Reprieve for Perchlorate

Effects Not a Significant Concern

Although perchlorate has pharmaceutical uses in the treatment of thyroid disorders, it is most commonly used as an oxygen source in rocket propulsion systems. This latter use is believed to be the source of perchlorate found in drinking water supplies throughout the U.S. Southwest at concentrations ranging from 5 to 20 parts per billion (ppb). But the millions of people drinking this perchlorate-laced water need not be concerned for their health, according to research by Monte Greer, the late head of the Endocrinology Section at Oregon Health & Science University, and colleagues [*EHP* **110:927–937**].

Perchlorate inhibits the uptake of iodine, which is used by the thyroid to produce thyroid hormone. If iodine uptake is inhibited by too much for too long, the result could be hypothyroidism, a condition in which blood levels of thyroid hormone are abnormally low and those of the pituitary hormone thyrotropin (TSH) are abnormally high. Because maternal thyroid hormone level plays a vital role in fetal brain development, the authors say it is important to protect against even mild hypothyroidism in pregnant women.

The research team wanted to establish the extent to which thyroidal iodine uptake is diminished in people given one of four daily perchlorate doses. In particular, they wanted to measure the no-effect level, the highest daily perchlorate dose a person can ingest without experiencing any inhibition of iodine uptake.

Safe for now. Perchlorate concentrations found in U.S. Southwest drinking water are not high enough to cause adverse health effects, say researchers.

To do this, the team enrolled 37 volunteers between the ages of 18 and 57 to drink a fixed volume of perchlorate solution 4 times a day for 14 days. To evaluate thyroidal iodine uptake, they administered a trace amount of radioiodine and then measured the accumulated radioiodine uptake (RAIU) over the thyroid at 8 and 24 hours. To establish the baseline uptake, the researchers performed an initial measurement of the RAIU before the volunteers ingested any perchlorate. The RAIU was also measured 15 days after stopping exposure.

The RAIU measurements performed during perchlorate exposure revealed a strong dose–response relationship, with the RAIU relative to baseline decreasing uniformly from the lowest to highest doses. The researchers also found that at 15 days postexposure the RAIU did not differ from baseline in any dose group. Based on the overall dose–response relationship they found, the researchers estimate the no-effect level for perchlorate inhibition of thyroidal iodine uptake to be at least 5.2 µg/kg-day, the approximate adult dose from a drinking water supply containing 180 ppb perchlorate. Further, based on the observed variability among the study volunteers, the team calculates a 95% probability that uptake will be inhibited by less than 9.5% in persons exposed to perchlorate at this dose. They call this amount of inhibition "physiologically insignificant" for groups (such as the U.S. population) with sufficient iodine intake.

The researchers measured thyroid hormone and TSH levels in serum prepared from blood drawn throughout the study. The only change observed was a slight downward trend in TSH in the high-dose group during the exposure period, with a return to baseline by 15 days postexposure. This finding was unexpected, say the authors, because if iodine uptake is inhibited to the point that thyroid hormone levels are depressed, this should lead to an increase in TSH secretion, not a decrease. The observed effect was thus the opposite of any expected change, and the authors have no explanation for it.

The team also measured the amount of iodine excreted into the urine; they will describe those results in a separate report and evaluate the extent to which iodine nutrition affects the inhibitory response at a given dose of perchlorate. The authors did not estimate a safe level of perchlorate exposure for iodine-insufficient populations. However, they say that iodine supplementation should be provided to iodine-insufficient persons or populations regardless of whether there are known exposures to perchlorate, other inhibitors of iodine uptake such as nitrate or thiocyanate, or foods that naturally contain such inhibitory compounds or their precursors. **–Rebecca Renner**

Weather Warning

Climate Change Can Be Hazardous to Your Health

If predictions of global climate change and greater temperature swings come true, the effect on death rates could be significant, says a Harvard research team led by Alfésio Braga [*EHP* **110:859–863**]. In a study of 12 U.S. cities, both markedly hot and markedly cold days were associated with pronounced effects in cooler climate settings, while hot days also had a significant impact in warmer climate settings.

