Cancer Risks Associated With Elevated Levels of Drinking Water Arsenic Exposure [Project #2738]

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OBJECTIVES:
The objective of this project was to examine whether lung and bladder cancer mortality or incidence rates are elevated in U.S. populations consuming drinking water that exceeds the new USEPA MCL for arsenic of 10 μg/L.

BACKGROUND:
In 2000, the USEPA reduced the drinking water arsenic MCL from 50 μg/L to 10 μg/L, affecting many U.S. community water systems. This study was conducted because of the large number of systems involved, the costs of compliance with the new standard, and the increasingly uncertain scientific basis for the regulation. Two large, recently conducted studies of low-dose drinking water arsenic exposures do not support the need for the regulation.

HIGHLIGHTS:
1) Thirty-three counties were identified with a mean drinking water arsenic concentration exceeding 10 μg/L and 12 counties were identified with a mean concentration of exceeding 20 μg/L.
2) For 1950–1999, the researchers found no evidence of elevated lung or bladder cancer mortality in the arsenic exposed counties compared to neighboring counties.
3) The analysis did detect other predictors of elevated cancer mortality, demonstrating the power of the modeling technique used to detect geographic relationships between exposures and health outcomes.

APPROACH:
This study took place in two phases. In the first phase, the research team estimated the mean drinking water arsenic level of most U.S. counties and identified counties with a mean arsenic level >10 μg/L and >20 μg/L. In the second phase, they evaluated the relationships between lung and bladder cancer mortality (1950–1999) and incidence (1973–1999) in these populations using multi-level, hierarchical statistical models (i.e., MLwiN statistical software). The research team employed three approaches: (1) combining all cancer deaths for all ages across the decades (1950–1990) for which data were available, (2) conducting a subanalysis limited to the population age 50 years and older, and (3) combining cancer deaths for those decades (1960–1999) for which comparable census variables were available.
RESULTS/FINDINGS:
Arsenic in drinking water at levels >10 μg/L was not associated with greater mortality from bladder or lung cancer, nor was a higher level of arsenic associated with greater incidence of bladder or lung cancer. There was considerable variation between counties in both lung and bladder cancer mortality. County lung and bladder cancer mortality rates were strongly related to neighboring county lung and bladder cancer mortality rates. This relation suggests that making an adjustment for neighboring county cancer mortality rates controls the unmeasured confounding factors. Higher mortality rates for bladder and lung cancer were observed in counties designated as metropolitan and, for males, counties with a high percentage of persons employed in manufacturing. Lower mortality rates were observed in counties with higher mean educational levels and counties with a larger mean household size. These same covariate relationships were not apparent in the incidence analysis. This study did not find evidence of increased risk for lung or bladder cancer mortality or incidence from exposure to arsenic in drinking water. The findings are consistent with other recent studies of the health effects of low dose arsenic exposure and are inconsistent with the USEPA predictions of excess cancer risk from low dose arsenic exposure.

IMPACT:
Multi-level hierarchical analysis is a highly appropriate method for determining if areas with elevated drinking water contaminants have elevated health risks. It makes optimal use of existing data in a cost-effective analysis that adjusts for many covariates. It is an approach that should be considered for addressing future drinking water health effects issues. In particular, this study adds to the literature on low dose arsenic health effects, providing the first summary of mortality and cancer incidence in U.S. populations exposed to elevated drinking water arsenic. It should provide some reassurance to customers of many drinking water utilities.

RESEARCH PARTNER:
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