

The aim should be to obtain the maximum of well-being with the minimum of consumption. The cultivation and expansion of needs is the antithesis of wisdom.

It is also the antithesis of freedom.

E.F. Schumacher, *Small Is Beautiful* (1973)

LEAD

## Economics of Enforcement

As one of its 467 objectives for improving the health status of Americans by the end of the decade, Healthy People 2010 calls for total elimination of elevated blood lead in children. That goal may be hard to achieve as long as thousands of older, mainly inner-city dwellings remain covered with deteriorating lead-based paint, the primary source of lead exposure for hundreds of thousands of children. But growing evidence shows that, while the cost of remediation may seem high, the cost of doing nothing is far higher.

Elevated blood lead can damage a child's central nervous system, kidneys, and reproductive system, and at higher levels can cause coma, seizures, or death. A strong link has also been shown between low-level lead exposure in early childhood and later decreased cognitive and academic performance. The Centers for Disease Control and Prevention (CDC) currently cites 10 micrograms per deciliter ( $\mu\text{g}/\text{dL}$ ) as its level of concern for blood lead; 25  $\mu\text{g}/\text{dL}$  is considered lead poisoning.

Many municipalities have lead paint abatement laws on the books, but the level of enforcement varies, as does that of abatement required. In areas with strict enforcement, failure to remediate lead-contaminated properties can lead to criminal charges, tort relief for victims, publication of the addresses of contaminated buildings, and notification of other tenants and mortgage- and lienholders. In areas with laxer enforcement, property owners face little incentive to spend the money to clean up their buildings. Yet, a recent econometric study by Mary Jean Brown, then of the Harvard School of Public Health, showed that strict enforcement of lead abatement statutes reaps enormous dividends.

Brown's analysis was based on data she and colleagues collected in a previous study on the effectiveness of lead abatement efforts.

That study, published in the April 2001 *American Journal of Public Health*, looked at 137 homes where children with lead poisoning had lived five years prior. Some of the dwellings were in an area with strictly enforced lead abatement statutes, and the rest were in an area of limited enforcement. In the area of limited enforcement, homes were 4.5 times more likely to house a child with blood lead above 10  $\mu\text{g}/\text{dL}$  than were homes in the strict enforcement area.

In her cost-benefit analysis, published in the November/December 2002 issue of *Medical Decision Making*, Brown applied econometric modeling to those earlier data and found that the expenses incurred in inspection, abatement, medical care, and special education in homes in the limited enforcement area totaled more than \$101,000 over 10 years. In homes in the strict enforcement area, the cost came to less than \$57,000. "The cost of cleaning a

dwelling of lead paint and dust may look expensive initially," says Brown, "but the research demonstrates that given the long-term costs to the families and to society of recurring cases of lead poisoning in buildings where children were lead-poisoned in the past, not doing anything to eliminate lead exposure is far more costly."

Lead poisoning expert Paul Mushak of the Durham, North Carolina, toxicology and risk assessment consultancy PB Associates calls Brown's research a valuable addition to the body of knowledge regarding the economic benefits of strict lead abatement. "This paper clearly has important potential implications for public health policy," he says. "There can no longer be any doubt that tighter lead paint controls are cost-effective."

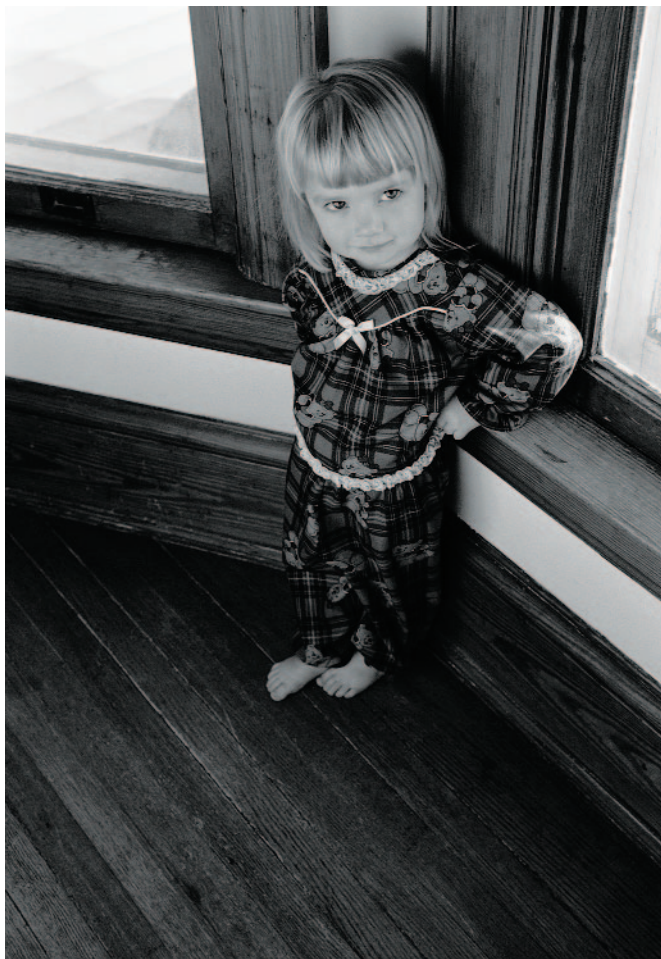
Mushak's only criticism of Brown's work is that it did not incorporate a timeline accounting for the expected life of a house.

