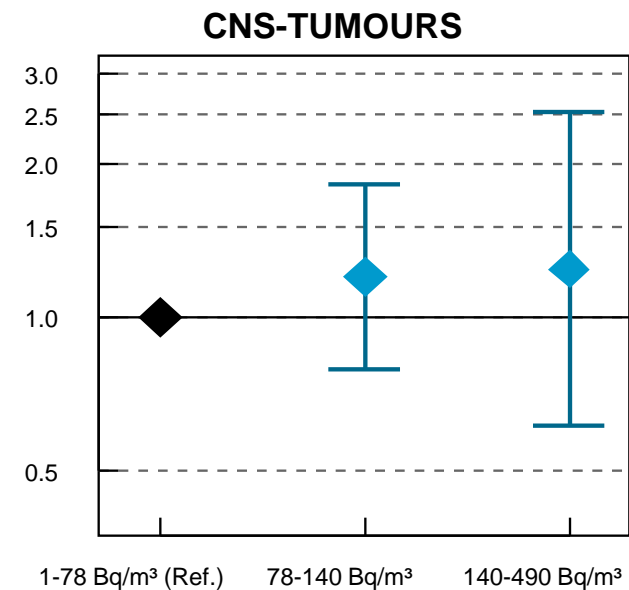
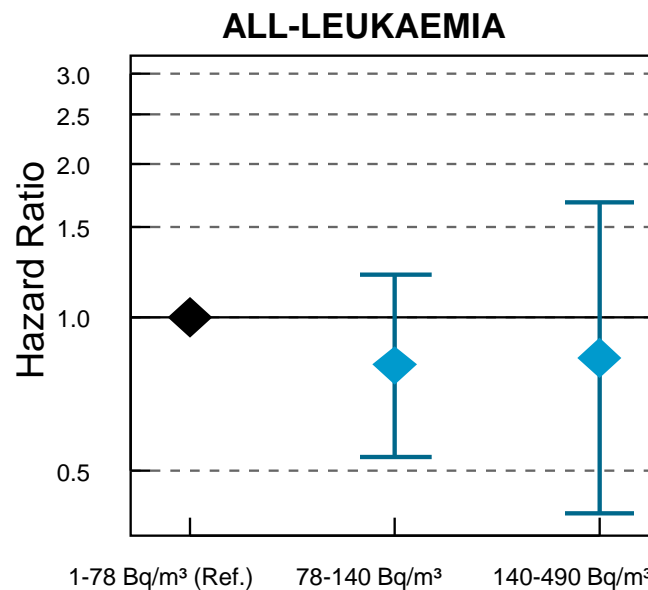
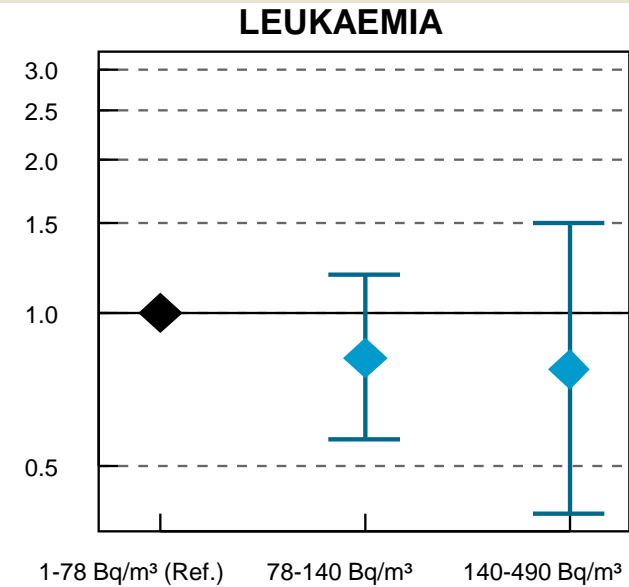
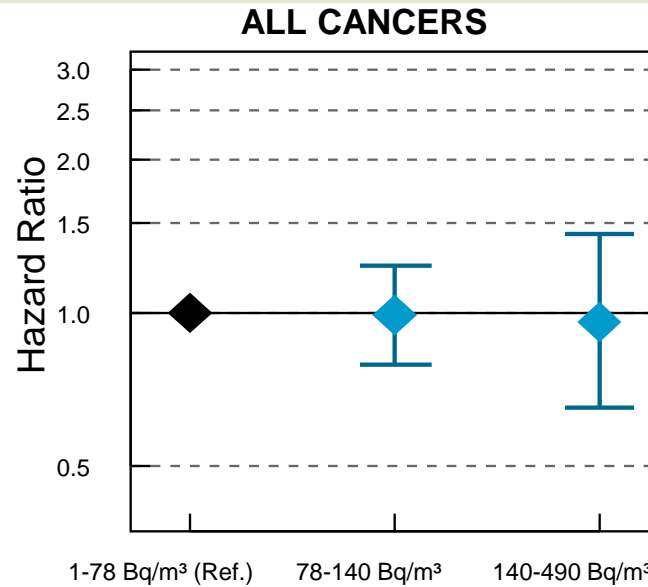


