

Title: Health Effects of Arsenic Contaminated Drinking Water

Project I.D.: DNR Project #158

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Background/Need: In 1987, a groundwater study conducted by the Department of Natural Resources identified a large vein of arsenic in a bedrock layer found at the interface of the St. Peter Sandstone and Sinnippee Dolomite. This geologic formation stretches from southern Brown County into Outagamie and Winnebago Counties and lies beneath more than 20,000 private water supply wells. Water samples from 1943 private wells in the Fox River Valley contained arsenic concentrations that ranged from 1.0 to 12,000 µg/L. Levels exceeded 5 µg/L in 622 (32%) of these wells, and 68 (3.5%) of the wells had arsenic concentrations that exceeded the federal standard of 50 µg/L.

In response to this finding, the Bureau of Environmental Health developed a public education campaign and conducted a family health survey. One component of the education campaign was the development of a fact sheet on the health effects of ingested arsenic that was distributed to private well owners in this area. In addition, bureau staff conducted an area-wide health and drinking water study. Self-administered surveys were used to collect information about individual water use habits and health status. Comparison of daily arsenic intake levels and illness rates found that people who ingested more than 49 µg of arsenic per day were significantly more likely to report skin cancer, kidney problems, tremors and unexplained hair loss than others.

More recent testing has found that arsenic levels are increasing over time. Families whose drinking water contains arsenic levels above 10 µg/L are advised to seek an alternate supply of water for drinking and cooking. However, families are encouraged to continue using their well water to bathe and shower. Several families with infants and pre-school aged children have questioned this advice, and additional research is needed to ensure protection of these age groups since their skin surface area:body weight ratio is significantly higher than an adults, and because their skin may allow more arsenic absorption. Arsenic test results below the current standard of 10 µg/L are deemed acceptable at this time.

Objectives: The primary objectives of this project were to evaluate the health impact of arsenic-contaminated drinking water and to assess absorption of arsenic from water during bathing and showering activities.

Methods: Absorption of arsenic during showering/bathing was assessed by analyzing urinary arsenic levels for adults and children who had stopped drinking water from wells that had tested high in arsenic. A self-administered questionnaire was used to collect information about water use and health status. This questionnaire was distributed along with water test kits during well water testing programs sponsored by 19 townships in Outagamie and Winnebago counties.

Results and Discussion: Well construction, water use and health outcome information were provided by 2,233 families including 6,669 residents. Approximately 20% of the water

supplies contained arsenic levels above 10 µg/L. Slightly more than 10% of the families consumed water that had an arsenic level greater than 20 µg/L. People over the age of 50 were more likely to report a diagnosis of skin cancer if they had consumed water that had an arsenic concentration greater than 5 µg/L for 10 years or more. Cigarette use was also associated with higher skin cancer rates: residents who both smoked and consumed arsenic-contaminated water reported the highest skin cancer prevalence rate. Smokers who consumed water that was high in arsenic were three times more likely to report a diagnosis of skin cancer than non-smokers whose water was contained no detectable arsenic.

No association was seen between exposure to arsenic-contaminated water and the incidence of other types of cancer. Findings from this study were consistent with previously reported associations between arsenic exposure and the prevalence of adult onset diabetes and cardiovascular disease, however, these results must be interpreted cautiously due to the small number of cases reported by study participants.

Six families, including 11 adults and 4 children, who had stopped using their wells as a source of drinking water but continued to use it for baths, showers, and household chores submitted first morning urine samples for arsenic analysis. All were advised not to consume fish or seafood products for at least three days prior to urine collection to avoid exposure to “fish arsenic.” Arsenic levels in these families’ wells ranged from 34 to 3,100 µg/L. All of the urine arsenic levels were within the normal range reported by the laboratory.

**Conclusions/
Implications:**

Residents who consumed water that had an arsenic level greater than 5 µg/L for 10 years or longer were more likely to report a diagnosis of skin cancer, adult onset diabetes, and cardiovascular disease than age-matched residents who drank water that contained no detectable arsenic. While these findings should be interpreted cautiously, they are consistent with previously published studies and support ongoing efforts to reduce long-term exposure to arsenic-contaminated drinking water. It is especially important for residents who use water from private wells to have them tested for arsenic. Water supplies that contain more than 10 µg of arsenic per liter should not be used as a primary source of drinking water unless they are treated with an approved arsenic-removal device.

Publications:

Knobeloch L. and H.A. Anderson. Arsenic-contaminated water and skin cancer in Wisconsin. Proceedings from the 5th International Conference on Arsenic Exposure and Health Effects. 2002.

Knobeloch L. and C. Warzecha. Cancer incidence among consumers of arsenic-contaminated groundwater. A poster presented at the 4th International Conference on Arsenic Exposure and Health Effects, 2000.

Key Words:

Arsenic, health, cancer, diabetes, cardiovascular, dermal absorption, Outagamie, Winnebago.

Funding:

Wisconsin Department of Natural Resources

Final Report:

A final report containing more detailed information on this project is available for loan from Wisconsin’s Water Library, University of Wisconsin - Madison, 1975 Willow Drive, Madison, Wisconsin 53706 (608) 262-3069.