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Does Exposure to Low Doses of Radiation Over Long Periods of Time Cause Cancer?

Studies of atom bomb survivors and patients treated with high doses of radiation over short periods of time clearly show increases in rates of death from leukemia and other cancers. Until recently, it has been unclear whether much lower doses of ionizing radiation received over longer periods, i.e., 10 to 20 years, cause similar increases in cancer death rates.

The first estimates of cancer risk resulting from exposure to low doses of radiation came from studies of people receiving high doses over very short periods of time. Cancer risk estimates calculated directly from studies on nuclear industry workers who received lower doses over a longer period of time began to be available in the 1970's and 1980's, but risk estimates varied widely between studies.

The largest study to date on cancer risks that are linked to low doses of radiation over long periods of time was published in the October 15, 1994, issue of The Lancet, entitled "Direct estimates of cancer mortality due to low doses of ionising radiation: an international study." This study by the International Agency for Research on Cancer (IARC) combines and analyzes data gathered on 95,673 nuclear industry workers from three countries.

The IARC study combines information on cancer death rates for seven large groups of nuclear industry workers from Hanford, Rocky Flats, and Oak Ridge National Laboratory in the United States; Sellafield, Atomic Energy Authority, and Atomic Weapons Establishment in the United Kingdom; and Atomic Energy of Canada, Ltd., in Canada. Most nuclear industry workers receive relatively low total doses of radiation (less than 50 mSv), whereas the high doses received by atom bomb survivors and patients treated with radiation typically exceed 1,000 mSv.

The purpose of this study was to estimate the risk of leukemia and other cancers

among nuclear industry workers exposed to low doses of ionizing radiation. Workers who were monitored for external radiation exposure were divided into dose categories according to the amount of total radiation received during the time they worked in the nuclear industry. Eleven percent of workers included in this study received total recorded doses of 0 mSv (no measurable exposure), nearly 80 percent total doses of less than 50 mSv. Cancer death rates for workers in different dose categories were then compared.

One of the strengths of the study was that the large number of workers included in the analysis allowed for more statistically precise estimates of the cancer risks than was possible from previous smaller studies.

This study found that the risk of all leukemias, excluding chronic lymphocytic leukemia (CLL) a type of leukemia thought to be unrelated to radiation, increased in a linear manner with greater lifetime radiation dose. This risk was 22 percent higher for nuclear industry workers exposed to a total lifetime dose of 100 mSv or greater (less than 1 percent of workers) than for workers who received no measurable dose of external ionizing radiation. The risk of all leukemias, excluding CLL, increased 2.2 percent for each additional 10 mSv of total dose. The risk of all other cancers combined, however, was no greater among exposed workers than among unexposed workers. As in all studies of human populations, the study must be viewed cautiously. For example, errors in the measurement of radiation dose or cause of death could affect the estimates of cancer risk.

According to the authors of this study, the estimates of cancer risk obtained from this study are consistent with earlier estimates derived from studies of atom bomb survivors and patients receiving high doses of radiation in a short period. Therefore, the authors indicated that their results are consistent with the current recommendations of the International Commission on Radiation Protection, which primarily are based on these earlier high-dose studies.

Two additional papers that explain the methods and results of this study in greater detail will be published in the near future, and [Health Bulletins](#) on these reports will be distributed as soon as the papers are available.

DOE, in cooperation with the National Institute for Occupational Safety and Health, will continue to evaluate the health of its current and former employees and to make these findings available to the public. For a copy of this article from [The Lancet](#), check with your local DOE reading room or contact the Office of Epidemiologic Studies at (301) 903-5328. For extra copies of this [Health Bulletin](#), please contact the Office of Epidemiologic Studies at (301) 903-5328.

Studies to share data from health studies throughout the DOE complex. The authors' conclusions do not necessarily reflect those of the Department. For more information contact: Lynn E. Judson, Office of Epidemiologic Studies, U.S. Department of Energy, Washington, D.C. 20585; Telephone (301) 903-1797.