Considering the realistic life of the house would only increase the overall savings of major abatement, he says, because the cost of abatement is loaded in up front and will not change materially. "If you extend [the timeline] out to thirty or fifty years for rental properties," he says, "it's going to be an enormous saving above and beyond what Brown has determined."

Mushak also notes that a 1988 Agency for Toxic Substances and Disease Registry report to Congress on childhood lead poisoning in America estimated that at least 10 successive sets of tenant children would likely experience lead poisoning in unremediated rental housing over 50 years.

Brown herself is now in a position to actively work toward the Healthy People 2010 goal. She recently became chief of the CDC Lead Poisoning Prevention Branch and has shifted her focus from research to action. "There are certain houses out there . . . that are truly 'bad actors,'" she says. "We should identify them, and if we could either fix them or [prevent people from living in them], that would be an enormous primary prevention strategy."

—Ernie Hood



**Short-term costs, long-term benefits.** Strict lead abatement and enforcement in contaminated dwellings may save money in the long run when factors such as medical and special education costs are considered.

## GENETIC RESEARCH

## Autism Research Made to Order

Over the past decade, many studies have suggested that the genetic risk for autism is related to several genes, but identification of a known autism susceptibility gene has eluded scientists. Now, using a new statistical method known as ordered-subset analysis (OSA), researchers at the Duke University Center for Human Genetics have linked one type of autistic behavior to a specific gene (*GABRB3*) on chromosome 15. With this study, the researchers have both narrowed a region of interest for future autism studies and shown that OSA is an effective means for mapping disease-susceptibility genes.

“The use of OSA in autism represents just one effort to adapt an analytical strategy in a new and exciting way to maximize the information we can extract from our data,” says Margaret Pericak-Vance, center director and principal investigator of the study, which was published in the March 2003 issue of the *American Journal of Human Genetics*.

Autism, estimated to affect some 1.5 million Americans, has been associated with a number of genes, giving rise to a multitude of variables and making the study of genetic links to autism exceedingly complex. “If only one gene contributes to a disease, all the families you study will have variations of that gene,” explains Ellen Wijsman, a research professor of medicine and biostatistics at the University of Washington. “But if two or three or ten genes are involved, a very small number of families may have variations in a given gene. You may need very large sample sizes to pick up these very weak genetic signals.”

Another problem arises in deciding how to group participants for statistical analysis. “When one is trying to subdivide a sample of families on the basis of a continuous covariate such as [child’s] age or severity of behavior, it can be very difficult to choose and defend cut points,” says Elizabeth Hauser, a statistical geneticist at the Duke center who helped develop the OSA method. Taking an example where age of onset might be analyzed as a variable, she asks, “Is the genetic effect likely to be strongest in the half of families with the youngest age of onset, or the third of families with the youngest age, or the quarter of families with the youngest age?”

Instead of comparing predefined groups, OSA ranks participants on a continuum and automatically selects the group that provides the best match, for example of a trait to a

particular gene. The OSA method was built on a technique used in the mapping of the breast cancer gene *BRCA1*. The OSA software can be downloaded at <http://www.chg.duke.edu/software/osa.html>.

Children with autism can vary greatly in the behaviors they exhibit, and in their ability to communicate and interact with others. The Duke researchers narrowed their search for autism genes by focusing on genetic links to specific autism traits, including repetitive behaviors such as “insistence on sameness,” a character trait defined by Duke child clinical psychologist and report coauthor Michael Cuccaro. In insistence on sameness, children exhibit repetitive compulsions and have a very difficult time adapting to change. An OSA analysis of the 221 children in the Duke study linked the subset of children with the insistence on sameness trait to the *GABRB3* locus on the 15q11-q13 chromosomal region.

