

## Radiation

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### LUNG DOSES DUE TO MULTIPLE RADIATION EXPOSURES AND RISK OF LUNG CANCER DEATH AMONG FRENCH URANIUM MINERS

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**Objectives** The study aims to assess the risk of lung cancer death associated with lung doses due to radon gas and its short-lived progeny (RnP), long-lived radionuclides (LLR) and external  $\gamma$  rays in the French cohort of uranium miners.

**Methods** The cohort included 3271 exposed miners followed from 1956 through 1999. Annual exposures were assessed individually and lung doses were calculated according to the Human Respiratory Tract Model (Publication 66 of the International Commission on Radiological Protection). Poisson regression was used to fit linear excess relative risk (ERR) models to estimate dose-risk relationships.

**Results** The mean absorbed lung dose due to  $\alpha$  emitters was 78 mGy, and to non- $\alpha$  emitters, 56 mGy. RnP accounted for 97% of the  $\alpha$  absorbed dose. A significant ERR of lung cancer death was associated with the total absorbed lung dose (ERR/Gy (95% CI) = 2.9 (0.8–7.5)), the  $\alpha$  absorbed dose (4.58 (1.3–10.9)) and RnP (4.6 (1.3–11.2)). Assuming a value of 20 for the relative biological effectiveness of  $\alpha$  particles in lung cancer induction, the ERR/Gy-equivalent for the total-weighted lung dose was 0.2 (0.1–0.5), similar to that for the  $\alpha$ -weighted and RnP-weighted lung dose.

**Conclusions** These first results about lung doses from the European Alpha-Risk project, with regard to the lung dose distribution, support the major role of RnP in the risk of lung cancer death.