

# Nitrates & Neural Tube Defects

**N**itrates—a commonly occurring group of substances found in foods, medications, drinking water, and cigarette smoke—have been implicated in cancer and other health outcomes. Might they be a factor in birth defects?

This comprehensive study by the California Birth Defects Monitoring Program estimates pregnancy exposure to nitrates from a variety of sources. We interviewed over 1000 mothers of babies with and without neural tube defects, exploring a broad range of topics including illnesses, medication, drugs, alcohol, tobacco, occupation, and hobbies. Women completed a detailed dietary inventory, recalling the foods they typically ate and the amount of tap water they drank for the 3 months before conception through the first 3 months of pregnancy. We contacted public water companies for information on drinking water sources and nitrate levels for the water supply to each woman's residence.

## NO RISK FOUND FOR DIETARY NITRATES

- More than 85% of women's dietary nitrates came from fruits and vegetables. Nitrates in food did not increase risk for neural tube defects.
- We identified a number of medications that metabolize to nitrate-like compounds in the body. Taking these medications did not change risk for neural tube defects.

## COMPLEX FINDINGS IN DRINKING WATER

- Only groundwater contained nitrate exceeding the current allowable standard of 45 milligrams/liter. Exposure above this maximum contaminant level (MCL) was associated with a 4 times higher risk for anencephaly (absence of the brain). There was no increased risk for spina bifida (open spine defects), another type of neural tube defect.
- Women whose drinking water contained nitrate levels below the MCL had a higher risk for anencephaly, but only when the source was groundwater. No increased risk was seen at comparable nitrate levels when drinking water was a mixture of surface and groundwater.

## DRINKING WATER FACTS

- Public drinking water sources vary considerably. About 20% of Californians drink groundwater pumped from underground aquifers. About 40% drink surface water collected from lakes and rivers. About 40% drink a mixture of both.
- Nitrate can be found as a groundwater contaminant; levels are generally low in surface water.
- Nitrate levels in public water supplies are monitored at least annually (more often if levels approach public health limits). About 6% of homes draw water from unregulated private wells.
- Nitrate can be removed from water only with specific filters. Boiling contaminated water can actually concentrate the nitrate.

## IS IT THE NITRATE?

Similar levels in groundwater and mixed water did not have the same effect. This inconsistency raises the possibility that some other factor, or combination of factors, is responsible for the increased risk noted in groundwater drinkers.

- Other contaminants in the groundwater—such as pesticides—did not provide an alternate explanation for the increased risk.
- The interview elicited other factors known to raise or lower risk for neural tube defects; however, these did not account for the findings.
- It is possible that nitrate exposure in water was misclassified, since it was estimated at the water supplier rather than at the tap. Mixed water sources may alternate between surface and groundwater, defying accurate classification.

We don't know if nitrate is responsible for the increased risk, so we don't know if lowering nitrate levels in water will mitigate the risk.

## FUTURE STEPS UNDER DISCUSSION

This study had rigorous methodology, with a large population, comprehensive exposure estimates, and accurate classification of birth defect diagnoses. Further research must focus on other factors—for example, consideration of other contaminants or the toxicological interactions within drinking water.

The California Birth Defects Monitoring Program and other Department of Health Programs are discussing possible follow-up studies and funding mechanisms for further research.

## WHAT ARE NITRATES?

The nitrogen-containing compounds collectively termed *nitrates* come from a variety of sources.

- Nitrate enters the soil from human or animal waste and nitrogen-containing fertilizers. Seepage into groundwater causes contamination.
- Nitrate levels are high in food grown in soil, such as fruits and vegetables. Nitrates are also found in processed meats.
- When consumed, nitrates are converted to potentially harmful by-products in the body. The process is complex and depends on many factors, such as stomach acidity. Vitamin C can prevent this conversion.
- Cigarette smoke contains a nitrate by-product, N-nitrosamines.
- Nitrates are potentially harmful only if ingested—showering and bathing are not exposure sources.

## REFERENCE:

*Croen LA, Todoroff K, Shaw GM. Maternal exposure to nitrate from drinking water and diet and risk for neural tube defects. American Journal of Epidemiology 2001; 153(4).*

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