Hälsorisker kring joniserande strålning

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Low and high doses of radiation

Low doses

In radiation protection (after ICRP, UNSCEAR, BEIR VII)

low dose: < 0.1 Gy,
low dose rate: < 0.1 mGy/min

Moderate/high doses

Anything above 0.1 Sv and 0.1 mGy/min

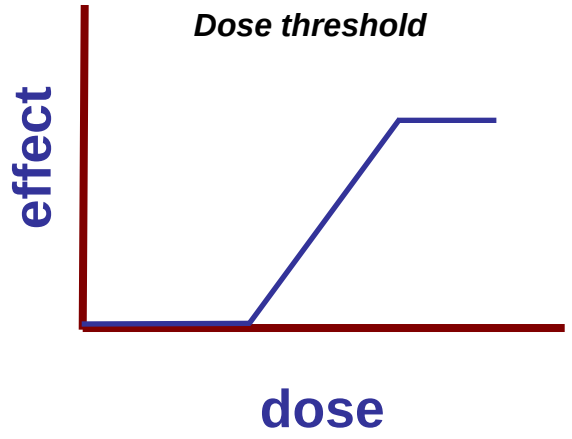
Stochastic and tissue (deterministic) effects

Tissue (deterministic) effects (high doses)

Examples: skin erythema, tissue necrosis

Cause: cell death of many cells

Probability of effect = Number of dead cells



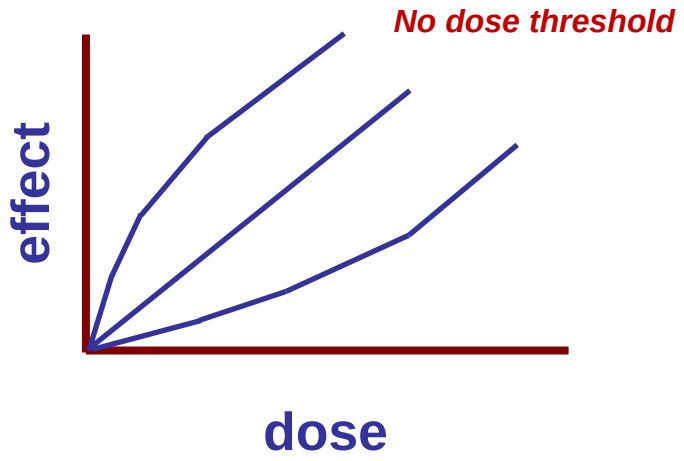
Degree of severity increases with dose

Stochastic effects (low doses)

Examples: cancer, mutations, cardiovascular effects (?), central nervous system effects (?)

Cause: non-lethal damage to a single cell

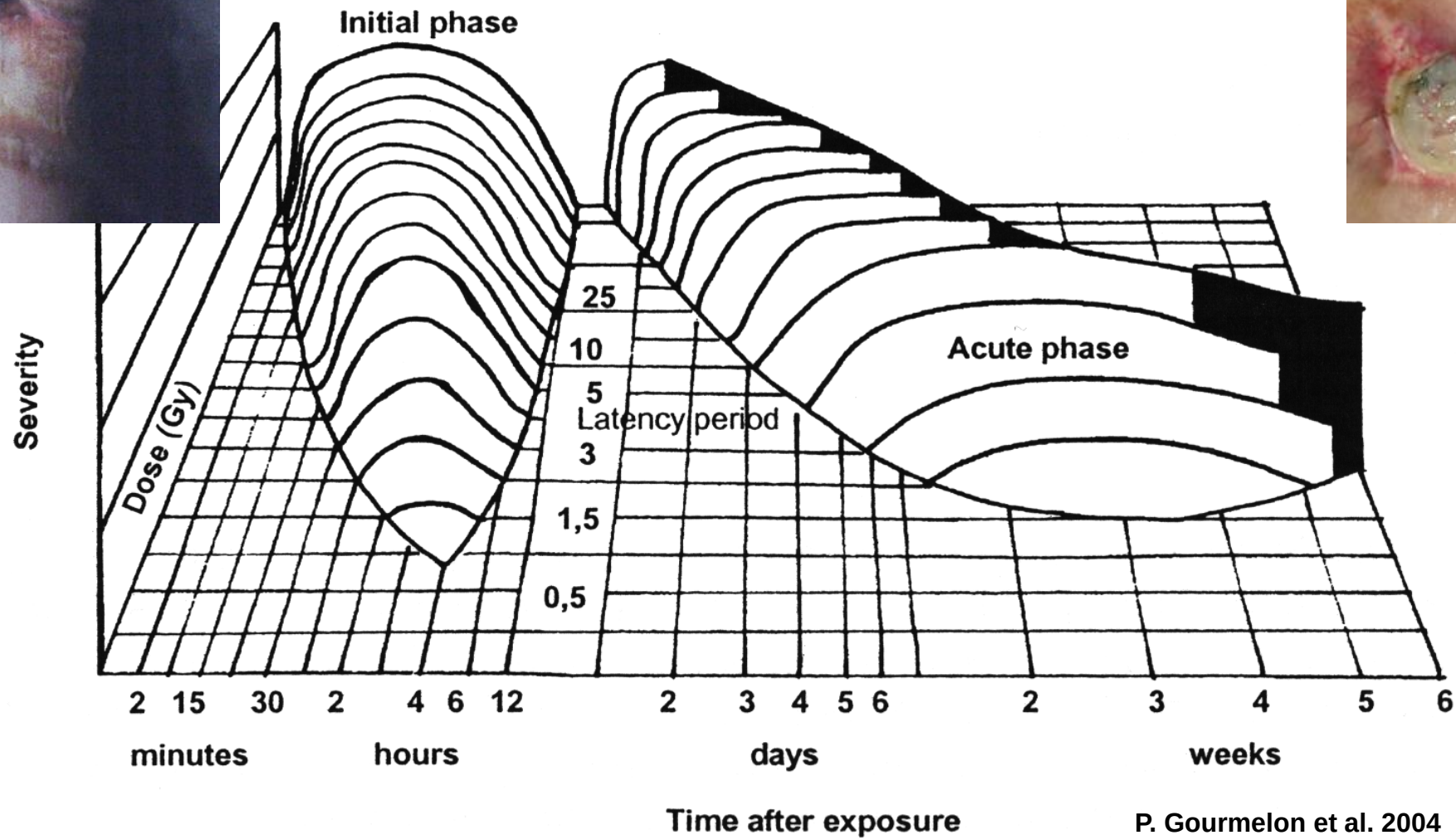
Probability of effect = Probability of damaging one cell



