

EPIDEMIOLOGY

Russian Cancer Study Adds to the Indictment of Low-Dose Radiation

A Cold War environmental calamity appears to be the cause of a spate of cancers in the Russian heartland. A landmark study this month by U.S. and Russian scientists blames excess cancers in the Ural Mountains on chronic exposures to radioactivity leaked from a weapons plant a half-century ago.

The study is the latest blow to the notion that there is a threshold of exposure to radiation below which there is no health threat (and there might even be a benefit). The results add weight to last summer's report from the U.S. National Research Council, which backed the hypothesis that radiation is risky even at the smallest doses (*Science*, 8 July, p. 233). Although that conclusion had been inferred from Japanese atomic bomb survivors, the Russian study—along with a recent report revealing an elevated cancer risk in nuclear workers around the globe—provides the strongest direct evidence yet of chronic, low-dose health effects.

Both sets of findings indicate that workplace radiation standards are correct in erring on the safe side. In 1991, the International Commission on Radiological Protection (ICRP) set an annual workplace limit of 20 millisieverts (mSv) per year over 5 years, which assumes there is no safe level. "This is an endorsement of the precautionary approach as a tool for radiation protection," says Lars-Erik Holm, director general of the Swedish Radiation Protection Authority and ICRP chair.

The new data come from villagers downstream from the Mayak weapons complex in the southern Urals, victims of the struggle for nuclear supremacy. From 1949 to 1956, they were exposed to a steady stream of plutonium production byproducts released into the Techa River. After the Soviet breakup, U.S. experts—including atomic bomb radiation expert Dale Preston, now at Hirosoft International Corp. in Eureka, California, and epidemiologist Elaine Ron of the U.S. National Cancer Institute—joined forces with colleagues at the Urals Research Cen-

ter for Radiation Medicine in Chelyabinsk to scrutinize the health of 25,000 people who lived in 41 villages along the Techa between 1950 and 1952, when radioactivity releases climaxed, and nearly 5000 people who moved to these communities between 1953 and 1960.

The biggest challenge has been getting a handle on individual radiation doses, which remain uncertain. The team has measured strontium-90, the most common downstream radioisotope, in teeth from scores of subjects and conducted whole-body counts of strontium and cesium-137. They have at least



Low-dose risks. A study of cancers in Muslyumovo (inset) and other villages near the radionuclide-laden Techa River points up the importance of limiting exposure to radiation in the workplace.

one strontium measurement for more than a third of the villagers.

According to death certificates, 1842 villagers died from solid tumors other than bone cancer, the prevalence of which would have been skewed by strontium-90. And 49 died from leukemia, not counting chronic lymphocytic leukemia (CLL), which is not thought to be triggered by radiation. The researchers attributed deaths above the background rate to radiation—46 from solid cancer (2.5%) and 31 from leukemia (63%). The risks increase with estimated dose, the team reports in the November issue of *Radiation Research*. "People were hoping that the risks would be a lot lower," says Lynn Anspaugh,

now at the University of Utah, Salt Lake City, who helped with the study's dosimetry.

The figures, although alarming, are in line with the largest study of nuclear power workers ever carried out. A team led by Elisabeth Cardis of the International Agency for Research on Cancer in Lyon, France, pooled data on more than 400,000 plant workers in 15 countries. In this group, 6519 have died from solid cancers and 196 from non-CLL leukemias. The finding suggests that between 1% and 2% of the deaths may be due to radiation, the team concluded in the 29 June issue of the *British Medical Journal*.

It's an "impressive study," says Holm, although he and others flagged a shortcoming: Smoking may account for a large share of deaths attributed to radiation. In the study, the risk of smoking-related tumors—primarily lung cancers—is much higher than for other solid cancers. Cardis points out that the paper acknowledges smoking

as a confounding factor. "Although smoking may play a role in the increased risk of all cancers excluding leukemia, it is unlikely to explain all of the increased risk observed," she says. Future publications will address concerns about the study's methods, she says.

Although the Cardis study has been challenged, exhibit B in the low-dose indictment, the Techa River study, provides corroborating evidence. The two studies come to "practically the same conclusion," says Peter Jacob of the Institute of Radiation Protection in Neuherberg, Germany. That means that the 20-mSv standard is unlikely to budge, despite arguments from industry that it is too stringent. The Russian results are "a setback for those who hope for a relaxation of the standards," says Anspaugh. The United States is one of the few nations that does not use the ICRP standard; it permits exposures up to 50 mSv per year.

In practice, most nuclear industry workers are exposed to far less radiation than the ICRP limit. That's a good thing: The average lifetime dose in the Cardis power plant study was only 19.4 mSv, with less than 0.1% of workers receiving more than 500 mSv. Calculations in the Techa study suggest that the vast majority of villagers received less than 50 mSv of lifetime accumulated dose to the stomach. In light of ongoing efforts to refine these estimates, says Urals center director Alexander Akleyev, cancer risks should be viewed as "preliminary." Jacob agrees: "This is not the final word," he says.

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