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NATIONAL CANCER INSTITUTE FactSheet

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Radon and Cancer: Questions and Answers

Key Points

- Radon is a radioactive gas released from the normal decay of uranium in rocks and soil (see Question 1).
- Radioactive particles from radon can damage cells that line the lungs and lead to lung cancer (see Question 3).
- Radon is the second leading cause of lung cancer in the United States and is associated with 15,000 to 22,000 lung cancer deaths each year (see Question 4).
- Studies showing a link between radon and lung cancer in humans include studies of underground uranium miners and of the general population exposed to radon in their homes (see Questions 5 and 6).
- Testing is the only way to know if your home has elevated radon levels. Health authorities recommend radon testing and encourage corrective action when necessary (see Question 7).

1. What is radon?

   Radon is a radioactive gas released from the normal decay of uranium in rocks and soil. It is an invisible, odorless, tasteless gas that seeps up through the ground and diffuses into the air. In a few areas, depending on local geology, radon dissolves into ground water and can be released into the air when the water is used. Radon gas usually exists at very low levels outdoors. However, in areas without adequate ventilation, such as underground mines, radon can accumulate to levels that substantially increase the risk of lung cancer.

2. How is the general population exposed to radon?

   Radon is present in nearly all air. Everyone breathes radon in every day, usually at very low levels. However, people who inhale high levels of radon are at an increased risk for developing lung cancer.

   Radon can enter homes through cracks in floors, walls, or foundations, and collect indoors. It can also be released from building materials, or from water obtained from wells that contain radon. Radon levels can be higher in homes that are well insulated, tightly sealed, and/or built on uranium-rich soil. Because of their closeness to the ground, basement and first floors typically have the highest radon levels.

3. How does radon cause cancer?

   Radon decays quickly, giving off tiny radioactive particles. When inhaled, these radioactive particles can damage the cells that line the lung. Long-term exposure to radon can lead to lung cancer, the only cancer proven to be associated with inhaling radon.

4. How many people develop lung cancer because of exposure to radon?

   Cigarette smoking is the most common cause of lung cancer. Radon represents a far smaller risk for this disease, but it is the second leading cause of lung cancer in the United States. Scientists estimate that approximately 15,000 to 22,000 lung cancer deaths per year are related to radon.

   Although the association between radon exposure and smoking is not well understood, exposure to the combination of radon gas and cigarette smoke creates a greater risk for lung cancer than either factor alone. The majority of radon-related cancer deaths occur among smokers.

5. How did scientists discover that radon plays a role in the development of lung cancer?

   Radon was identified as a health problem when scientists noted that underground uranium miners who were exposed to it died of lung cancer at high rates. Results of miner studies have been confirmed by experimental animal studies, which show higher rates of lung tumors among rodents exposed to high radon levels.

6. What have scientists learned about the relationship between radon and lung cancer?

   Scientists agree that radon causes lung cancer in humans. Recent research has focused on specifying the effect of residential radon on lung cancer risk. In these studies, scientists measure radon levels in

the homes of people who have lung cancer and compare them to the levels of radon in the homes of people who have not developed lung cancer.

One of these studies, funded by the National Institute of Environmental Health Sciences, examined residential radon exposure in Iowa among females who had lived in their current home for at least 20 years. This study included 413 females with lung cancer and 614 females without lung cancer. During the study, radon levels were tested in homes, lung cancer tissues were examined, and the scientists collected information about home characteristics and other topics. Results from this study suggested a link between exposure to radon and lung cancer.

Scientists have conducted more studies like this in other regions of the United States and around the world. Many of these studies have demonstrated an association between residential exposure to radon and lung cancer, but this finding has not been observed in all studies. The inconsistencies between studies are due in part to the small size of some studies, the varying levels of radon in many homes, and the difficulty of measuring a person's exposure to radon over time.

Researchers have combined and analyzed data from all radon studies conducted in Canada and the United States. By combining the data from these studies, scientists were able to analyze data from thousands of people. The results of this analysis demonstrated a slightly increased risk of lung cancer associated with exposure to household radon. This increased risk was consistent with the level of risk estimated based on studies of underground miners.

Researchers are also investigating more precise ways to measure a person's exposure to radon over time. In a study published in 2002, scientists examined radon exposure among people in Sweden who had not smoked daily for more than a year. This study included 110 people with lung cancer and 231 people without lung cancer. As with previous studies, the scientists measured radon levels of indoor air. The researchers also used a new technique of analyzing glass to estimate radon exposure over time. Using this technique, the scientists took measurements from glass in an object (e.g., a mirror or picture frame) that was at least 15 years old and had been in the person's home throughout that time, even if the person had moved from one home to another. In this study, both of the techniques for measuring radon demonstrated a relationship between long-term exposure to radon and lung cancer, and supported the results of previous studies.