Results: Main analysis



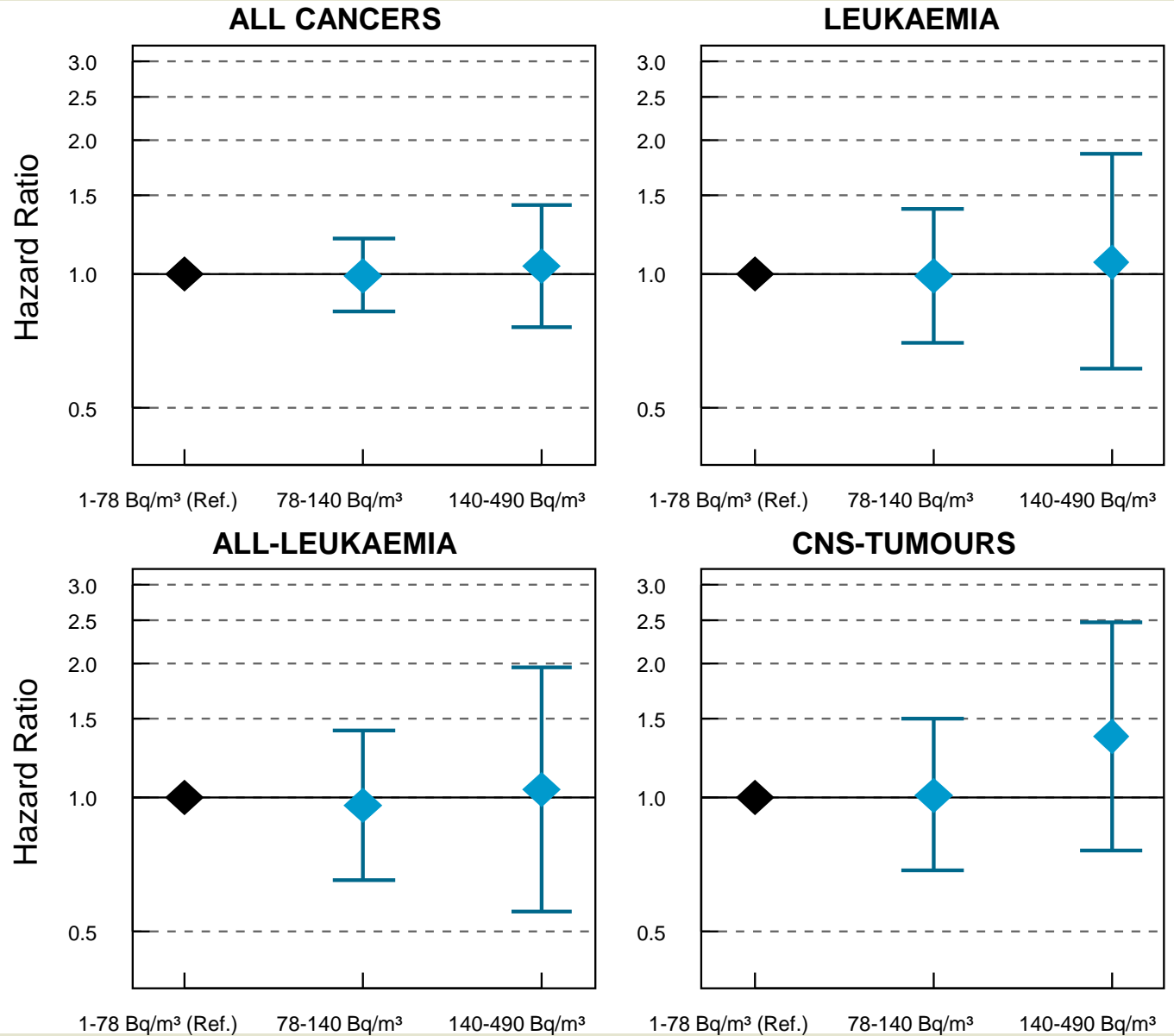


Results: infants (0-4 years old)





Results: Boys





Discussion

strengths

- population-wide cohort study
- consideration of confounding factors
- assessment of association on individual level

limitations

- uncertainties in exposure estimation



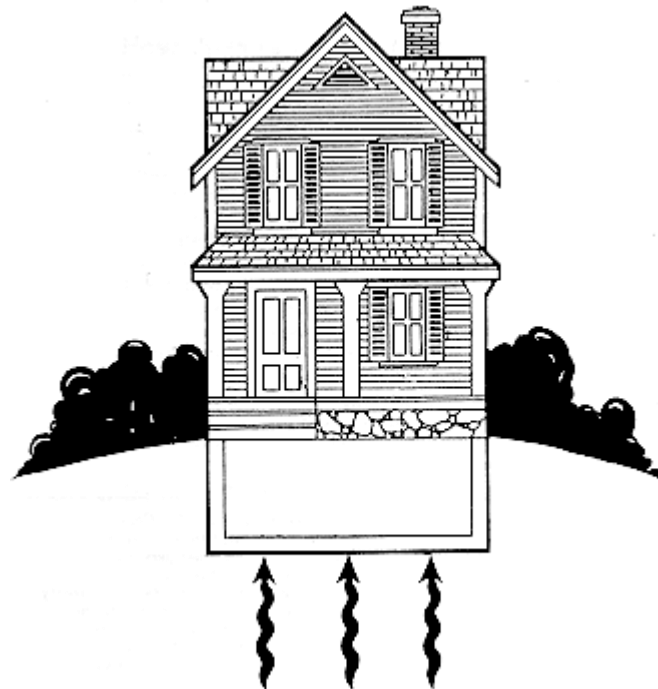
Conclusion

- no evidence for an association between residential radon and different childhood cancer outcomes

➔ in line with current organ specific dose estimation
(Kendall 2002, 2005)



Thank you for your attention!



United States Environmental Protection Agency, <http://www.epa.gov/region1/eco/radon/test.html>