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Environmental manganese and cancer mortality rates by county in North Carolina: an ecological study

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Abstract

Manganese is an element essential for health in trace amounts, but toxic at higher exposures. Since manganese is replacing lead in gasoline globally, evaluation of potential cancer effects is essential. To determine whether environmental manganese is related to cancer at the county level in North Carolina (n = 100 counties; North Carolina 2000 population = 8,049,313), we carried out an ecological study using data from the North Carolina State Center for Health Statistics, North Carolina Geological Survey, US Geological Survey, and US Census. County-level all-cause and cancer mortality rates between 1997 and 2001 reported in deaths per 100,000 population associated by multivariable regression with logarithmically transformed groundwater (microgram per liter) and airborne (microgram per cubic meter) manganese concentrations by county measured between 1973 and 1979 (water) and in 1996 (air). Models controlled for county characteristics. Median all-cause and cancer mortality rates by county in North Carolina (1997-2001) exceeded those of the USA (2000). For each log increase in groundwater manganese concentration, there was a corresponding county-level increase of 12.10 deaths/100,000 population in all-site cancer rates, 2.84 deaths/100,000 in colon cancer rates, and 7.73 deaths/100,000 in lung cancer rates. For each log increase in airborne manganese concentration, there was a corresponding county-level decrease of 8.10 deaths/100,000 population in all-site cancer rates, 3.28 deaths/100,000 in breast cancer rates, and 3.97 deaths/100,000 in lung cancer rates. Neither groundwater nor air concentrations of manganese correlated with county-level all-cause or prostate cancer death rates. These are the first data we know of to document a potential relationship between environmental manganese and population-level cancer death rates. The positive association between groundwater manganese and specific cancer mortality rates might be a function of the high concentrations measured, while the inverse relationship between air manganese and death rates might point toward adequate (e.g., healthy) county-level manganese exposures. Since manganese is replacing lead in gasoline globally, these ecological findings should be confirmed at the individual level or in animal models.

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