Degree of severity independent of dose

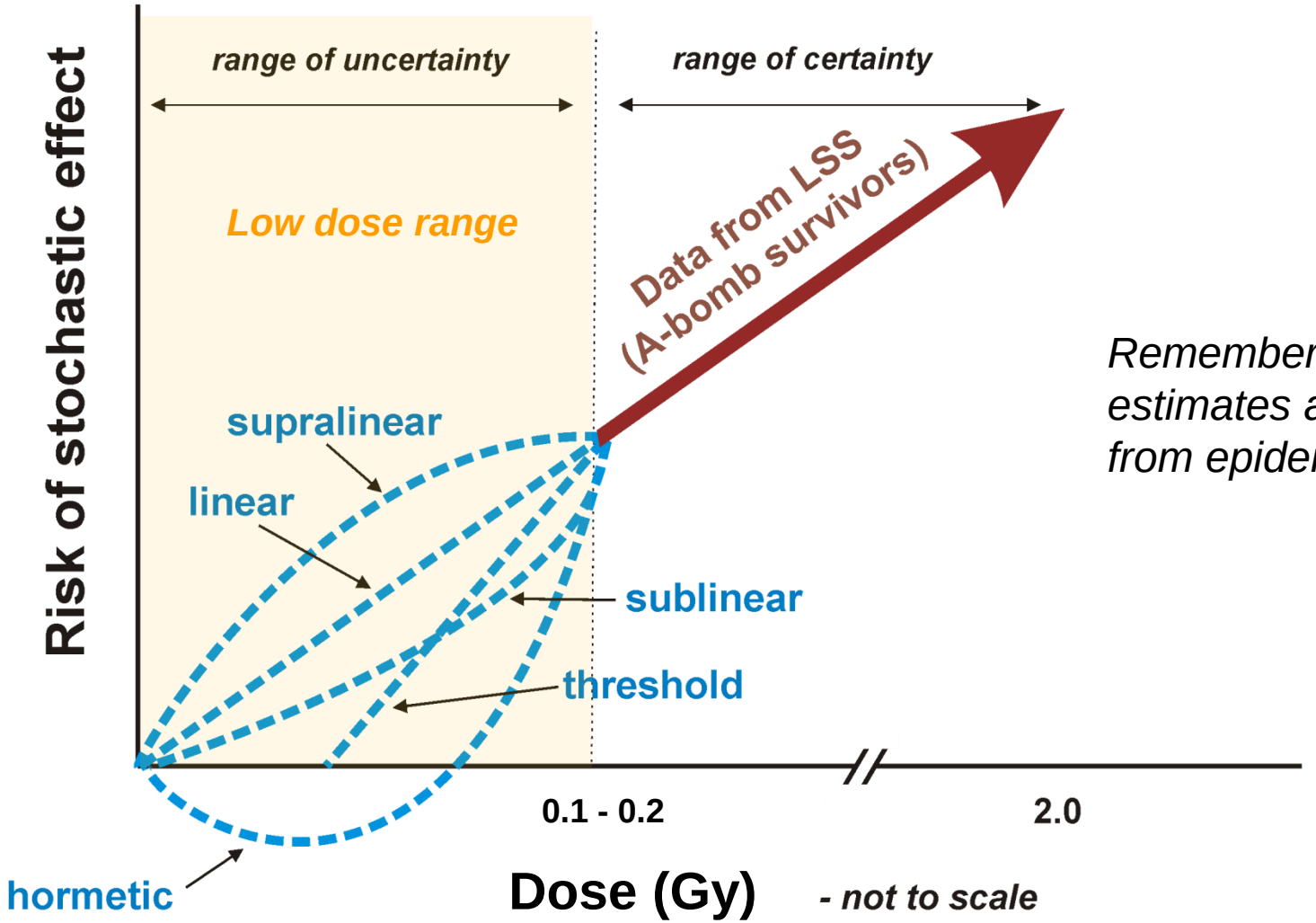
Psychological effects are not the direct outcome of radiation-induced damage but their consequences after low dose exposure can exceed those of biological effects

