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Thyroid Cancer and other Thyroid Diseases and Exposure to Ionizing Radiation

Summary: Strong evidence has been recorded of a possible connection between thyroid cancer and exposure to ionizing radiation. This evidence is based upon studies conducted at Los Alamos National Laboratory, studies of nuclear workers at other sites, and others exposed to ionizing radiation. These findings are consistent with the National Research Council's determination that the thyroid is sensitive to ionizing radiation. Thyroid cancer is designated as a "specified" cancer under the Energy Employees Occupational Illness Compensation Program Act. Historically, thyroid cancer incidence for both Los Alamos County and Rio Arriba County are very high in comparison to other counties in New Mexico. Mortality rates for both counties were very low. Incidence means new cases of cancer, while mortality means deaths due to cancer.

What is Thyroid Cancer?

The thyroid is a gland in the neck. The thyroid lies at the front of the neck, beneath the voice box (larynx). It has two parts, or lobes. A healthy thyroid is a little larger than a quarter and usually cannot be felt through the skin. A swollen lobe might look or feel like a lump, or nodule, in the front of the neck. Most thyroid nodules are benign, which means they are not cancerous. (National Cancer Institute)

Findings of Human Health Research Studies

Human health research studies compare the patterns of disease among groups of people with different amounts of exposure to a suspected risk factor. Below are results reported from such studies of thyroid cancer among people exposed to ionizing radiation.

All of these studies found increases and possible increases in thyroid cancer among certain groups of exposed workers. Statistically significant is a term used to mean that the connection between the health outcome and the exposure was strong enough that it was unlikely to be due to chance. An asterisk (*) was placed by statistically significant findings. Most studies of nuclear workers in the U.S. were mortality studies of cancer deaths. Incidence studies, which look at new cases of cancer, can track health more quickly and accurately. Thyroid cancer seldom results in death. It spreads slowly, if at all. And it is easily detected, especially in nuclear workers who are medically screened on a regular basis. So it is not surprising that the few positive studies are those in which the incidence of the disease was studied.

Studies of Los Alamos National Laboratory (LANL) Workers

Research conducted of LANL workers provides the most direct evidence about possible relationships between a health problem and workplace exposures at LANL.

- **UC & Zia Employees:** A possible increased incidence of thyroid cancer was found in Anglo females employed between 1969 and 1978. But this finding was based on just two cases.[16]

- **State of New Mexico Study:** From 1998 to 1995 the incidence of thyroid cancer in Los Alamos County as a whole was four times higher than state or national rates.* About 30 cases of thyroid cancer accounted for the increase. Only 12 had ever worked at LANL.[1] This raised the possibility of a community-wide exposure. Centers for Disease Control's Historical Documents Discovery Project may shed light on past emissions of radioactive materials from LANL that could have caused the increase.

Studies of Other Nuclear Workers in the United States

The next most relevant evidence comes from studies of workers in similar occupations with the same types of exposures. Listed below are studies that looked at thyroid cancer and workplace exposures among nuclear workers in other parts of the United States.

- **Lawrence Livermore, California:** Possible increased incidence of thyroid cancer in males employed between 1969 and 1980. But based on just three cases. [22]

Studies of Other Nuclear Workers Worldwide

- **Atomic Weapons Establishment of the U.K.:** A possible increase in thyroid cancer deaths was observed in a study of 9,389 workers with a radiation record who were employed between 1951 and 1982. [53]

- **Canadian Radiation Workers:** Increased incidence of thyroid cancer was found in a study of 191,333 workers employed between 1951 and 1988. [47 *]

- **Sellafield, England:** Increased thyroid cancer deaths were observed in non-plutonium radiation workers who were employed between 1947 and 1975, and then followed through 1992.[*] Also observed was increased incidence of thyroid cancer in non-plutonium radiation workers. [3 *]

- **Registry of Nuclear Workers in the U.K.:** Increased thyroid cancer deaths were found in a study of more than 95,000 radiation workers. [5 *]

- **Three Nuclear Workforces in the U.K.:** Possible increased thyroid cancer deaths were seen in a study of 75,006 workers who were exposed to external radiation while employed between 1946 and 1983, and then were followed through 1988,when compared to unexposed workers.[2]

Studies of Other Ionizing Radiation Exposures

Studies among other groups of people who were not nuclear workers can also be significant as evidence of possible increases in thyroid cancer among those who have been exposed to ionizing radiation. Most other research has been conducted of people exposed to atomic bombs.

- **Atomic Bomb Survivors:** With increasing doses of radiation the rates of thyroid cancer[3, 4] and benign nodules[5] increase in incidence in A-bomb survivors.[*+] Also, increased rates of autoimmune thyroid disease. [6 *]

Is the Thyroid Sensitive to Radiation?