The results add several new twists to the existing generalized information on the subject. The team also uncovered new information on associations between deaths and lag periods, temperature swings, and seasonal effects, and found that many of the observed deaths were not simply "harvesting," or imminent death occurring a few days earlier than would naturally have happened. As future research builds on these and other findings, both public health officials and residents in affected areas may be able to more effectively target their efforts to save lives.

The team evaluated deaths from two respiratory conditions—pneumonia and chronic obstructive pulmonary disease (COPD)—and from all cardiovascular diseases (CVD), using data for 1986–1993. Within CVD, they also broke out myocardial infarction (MI), which unveiled some substantial contrasts with other CVD deaths.

Christopher G. Reuther/EHP

The team identified three "hot cities"—Atlanta, Houston, and Birmingham—and eight "cold cities"—Canton, Chicago, Colorado Springs, Detroit, Minneapolis, New Haven, Pittsburgh, and Spokane. They also looked at Seattle, but its mild temperatures were so limited in their extremes that the city was not included in the final analysis.

Residents in cold cities suffered higher CVD death rates during both hot and cold periods. But while the effects of a hot day (defined as a 24-hour mean of 30°C) were largely felt on that day or the next, the effects of a cold day (24-hour mean of 10°C) tended to last for many days. Within those overall trends, MI deaths showed a very different pattern from all CVD deaths. Hot days had double the immediate impact on MI deaths compared with cold days (a 6% versus 3% increase), whereas CVD deaths were just the reverse—increased, but by just 1% with a hot day compared with 5% with a cold day. For both CVD and MI, there was noticeable harvesting with hot days, while none was apparent with cold days.

Cold city residents also suffered a 25% increase in COPD death rates on hot days, while cold days caused no change. For pneumonia, the greatest effects were linked with cold days and were immediate, although hot days led to a lesser increase 3–5 days later.

In hot cities, hot days had only a delayed impact on MI and COPD. MI deaths increased by 4% after 4–6 days, while COPD deaths increased by 6% after 3–4 days. CVD and pneumonia death rates in hot cities weren't altered much by either hot or cold days.

For all cities, the use of air conditioning played a large part on average in reducing deaths from MI (–17%), COPD (–13%), and pneumonia (–8%), although deaths still rose significantly in some cities. On the other hand, high variance in summer temperatures had a major impact on deaths from the same three causes. Similarly, high variance in winter temperatures substantially boosted deaths from COPD and pneumonia.

In analyzing other potential factors, the team found no link with humidity, city size, background mortality rate, mean age, unemployment rate, or percentage of the city population that had a college degree, that was nonwhite, or that lived below the poverty level. However, the team's data included only one city with relatively low humidity (Colorado Springs), and little is known about the specific cause-and-effect relationships in the patterns observed in this study. Future studies might also investigate alternative ways of assessing temperature (such as minimum temperatures instead of mean temperatures) and humidity (such as dew point). **–Bob Weinhold**