The *GABRB3* locus is near genes that encode parts of the receptor for the inhibitory neurotransmitter  $\gamma$ -aminobutyric acid, or GABA. This finding is consistent with previous research implicating this area of chromosome 15 with autism. The functional relationship between *GABRB3* and autism is not well understood, says Cuccaro. “An intuitively appealing hypothesis is that, given the role of GABA in inhibition, a disruption of this system could result in a corresponding problem with behavioral controls.”

Two other neurodevelopmental disorders, Prader-Willi syndrome and Angelman syndrome, have also been linked with damage to the same area of chromosome 15. Both of these syndromes share some symptoms with autism, including language and motor delays, learning disabilities, and behaviors such as tantrums (for Prader-Willi syndrome) and hand-flapping (for Angelman syndrome).

Research linking autism symptoms with specific genes may eventually have implications for treatment, says Cuccaro. “Individuals who have shared clinical features may also have common underlying mechanisms, which in turn may be responsive to certain types of intervention, both biological and psychosocial.”

Duke researchers continue to use OSA in studies of autism and other complex diseases linked to multiple genes, including diabetes mellitus, Alzheimer disease, Parkinson disease, and heart disease. In a study of early-onset heart disease, researchers are using factors including waist circumference and lipid levels in the blood to analyze potential genetic linkages, and with Alzheimer disease, they are analyzing age of onset, says Pericak-Vance. —**Kris Freeman**

## Framework Convention Gains Ground

On 16 June 2003, the WHO Framework Convention on Tobacco Control (FCTC) was opened for signing. Within two months, 47 countries and the European Community had signed, indicating a good faith commitment to ratify the convention (so far, Norway and Sri Lanka have done so). Once 40 countries ratify the convention, it will become law for its signatories.

The convention language was unanimously adopted in May 2003 after four years of tough negotiations. The FCTC addresses tobacco advertising and sponsorships, tax and price increases, labeling, illicit trade, and environmental tobacco smoke. It aims to thwart transnational attempts—such as cross-border advertising and tobacco smuggling—to undermine national legislation on such matters.



## ETS Reduces Vitamin C in Kids

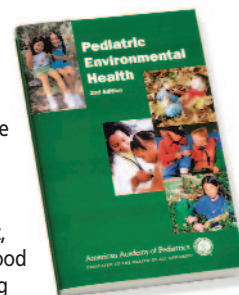
Researchers at the University of Puerto Rico have shown that even very low exposure to environmental tobacco smoke (ETS) can significantly reduce concentrations of ascorbate (a form of the antioxidant vitamin C) in children. Compared to unexposed children who consumed equivalent amounts of vitamin C, children exposed to ETS at home had plasma ascorbate levels that were lower, on average, by 3.2  $\mu\text{mol/L}$ —over one-quarter the reduction seen in smokers themselves. The study appears in the January 2003 *American Journal of Clinical Nutrition*.

The researchers note that ETS-exposed children with marginal intake of vitamin C could be at risk for deficiency-related effects such as slower wound healing and susceptibility to infection. They suggest that such children consume a diet rich in vitamin C or take vitamin C supplements.

## Pediatric Environmental Health Primer

In November 2003 the American Academy of Pediatrics will release the second edition of its *Handbook of Pediatric Environmental Health*, edited by Ruth Etzel. The handbook is geared toward helping clinicians identify, prevent, and treat childhood environmental health problems. The greatly expanded new edition, which is nearly twice as long as the first, includes more than 40 chapters.

Chapters added for the second edition cover arsenic, gasoline and its additives, food irradiation, metals (including chromium, manganese, and nickel), chemical/biological terrorism, and environmental threats specific to developing countries. Each chapter also provides a section of frequently asked questions.





## CHILDREN'S HEALTH

## Green Spaces Raise Chances of Success

Trees and grass in urban settings are known to help mitigate some of the detrimental effects of the built environment, including poor air quality, noise pollution, and heat buildup. Now research by environmental psychologists from the University of Illinois at Urbana-Champaign shows that a view of leafy green spaces also may help inner-city children become more academically successful through increased self-discipline.

Andrea Faber Taylor, Frances Kuo, and William Sullivan measured concentration, impulse control, and ability to delay gratification in 169 black children aged 7–12 who lived in a Chicago public high-rise project. The team chose these three traits because they play a pivotal role in the development of self-discipline and successful outcomes later in life.