- According to the National Research Council's BEIR V committee, "[t]hyroid cancer is well established as a late consequence of exposure to ionizing radiation from both external and internal sources..." [9]

The National Research Council advises the U.S. government on scientific matters. Their Committee on Biological Effects of Exposure to Ionizing Radiations (BEIR) V reviewed sensitivity of parts of the body to radiation. Their findings are based mostly on studies of cancer among atomic bomb survivors, as well as on some of the available information on the biology of the body, animal studies, and other evidence. The greatest risk is at high exposure levels.

Is Thyroid Cancer a "Specified" Cancer Under the Energy Employees Occupational Illness Compensation Program Act (EEOICPA)?

- **Yes.** Thyroid cancer is a "specified" cancer under the EEOICPA consideration of Special Exposure Cohorts.

Policy makers have identified certain types of cancer among energy employees at nuclear facilities, including those employed at Los Alamos National Laboratory, as being potentially related to occupational exposures under the EEOICPA.

Rates of Thyroid Cancer in Exposed Counties

Los Alamos County

Rates of thyroid cancer incidence was very high in Los Alamos County, while mortality was very low. Los Alamos County:

- Ranked highest in incidence from 1970 to 1996 in the 33 counties in New Mexico.
- Mortality due to thyroid cancer was very low in the county. [33]

Rio Arriba County

Rates of thyroid cancer incidence for Rio Arriba County was very high, while mortality was very low. The county:

- Ranked 5th highest in incidence from 1970 to 1996 among the 33 counties in New Mexico.
- Mortality due to thyroid cancer was very low in the county. [33]

The low mortality rates are evidence of earlier detection and successful treatment of thyroid cancer in these counties.

[1] Athas WF, Key CR, Sewell M, Voorhees R. Supplement to Cancer Trends in Los Alamos County, 1973-1997. In: Fuller Lodge; 1999 July 14, 1999; Los Alamos, NM; 1999.

[2] Athas WF. Investigation of Excess Thyroid Cancer Incidence in Los Alamos County. Santa Fe, NM: New Mexico Department of Health; 1996 April.

[3] Carpenter L, Higgins C, Douglas A, Fraser P, Beral V, Smith P. Combined analysis of mortality in three United Kingdom nuclear industry workforces, 1946-1988. Radiation Research 1994;138:224-238.

[4] Wakabayashi T, Kato H, Ikeda T, Schull WJ. Studies of the mortality of A-bomb survivors, report 7. Part III. Incidence of cancer in 1959-1978, based on the Tumor Registry, Nagasaki. Radiation Research 1983;93:112-146.

[5] Prentice RL, Kato H, Yoshimoto K, Mason M. Radiation exposure and thyroid cancer incidence among Hiroshima and Nagasaki residents. National Cancer Institute Monograph 1982;62:207-212.

[6] Nagataki S, Shibata Y, Inoue S, Yokoyama N, Izumi M, Shimaoka K. Thyroid diseases among atomic bomb survivors in Nagasaki. JAMA 1994;272(5):364-370.

[9] Committee on the Biological Effects of Ionizing Radiation. Health Effects of Exposure to Low Levels of Ionizing Radiation; BEIR V. Washington, D.C.: National Academy Press; 1990.

[16] Acquavella JF, Wilkinson GS, Wiggs LD, Tietjen GL, Key CR. An Evaluation of Cancer Incidence Among Employees at the Los Alamos National Laboratory. Los Alamos, NM: Los Alamos National Laboratory; 1983 January. Report No.: LA-UR-83-62.

[22] Reynolds P, Austin DF. Cancer incidence among employees of the Lawrence Livermore National Laboratory, 1969-1980. The Western Journal of Medicine 1985;142(2):214-218.

[33] Athas WF. Cancer in New Mexico 1970-1996: Changing Patterns and Emerging Trends. Santa Fe, NM: New Mexico Department of Health, 1998.

[47] Sont WN, Zielinski JM, Ashmore JP, Jiang H, Krewski D, Fair ME, et al. First analysis of cancer incidence and occupational radiation exposure based on the National Dose Registry of Canada. American Journal of Epidemiology 2001;153(4):309-318.

[53] Beral V, Fraser P, Carpenter L, Booth M, Brown A, Rose G. Mortality of employees of the Atomic Weapons Establishment, 1965-1982. British Medical Journal 1988;297(6651):757-770.

* *Findings were statistically significant (strong evidence)*

\+ *Evidence of a dose-response relationship (strongest evidence)*