Widening the Pool of Factors

Studies Needed to Assess Asthma–Swimming Link

Several epidemiologic studies have suggested an association between childhood asthma and exposure to disinfection by-products (DBPs) in the swimming pool environment. In August 2007 a group of clinicians, epidemiologists, exposure scientists, pool operations experts, and analytical chemists met to discuss the literature on childhood asthma and swimming pools, and to develop recommendations for future research. In a review based on the results of that workshop, the authors state that current evidence, while suggestive, is inconclusive for an association with childhood asthma, and they point to several substantial data gaps that must be filled [***EHP* 117:500–507; Weisel et al.**].

The authors articulate several variables that must be measured in more detail to properly characterize inhalation exposure to chemicals around pools. The review calls for a comprehensive assessment of a substantially larger number of chemicals in the pool area than the limited number of DBPs studied to date. Earlier epidemiologic studies suggested trichloramine as a DBP of interest, but one 2007 study revealed previously unknown volatile DBPs in the air surrounding swimming pools.

A number of variables still must be studied in greater detail to better characterize exposure to pool-related chemicals.

The frequency and extent of exposure to chemicals around pools also must be studied. In research to date, only simple exposure indices have been used, including whether the pool was indoors or outdoors, specific disinfection treatment, whether the child swam in or was simply present at an indoor pool, and cumulative duration of swimming. But to evaluate the breathing rate and DBP dose delivered to the lungs, more detailed, validated assessments of activity levels are needed. To obtain these data, the authors recommend that future studies use prospective questionnaires in which participants report their pool use and activity levels over time as they occur.

The authors also point to the need for studies that define asthma cases in a rigorous, reproducible way, utilizing the International Study of Asthma and Allergy in Children questionnaire. Previous studies have often used clinical diagnoses, but this may be insufficient for epidemiologic studies because asthma is a heterogeneous disease with no single reliable diagnostic test. Additional needs include development and validation of new biomarkers for asthmatic reactivity and studies designed to refine guidelines for proper pool maintenance and disinfection to reduce levels of DBPs.

The authors conclude this research area requires studies across multiple disciplines. Once chemicals of interest are identified, studies of the mechanisms behind the possible association—such as oxidative stress, inflammation, and changes in lung permeability—may be useful. But long-range prospective studies starting in early childhood will be needed to better gauge the relationship between swimming pools and childhood asthma.

Absent conclusive studies, the authors say children's exposures should be minimized. Pool managers must be well educated about pool chemistry so they can understand the potential dangers of disinfectants and DBPs. Swimmers, too, must be educated about the need for proper pool hygiene (for example, showering before swimming and not urinating in the pool), as swimmer hygiene can affect the formation of DBPs and the amount of disinfectant used. –Angela Spivey

It All Adds Up over Time

Cumulative Lead Exposure and Cognition in Older Women

Many older people in the U.S. population were chronically exposed to lead from paint and gasoline prior to the 1980s. To date, most of the research on lead and cognitive functioning in older age has focused on men, despite the fact that women live longer on average and therefore may be more likely to develop dementia over the course of their life span. Now, in a prospective look at a subset of data from the Nurses' Health Study—which began in 1976 and included 121,700 registered nurses aged 30–55 years—researchers report that even low-level cumulative lead exposure may exacerbate cognitive decline in older women [***EHP* 117:574–580; Weuve et al.**].

The study looked at 587 women (now aged 47–74 years) who had undergone bone lead evaluations as part of two studies during the 1990s; to assess long-term exposures, bone lead concentrations were determined at each woman's mid-tibial shaft (shin bone) and patella (kneecap). All but 6 of those individuals had also provided blood samples for assessment of more recent lead exposure.

Trained interviewers conducted telephone interviews an average of 5 years after the lead measurements were taken to obtain cognitive data. The interviewers asked participants to perform a variety of tasks related to memory and verbal abilities.

The researchers found a significant positive association between cognitive deficits and higher lead levels in the tibia but not in the patella or blood. Because the type of bone in the tibia is known to provide a longer record of lead exposure than other tissues, the research points to long-term exposure to lead—but not to current or recent exposures—as the most likely source of deterioration in cognitive functioning in this population. One standard deviation increase in lead exposure produced, on average, as much decrement in cognitive functioning as 3 years of aging in the women in the study.

