

Title: Nitrate-Contaminated Drinking Water Follow-back Study

Project I.D.: DNR Project # 131

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Period of Contract: July 1, 1996 through June 30, 1997

Background/Need: Previous well-water sampling programs by DNR, DATCP, and WGNHS have identified nitrate as one of the most common contaminants found in Wisconsin's groundwater. More than 50,000 Wisconsin families are believed to be using nitrate-contaminated groundwater as their primary source of drinking water. Little is known about the actions that are taken by families whose wells are found to be high in nitrate. In addition, the reproductive and chronic health effects of nitrate exposure are poorly understood.

Objectives: To assess the reaction of well owners to their nitrate test results and to evaluate the chronic health and reproductive effects of prolonged consumption of nitrate-contaminated water.

Methods: Phase I of the project consisted of developing a questionnaire that was used to collect information about each family's well, residential history, water consumption patterns, general health, and reproductive success. During this phase, approximately 1500 families whose wells had been tested for nitrate during 1994, 1995 and 1996 and had nitrate-N levels of 0-2 or ≥ 13 mg/L were selected from databases maintained by the State Lab of Hygiene and DATCP. Families in the low exposure group were matched to high exposure families by county of residence. Letters explaining the research and questionnaires were sent to each household in the high and low exposure group.

Phase II of the project consisted of entering data from the returned surveys into an electronic database, performing statistical analyses, and preparing a written report.

Results/Discussion: A total of 562 surveys were returned. Analysis of these surveys found that families whose wells were high in nitrate tended to be slightly older and had lower household incomes than families whose wells were low in nitrate. In addition, families in the high exposure group were more likely to live on a farm and had lived in their current homes longer than families in the low exposure group. The majority of participating families understood their nitrate test result, however, few took action to reduce their nitrate exposure. Of those who took action, most purchased bottled water for drinking. This action appeared to have been taken primarily due to the presence of an infant or pregnant woman in the home.

Analysis of chronic health and reproductive outcome data found that residents of homes with nitrate-contaminated water supplies reported a higher incidence of thyroid disorders, fibromyalgia, and arthritis than residents of homes with low-nitrate water supplies. After adjusting for the residents' ages, these differences were not statistically significant.

Compliance with the advisory for pregnant women was very high and few women in our study population consumed significant quantities of nitrate-contaminated water after the advisory was issued in 1993. Women who consumed nitrate-contaminated water during their pregnancies

were slightly more likely to report an early pregnancy loss than others, however, this difference was not statistically significant. The incidence of birth defects and low birthweight was very low in both exposure groups and no differences were observed in rates among women in high versus low exposure households.

Conclusions/Recommendations:

- Most private wells were tested less than once a year for nitrate and many families who tested because of a pregnancy or new baby, tested late in the pregnancy or shortly after the birth.
- Families should be encouraged to test more frequently. Women planning a pregnancy should be encouraged to test before the pregnancy is established or soon after it is confirmed.
- Many families whose nitrate test result exceeded 12.9 mg/L, didn't know that their nitrate level was above the health advisory level. In addition, fewer than half of the respondents were familiar with the Nitrate in Drinking Water brochure.
- All state-funded laboratories should include the brochure with nitrate-N test results over 10 mg/L.
- Most women were aware of the advisory for pregnant women and compliance with the advisories for pregnant women and infants was high.
- State and local agencies should continue their efforts to inform the public of these advisories.
- Non-significant increases were observed in the incidence of unspecified heart disease, thyroid disorders, arthritis, fibromyalgia, and spontaneous abortions among families that consumed nitrate-contaminated water. Due a small number of pregnancies in our study population, we were unable to evaluate the effects of maternal nitrate exposure on the incidence of low birthweight or birth defects.
- Additional research is needed to evaluate these associations. To ensure adequate statistical power of future studies, a large study population and high participation rate will be needed.
- Other than families with pregnant women and infants, very few households took any action to reduce their nitrate exposure.
- Additional research is needed to determine whether chronic exposure to high-nitrate water poses a risk to older children and adults..

Related publications: None at this time

Key words: Nitrate, Chronic effects, Reproductive effects, Remediation, Groundwater

Funding: Wisconsin Department of Natural Resources (DNR)

Final Report: A final report containing more detailed information on this project is available for loan from Wisconsin's Water Resources Library, University of Wisconsin-Madison, 1975 Willow Drive, Madison, WI 53706-3069.