Exposure to low levels of radon appears to reduce the risk of lung cancer, new study finds

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Exposure to levels of radon gas typically found in 90 percent of American homes appears to reduce the risk of developing lung cancer by as much as 60 percent, according to a study published in the March 2008 issue of the journal *Health Physics*. The finding differs significantly from the results of previous case-control studies of the effects of low-level radon exposure, which have detected a slightly elevated lung cancer risk (but without statistical significance) or no risk at all.

The study, undertaken jointly by researchers at Worcester Polytechnic Institute (WPI), Fallon Clinic, and Fallon Community Health Plan, is the first to observe a statistically significant hormetic effect of low-level radon exposure. Toxins and other environmental stressors (including radiation) that have a beneficial effect at very low doses are said to exhibit hormesis (scientists believe that the low doses of toxins may stimulate repair mechanisms in cells). Home exposure to radon, a naturally occurring radioactive decay product of radium, has been thought to be the second leading cause of lung cancer, after cigarette smoking. Chemically inert, it can percolate out of the ground into basements.

The study was initiated and managed by Donald F. Nelson, now professor emeritus of physics at WPI, during the 1990s, a time when concern over the link between residential radon exposure and lung cancer was growing. Nelson says the aim was to try to establish what

level of radon exposure actually correlated with significant lung cancer risk and to establish a safety zone for home radon levels. “We were certainly not looking for a hormetic effect,” says co-author Joel H. Popkin of Fallon Clinic and St. Vincent Hospital in Worcester. “Indeed, we were stunned when the data pointed to that conclusion in such a strong way.”

In the study, the exposure of 200 individuals with confirmed cases of primary lung cancer to radon was compared to the exposure of 397 carefully matched, randomly selected control subjects. All subjects were 40 years old or older and had lived in their homes for at least 10 years. All of the cases and controls were residents of Worcester County in Massachusetts and were enrolled in the same health maintenance organization, Fallon Community Health Plan.

The results were statistically adjusted for factors known to be correlated with lung cancer risk, including smoking, occupational exposure to carcinogens, and level of education. The adjusted results show that the odds ratios of developing lung cancer fall below one (the no effect level) at radon exposure levels within the range measured in about 90 percent of homes across the United States (0-150 Becquerel per cubic meter of air, or about 0-4 picoCuries per liter). The Environmental Protection Agency (EPA) recommends that homeowners take remediation actions when household radon exposure levels rise above 4 picoCuries per liter, based on the belief that radon exposure presents a linearly increasing lung cancer risk (a view not supported by the new study in the low-dose region).

In a statistical analysis led by Richard E. Thompson, associate scientist in the department of biostatistics at the Johns Hopkins University Bloomberg School of Public Health, two mathematical techniques were used to compute the odds ratios of developing lung cancer. They each showed a statistically significant lowered lung cancer risk—a reduction

of as much as 60 percent--over portions of the 0-150 Becquerel per cubic meter range.

The results of the current study do not fall within the “linear, no threshold” (LNT) model commonly used to analyze radon’s cancer risk (in fact, the current study calls into question the validity of that model). The model starts with cancer risks documented for exposure to high levels of radon (for example, by uranium miners) and extrapolates a considerable distance to risks at low levels (for example, for homeowners). In that model, the odds ratios of developing cancer rise linearly from one, beginning at a radon level of zero. The model has been used by the EPA to derive its estimate that 21,000 cancer deaths annually can be attributed to radon exposure, and also accounts for the common belief that there is no safe level of radon exposure.

Donald Nelson says the differences in the outcomes of this and previous studies may be attributable to key elements of the new study’s design. For example, he noted, care was taken to place radon monitors (for yearlong measurements) in areas of the home where the subjects spent the most wakeful time. Monitors were also place in the subjects’ present and former bedrooms and on any other home level where they spent as little as one hour per week. The subjects’ exposures were then obtained by weighting the measurements according to the time typically spent near each detector. The results were further adjusted to account for how subjects’ home use changed with changing lifestyle (for example, transitioning from full-time employment to retirement). “Our analysis shows this to be an important improvement over exposure measures used by almost all other studies,” he said.

“It is important to note,” Nelson added, “that these new results do not dispute the lung cancer risk associated with higher levels of radon exposure experienced by uranium miners. Nevertheless, the results represent a dramatic departure from previous results and beliefs. Of

course, a single epidemiological study is seldom regarded as definitive, so our results point to the need for new studies using our techniques."

Nelson also noted that the study revealed a dramatic correlation between level of education and lung cancer risk. Subjects who had at least some college education were found to have only 30 percent of the lung cancer risk of those with less than a high school education. "While education has been found to be an important correlated variable in many health studies," he said, "this is a particularly striking and statistically significant result, one found after smoking, job exposures, and radon were statistically adjusted for."

Source: Worcester Polytechnic Institute