Phases and time scale of the radiation syndrome after high doses



P. Gourmelon et al. 2004

The risk of cancer and the radiological protection dilemma



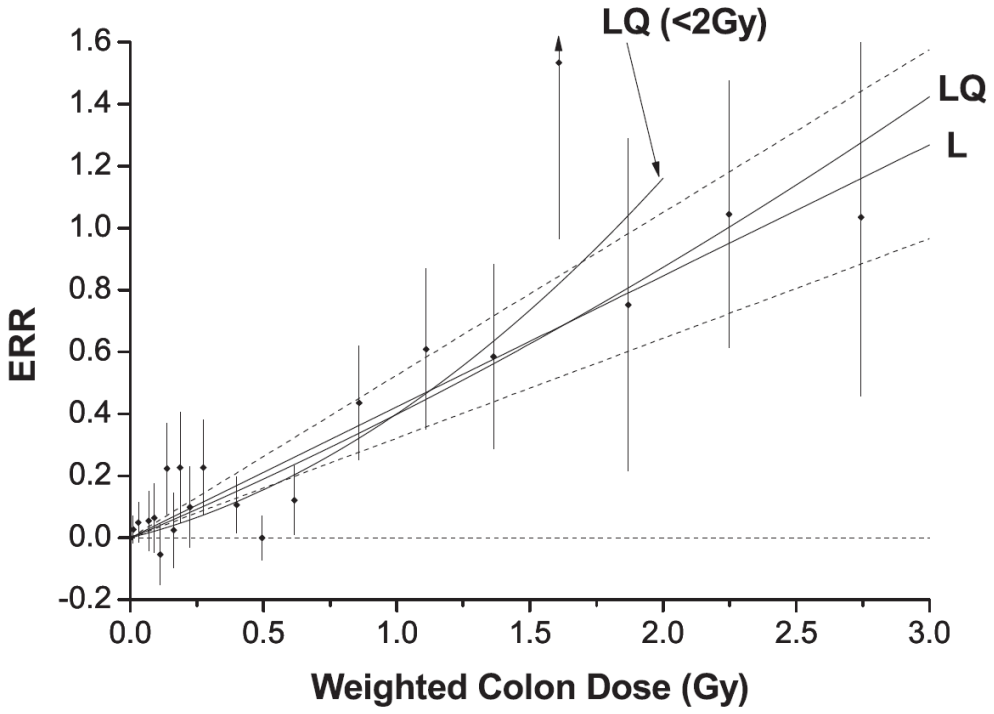
Remember: radiation risk estimates are based on results from epidemiological studies

Cancer incidence

Solid cancer incidence among Hiroshima and Nagasaki survivors in the years 1950 - 2003
size of the collective: 86 000 (Osaza et al. 2012)

