Ozone Overload

Current Standards May Not Protect Health

Smog alert. A new study was unable to identify a threshold below which ozone no longer affected premature mortality.

Ozone is a common urban pollutant that has been linked to health effects such as reduced lung function, increases in respiratory symptoms, and development of asthma. Now a team of researchers reports that ozone may pose a danger to human health even at levels far below the limits set by current U.S. and international regulations [***EHP* 114:532–536; Bell et al.**]. The team conducted a study of 98 U.S. urban communities between 1987 and 2000 to investigate whether there is a threshold below which ozone does not affect mortality, and report that they were unable to identify such a threshold.

More than 100 million Americans live in areas that exceed the EPA's National Ambient Air Quality Standard (NAAQS) for ozone of 80 parts per billion (ppb) ozone averaged over a peak 8-hour time period. The EPA is currently reviewing scientific evidence to determine whether that NAAQS should be revised in order to meet the 1997 Clean Air Act's goal of protecting human health with an adequate margin of safety.

The researchers embarked on this project to better identify that margin. Data were gathered from the National Morbidity, Mortality, and Air Pollution Study, a project launched in 1996 to address questions about the degree to which particulate matter is responsible for changes in daily mortality rates. They also used ozone data from the EPA and weather data from the National Climatic Data Center. Then they applied a Bayesian hierarchical model to mortality data from the National Center for Health Statistics to evaluate the relationship between ambient ozone levels and mortality rates within each community over a 14-year period.

The key finding of their research is strong and consistent evidence that daily increases in ambient ozone exposure were associated with daily increases in premature mortality. This was true even at very low pollution levels, including an idealized scenario in which every community always met current ozone regulations. In that scenario, each daily 10-ppb increase of 8-hour ozone was associated with a 0.30% increase in mortality.

"All results indicate that any threshold would exist at very low concentrations, far below current U.S. and international regulations and nearing background levels," the authors write. They conclude that any reduction in ambient ozone levels, such as through transportation planning in urban areas, could be expected to yield important benefits to public health, even in areas that already meet current regulatory standards. **–Richard Dahl**

Color by Soy

Genistein Linked to Epigenetic Effects

There is substantial evidence that a pregnant mother's exposure to environmental substances can affect her young. Now researchers have uncovered the first direct evidence that maternal exposure to a phytoestrogen in soy can cause lifelong epigenetic changes—that is, changes in gene activity from processes other than changes in the DNA sequence—in mouse offspring [***EHP* 114:567–572; Dolinoy et al.**]. If the findings hold up, there eventually could be repercussions in several important arenas, including recommendations about what pregnant women and infants should eat.

The researchers made their observations in genetically identical yellow mice. The mothers in the test group ate a diet modified to include a concentration of genistein typical of what people eating a high-soy diet would consume, while the control group mothers ate the same food without the genistein. The diets began two weeks before mating and continued through pregnancy and lactation. At 21 days after birth, the offspring were weaned to a stock maintenance diet, which they ate for the rest of the study period.

Telltale traits. Differences in the size and color of offspring are epigenetic effects of genistein consumption (via a high-soy diet) by mouse moms.

The researchers assessed offspring coat color and body weight, traits that can vary with methylation (a mechanism in which methyl groups attach to DNA where cytosine bases occur consecutively). The offspring exhibited wide color differences, ranging from yellow to brown, with varying degrees of mottling in between. The researchers found that these differences corresponded closely with methylation in a DNA region upstream of the offspring's *Agouti* gene, which determines coat color. The 44 genistein-fed offspring were more than twice as likely as the 52 controls to have brown fur and to have much higher methylation, while they were only one-third as likely to have yellow fur and much lower methylation. Animals that had a blend of yellow and brown fur had progressively increased methylation as brown became more dominant.

For weight gain, the brown mice showed by far the least propensity to become overweight. The other groups, with yellow or various combinations of yellow-brown fur, had roughly the same trend toward becoming significantly overweight. The researchers also found that methylation was evident in many parts of the body, including the brain, liver, kidney, and tail.

The team speculates that the ability of genistein to increase DNA methylation provides a plausible explanation for the lower incidence of certain cancers in Asians compared to Westerners. Nevertheless, the pathway by which these changes occurred suggests there could also be significant adverse interactions between genistein and common dietary supplements such as folic acid, which is added to many foods and recommended for pregnant women. Soy-based infant formulas might also be a concern because of the high levels of genistein present in these products. More research is needed to determine if these worrisome possibilities are correct. **–Bob Weinhold**

Top to bottom: Photodisc; Dolinoy et al.

