



Nitrate contamination in drinking water and adverse birth outcomes: emerging evidence is concerning for NZ

23 May 2021

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While there is growing evidence that nitrates in drinking water are a risk factor for bowel cancer, there is also emerging evidence concerning adverse birth outcomes such as prematurity. This blog takes a brief look at this new evidence and puts it into a NZ context.

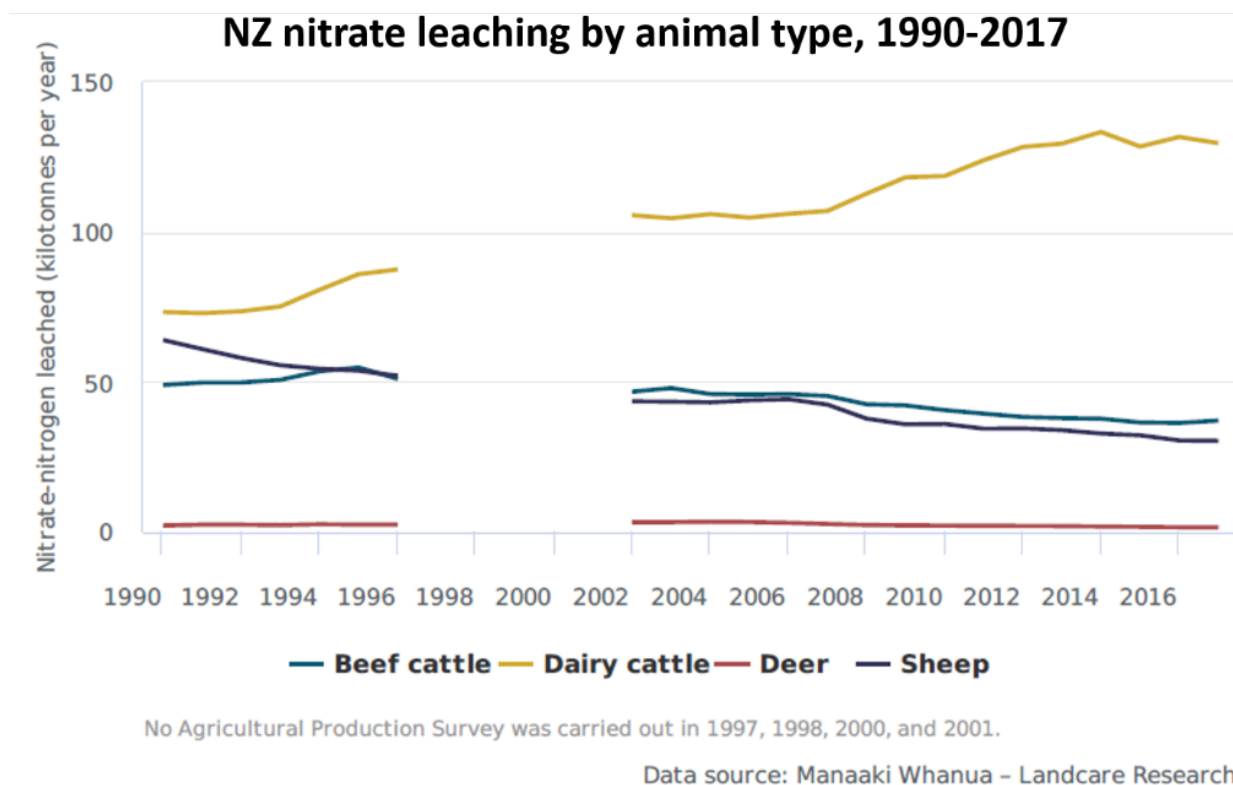
Nitrate is one of the most common drinking water contaminants in NZ, largely driven by agricultural activity (nitrogen fertiliser application and livestock urine). Nitrate leached into

water from dairy farming has increased substantially since 1990 (see Figure 1).

Recent studies linking nitrate levels as low as 0.87 mg/L NO₃-N (from here on simply mg/L) in drinking water to bowel cancer have raised public concerns over nitrate contamination.¹⁻³ Our recent study of the current nitrate levels in NZ drinking water showed as many as 800,000 people could be on water supplies with nitrate above 1 mg/L. These nitrate levels are far below the current drinking water nitrate limit of 11.3 mg/L set by the World Health Organization (WHO). The WHO limit is only designed to prevent death from methaemoglobinaemia in infants. Thus, the current nitrate limit does not account for the potential links to cancer or other adverse health outcomes.