In the study, published in the March 2002 *Journal of Environmental Psychology*, some children reported seeing varying amounts of grass and trees from their apartment windows, whereas others saw only pavement. Among the girls, the greener their view from home, the better they concentrated and performed on standard tests of impulse control and delayed gratification. However, no connection was seen between near-home views of nature and the measured traits in boys.



**Room with a view improves prospects.** A greener view at home may help children perform better at school.

Boys may be less affected by trees and grass near their homes because multiple studies have shown they spend less time at home and wander farther than girls. “If we could capture the amount of nature where [boys] spend most of their time, we may find a link between nature and functioning [in them as well],” Taylor says.

This work contributes important new dimensions to the body of research showing the remarkable potential of green spaces, says Stephen Kaplan, a professor of psychology and computer science at the University of Michigan in Ann Arbor. Research by Kaplan and others in the early 1990s linked exposure to nature with fewer sick days and higher job satisfaction among adults, improved attention and scores on proofreading tasks, and faster recuperation among recovering cancer patients. Taylor’s findings bolster the theory that planting trees and grass could improve the quality of life of inner-city children. Moreover, planting trees and grass is relatively inexpensive, compared to many other social support services, such as Medicaid and Head Start. Furthermore, Taylor says, “once [trees and grass] get established, they last.” In comparison, many social services are subject to the

vagaries of politics and funding shortages.

Studies such as Taylor’s have caught the attention of Chicago mayor Richard Daley, who has presided over the planting of 300,000 trees in that city. Chicago contracts with a religious organization that hires indigent people to care for the trees and plants. —Carol Potera

## ASTHMA

## How Safe Are Swimming Pools?

Breathing large doses of chlorine-based disinfectants is known to cause lung damage, but what about smaller levels, such as the 0.02–0.2 parts per million in the air surrounding indoor pools? According to a report in the June 2003 issue of *Occupational and Environmental Medicine*, cumulative exposure to such levels increases the prevalence of asthma, particularly for young children. The likely culprit is nitrogen trichloride (trichloramine), a highly reactive by-product created when chlorine reacts with organic matter such as urine and sweat.

In the three-part study, researchers led by Alfred Bernard, a professor of toxicology at the Catholic University of Louvain in Brussels, took blood samples from 235 Belgian children who attended schools requiring weekly or biweekly swimming. The researchers measured lung-specific proteins—including surfactant-associated

protein A (SP-A) and surfactant-associated protein B (SP-B)—whose presence in the blood is associated with cellular damage.

Cumulative time spent at indoor pools was the independent variable most consistently associated with higher concentrations of SP-A and SP-B. These proteins are produced primarily deep in the lung epithelium, and their rising levels in the blood indicate that epithelial membranes have been damaged. Children with the highest pool attendance over time showed a 50% increase in serum SP-A and SP-B, increases similar to those found in regular smokers and reported by Bernard and colleagues in the November 2002 *European Respiratory Journal*.

In an epidemiological portion of the study, the researchers analyzed data on health status, lifestyle, and pool attendance gathered from 1,881 primary school children. Then they screened the children for asthma and found that total asthma prevalence was significantly correlated with cumulative pool attendance. The strongest association was seen in children in kindergarten and first grade, who showed a correlation of 64% even after adjusting for other

asthma risk factors such as exposure to pets and environmental tobacco smoke.

Finally, the researchers measured changes in blood levels of SP-A and SP-B in 16 children and 13 adults after the subjects spent two hours in and around an indoor pool. Strikingly, after just one hour, the adults’ levels rose significantly, and the children’s rose significantly after two hours. Commenting on the paper, Kaye H. Kilburn, director of the Environmental Sciences Laboratory at the University of Southern California, says, “People who complain of problems after exposure to chlorine are not being overly sensitive. Damage is being done.”

To prevent this damage, Bernard suggests several solutions, such as better ventilation for indoor pool facilities and requiring swimmers to shower before entering the pool, to reduce the amount of by-products created. Better methods for measuring chlorine and its by-products in the air are needed, he says. He adds that if you can detect a strong smell of chlorine in the air, the level is probably too high. He also suggests exploring nonchlorine-based disinfectants such as ozone or copper. —Angela Spivey

ehpnet

## Partnership for Children's Health and the Environment

Compared to adults, children are disproportionately and uniquely vulnerable to environmental toxicants, a reality that the children's environmental health movement has sought to bring to the attention of policy makers and government agencies over the past decade. In 1999, the Children's Health Environmental Coalition and the Institute for Children's Environmental Health convened the Children's Environmental Health Summit. Following that summit, the Partnership for Children's Health and the Environment was formed as a means for building and sustaining the movement's growing momentum. Today this partnership of North American governmental, academic, and community groups has a membership of almost 100 organizations. Its website, located at <http://www.partnersforchildren.org/>, is designed to promote its agenda and to educate the public about children's environmental health issues.



