Results of a NIOSH Study of Former Microelectronics and Business Machines Manufacturing Workers

Overview

Residents from the Village of Endicott, New York have been concerned about contamination, both residential and workplace, from a microelectronics and business machines manufacturing facility in Endicott. These concerns led to studies of area residents and also prompted the New York State Department of Health (NYSDOH), Congressional representatives from New York, and community stakeholders to ask the National Institute for Occupational Safety and Health (NIOSH) to conduct a study of former workers from the facility.

In 2009, NIOSH began a multi-year effort to conduct a study of former workers using existing records. Our goals for the study were to evaluate:

1) overall causes of death among former workers,
2) testicular cancer diagnoses among former workers, and
3) birth defects among children of former workers.

Our assessment of the causes of death and testicular cancer diagnoses among former workers is complete. The study found that most causes of death, including most cancers, were not increased compared to what we would expect from general population statistics (U.S. population or New York State excluding New York City). However, we did find some health outcomes that were increased in the study population or that appeared to increase with job exposures. These findings could be due to job exposures, other factors we could not assess in this study, or chance.

Collectively, the study findings do not suggest a strong role for job exposures in health outcomes in this workforce. However, the study was limited because of incom¬plete data. Also, because of the relative youth of the study population, it may be too soon to observe some work-related health effects.

We are not recommending that former workers take any specific actions as a result of this study.

Our next step is to work with the NYSDOH to finish our evaluation of birth defects among the children of former workers. We hope to complete this within the next year.

Continue reading for more information about the study and results.

National Institute for Occupational Safety and Health
NIOSH

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How the Study Was Done

Our study had four steps:

Step 1. We assembled the study population.

This study included records for the 34,494 people who worked at the facility for more than 90 days between January 1, 1969 and December 31, 2001. Due to lack of data, we excluded those who only worked at the facility before 1969, very short-term workers, and contractors.

Step 2. We assessed each person's potential job exposure to certain chemicals at the facility using available records and professional expertise.

As at most industrial facilities, the company did not directly measure the chemical exposures for each worker. Because records of individual workers' exposures did not exist, we assessed each person's potential exposure to chemicals based on his/her work history (e.g., department, how long in each department, which time period). Former workers and company representatives provided valuable input to this process.
We selected four specific chemicals (lead, methylene chloride, perchloroethylene (PCE), and trichloroethylene (TCE), and three chemical groups (acids and bases, chlorinated hydrocarbons, and a group of other non-chlorinated, non-aromatic hydrocarbons) for inclusion in the analysis because they had either previously been associated with health concerns in the community or were widely used in the facility.

Step 3. We gathered cancer and death information.

We linked a list of former workers in the study with national and state death certificate data and state cancer registry data. From the death certificate data, we determined how many former workers had died and from what causes. Using the Pennsylvania and New York State cancer registries, we identified former workers who were diagnosed with testicular cancer. Based on previous studies, the diseases of primary concern were:

- Cancers of the bladder, blood, brain, kidney, liver, lung, and testes
- Malignant melanoma
- Chronic non-malignant kidney (renal) disease
- Chronic non-malignant diseases of the nervous system
- Chronic obstructive pulmonary disease (COPD)

Though we examined all causes of death, we looked at the diseases of primary concern more closely.

Step 4. We compared disease outcomes by various groups.

To examine the potential link between job exposures and health, we compared death rates and testicular cancer diagnoses in the following groups:

- Former workers compared to the general public
- Former workers who worked in seven major manufacturing buildings for longer periods of time compared to those who worked in these buildings for shorter periods of time or never worked in the building
- Former workers with more potential exposure to a specific chemical or chemical group (based on employees' work histories) compared to former workers with less potential exposure

Findings

What did we find in terms of overall health?

Overall, the total number of deaths and the total number of cancer deaths were lower among former workers than what would be expected from the general population. This is a common finding when we conduct studies of workers, because workers are typically healthier than the general population.

Were any health outcomes more frequent in the former workers than the general population?

Yes. Of the over 100 outcomes we evaluated, five were more frequent among either hourly-wage (exempt) or salaried (non-exempt) men.

- Of the 15,447 men paid an hourly wage, 36 died of rectal cancer. We expected 21 based on statistics from general population.
    - 65 died of non-Hodgkin lymphoma. We expected 44.
    - 7 died of mesothelioma. We expected 3.
- Of the 8,590 men paid on a salaried basis, 3 died of pleural cancer. We expected fewer than one.
    - 12 were diagnosed with testicular cancer. We expected six.

Were any other health outcomes more frequent in the former workers than the general population?

Some other causes of death were a bit more frequent in men than expected, but the numbers were not high enough for us to draw firm conclusions about the results. The frequency of most other causes of death in men was near or less than what was expected. Among women, the numbers were not high enough for most causes of death for us to draw firm conclusions about the results.

Were any health outcomes more frequent among former employees who worked in certain buildings for longer periods of time?

Yes. We examined whether the diseases of primary concern were associated with length of time spent working in buildings 18, 41, 46, 47, 53, 57, and 259. Of the 84 potential associations we evaluated, we found only three situations in which time spent working in a building appeared to increase the chances of dying from a specific disease. Former workers were:

- More likely to die of COPD the longer they worked in building 47.
- More likely to die of melanoma the longer they worked in building 53, but this finding was based on only three deaths in people who ever worked in building 53.
- More likely to die of leukemia (excluding chronic lymphocytic leukemia) the longer they worked in building 18.

No other diseases of primary concern were associated with time spent working in these buildings.

