DRINKING WATER CONTAMINATION AND THE INCIDENCE OF LEUKEMIA AND NON-HODGKIN'S LYMPHOMA

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EXECUTIVE SUMMARY

For the full text of this study, please write to the New Jersey Department of Health and Senior Services, Consumer and Environmental Health Services, PO Box 360, Trenton, New Jersey 08625-0360.

Since the mid-1970s, several epidemiologic studies have suggested an association between organic drinking water contaminants and increased cancer incidence. The focus to date has been on chlorinated volatile organic compounds (VOCs). In Woburn, Massachusetts, exposure to the solvents, trichloroethylene (TCE) and perchloroethylene (PCE), was linked to a leukemia cluster among children (Lagakos et al., 1986). Bladder cancer was related to surface water chlorination by-products, such as the trihalomethanes (THMs), in both a five state/five metropolitan region case-control study (Cantor et al., 1987) and a case-control study in Massachusetts (Zierler, 1988).

In 1984 New Jersey enacted legislation requiring that all public community water systems monitor semiannually for 14 VOCs, including many chlorinated solvents. In the first year of mandatory testing, approximately 110 water supplies out of 620 supplies in the state had detectable levels of non-THM VOCs (NJDEP, 1986; Krietzman et al., 1987). These 110 water supplies were primarily those with groundwater sources. The most commonly occurring contaminants were TCE, PCE and 1,1,1-trichloroethane. Many of the sources include improper disposal by commercial and individual users, as well as groundwater pollution at hazardous waste sites.

The New Jersey Department of Health (NJDOH) previously conducted an exploratory study of leukemia incidence in a part of the state with a broad range of contamination. Comparison of data from the New Jersey State Cancer Registry (NJSCR) with the water testing results from 1984-1985 demonstrated a statistically significant association between the concentrations of TCE and PCE and the overall leukemia rate among females from 1979 to 1984 in 27 towns (Fagliano et al., 1987; 1990).

The NJSCR is population-based and reporting is mandatory by law. Information from the NJSCR included age at diagnosis, sex, race, town of residence at diagnosis and histologic type according to the WHO International Classification of Diseases for Oncology (WHO, 1976).

The current investigation expands the earlier NJDOH study from 27 to 75 towns for the 1979-1987 period and also includes non-Hodgkin's lymphomas as well as leukemias. As in the original study, the counties and townships were selected because they were in a portion of the state that 1) was almost completely served by public water supplies and 2) had a wide dispersion of type and concentrations of water contaminants. The area encompasses 1.5 million people.

Poisson regression statistical analysis (summarized in the Table, page v) yielded an age-adjusted rate ratio (RR) for total leukemia among females of 1.43 with a 95% confidence interval (95%CI) of 1.07-1.90 when incidence in towns in the highest stratum of trichloroethylene (TCE) exposure (>5 parts per billion, ppb, or micrograms/liter) was compared to towns with no detectable TCE in the drinking water. (If the lower bound of the 95%CI is greater than 1.0, then the RR can be considered statistically significant.) For leukemia subcategories, RRs of 2.36 (95%CI 1.03-5.45), 1.57 (95%CI 0.95-2.60), and 1.79 (95%CI 0.90-3.55) were observed in the highest TCE stratum for females with acute lymphocytic leukemia (ALL), chronic lymphocytic leukemia (CLL), and chronic myelogenous leukemia (CML), respectively. (CLL was elevated to the same degree in males.) For females under 20 years old, the RR for ALL was 3.26 (95%CI 1.29-8.28).

Non-Hodgkin's lymphomas (NHL) among women were associated with the highest TCE stratum, with an RR of 1.36 (95%CI 1.08-1.70). In particular, diffuse large cell and high grade NHL (excluding Burkitt's lymphomas) were associated, with RRs of 1.66 (95%CI 1.07-2.59) and 3.17 (95%CI 1.23-8.18), respectively. Perchloroethylene was also associated with incidence of high grade lymphomas among females, but because of the collinearity of TCE and PCE contamination, it was difficult to assess the relative influences of each.

Among males diffuse large cell NHL was also associated with the highest TCE category, RR = 1.59 (95%CI 1.04-2.43), while the RR for non-Burkitt's high grade NHL was non-significantly elevated, 1.92 (95%CI 0.54-6.81).

To study whether there were associations with any history of drinking water contamination utilizing other evidence besides the mandatory monitoring in 1984-1985, the non-systematic drinking water survey data from 1978-1983 was combined with the 1984-1985 mandatory monitoring data study. This combined data showed associations between towns "ever" contaminated with both TCE and PCE and the incidence of childhood ALL and non-Burkitt's high grade NHL among females.

The results of this study suggest a link between TCE and PCE in drinking water and the incidence of certain types of leukemias and NHL. However, the study utilized an ecologic method of determining exposures, i.e., employing geographically aggregated data. This method is suitable for relatively rapid, exploratory work, but is subject to potential misclassification of exposures due to the lack of individual information on degree of exposure to drinking water contaminants and long-term residence. (Nevertheless, in this study the exposure variable comes close to estimating the exposure of all of the population in each exposure group.) Information about potentially confounding exposures was also not available. However, there is no a priori reason to believe that radiation, smoking, occupational exposures, genetic predisposition or infectious agents were differentially distributed among the exposure strata in this study to an extent that would affect these findings. Smoking may not be a sufficiently strong risk factor to be able to cause major bias. Studies with individually-based information on exposures are the next step for investigating the possibility of causality.

Nevertheless, this study is consistent with current efforts by the State and the water utilities that have dramatically reduced contamination in New Jersey (Bono et al., 1992). Because 5 ppb is the maximum contaminant level (MCL) allowed by the U.S. Environmental Protection

Agency (U.S.E.P.A) for both PCE and TCE, the observed association of these cancers with contaminants above this level supports maintaining the stringent New Jersey MCLs of 1 ppb.

EXECUTIVE SUMMARY TABLE: STATISTICALLY SIGNIFICANT POSITIVE ASSOCIATIONS

Exposure	Sex	Outcome	RR
TCE >5ppb	Females	Total leukemia	1.4
	"	ALL	2.4
	"	Childhood ALL (0-19 years)	3.3
	"	Total NHL	1.4
	"	Diffuse large cell NHL	1.7
	"	Non-Burkitt's high grade NHL	3.2
	Males	Diffuse large cell NHL	1.6
PCE >5ppb	Females	Non-Burkitt's high grade NHL	2.7