

Brief Report

Update to Vinyl Chloride Mortality Study

The mortality experience of 593 Dow Michigan Division employees potentially exposed to vinyl chloride was recently updated through 1982. An earlier study evaluated this group for the time period 1942 through 1973 and found an excess of total malignancies among the subgroup considered to have the highest exposure.¹ However, during the additional period of follow-up (1974 to 1982), a deficit of malignant neoplasms was observed for this subgroup.

During the 9 years of additional follow-up, the total deaths in the study group increased by 63 (to 155) and the person-years by 4,234 (to 17,114). The study's primary focus was directed at cancers of the liver (including angiosarcoma), biliary tract, lung, and brain, and to emphysema because of previous reports linking these conditions to vinyl chloride exposure in some work forces.^{2,3} No deaths from angiosarcoma were found and there were no statistically significant excesses for any of the other conditions of interest.

Only those employees identified for the original study were included in the recent investigation and their work histories and exposures were updated through 1977 to ensure a minimum 5-year induction latency period. Consistent with past practice, separate analyses were conducted first including and then excluding the subset of employees with prior, competing exposures to arsenic insecticides.⁴

Cause-specific mortality among the study group was contrasted both with expected levels based on age- and era-specific mortality rates for US white men, and also with the mortality experience of 24,410 other male employees from this company location⁵ who were not exposed to vinyl chloride or arsenic.

The comparison with US men is shown in the Table. Total malignant neoplasms were less than expected in the updated follow-up period (1974 to 1982), 12 v 16.3 and for the total follow-up period (1942 to 1982), 27 v 31.7. There were no statistically significant excesses for any of the diseases of interest. Similar results were seen for the comparison with other employees from this company location.

One death from liver cancer occurred in the study group (0.6 expected). The pathology and autopsy reports indicated that it was an intrahepatic bile duct carcinoma. There were two deaths from brain cancer (1.2 expected), one of which occurred less than 5 years

after first exposure to vinyl chloride. Both individuals had only short-term exposure in jobs categorized as less than 200 ppm time-weighted average (TWA).

There were six deaths from emphysema or chronic obstructive pulmonary disease (approximately 5 expected). None of these individuals worked in areas where there was a potential for exposure to polyvinyl chloride dust.

An increased risk of lung cancer was not found (standardized mortality ratio = 89) and the study was capable of ruling out more than a 60% increase with 95% certainty. The lack of an association with lung cancer is consistent with the findings from the majority of other studies, especially those with the greatest statistical power to detect an excess.⁶

To examine for a dose-response relationship, subjects were allocated to one of four intensity-of-exposure categories (undetermined, less than 25 ppm TWA, 25 to 200 ppm TWA, and 200+ ppm TWA) based on their highest rated job assignment held for at least 1 month. During the updated follow-up period (1974 to 1982), a deficit of total cancer occurred in the highest exposure category (3 observed v 5.4 expected); however, for the entire follow-up period this subgroup experienced an excess which was confined principally to the men with at least 5 years of exposure above 200 ppm (7 observed v 2.8 expected). As was noted in the original study,¹ there was no predominant tumor site nor was there a unique histologic type among this subgroup, weakening any interpretation of a causal link with vinyl chloride.

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TABLE
Observed and Expected Deaths for Selected Causes Excluding Employees with Prior Exposure to Arsenic Insecticides

Cause of Death (ICD-8)	Period of Follow-up							
	1942-1973		1974-1982		1942-1982			
	Obs	Exp*	Obs	Exp	Obs	Exp	SMR†	95% CI‡
All causes	80	84.9	50	67.0	130	151.9	86	72-102
All cancers (140-209)	15	15.4	12	16.3	27	31.7	85	56-124
Digestive system cancer (150-159)	6	4.4	3	4.1	9	8.5	106	48-201
Liver cancer (155, 156)	0	0.3	1	0.3	1	0.6	—§	4-899
Respiratory system cancer (160-163)	4	4.9	6	6.4	10	11.3	89	42-163
Brain cancer (191, 192)	1	0.6	1	0.5	2	1.1	—§	23-682
All circulatory diseases (390-458)	38	41.1	27	34.3	65	75.4	86	67-110
All nonmalignant respiratory diseases (460-519)	6	4.2	3	4.4	9	8.6	104	48-198
All accidents (E800-E949)	7	8.4	1	2.5	8	10.9	74	32-144

* Expected numbers are based on calendar time and age-specific mortality rates of US white men.

† Standardized mortality ratio; observed divided by expected number of deaths × 100.

‡ CI, confidence interval of Obs/Exp.

§ Not calculated when expected number of deaths fewer than 5.

References

1. Ott MG, Langner RR, Holder BB: Vinyl chloride exposure in a controlled industrial environment. *Arch Environ Health* 1975;30:333-339.
2. Wong O, Whorton MD, Ragland D, et al: An update of an epidemiologic study of vinyl chloride workers, 1942-1982. Prepared for the Chemical Manufacturer's Association, October 17, 1986.
3. Purchase IFH, Stafford J, Paddle GM: Vinyl chloride: An assessment of the risk of occupational exposure. *Food Chem Toxicol*

1987;25:187-202.

4. Ott MG, Holder BB, Gordon HL: Respiratory cancer and occupational exposure to arsenicals. *Arch Environ Health* 1974;29:250-255.

5. Bond GG, McLaren EA, Cartmill JB, et al: Cause-specific mortality among male chemical workers. *Am J Ind Med* 1987;12:353-383.

6. Beaumont JJ, Breslow NE: Power considerations in epidemiologic studies of vinyl chloride workers. *Am J Epidemiol* 1981;114:725-734.

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