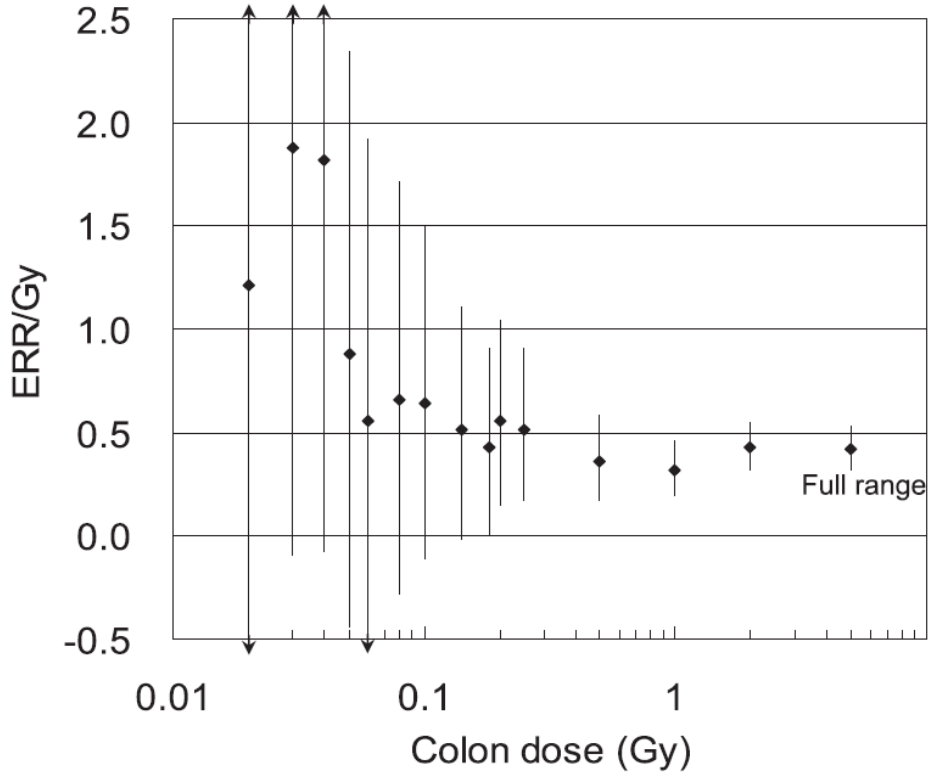
The gold standard in radiological protection

ERR vs dose



Excess relative risk (ERR) for all solid cancer in relation to radiation exposure. The black circles represent ERR and 95% CI for the dose categories, together with trend estimates based on linear (L) with 95% CI (dotted lines) and linear-quadratic (LQ) models using the full dose range, and LQ model for the data restricted to dose < 2 Gy.

ERR per Gy



Excess relative risk per Gy (ERR/Gy) for all solid cancer for selected dose ranges. The figure shows the ERR/Gy and 95% CI for a dose range from zero to a given dose based on the linear model for the full data that allowed for different ERRs below and above the given dose and taking radiation effect modifiers as common to the two dose ranges.

Some cancer show a threshold of dose – bone cancer in female radium dial painters