Locating Lead

Mapping Leads to Intervention

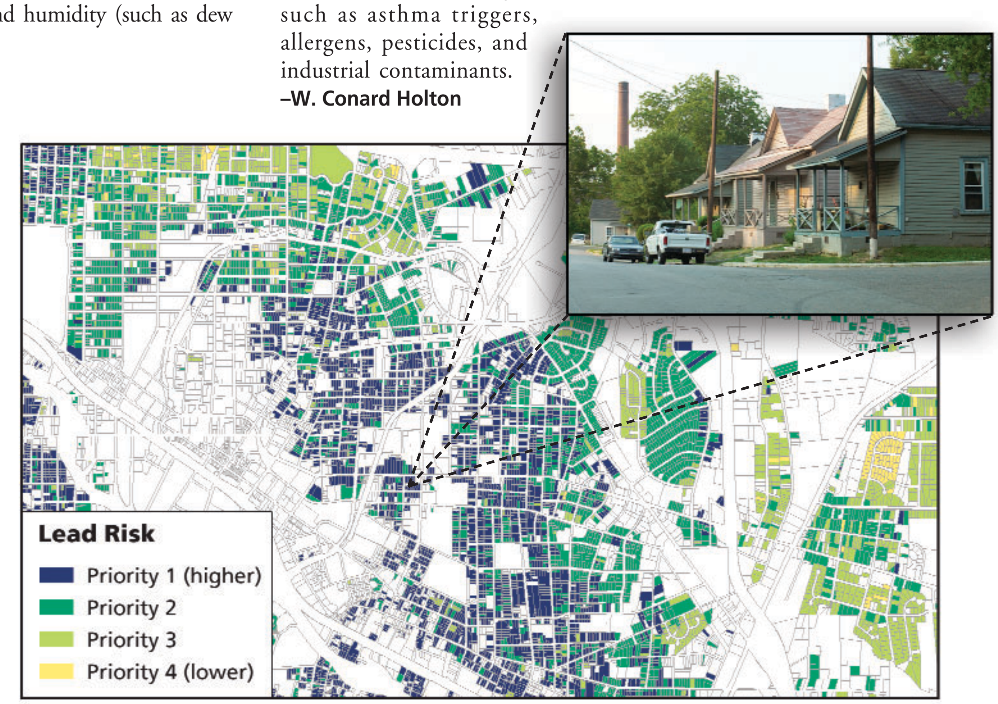
Children's environmental health programs have been handicapped by the difficulty in identifying specific sites that pose the greatest risks and exposure potential within a larger geographic region. As a result, health programs such as those intended to reduce the threat of low-level lead exposure have had to focus on mitigating effects rather than implementing preventive steps. But a new mapping model developed by Marie Lynn Miranda and colleagues at Duke University's Nicholas School of the Environment and Earth Sciences identifies individual buildings and sites where the risk of lead exposure is statistically high, providing an intervention analysis tool for policy makers and public health officials [*EHP* 110:947–953]. The model looks at health data at the level of tax parcels (such as houses), which gives a degree of detail that should help health programs become better focused and more effective. The model uses a geographic information system, or GIS, to compile data the researchers gathered while studying childhood lead exposure risk in six North Carolina counties. The detailed spatial analysis incorporates blood lead screening results, county tax assessor records, and U.S. Census data.

Such detail is important because lead poses a complex threat to children's health that reflects many different risk factors, including the age of their homes, whether they live in rural or urban areas, their race or ethnicity, household income, and nutrition. For example, across the nation children from low-income families exhibit blood lead levels nearly eight times the rate of children from high-income families. However, unlike in other regions of the country, North Carolina's urban housing, much of which was built since the 1978 ban on lead in paint, generally poses less of a lead exposure risk than the state's older, rural housing.

Past studies of childhood lead exposure risk have captured only part of the picture. Some identified risk factors but didn't considered the relative weight for each factor. Others considered relative weights but didn't link analysis to geographic locations. Still others linked analysis to larger, aggregated areas without factoring in the relative weights.

Gathering the multiple types of data for this level of mapping was the biggest single challenge of the project. Two confidentiality agreements with the state's Childhood Lead Poisoning Prevention Program and the State Registrar's office provided the researchers with the data they needed for children born and screened between 1994 and 1999. Miranda says that such trust and cooperation with state and local officials was essential to the success of the project.

The resulting multilayer map of each county combined all screening data in a manner that allowed the researchers to analyze the relationship between observed blood lead levels and individual tax parcels, and compare that to data on the age of housing, median income, rental status, families in poverty, one-parent households, race, and other variables specific to each county. Color-coded maps were then generated showing which households or buildings were most likely to contain lead-based paint hazards, based on all the variables considered. The researchers are now in the process of collecting environmental samples to validate their models, and are applying this approach to other children's health issues such as asthma triggers, allergens, pesticides, and industrial contaminants.
–W. Conard Holton



Marie Lynn Miranda et al.; inset: Christopher G. Reuther/EHP

Zeroing in on exposure. GIS technology can help public health officials focus their efforts by pinpointing, on a house-by-house basis, where the worst lead exposure can be expected.