Because there are a number of different jobs and exposures within each building, these results cannot be attributed to specific manufacturing processes or jobs. Therefore, we also looked at potential exposures to specific chemicals and chemical groups.

Were any health outcomes more frequent among former workers with more potential job exposure?

Yes. We examined whether the diseases of primary concern were associated with exposure to four specific chemicals and three chemical groups. Of the 47 potential associations we evaluated, we found two situations in which employees with more potential job exposure to a specific chemical appeared to have an increased chance of dying from a specific disease:

- Former workers with more potential exposure to PCE were more likely to die from chronic non-malignant diseases of the nervous system. This cause of death category includes diseases such as multiple sclerosis, amyotrophic lateral sclerosis, and Parkinson's disease.
- Former workers with more potential exposure to TCE may be more likely to die from leukemia (excluding chronic lymphocytic leukemia).

What It Means

The frequency of most causes of death (including most cancers) was not increased. However, we did find a few that were more frequent than expected. Of the many outcomes we evaluated:

- Rectal cancer, non-Hodgkin lymphoma, mesothelioma, pleural cancer, and testicular cancer occurred at higher rates in some groups of workers than would be expected from the general population.
- COPD, melanoma, leukemia and chronic non-malignant diseases of the nervous system were relatively more common among those who worked in certain buildings for longer periods of time or had more potential job exposure to certain chemicals.

These findings could be due to job exposures, other factors we could not assess in this study, or chance. Among the factors we could not assess are family disease history, job exposures at the facility before 1969, job exposures at other worksites, environmental chemical exposures, and smoking.

The findings are discussed in more detail below.

Pleural Cancer and Mesothelioma

The increase in pleural cancer deaths in salaried males and mesothelioma deaths in hourly males was unexpected. These findings were restricted to men hired by the company before 1969 and are probably due to asbestos exposure. However, we do not know if these men were exposed to asbestos at the facility or somewhere else. None of the available records suggest asbestos was used in manufacturing processes at the facility during the study period. Other possible sources for asbestos exposure include exposures at the facility prior to the study period, exposures at the facility from repair or renovation work, exposures at other worksites, or non-job asbestos exposures.

Testicular Cancer

Testicular cancer was an outcome of primary concern because the NYSDOH found increased testicular cancer among residents of the area primarily contaminated with PCE. We found increased testicular cancer in salaried males but not in men paid hourly. Other studies have found that men of higher socioeconomic status are more likely to get testicular cancer. This suggests our findings of increased testicular cancer

among salaried males may be due to factors other than job exposures at the facility. We did not find an association between testicular cancer diagnoses and exposure to PCE.

Rectal Cancer, Non-Hodgkin Lymphoma, COPD and Melanoma

Deaths from rectal cancer and non-Hodgkin lymphoma were more frequent than expected in men paid an hourly wage. Deaths from COPD and melanoma were more frequent among workers who worked in certain buildings for longer periods of time. However, there were no clear links between these outcomes and the specific chemicals and chemical groups we evaluated.

Leukemia

Deaths from leukemia were more frequent in workers who worked in building 18 for longer periods of time and in workers with more potential job exposure to TCE. Some data from other studies also suggest that there may be a link between leukemia and exposure to TCE, but these studies are inconclusive.

Chronic Non-Malignant Diseases of the Nervous System

Deaths from chronic non-malignant diseases of the nervous system were more frequent in workers with more potential job exposure to PCE. Data on chronic non-malignant diseases of the nervous system and exposure to PCE from other studies are limited, and the results from other studies are inconclusive.

Study Limitations

There are several limitations of the study:

- The work history records were often incomplete or provided conflicting information.
- The study population was fairly young, and therefore it may be too soon for our study to detect possible health effects from job exposures.
- Except for testicular cancer, we only looked at deaths. For this reason, we could not assess health problems that did not lead to death.
- Data on other factors that can influence disease and death rates, such as family disease history, environmental chemical exposures and smoking, were not available.
- Job exposures at the facility before 1969 and job exposures at other worksites could not be assessed.
- There were very little data for some of the exposures of greatest interest, particularly TCE and PCE, and before 1974, when exposures were likely higher. This limited our assessment of job exposure to chemicals.

Conclusion

Collectively, the study findings do not suggest a strong role for job exposures in health outcomes in this workforce. However, the study was limited because of incomplete data. Also, because of the relative youth of the study population, it may be too soon to observe some work-related health effects.

What You Should Do

We are not making any specific recommendations as a result of this study. If you are concerned about your health, we recommend talking to your health care provider and following the general guidelines for good health at www.health.gov.

To learn more about this study, call NIOSH at 1-513-841-4343. To learn more about studies of community residents, visit www.health.ny.gov/environmental/investigations/broome/.

Documents about our study and investigations in Endicott may also be reviewed at the George F. Johnson Memorial Library, Village of Endicott, 1001 Park Street, Endicott, NY 13760.

Two scientific papers discussing the study methods and results have been published:

- Fleming DA, Woskie SR, Jones JH, Silver SR, Luo L, Bertke SJ. Retrospective assessment of exposure to chemicals for a microelectronics and business machine manufacturing facility [published online ahead of print November 13, 2013]. J Occup Environ Hyg 2013. doi: 10.1080/15459624.2013.862591.
- Silver SR, Pinkerton LE, Fleming DA, Jones JH, Allee S, Luo L, Bertke S. Retrospective cohort study of a microelectronics and business machine facility [published online ahead of print 24 December 2013]. Am J Ind Med 2013. doi: DOI10.1002/ajim.22288.

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