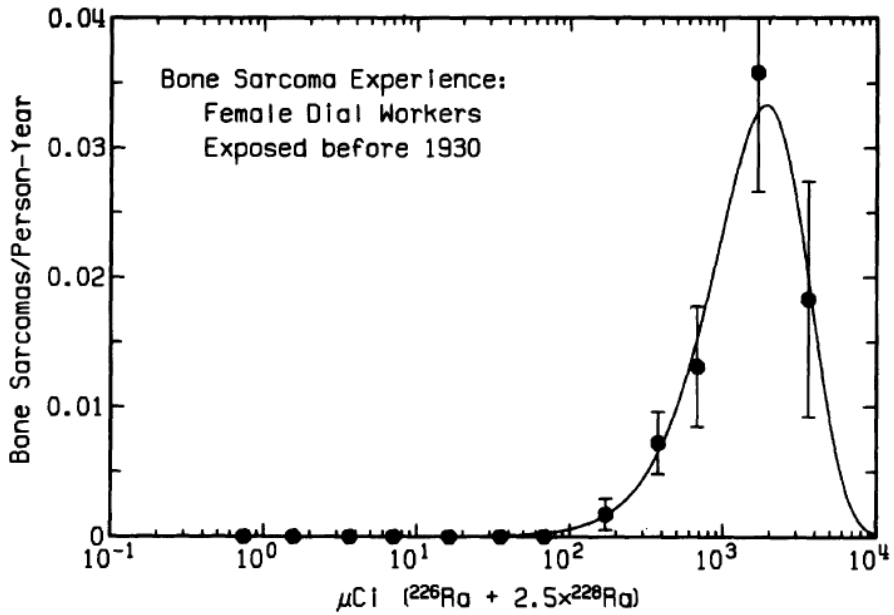
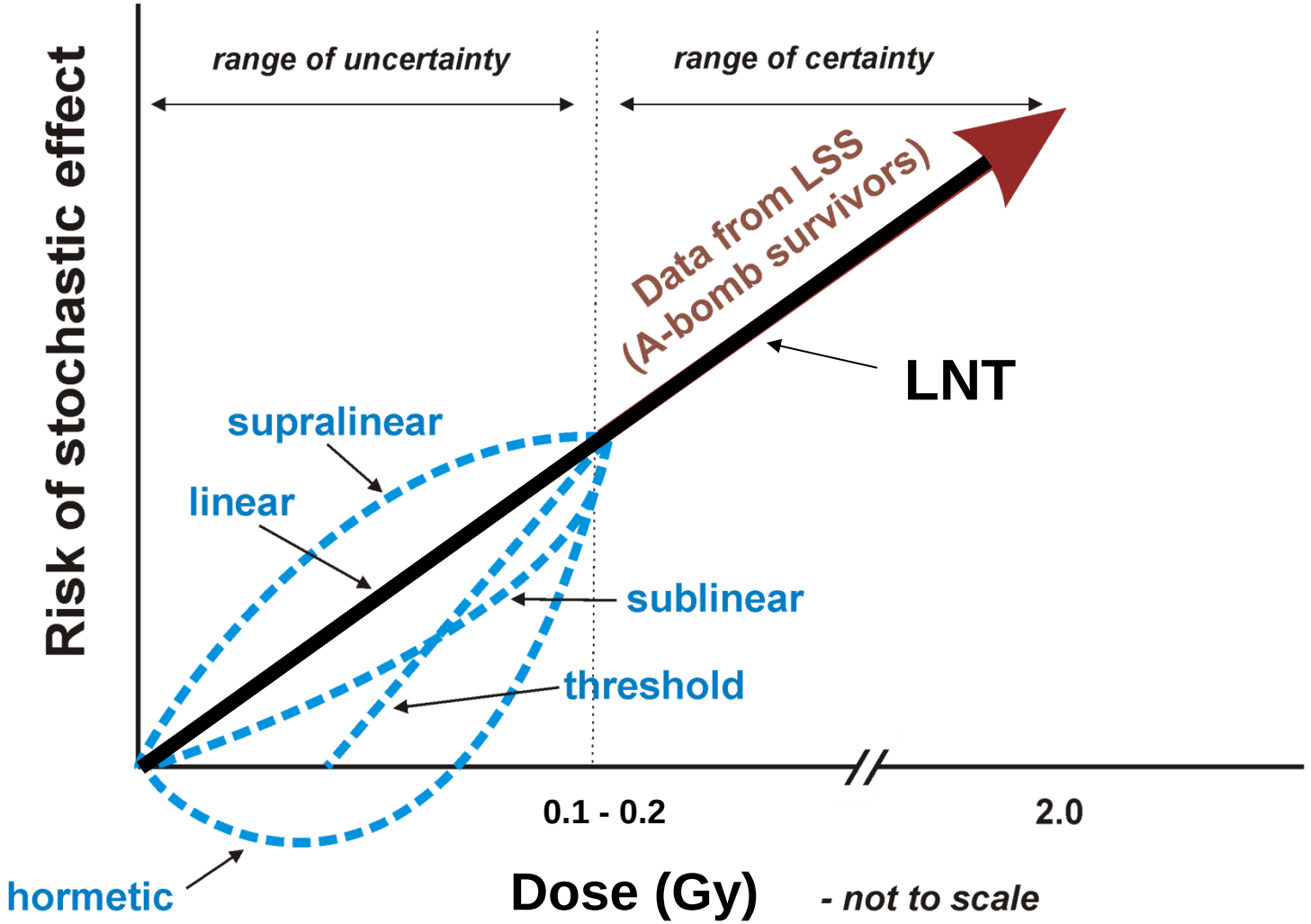


FIG. 1. Bone sarcomas per person-year at risk (I) plotted as a function of systemic intake (D) in units of microcuries of ^{226}Ra plus 2.5 times microcuries of ^{228}Ra. The solid line is the equation $I = (C + \beta D^2)e^{-\gamma D}$ calculated for a 5-year latent period with $C = 1 \times 10^{-5}$ sarcomas per person-year, $\beta = 6.8 \times 10^{-8}$ sarcomas per person-year-μCi^2, and $\gamma = 1.1 \times 10^{-3}$ per μCi. The error bars represent the binomial standard errors of the observed incidences.

Source: R.E. Rowland et al. Dose-Response Relationships for Female Radium Dial Workers. Radiation Research 76: 368-383, 1978.