7. How can people know if they have an elevated level of radon in their homes?

Testing is the only way to know if a person's home has elevated radon levels. Indoor radon levels are affected by the soil composition under and around the house, and the ease with which radon enters the house. Homes that are next door to each other can have different indoor radon levels, making a neighbor's test result a poor predictor of radon risk. In addition, precipitation, barometric pressure,

and other influences can cause radon levels to vary from month to month or day to day, which is why both short- and long-term tests are available.

Short-term detectors measure radon levels for 2 days to 90 days, depending on the device. Long-term tests determine the average concentration for more than 90 days. Because radon levels can vary from day to day and month to month, a long-term test is a better indicator of average radon level. Both tests are relatively easy to use and inexpensive. A state or local radon official can explain the differences between testing devices and recommend the most appropriate test for a person's needs and conditions.

The U.S. Environmental Protection Agency (EPA) recommends taking action to reduce radon in homes that have a radon level at or above 4 picocuries per liter (pCi/L). About one in 15 U.S. homes is estimated to have radon levels at or above this EPA action level. Scientists estimate that lung cancer deaths could be reduced by 2 to 4 percent, or about 5,000 deaths, by lowering radon levels in homes exceeding the EPA's action level.

The cost of a radon reduction depends on the size and design of a home and the radon reduction methods that are needed. These costs typically range from $800 to $2,500, with an average cost of $1,200.

8. Where can people find more information about radon?

The following organizations can provide additional resources that readers may find helpful:

- The EPA Web site contains news, information, and publications on radon. It is located at http://www.epa.gov/iaq/radon on the Internet.

- The National Safety Council (NSC), in partnership with the EPA, operates a Radon Hotline.
  - To reach an automated system for ordering materials and listen to informational recordings, call 1–800–SOS–RADON (1–800–767–7236).
  - To contact an information specialist, dial 1–800–55–RADON (1–800–557–2366) or send an e-mail to airqual@nsc.org.
  - More information about radon and its testing can be found on the NSC's Web site at http://www.nsc.org/ehc/radon.htm [1] on the Internet.

- The Indoor Air Quality Information Clearinghouse (IAQ INFO) is operated by the EPA. To order publications or contact an information specialist, dial 1–800–438–4318. Alternatively, IAQ INFO can be reached by e-mail at iaqinfo@aol.com, by fax at 703–356–5386, or by mail at Post Office Box 37133, Washington, DC 20013–7133.

- The National Hispanic Indoor Air Quality Helpline is a service of the National Alliance for Hispanic Health, in partnership with the EPA. The Helpline provides bilingual (Spanish/English) information about indoor air pollutants. To speak with an information specialist, call 1–800–SALUD–12 (1–800–725–8312).

Selected References

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2. Field RW. A review of residential radon case-control epidemiologic studies performed in the United States. *Reviews on Environmental Health* 2001; 16(3):151–167.

3. Field RW, Steck DJ, Smith BJ, et al. Residential radon gas exposure and lung cancer: The Iowa Radon Lung Cancer Study. *American Journal of Epidemiology* 2000; 151(11):1091–1102.

4. Frumkin H, Samet JM. Radon. CA: *A Cancer Journal for Clinicians* 2001; 51(6):337–344.

5. Lagarde F, Falk R, Almren K, et al. Glass-based radon-exposure assessment and lung cancer risk. *Journal of Exposure Analysis and Environmental Epidemiology* 2002; 12(5):344–354.

6. National Research Council. Committee on Health Risks of Exposure to Radon: BEIR VI. *Health Effects of Exposure to Radon*. Washington, DC: National Academy Press, 1999.

7. U.S. Environmental Protection Agency (May 2002). A Citizen's Guide to Radon: The Guide to Protecting Yourself and Your Family From Radon (4th ed.). Retrieved July 13, 2004, from: http://www.epa.gov/iaq/radon/pubs/citguide.html.

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Related Resources

Publications (available at http://www.cancer.gov/publications)

- *Cancer and the Environment: What You Need To Know, What You Can Do* [2]
- *What You Need To Know About™ Cancer* [3]
- *What You Need To Know About™ Lung Cancer* [4]

National Cancer Institute (NCI) Resources

Cancer Information Service (toll-free)

Telephone: 1–800–4–CANCER (1–800–422–6237)
TTY: 1–800–332–8615

Online

NCI's Web site: http://www.cancer.gov
LiveHelp, NCI's live online assistance: https://cissecure.nci.nih.gov/livehelp/welcome.asp

Table of Links

1 http://www.nsc.org/ehc/radon.htm

2 http://www.cancer.gov/images/Documents/5d17e03e-b39f-4b40-a214-e9e9099c4220/Cancer%20and%20the%20Environment.pdf

3 http://cancer.gov/cancerinfo/wyntk/overview

4 http://cancer.gov/cancerinfo/wyntk/lung