



Nitrate pollution of drinking water linked to preterm birth: Aotearoa New Zealand study

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Tim Chambers, Alice Kim, Frank Dean, Isaac Bain, Jeroen Douwes, Mary Berry, Michael Baker, Simon Hales

Summary

About 1 in 15 babies in Aotearoa New Zealand (NZ) are born “preterm” (before 37 weeks of gestation). Emerging evidence suggests nitrate in drinking water may increase the risk of preterm birth at levels well below the current regulatory limit (11.3 mg/L). [In a newly published peer-reviewed study](#), we analysed more than 700,000 singleton birth records in NZ, linking gestational age with estimated nitrate concentrations in drinking water at the mother’s usual residence.

The risk of preterm birth increased by about 1% per 1mg/L increase in nitrate exposure. As an observational study, the findings do not prove causality but are consistent with previous large cohort studies in other countries. If the relationship is causal, nitrate exposure could contribute to around 4% of preterm births nationally each year. The increased risk is likely to be small for most populations served by a community drinking water supply, but could be more substantial for those relying on private ground water supplies for which nitrate pollution is a known problem in parts of NZ. The NZ Government needs to reassess regulatory limits for nitrates in drinking water based on this new evidence and from evidence that has prompted the [Government of Denmark to commit to setting lower limits](#). Both central and local government in NZ need to give greater emphasis on the protection of the quality of drinking water at source, which will reduce both nitrate pollution and microbiological contamination of water supplies.

Preterm births and nitrate exposure

Preterm birth occurs in over 7% of births in NZ and greatly increases the risk of health problems at birth and in later life. Established risk factors for preterm birth include low socio-economic status, very low or high maternal age, maternal tobacco use, obesity and prior history of preterm birth.¹

Several environmental exposures have been suggested as additional risk factors, including air pollution² and nitrate contamination in drinking water.³ Recent large epidemiological studies³⁻⁵ report increased risks of preterm birth from prenatal exposure to nitrate in drinking water at levels well below regulatory limits set by the World Health Organization (WHO) and adopted by NZ (11.3 mg/L nitrate-nitrogen (NO₃-N)), a limit set to protect against infant methaemoglobinaemia (“blue baby syndrome”), rather than preterm birth.⁶

The great majority of public water supplies in NZ have low levels of nitrate (less than 1 mg/L), while 4.3% have between 1 and 5.64 mg/L and 0.2% have over 5.65 mg/L.⁷ In contrast, there is evidence of widespread contamination of shallow groundwater bores used by people relying on domestic self-supplies (ie, private wells). A national survey of domestic self-supplied drinking water bores showed that 20.8% were over half, and 3.7% exceeded, the drinking water standard.⁸

NZ observational study of nitrates and preterm birth

Based on the place of mother’s residence, we linked (at the individual level) estimates of nitrate in drinking water with records of singleton births (when one baby is born as opposed to twins, etc) from the National Maternity Collection. The study included 735,831 singleton

births from 2008 to 2021 with complete data and linked nitrate exposure. Overall, 94.3% of births were full term (≥ 37 weeks), 4.8% were moderate preterm, 0.6% very preterm, and 0.3% extremely preterm.

We analysed the data in two ways: (1) all singleton births (“individual cohort”) and (2) all singleton births to mothers with 2 or more births during the period (“sibling cohort”). In the first method, we allowed for the risk of preterm birth due to the mother’s age, number of previous children, ethnicity, body-mass index and smoking. The second method allowed us to assess the risk of nitrate on premature birth while largely excluding the influence of additional factors such as the mother’s diet, for which we did not have information.

Higher nitrates associated with increased risk of preterm births

If we assumed a linear (straight-line) increase in preterm birth risk with increasing concentration of nitrate in drinking water, there was a small increase in risk for all preterm births (approximately a 1% increase in risk per mg/L increase of nitrate). Since information about the change in risk with increasing exposure to nitrate is not well established, we also analysed the data without assuming a linear relationship. We divided the study population into 4 equal groups with increasing levels of exposure. Comparing the lowest and highest exposure groups, the risk of preterm births increased by approximately 8%. The risk increased further with the degree of prematurity.

Overall, higher nitrate concentrations in drinking water were associated with small but consistent increased risks of preterm births, which increased across exposure groups as well as gestational age groups. At a population level, the estimated risk of preterm birth increased from about 4.5% in communities with zero nitrate to about 4.7% at 0.5 mg/L. Results were not materially different in sensitivity analyses. Assuming a causal relationship between nitrate and preterm birth, an average of 120 preterm births per year (approximately 4%) were attributable to nitrate in drinking water in NZ.

Nitrate from drinking water typically contributes a smaller share of total dietary nitrate than food sources. However, food contains substances such as vitamin C, that inhibit harmful effects of nitrate. This difference is why regulatory agencies conduct risk assessments for nitrate from water and food separately.^{9,10}

Need for NZ to reassess regulatory limits for nitrates in drinking water

Our results should be interpreted cautiously as we cannot completely exclude the possibility that other contaminants (eg, pesticides), correlated with nitrate in drinking water, which may also contribute to the risk.^{11,12}

Because nitrate exposures above 5.65 mg/L were rare (only about 1% of pregnancies), we have limited ability to predict risks of preterm birth at higher nitrate levels. The increase in risk is small for the great majority of communities that have a public water supply with low levels of nitrate.

Nevertheless, this study lends further urgency for the NZ Government to reassess regulatory limits for nitrates in drinking water, as [discussed in a recent Briefing](#) about the Government of Denmark’s response to the scientific evidence.

What this Briefing adds

- A new study observed associations between nitrate concentrations in drinking water and preterm birth at concentrations well below current drinking water standards.
- Higher nitrate concentrations were associated with increased risk of preterm birth, with stronger effects among infants with greater prematurity.
- Findings were robust across sensitivity analyses, including sibling cohort models.

Implications for policy and practice

- Nitrate in drinking water may be a modifiable risk factor for preterm birth.
- The NZ Government needs to reassess regulatory limits for nitrates in drinking water based on evidence of potential adverse health effects from this and other studies.
- Central and local government in NZ need to give greater emphasis on the protection of the quality of drinking water at source, which will reduce both nitrate pollution and microbiological contamination of water supplies.

Authors details

[Associate Professor Tim Chambers](#), Ngāi Tahu Research Centre, Te Whare Wānanga o Waitaha | University of Canterbury

[Alice Kim](#), Biostatistics Group – Ratonga Tauanga Koiora, Ōtākou Whakaihu Waka, Pōneke | University of Otago, Wellington

[Frank Dean](#), Ngāi Tahu Research Centre, Te Whare Wānanga o Waitaha | University of Canterbury

Isaac Bain, Quantitative freshwater ecologist, Department of Public Health, Ōtākou Whakaihu Waka, Pōneke | University of Otago, Wellington

[Professor Jeroen Douwes, Director](#) - Centre for Public Health Research, Massey University | Te Kunenga ki Pūrehuroa

Dr Mary Berry, Paediatrics, Ōtākou Whakaihu Waka, Pōneke | University of Otago, Wellington

[Prof Michael Baker](#), Director, Public Health Communication Centre, and Department of Public Health, Ōtākou Whakaihu Waka, Pōneke | University of Otago, Wellington

[Professor Simon Hales](#), Co-Director, Public Health Communication Centre, and Department of Public Health, Ōtākou Whakaihu Waka, Pōneke | University of Otago, Wellington

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