

Mortality Experience of a
Cohort of Vinyl Chloride
Polymerization Workers and
A Cohort of Polyvinyl Chloride
Fabrication Workers

Background

In 1938, Monsanto purchased the Fiberloid Corporation and moved to its present site in Springfield, Massachusetts. At that time the plant complex, which had been operating since 1901, employed about 900 workers on an 80 acre site, and was involved in the production of Fibestos (cellulose acetate), Fiberloid (cellulose nitrate), Safelux (polyvinyl butyral), Vupak (cellulose acetate film), Fibestos (cellulose Acetate molding powders), and Fiberlac (lacquers). Monsanto rapidly expanded its new plastics division over the next decade. In 1940, a new plant for the manufacture of Resinox (phenol formaldehyde) was built at the Springfield site. In 1946, the plastics division again expanded its facilities and began producing Lustrex, Monsanto's polystyrene plastic. Over the next several years about 100 acres of adjacent land was purchased on which three new buildings were erected in the late 1940's for the manufacture of Opalon resin and Ultron film and compound (polyvinyl chloride) and Resamine (melamines).

In 1975, a group of Monsanto employees and a Massachusetts Physician reported to NIOSH that a preliminary study of Monsanto employees indicated an overall excess of cancer deaths and an excess of deaths from cancer of the pancreas. In response to this report, NIOSH initiated a mortality study of 465 deaths among male employees who were eligible for death benefits during 1950 through April, 1976. Results of this study indicated an elevated proportion of deaths due to cancer of the digestive organs and the genitourinary tract (1).

Monsanto also performed an independent mortality study using 564 deaths observed from 1950 through 1976. Results of this study indicated a significant excess in the number of deaths from arteriosclerotic heart disease. The Monsanto study demonstrated a small, non-significant increase in digestive and genitourinary cancers (2).

As a result of these proportional mortality studies, the University of Pittsburgh, under contract with the Monsanto Company, performed a historical cohort study among employees and ex-employees of the Monsanto-Springfield Plant. The cohort consisted of 2490 male workers with at least one year of employment as a wage earner between January 1, 1949 and December 31, 1966. Mortality experience of the cohort was examined from January 1, 1949 through December 31, 1976. Based on Hampden County comparisons, elevated Standardized Mortality Ratios (SMR's) were observed for all digestive cancers, and many specific sites of the digestive tract. Although not statistically significant, most of these increases showed evidence of a relationship with duration and time from onset of employment, as well as calendar year of death. In addition, significantly elevated SMR's were observed for genitourinary tract cancers, coronary heart disease, and influenza and pneumonia (3).

None of the previous studies have examined mortality by worksite. The lack of this particular type of analysis decrease the chance of uncovering any increased mortality from occupational exposure at this plant.

Discussion

The mortality experience of a group of vinyl chloride exposed and polyvinyl chloride exposed workers was analyzed. The results indicate that there was excess mortality in both these groups. There was one death due to hemangiosarcoma of the liver among workers polymerizing vinyl chloride. In addition, there was a statistically significant increase in buccal cancer with three observed deaths (Table 4). All malignant neoplasms, cancer of digestive organs and lymphatic cancers were increased although the increase was not statistically significant (Table 4). Among the polyvinyl chloride fabricators, Hodgkins disease was statistically increased. All malignant neoplasms, digestive cancers and respiratory cancers were increased but not to statistically significant levels (Table 9).

Supporting the occupational nature of the increases found was the positive trend of the SMRs with time since first exposure for all malignant neoplasms, digestive cancer for both cohorts (Figure 1 and 2) and respiratory cancer for the polyvinyl chloride cohort (Figure 2). The three latency periods since first exposure for the three men who died of buccal cancer in the vinyl chloride cohort were 21, 25 and 25 years respectively and 20 and 25 years for the two workers dying of Hodgkins disease in the polyvinyl chloride cohort. Six previous reports of workers exposed to vinyl chloride have documented an increased risk of liver, lung, brain and hematolymphatic cancer (7-12). One previous study has also found an increase in buccal cancer although in that report there was inverse relationship with exposure (11).

There have been two previous reports on polyvinyl chloride fabricators (12, 13). One study found an increase in stomach cancer, the other increased digestive cancer in men and women and breast and urinary organs in women.

The unexpected finding in our study was the elevated risk of lung cancer in polyvinyl chloride workers but not vinyl chloride workers.

Possible explanations for these findings include (1) the method of cohort development whereby individuals with vinyl chloride exposure maybe in the polyvinyl cohort (2) vinyl chloride monomer contamination of the polymer (3) adverse effect of one of the many additives used in this work area, or (4) other confounding factors (i.e. cigarette smoking). Cigarette smoking is probably not the reason as there was less nonmalignant respiratory disease than expected. However, the issue is clouded by the fact that previous reports of increased lung and lymphopietic cancer in vinyl chloride workers were based on studies of workers exposed to both vinyl chloride and polyvinyl chloride.

The results of this study reinforce the importance of examining large occupational cohorts by specific departments or exposure so as to be able to ascertain adverse effects among subsets with specific work histories. The findings of excess mortality for specific causes among workers exposed to vinyl chloride or polyvinyl chloride were not evident in previous studies done on workers from the whole plant.

Despite the problems with development of this cohort we feel that the results of this study demonstrate excess mortality among workers exposed to vinyl chloride and polyvinyl chloride. The long latency periods since first exposure in these cohorts (more than 80% of the cohort greater than 20 year latency) make continued follow up of this group important. Also the possibility of medical screening for this group of workers at increased risk needs to be considered. An even better ascertainment of individual work histories and approximate levels of exposures is necessary to assess the health effects of polyvinyl chloride in the absence of exposure to the monomer.