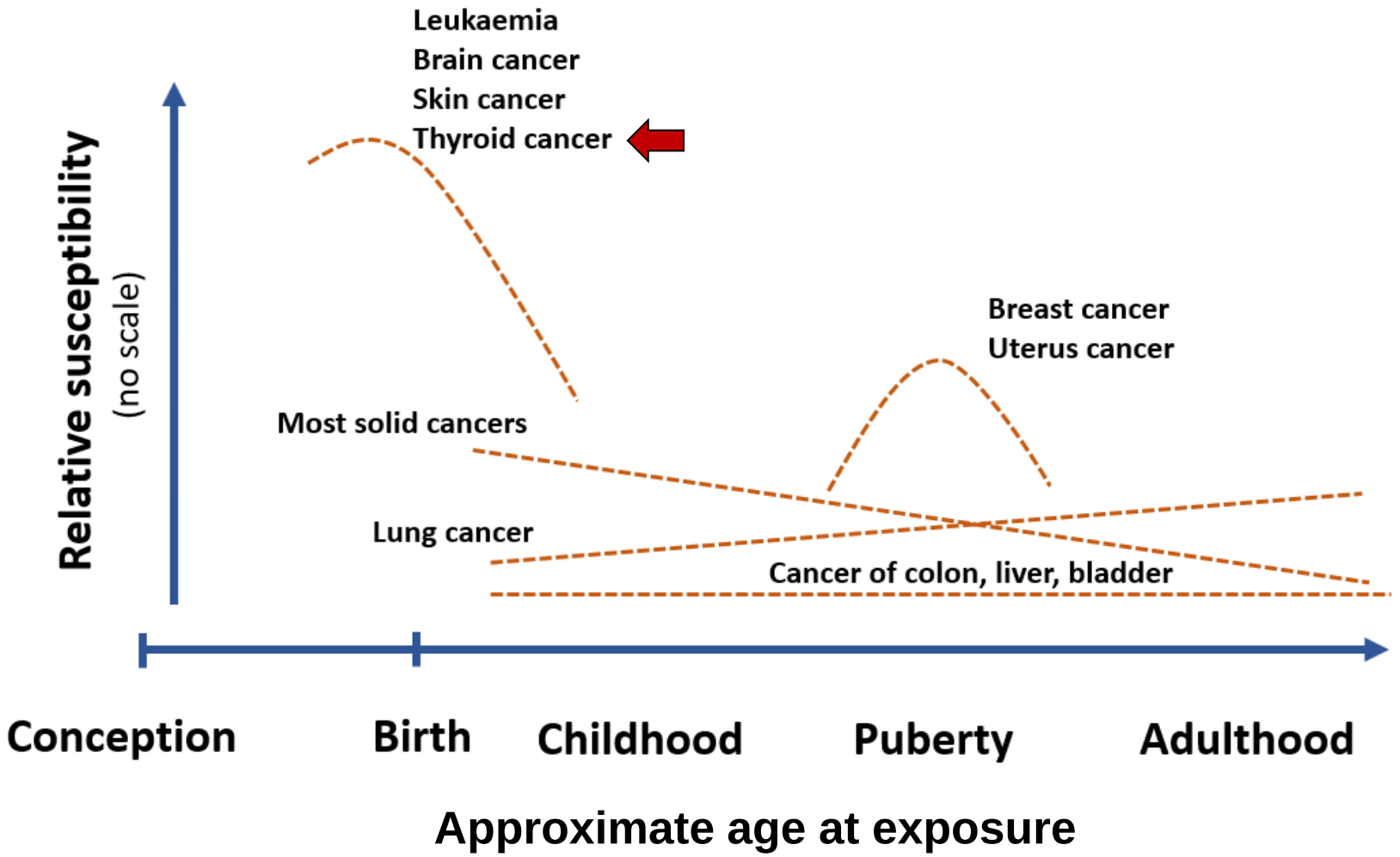
With respect to low doses, the LNT approach is not based on scientific evidence, it is based on the precautionary principle



ICRP 9, 1965

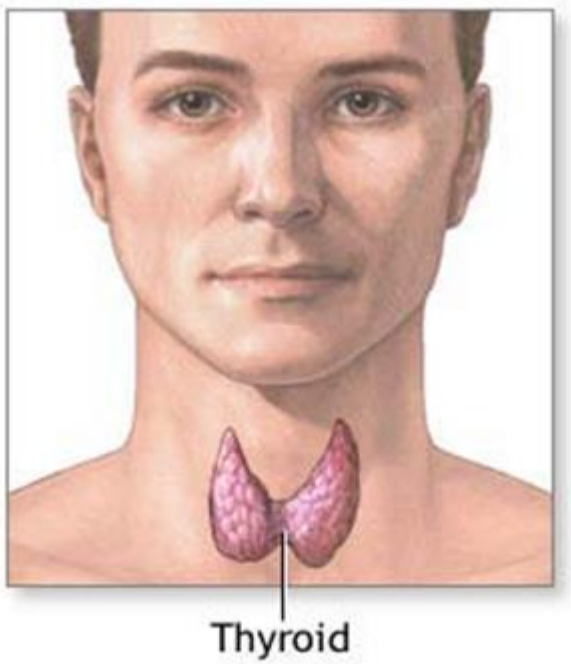
"The Commission is aware that the assumptions of **no threshold and of complete additivity of all doses may be incorrect**, but is satisfied that they are unlikely to lead to the underestimation of risks. Information is not available at the present time which would lead to any alternative hypothesis".