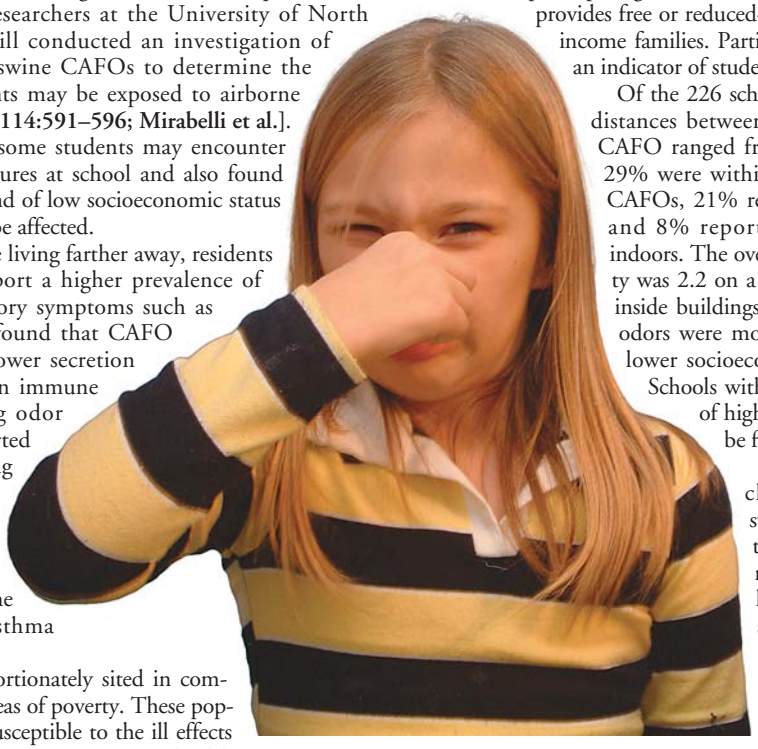
Hogging the Air

CAFO Emissions Reach into Schools

Confined animal feeding operations (CAFOs) can pollute the surrounding air with malodorous compounds, bacteria, fungi, and endotoxin. CAFO-related health impacts have been investigated primarily in adults, but children may be at greater risk because of their size and developmental stage. Since children spend considerable time at school, researchers at the University of North Carolina at Chapel Hill conducted an investigation of schools' proximity to swine CAFOs to determine the extent to which students may be exposed to airborne CAFO emissions [***EHP* 114:591–596; Mirabelli et al.**]. They determined that some students may encounter CAFO-associated exposures at school and also found that students of color and of low socioeconomic status were the most likely to be affected.

Compared to people living farther away, residents living near CAFOs report a higher prevalence of headaches and respiratory symptoms such as coughing. One study found that CAFO neighbors experience lower secretion and concentration of an immune system protein during odor episodes; another reported livestock odor as having a negative impact on adult levels of tension, depression, and anger. For children, the closer they live to a CAFO, the greater their risk of asthma symptoms.

CAFOs are disproportionately sited in communities of color and areas of poverty. These populations may be more susceptible to the ill effects of airborne exposures owing to existing health challenges such as higher-than-average disease rates and inadequate health care access.



Sniffing out inequalities. New data show that minority and lower-income students are most likely to encounter odors from swine feedlots near schools.

The study findings are based in part on the geographic locations of swine CAFOs and 339 public schools in North Carolina, a state with significant hog, cattle, and poultry industries. Additionally, personnel from 267 schools completed a 21-item survey that included questions about the frequency and intensity of livestock odors in the schools' indoor and outdoor environments. Publicly available records detailed schools' racial and ethnic composition and the proportion of students participating in the National School Lunch Program, which provides free or reduced-price meals to students from low-income families. Participation in the program served as an indicator of students' socioeconomic status.

Of the 226 schools included in the final analysis, distances between a school and the closest swine CAFO ranged from 0.2 to 42.0 miles. Of these, 29% were within 3 miles of one or more swine CAFOs, 21% reported livestock odors outdoors, and 8% reported noticeable livestock odors indoors. The overall average rating of odor intensity was 2.2 on a scale of 1 to 5; the average rating inside buildings was 2.8. Schools with noticeable odors were more likely attended by students of lower socioeconomic status, regardless of race. Schools with more white students or students of higher socioeconomic status tended to be farther from a swine CAFO.

Although the researchers did not characterize the composition of swine CAFO–associated air pollution or identify specific health-related effects, they conclude that livestock-related odors in and around schools may indicate the presence of hazardous airborne contaminants from nearby CAFOs. Their results confirm and expand previous research describing racial and economic disparities in exposure to CAFO emissions. **–Julia R. Barrett**

One Less Lead Link?

Exposure–Hypertension Association Not Replicated in Young Children

For two decades, scientists have known that lead exposure can induce hypertension in lab animals. More recent studies suggest it might also promote hypertension in adults. But little was known about the metal's effects on blood pressure in children. Now researchers who studied 780 lead-exposed children for five years report seeing no indication that lead raises blood pressure in young children [***EHP* 114:579–583; Chen et al.**].

Lead's most widely documented effects are neurological. Exposure diminishes intelligence and alters behavior. Young children are particularly vulnerable to these effects because their nervous systems are still developing. Children are exposed primarily through paint particles in household dust and outdoor soil contaminated with lead from paint and industrial and motor vehicle emissions. Lead exposure in the United States plummeted after the 1978 ban on lead paint, when the CDC reported that 88% of children aged 1 through 5 had blood lead levels above the level of concern of 10 micrograms per deciliter (μg/dL). By 2000, that rate had dropped to 2.2%.

The researchers originally set out to determine whether treatment with the oral chelating agent succimer would improve lead-exposed children's scores on behavioral and cognitive tests. They recruited 780 children at clinics in Baltimore, Cincinnati, Philadelphia, and Newark. All were between 12 and 33 months of age and had moderately high blood lead levels of 20–44 μg/dL. Succimer was given to 396 children in the randomized, double-blind study. The remaining 384 children were given a placebo.

Succimer lowered blood lead levels dramatically, but there was no change in test scores. So the researchers opted to examine the data for blood pressure changes.

Clinicians had measured the children's blood pressure every time they tested blood lead—immediately before the study and 7, 28, and 42 days after the start of each of three 26-day rounds of treatment. Measurements also were taken every three to four months for five years following treatment.

The only difference noted was a 1-mmHg increase in systolic blood pressure between one and five years after treatment—but only in the succimer group. The researchers considered this change insignificant. Diastolic pressure remained unchanged for both the succimer and placebo groups.

The team acknowledges that lead exposure might still cause hypertension years or even decades after exposure. This, combined with lead's known neurological effects, renders the metal an important contributor to the global burden of disease. **–Cynthia Washam**