



National Institute for Occupational Safety and Health Announcement of Findings

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Glossary of Terms

Carcinogenic: Materials that may cause cancer

Ionizing radiation: Natural or man-made (x-rays) radiation that is capable of damaging human tissue.

Mortality Study: An epidemiologic study that evaluates causes of death in a population. Studies that examine relationships between mortality and prior exposures produce measures of association that reflect average relationships between exposures and mortality for the population, not risk for individuals.

Plutonium: Radioactive substance used in nuclear weapons

Hanford Site Mortality Update: Age at Exposure to Ionizing Radiation

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Study Rationale: This study examined whether there are associations between occupational exposure to external ionizing radiation and mortality (death), particularly from cancer, among workers employed at the Hanford Site. Evaluation of the ages at which workers were exposed to radiation was an important part of this research. Older people may be more susceptible to carcinogenic (cancer-causing) exposures due to:

- accumulated cellular damage from exposures to carcinogens over their lifetime;
- age-related declines in ability to repair genetic mutations, and decreases in immune function.

Researchers at the University of North Carolina at Chapel Hill performed the study.

Study Population: The study included 26,389 employees of prime contractors who were hired at the Hanford site between 1944 and 1978 and monitored for ionizing radiation exposures during employment.

How This Study Was Done: Information on causes of deaths for the Hanford workers was obtained for the period 1944-1994 using data from federal, state and pension records. Hanford employment history and radiation monitoring records were used to estimate cumulative external radiation doses at all ages, and in specific age ranges. For periods of employment with missing external radiation exposure records, estimated doses were derived based upon the historical dosimetry records that were available. Since available data on plutonium exposure were inadequate to reconstruct historical plutonium doses, workers were assigned potential plutonium exposures based on job titles and process areas at Hanford.

Study Results: The study found no evidence of an association between overall cancer mortality and cumulative external ionizing radiation dose when age at exposure was not considered. However, deaths from all cancers combined were associated with external ionizing radiation exposures received at ages 55 and older. This finding was primarily due to lung cancer mortality. Radiation doses at ages 55 and above were more strongly associated with lung cancer mortality among workers in jobs with routine potential for plutonium contamination than among other Hanford workers. External ionizing radiation exposures at ages below 55 years showed essentially no association with deaths from lung cancer or all cancers combined. Ionizing radiation at older ages was not associated with mortality from non-cancer causes, which are primarily smoking-related diseases such as heart attack and stroke.



Study Strengths:

- Use of measurements of external ionizing radiation exposure from personal dosimeters worn by employees while at work are a major strength of this study.
- Use of additional mortality data through 1994 improves the reliability of the epidemiologic analysis.

Study Limitations:

- Quantitative information on internal radiation doses from plutonium and other radionuclides was not available for review; the greater association between lung cancer deaths and radiation exposures accrued at older ages among plutonium workers may reflect, in part, doses from plutonium that could not be measured in this study.
- This study used death certificate information as the primary source of information
- This study had a lack of information on cancers among people who did not die from cancer.
- Exposures such as asbestos and smoking, which can cause lung cancer, could not be directly evaluated in this study, and this lack of information could have led to an over- or under-estimation of the association between ionizing radiation and lung cancer.

Conclusions:

This study suggests that external radiation exposures of Hanford workers at ages 55 and older increased their risks of dying from lung cancer. However, the possible contributions of plutonium and smoking to this risk could not be directly estimated due to limitations in the available information.

The findings and conclusions in this document are those of the authors and do not necessarily represent the views of the National Institute for Occupational Safety and Health.

Publications:

Wing S, Richardson D, Wolf S, Mihlan G. Plutonium-Related Work and Cause-Specific Mortality at the United States Department of Energy Hanford Site. *American Journal of Industrial Medicine* 45: 153-164 (2004).

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Richardson D, Wing S, Watson J, Wolf S. Evaluation of annual external radiation doses at or near minimum detection levels of dosimeters at the Hanford nuclear facility. *Journal of Exposure Analysis and Environmental Epidemiology*, 10:27-35, 2000.

Richardson D, Wing S, Watson J, Wolf S. Missing annual external radiation dosimetry data among Hanford workers. *Journal of Exposure Analysis and Environmental Epidemiology*, 9:575-585, 1999.

Further NIOSH Information

For a copy of the final report, call:
1-800-356-4674

For a summary of NIOSH research involving Department of Energy workers, visit on-line at:

<http://www.cdc.gov/niosh/2001-133.html>

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