Susceptibility to radiation-induced cancers as a function of age at exposure



Source: Wojcik and Pei, Radiation Protection No 196, EU Scientific Seminar 2020

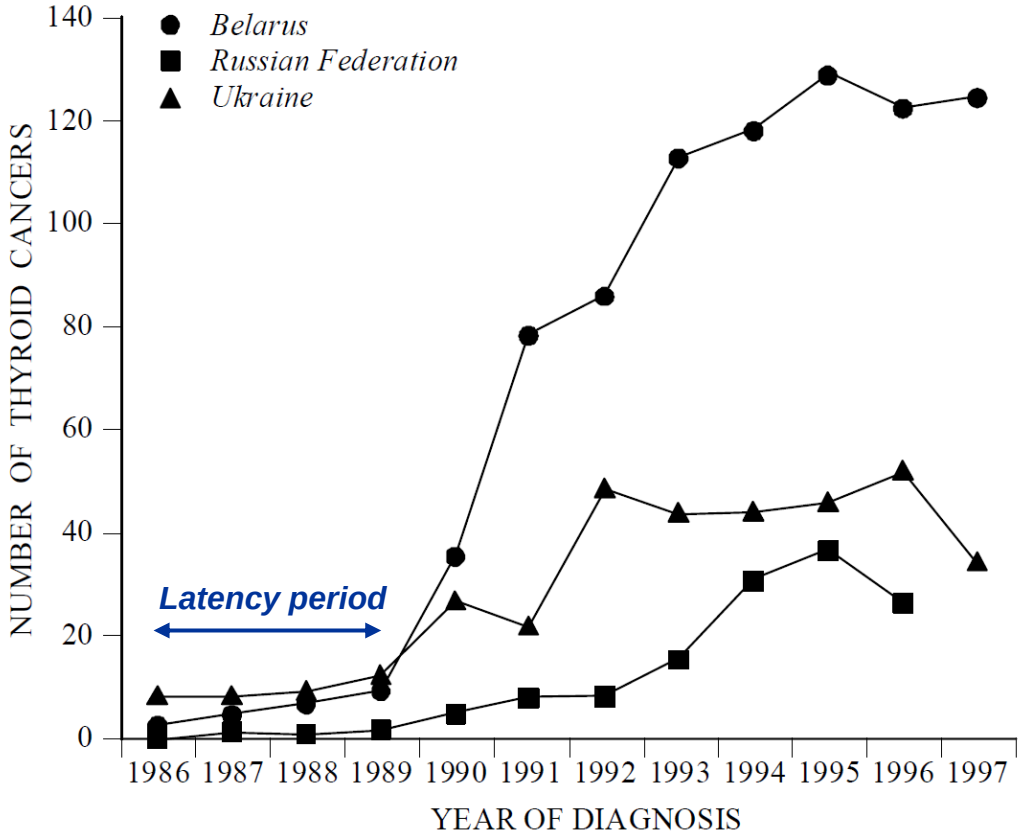
The thyroid gland and ^{131}I uptake



- The thyroid gland uses iodine to synthetize the hormone thyroxine.
- ^{131}I is taken up by the thyroid gland in people who suffer from iodine deficiency.
- ^{131}I uptake in children increases the risk of thyroid cancer in a dose-dependent manner.

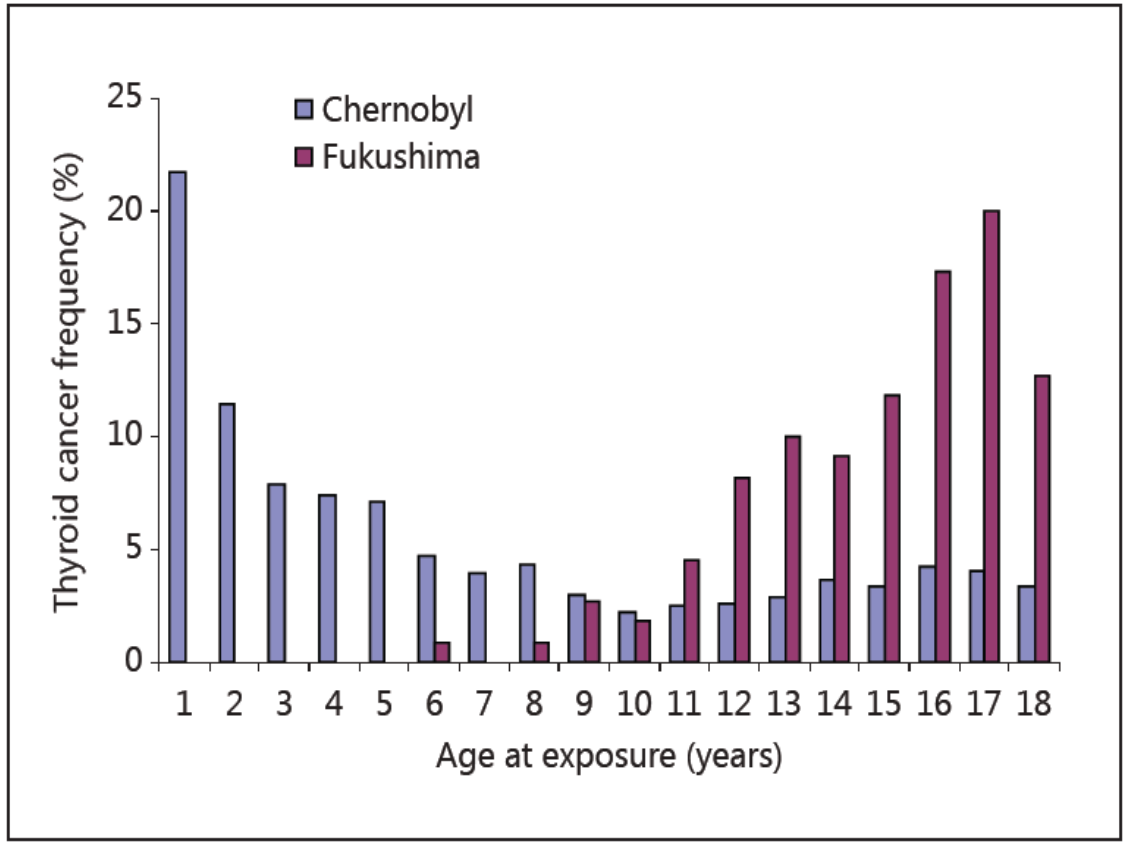
Epidemiological evidence for the incidence of thyroid cancer after ^{131}I uptake

