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GERMAN SOCIETY OF
TOXICOLOGY

Poison of the month

Radon (Rn)

Radon

The International Agency for Research on Cancer (IARC) classifies radon as proven carcinogenic to humans. The Federal Office for Radiation Protection (BfS) and the German Commission on Radiological Protection (SSK) agree with this assessment.

Smoking and radon

The health risks from radon are significantly increased if people smoke or have smoked in the past. Studies show that the combined effect of radon and tobacco smoke significantly increases the likelihood of developing lung cancer. Smoking damages the lungs, which further increases susceptibility to the carcinogenic effect of the alpha radiation released by radon.

Radon in so-called healing galleries

The radon concentration in healing tunnels is often in the range of 20,000 to 100,000 Bq/m³, which is significantly higher than in living spaces, where concentrations are usually around 50 to 100 Bq/m³ in Germany and other parts of Europe. The high concentrations result from the geological location of the tunnels in radon-rich regions. Radon accumulates in the closed, underground rooms and remains in breathing air for longer due to the high humidity and heat. Well-known healing galleries include the Gastein Healing Gallery in Austria and the Bergmannstrost Clinic Gallery in Bad Kreuznach. During a typical healing gallery session, a patient can absorb radon doses of 1 to 2 millisieverts (mSv), which is roughly equivalent to the annual natural radiation exposure.

Studies report a reduction in pain and an improvement in quality of life, particularly in the case of diseases such as rheumatoid arthritis, ankylosing spondylitis and osteoarthritis. However, the high level of exposure raises concerns in the majority of cases, as the risk of developing lung cancer could outweigh the short-term therapeutic effects in the long term. There are currently no studies that have adequately investigated this exposure scenario.

Danger from indoor air: Why are elevated radon levels a risk?

Radon (Rn) is a naturally occurring radioactive noble gas produced by the decay of uranium in soils and rocks.

The radioactive decay of radon produces short-lived radioactive isotopes of polonium, bismuth and lead. As aerosols, i.e. finely dispersed particles, these are attached to dust particles in the air and are thus inhaled. However, while gaseous radon is almost completely exhaled again, the radioactive by-products can attach themselves to the sensitive lung tissue and continue to decay there. This produces radioactive alpha radiation. This radiation can damage the cells in the lungs. Damage to the DNA and thus the genetic material can lead to mutations in the cells, which can cause the development of lung cancer.

If radon and its radioactive by-products are inhaled at elevated levels over a longer period of time, the risk of developing lung cancer increases. Studies show that the risk of cancer increases linearly with long-term radon concentrations in the air we breathe.

The Federal Office for Radiation Protection (BfS) assumes that around six per cent of lung cancer deaths per year in Germany (around 2,800 people) can be attributed to increased exposure to radon in the air we breathe. After smoking, radon is identified as one of the most important causes of lung cancer.

There are large regional differences in the occurrence of radon in the soil and therefore also in the radon levels in the air we breathe. However, there is no health risk in the outside air, even in highly contaminated areas, as radon is quickly diluted. However, radon can enter buildings through cracks in the foundations, leaking floor slabs, porous building

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materials or pipes. As radon is a colorless, odorless and tasteless gas, it is possible for high concentrations to accumulate unnoticed in poorly ventilated indoor spaces.

The reference value of 300 becquerels per cubic meter (Bq/m³) currently applies in Germany. According to the gernan Radiation Protection Act, this should serve “as a benchmark for assessing the appropriateness of measures to protect against radon”. To date, there is no radon concentration that can be classified as safe and no indication of a threshold value below which radon is definitely not a health risk. It is assumed that the risk of lung cancer increases by around 16 % from a radiation exposure of 100 Bq/m³. This assumption is based on extensive scientific studies dealing with the consequences for the health of miners in uranium mines who are occupationally exposed to radon.

A key strategy for detecting indoor radon exposure is to measure the radon concentration, which can be done using simple test kits. In regions with an increased risk, regular measurements and, if necessary, remediation measures should be carried out. As radon is invisible and odorless, it often goes unnoticed, which makes preventive monitoring all the more important. Furthermore, broad education about the risks of increased radon exposure is essential in order to minimize possible health impairments and improve the quality of life in contaminated regions.

By Ute Haßmann

Literature and links:

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Reference value for radon

The BfS has set a reference value of 300 Bq/m³, but no limit value for radon. As radon is a naturally occurring radioactive gas, its source cannot be eliminated and everyone is inevitably exposed to it. Even low concentrations pose a detectable risk.

If a limit value were set for radon, mandatory measures would have to be implemented to reduce the concentration, for example by restricting the use of buildings or extensively renovating them - including in the private sector. International radiation protection experts do not consider such measures to be proportionate. It was therefore decided to set a reference value for radon. This serves as a guide to the concentration above which measures can be recommended, but remains more flexible and less mandatory.

Wismut study

Is one of the largest cohort studies worldwide to investigate the health effects of occupational radon exposure. The study examines around 59,000 male employees who worked in uranium mining in the former German Democratic Republic (GDR) between 1946 and 1990. The study has been conducted by the BfS since the 1990s in order to comprehensively analyze the consequences of occupational exposure to radiation and dust. Important findings on the health risks associated with occupational radon exposure are being obtained.

Rn precautionary areas

These are areas in which the reference value of 300 Bq/m³ in indoor air is frequently exceeded. According to § 121 of the Radiation Protection Act, special protection requirements for new buildings and workplaces have applied since 2021. The federal states of Germany are responsible for defining these areas.