Effect modification of the association between nitrates and rectal cancer by drinking water hardness: evidence from an ecological study

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Background and Aims: The objectives of this study were to (1) examine the relationship between nitrate levels in public water supplies and increased risk of death from rectal cancer and (2) determine whether calcium (Ca) and magnesium (Mg) levels in drinking water might modify the effects of nitrate on development of rectal cancer.
Methods: A matched case-control study was used to investigate the relationship between the risk of death from rectal cancer and exposure to nitrate in drinking water in Taiwan. All rectal cancer deaths of Taiwan residents from 2003 through 2007 were obtained from the Bureau of Vital Statistics of the Taiwan Provincial Department of Health. Controls were deaths from other causes and were pair-matched to the cases by gender, year of birth, and year of death. Information on the levels of nitrate-nitrogen (NO_3-N), Ca, and Mg in drinking water was collected from Taiwan Water Supply Corporation (TWSC). The municipality of residence for cancer cases and controls was presumed to be the source of the subject's NO_3-N, Ca, and Mg exposure via drinking water.
Results: Relative to individuals whose NO_3-N exposure level was <0.38 ppm, the adjusted odds ratio (OR) (95% CI) for rectal cancer occurrence was 1.15 (1.01-1.32) for individuals who resided in municipalities served by drinking water with a NO_3-N exposure > or =0.38 ppm. There was no apparent evidence of an interaction between drinking water NO_3-N levels with low Mg intake via drinking water. However, evidence of a significant interaction was noted between drinking-water NO_3-N concentrations and Ca intake via drinking water.
Conclusions: Our findings showed that the correlation between NO_3-N exposure and risk of rectal cancer development was influenced by Ca in drinking water. This is the first study to report effect modification by Ca intake from drinking water on the association between NO_3-N exposure and risk of rectal cancer occurrence. Increased knowledge of the mechanistic interaction between Ca and NO_3-N in reducing rectal cancer risk will aid in public policymaking and setting threshold standards.