Number of thyroid cancers in children exposed before the age of 14 years as a result of the Chernobyl accident



UNSCEAR 2000 Report Annex J: Exposures and effects of the Chernobyl accident

Thyroid cancer frequency (percentage distribution) by age at exposure to fallout from Chernobyl and in the first 3 years after Fukushima.



Williams. Thyroid growth and cancer. Eur Thyroid J. 4: 164-173, 2015

Recommendations for kalium iodine (KI) to block ^{131}I uptake

Stockholms universitet

DSA Norwegian Radiation and Nuclear Safety Authority

About DSA Norwegian

Home • Preparedness • Taking iodine tablets in the event of a nuclear accident

Taking iodine tablets in the event of a nuclear accident

Under 40 years of age, pregnant, breast-feeding or have children living at home? If so, we recommend that you store iodine tablets at home. These tablets can provide protection against radioactive iodine in the event of a nuclear accident and should only be taken on the advice of the public authorities.

Strål säkerhets myndigheten
Swedish Radiation Safety Authority

English website Lättläst

Sök på stralsa

Områden | Om oss | E-tjänster och blanketter | Riksmätplatsen | Regler | Publikationer

Startsida / Områden / Beredskap / Kärnenergiberedskap vid kärnteknisk olycka i Sverige / Skyddsåtgärde / Jodtabletter

Jodtabletter

Sidomeny

Beredskap

Forskning

Om en kärnkraftsolycka inträffar som leder till utsläpp av radioaktiva ämnen så kan det bli aktuellt för barn och vuxna upp till 40 år att ta jodtabletter. Jodtabletter ska enbart tas på uppmaning av länsstyrelsen.

Bundesamt für Strahlenschutz

Iodine tablets are advisable for people up to the age of 45, including pregnant women and children

In principle, all people up to the age of 45 in the affected areas should take iodine tablets, with the correct dosage varying according to age.

- As the thyroid is particularly sensitive in children and young people up to the age of 18, it is especially important for children and young people to take iodine tablets.
- For pregnant women, taking iodine tablets particularly helps to protect the unborn child.

stuk

Intag av jodtabletter i en nödsituation med strålrisk orsakad av en kärnkraftsolycka rekommenderas för personer upp till 40 år, gravida och ammande.

Evidence for the benefit of blocking ^{131}I uptake with KI

IOP Publishing | Society for Radiological Protection — Journal of Radiological Protection
J. Radiol. Prot. **36** (2016) R112–R130 — doi:10.1088/0952-4746/36/4/R112

Review

The effects of iodine blocking on thyroid cancer, hypothyroidism and benign thyroid nodules following nuclear accidents: a systematic review

M Pfinder[1,2,3,4,6,7], S Dreger[1,7], L Christianson[1], S K Lhachimi[1,2,3] and H Zeeb[1,5]

BUT
Administration of KI may help in comforting people and preventing psychological effects (I did everything to pretect myself and my family…).

- We identified **low to very low-quality evidence that KI administration after a nuclear accident resulted in a reduction of the risk of thyroid cancer in children.** The KI administration and dose was not well described in the studies.
- **No conclusions can be drawn about the effectiveness of KI intake with respect to the prevention of hypothyroidism and benign thyroid nodules**.

Stockholms universitet

It is all about radiological protection