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Other Research

When Radon Levels Rise

Ecological Study Shows Lower Cancer Rates

Unequivocal data exist demonstrating that exposure of underground miners to high concentrations of radon decay products causes lung cancers at higher rates than would be expected without the exposure. Lung cancer mortality in miners has been used by several national organizations to calculate expected numbers of lung cancers caused by indoor radon.

The calculations are based on a lifetime exposure to typical indoor concentrations and assume that the lung cancer risk can be extrapolated linearly to the general population from total exposures in miners. The miners' exposure is considered to be an order of magnitude greater than most people accumulate over a lifetime. Thus, if ten units of radon causes a given risk, it is assumed that one unit will cause one-tenth of that risk.

The linear theory of radiation carcinogenesis has not been tested because the necessary human data do not exist. Results of animal studies cannot definitively be extrapolated to humans.

University of Pittsburgh researcher Bernard L. Cohen believes environmental radon exposure may offer valuable clues in the investigation of linearity.

He has collected nearly 200,000 short-term radon measurements from charcoal detectors in U.S. homes. By relating average county radon measurements with published lung cancer mortality data, Cohen consistently finds a negative relationship. As the average radon rises, lung cancer mortality declines.

Epidemiological studies of this kind, in which groups of people rather than individuals are studied, are known to have various shortcomings. The most serious shortcoming is lack of data on most factors influencing the disease. There is no information in the study about smoking, for example, which is the primary cause of lung cancer, nor are there data on air pollution. Still, many epidemiologists use these ecological studies to describe differences in populations and to identify potential areas for further study.

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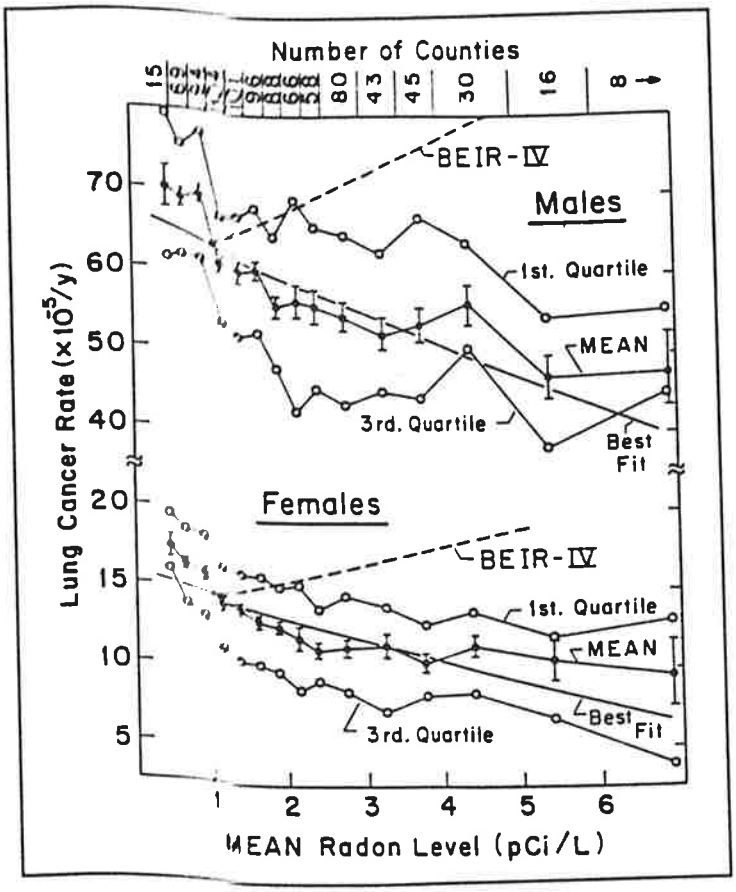
The figure on page 7 shows lung cancer rates for men and women in 965 U.S. counties and average indoor radon exposures in these counties. The solid line shows the best fit to the data. The figure indicates a strong tendency for lung cancer rates to decrease as radon exposure increases.

This trend is statistically significant. The linear theory would predict an increase in lung cancer rates. One such prediction, the BEIR IV model published by the National Academy of Sciences in 1988, is shown as dashed lines in the figure.

In trying to interpret the lack of correlation with the linear theory,



Lung cancer rates in 965 U.S. counties vs their mean radon levels. Abscissa is divided into ranges as shown at the top (figures are the number of counties in each range). For the counties in each range, solid circles are the mean lung cancer rate, error bars are one standard deviation of the mean, and open circles are first and third quartiles of the distribution. Solid lines are the best fit to the 965 county data points, and dashed lines are predictions of the linear model (BEIR IV).

Cohen notes that most people do not spend their whole life in the same county. Accordingly, their exposure to radon occurs at various locations. He corrects for this in the (BEIR IV) model line. He has also performed multiple regression studies involving 17 socioeconomic variables and attempts to correct for differences in smoking habits. The trend of the data remains significantly negative statistically.

He has also divided the data into subsets in hundreds of ways, including considering the poorest, wealthiest, most rural, and various regional differences. He also examined the validity of his data and found the same results even when he substituted EPA surveys of indoor radon.

Cohen notes that it is difficult to establish a correlation between smoking and radon in the counties he studied. However, he says that even if smoking and radon were highly correlated, there still exists a discrepancy with linear models.

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In a descriptive study to be published in late 1992, John S. Neuberger of the University of Kansas Medical School reports on his examination of radon and mortality data collected by the Washington State Health Department.

In 1988, the state added a question to its death certificate form asking whether the deceased smoked during the 15 years before death. Counties with significant in-migration were not used in Neuberger's analysis and age-specific lung cancer rates for white females were calculated for four categories of radon exposure, ranging from very low to high (0.4 to 9 pCi/l).

Using the death certificates, Neuberger found 447 women aged 65 or older who died of lung cancer. Thirty of these women were reported not to have smoked during the 15 years preceding their deaths.

Death rates among the women exposed to high rates of radon were significantly lower than those women whose exposure to radon was very low. No statistically significant excess or trend with radon exposure was perceived among the women who reportedly had not smoked for the preceding 15 years. However, since only 30 women fit this category, there is no definitive evidence.

Ordinarily, no highly significant correlation can be extrapolated from ecological studies. To evaluate radon's significance in the onset of disease, investigators need accurate, quantitative data based on investigation of individuals, not groups of people. Accurate data about smoking and urbanization must be included. Cohen suggests, however, that results of ecological studies may be used as the basis upon which to initiate more definitive epidemiological investigations.▲

Reported by
Naomi H. Harley
New York University