Radon and cancers other than lung cancer in uranium miners - Results of the German uranium miner cohort study

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Background It is well established that lung cancer is caused by radon, while uncertainty exists as to whether cancers other than lung might be related to exposure from radon. To investigate further the risk of extra-pulmonary cancers, mortality data from the German uranium miners cohort study are analysed.

Materials and methods The cohort includes 58,747 men who were employed for at least 6 months between 1946 and 1989 at the former Wismut uranium company in Eastern Germany. Exposure to radon and its progeny, long-lived radionuclides, external gamma radiation as well as exposure to arsenic and dust was estimated by using a detailed job-exposure matrix. A total of 20.680 deaths were observed in the follow-up period 1960 to the end of 2003. The different causes of death were compared with the age- and calendar-year specific national death rates of Eastern Germany, formerly GDR. Standardized mortality ratios (SMR) with 95% confidence limits (CI) were calculated. To investigate the exposure-response relationship an internal poisson regression using a linear model was applied and the excess relative risk (ERR) per unit of cumulative exposure to radon in Working Level Month (WLM) was calculated.

Results For 19.598 (94.3%) of the deceased cohort members causes of death had been available, among them 2.999 lung cancer deaths and 3.341 deaths from cancers other than lung. After adjusting for missing causes of deaths, for all cancers other than lung combined mortality in the cohort was close to that expected from national rates (SMR=1.02, 95% CI: 0.98-1.05). Among 23 individual cancer categories, statistically significant increases in mortality for cancers of the stomach (SMR=1.15, 95% CI: 1.06-1.25) and liver (SMR=1.26 , 95% CI: 1.07-1.45) and statistically significant decreases for cancers of the tongue, mouth and pharynx combined and bladder were observed. A statistically significant relation with cumulative exposure was observed for all non-lung cancers combined (ERR/WLM=0.014%) and stomach cancer (ERR/WLM=0.021%).

Conclusion Our findings suggest a weak evidence for a relationship between exposure to radon and mortality from cancers other than lung cancer. Chance, confounding by unconsidered risk factors and bias due to missing causes of deaths cannot be ruled out. If at all, the risk for extrapulmonary tumors associated with radon is appreciably lower than that for lung cancer.

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