The partnership's guiding principles are set forth on their own separate page of the site. These principles include the rights of children to clean air, food, and drinking water; to healthy homes and other built environments where they spend the majority of their time (such as schools); and to information about health and safety risks that could possibly compromise their health.

The Collaborative Initiatives page provides links to the websites of partnership members and brief overviews of their philosophies and activities. The partnership's membership is far-reaching, including national, state, and local environmental and health advocacy groups; federal agencies; professional associations; academic centers; and international organizations including the Commission for Environmental Cooperation of North America.

The Major Consensus Statements page includes the full text of five important declarations relevant to children's environmental health. These statements, developed by various bodies over the past several years, have done much to focus international attention on the differences between child and adult health effects stemming from environmental exposures and on related issues such as environmental justice. Among the texts available on this page are the statement from the multidisciplinary international work session on the effects of environmental endocrine-disrupting chemicals that was held in Erice, Sicily, in November 1995 and the Declaration of the Environment Leaders of the Eight on Children's Environmental Health that was developed at the May 1997 summit of the environmental ministers of the eight major industrialized countries.

The homepage features a list of links to recently released children's environmental health resources, including reports, educational guides, and new partnership member websites. Recent additions include links to *The Guide to Playgrounds and Arsenic Wood* (a publication of the non-profit Healthy Schools Network) and the Emerging Links series (reports by Physicians for Social Responsibility on environmental contributions to certain chronic diseases). A comprehensive page of pertinent upcoming meetings features summaries of meeting topics and activities as well as links to meeting websites. —Erin E. Dooley

The homepage features a list of links to recently released children's environmental health resources, including reports, educational guides, and new partnership member websites. Recent additions include links to *The Guide to Playgrounds and Arsenic Wood* (a publication of the non-profit Healthy Schools Network) and the Emerging Links series (reports by Physicians for Social Responsibility on environmental contributions to certain chronic diseases). A comprehensive page of pertinent upcoming meetings features summaries of meeting topics and activities as well as links to meeting websites. —Erin E. Dooley

## Labeling Lindane

Each year in the United States, up to 1 million prescriptions are written for lindane lotion and shampoo to treat lice and scabies, mostly in school-age children. To help consumers avoid adverse reactions associated with lindane, which include neurologic symptoms ranging from dizziness to seizures, on 28 March 2003 the FDA issued a public health advisory and announced significant changes in the required labeling of these products.

Labels must emphasize that lindane products should be used with caution in patients weighing less than 110 lbs and are not recommended for infants. Pharmacists must dispense a leaflet with every prescription, and containers are limited to 1- or 2-ounce sizes to avoid misuse or overuse.



## Leaded Gas Out of Africa

In one of the first tangible results of the 2002 World Summit on Sustainable Development, countries across Africa are working to eliminate leaded gasoline from their markets by joining the UNEP-sponsored Partnership for Clean Fuels and Vehicles that was established at that summit. Childhood lead exposure can result in decreased cognitive performance and behavioral problems.

Egypt, Libya, Mauritius, Cape Verde, and Sudan have already fully eliminated leaded gas, and 11 other countries, including South Africa, Mauritania, and Nigeria, have introduced unleaded fuel into their markets and plan to phase out leaded fuel. Many others are developing action plans or have taken other concrete steps toward this goal. UNEP officials foresee that most of the continent will have made the switch to unleaded gasoline by 2008.

## Safer School Buses

The EPA's Clean School Bus USA program aims to reduce diesel exhaust exposure for the 24 million U.S. children who ride school buses and help school bus fleets meet stringent engine standards that take effect in 2007. The program, launched in April 2003, urges policies and practices that eliminate unnecessary bus idling and encourages school districts to retrofit or replace polluting buses. The EPA classifies diesel exhaust as likely to be a human carcinogen.

In support of the new program, Congress and the EPA have earmarked \$25 million for grants to support school districts in efforts to upgrade their bus fleets. Clean School Bus USA is an extension of the agency's Voluntary Diesel Retrofit program, through which more than 130,000 vehicles and engines across the country have been upgraded since 2000.

