A Case-Control Study of Lung Cancer Near A Zinc Smelter

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Background and rationale

In 1969 a cohort study of employees of a large copper smelter in the Western United States revealed a 3-fold increased risk of lung cancer, reaching 8-fold among workers most heavily exposed to arsenic trioxide (1). This finding was substantiated by other studies of copper smelter workers in the U.S. (2,3), Japan (4), and Sweden (5). Although many suspect chemicals are present in the smelter environment, inorganic arsenic has been implicated as the respiratory carcinogen. This is also the case in other industries, including the manufacturing of arsenical pesticides (6,7), where exposures to inorganic arsenic are relatively heavy. The consistent epidemiologic evidence linking occupational arsenic exposure to lung cancer has been sufficient to label arsenic a carcinogen, even though the agent has not induced tumors in laboratory animals.

In the 1970's environmental measures of stack emissions from copper smelters indicated high airborne levels of a number of pollutants including arsenic (8). Substantial amounts of inorganic arsenic were then detected in the soil and air near a copper smelter, and in neighborhood families the levels of urinary arsenic were as high as in smelter workers (9). The possibility that smelter emissions into the general community might pose a cancer risk was raised by the significantly increased mortality from lung cancer in male and female residents of counties with copper, lead, or zinc smelters and refiners (10). Inorganic arsenic is often a

component of these ores, more so for copper ores, and during processing it is released as an airborne or solid by-product. It was felt that work exposures alone would not completely account for the large excess mortality in male residents or the increased risk in females living in the communities.

To determine whether air pollutants such as arsenic from nonferrous smelters may contribute to the risk of respiratory cancer in surrounding communities, and to evaluate the confounding or modifying effects of cigarette smoking and work exposures, we planned a case-control interview study of lung cancer in areas of the U.S. where the smelters were located. The original study design called for parallel studies near several non-ferrous smelters (copper, lead, zinc) around the country. This was scaled down when the State of Montana initiated with the EPA an interview study centering about two copper smelters, and CDC-NIOSH developed related projects with respect to lead smelters. Therefore we decided to focus on a case-control study of lung cancer in a tri-county area of eastern Pennsylvania where a zinc smelter is located.

Methods and data collection

Since the survival rate of lung cancer is relatively short and there were no cancer registries or other means of rapidly identifying all newly diagnosed cancers, we selected cases and controls from a computer listing of death certificates supplied by the state of Pennsylvania. Death certificates were drawn for Northampton and Lehigh county residents who died of lung cancer during the years 1976-1977 and Carbon county

residents who died of lung cancer during the years 1974-77. A total of 447 lung cancer cases and an equal number of controls who died of other causes (excluding lung diseases and suicide) were identified. Medical records were sought on each lung cancer patient for further details on the disease, including the method of diagnosis and histologic type. Field operations were conducted through a support service contract with Lehigh University.

Interviews were conducted with the next-of-kin of cancer cases and controls, using a standardized questionnaire that solicited information on smoking habits, occupational and residential histories, associated medical conditions, and family history of cancer. To date, interviews have been completed on 430 lung cancer cases and 426 controls. This represents a remarkably high response rate of 96%. The medical records were available on 389 cases, with pathologic confirmation of primary lung cancer in 89%. The interview data have been entered into computer readable form and analysis will begin shortly. The residences of the cases and controls are being plotted on a grid map. For each individual it should be possible to determine residential proximity to the smelter's two stacks, and to estimate exposures to several pollutants including arsenic based on data from prior environmental surveys conducted primarily by EPA.

Summary

A case-control study of lung cancer is underway in a tri-county area of eastern Pennsylvania in the vicinity of a zinc smelter. The next-of-kin of approximately 430 patients who died of lung cancer, and

426 controls, have been interviewed. From these data we hope to clarify the role of occupational and neighborhood exposures to smelter pollutants as risk factors in lung cancer.

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