Attracting less public attention is the link between nitrate exposure during pregnancy and poor birth outcomes. Two recent studies published in 2021 link prenatal nitrate exposure to low birth weights⁴ and preterm births.⁵ These studies build on existing evidence linking prenatal nitrate exposure and adverse birth outcome including neural tube defects, small for gestation age, low birth weight and preterm births.⁶⁻¹⁰ However, what differentiates these two new studies from previous research is their scientific quality. For example, Sherris et al (2021)⁵ was a US study that looked at 1.4 million births between 2001 and 2011. Their analysis included consecutive births from the same mother, effectively accounting for differences observed between participants in other studies. The authors found nitrate above 5 mg/L increased the odds of a preterm birth (20-31 weeks) by 47%, while exposure above 10 mg/L increased the odds of a preterm birth 2.5 times. This finding is consistent with other studies looking at preterm and low birth weights.⁶⁻¹⁰

Figure 1:



What is the risk in NZ?

Our [recent study](#) of the current nitrate levels in NZ drinking water estimated as many as 138,000 people could be on water supplies with nitrate above 5 mg/L. There are also

concerning trends in the degradation of freshwater, which has seen NZ's groundwater nitrate levels continue to rise.

The at-risk population mainly consists of people in rural areas who are on unregistered supplies (most city supplies have very low levels of nitrate). However, we are beginning to see contamination of larger water systems which are impacting city water supplies. A [recent study](#) has shown that even our push for increased water efficiency through pivot irrigators has actually accelerated the rate of groundwater degradation.¹¹

How might nitrates be linked to adverse birth outcomes?

The proposed mechanism for nitrate impacting birth outcomes is through the conversion of haemoglobin to methaemoglobin. Haemoglobin transports and delivers oxygen to cells in the body. Nitrate consumption initiates the conversion of haemoglobin to methaemoglobin. Methaemoglobin cannot carry oxygen which reduces the blood's ability to transport oxygen to cells in the body. Elevated methaemoglobin levels have been observed in cord blood of pregnant women exposed to nitrates. Infants do not produce a sufficient number of the enzymes required to convert methaemoglobin back to haemoglobin – effectively limiting their oxygen supply. This is the same mechanism associated with the well-established risk of methaemoglobinaemia from nitrates, which is the basis of the current drinking water standard of 11.3 mg/L used in NZ.

What is the impact of adverse birth outcomes?

In NZ, around 6% of live births have a low birth weight (OECD average is 6.5%),¹² while around 6% of births are preterm (before 37 weeks).¹³ Low birth weights and preterm births are associated with adverse health, social and educational outcomes in later life.¹⁴ These include cerebral palsy, visual and auditory deficits, poor respiratory outcomes, impaired motor and cognitive ability, and psychiatric disorders. One US study estimated the lifetime economic burden of each preterm birth is NZ\$90,000.¹⁵ In NZ, there is an average of 4400 preterm births each year which would be equivalent (based on this US study), to an extra cost of NZ\$396 million per year going forward.

What other evidence is out there for health effects of nitrate contamination?

An International Agency for Research on Cancer (IARC) assessment of studies up to the year 2006 reported that “ingested nitrate or nitrite under conditions that result in endogenous nitrosation is probably carcinogenic to humans” (Group 2A).¹⁶ While a [Danish Study](#) found an association and attracted a lot of attention,¹ at least 11 other studies (with wide variations in study quality) have investigated nitrate and bowel cancer, with most showing an association at one or more exposure thresholds.^{2,3,17-25} While there is some variance in the study results, those studies conducted most recently,^{1,2,4,5} with the most sophisticated study designs and analyses, suggest causal links between nitrate and adverse health outcomes.

Conclusions

The growing evidence linking nitrate in drinking water with adverse birth outcomes builds on existing evidence on the potential adverse health impacts of nitrate contamination. Adverse birth outcomes are particularly concerning given the potentially lifelong harms

from conditions such as prematurity. This evidence reinforces the need for a precautionary approach to setting lower nitrate limits in drinking water for human and ecological health. Further, it reinforces the need for 1) better reporting systems for nitrates in the environment and drinking water; and 2) additional research into the health implications of nitrate contamination internationally and in the NZ setting.

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