Lead may damage brain neurons through a range of mechanisms, including oxidative damage and programmed cell death. As the population of older adults grows, it becomes ever more critical to understand ways to ward off dementia. Clues to this understanding may come from studying subtle decreases in cognitive functioning, which, as several researchers have found, often precedes the development of dementia. If other studies confirm the observed relationship between cumulative lead exposure and impaired cognition, measures to minimize exposure or reduce the body's lead burden could have a substantial impact on aging-related cognitive impairment. –David J. Tenenbaum

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Dramatic Devices?

Medical Procedures May Expose Infants to BPA

The industrial chemical bisphenol A (BPA) is widely used to make polycarbonate plastic and epoxy resins. Low-level exposure to BPA has been shown to cause endocrine disruption in animal experiments, resulting in abnormal development of the prostate and mammary glands, among other adverse outcomes. Interpreting these studies with regard to human health has generated substantial debate, one heightened by growing awareness of the widespread nature of BPA exposure. In this report, researchers describe evidence of substantial exposure to BPA and other potential endocrine disruptors through medical treatment of premature infants [***EHP* 117:639–644; Calafat et al.**].

In an earlier study by the same group [*EHP* 113:1222–1225 (2005)], urine samples were collected from 54 premature infants in neonatal intensive care units at two institutions. The infants required medical interventions such as ventilation, enteral feeding, parenteral feeding, and indwelling catheterization. Some of the medical devices used in these procedures contained the plasticizer di(2-ethylhexyl) phthalate (DEHP), and urine sample analysis revealed that concentrations of DEHP metabolites correlated with the relative intensity (low, medium, or high) of medical device use—that is, the variety, invasiveness, and duration of the procedure(s) that each infant underwent.

In the current study, the team used some of those same urine samples to assess exposure to several other potential endocrine disruptors, including BPA, the antimicrobial triclosan, the preservatives methyl paraben and propyl paraben (found in personal care products), and benzophenone-3, a sunscreen agent. For each chemical, urinary concentrations of the free (unmetabolized) and total (both free and conjugated, or metabolized) compounds were measured.

The detection of BPA and both parabens in the urine of all the samples analyzed suggested that all the infants had been exposed to those chemicals. Benzophenone-3 was detected in the urine of all but 2 infants, whereas triclosan was detected in only 8 infants. Urinary concentrations of BPA correlated with those of DEHP, suggesting a common pathway of exposure. Of the chemicals assessed in the current study, only BPA correlated significantly with the intensity of medical device use, although the authors have no information about whether or how BPA is used in these devices.

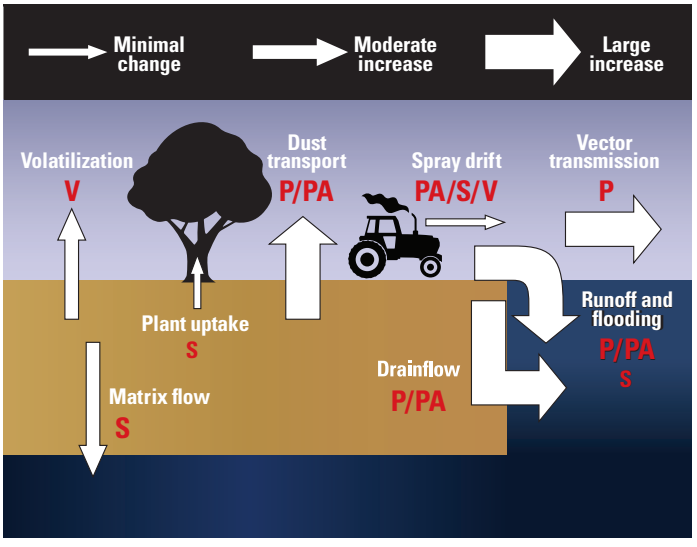
The median urinary BPA concentration in these infants was almost 10 times higher than levels reported elsewhere for 6- to 11-year-old children in the general population. The fact that more than 90% of the BPA was conjugated suggests that premature infants are able to metabolize the compound even though metabolic pathways typically do not function at an adult level for some months after birth. The authors suggest that, given concerns over BPA toxicity and the demonstrated exposure, use of BPA-free products may be justified in this developmentally vulnerable population. –Julia R. Barrett

Climate Change and Agricultural Agents

Planning for Future Interactions

Global climate change is expected to cause increasingly extreme oscillations in atmospheric temperatures as well as increased frequencies and intensities of storms and natural disasters. Other effects may be felt in more indirect ways, such as through altered exposures to chemicals and pathogens whose use and spread, respectively, may shift in response to climate change. Researchers now present various scenarios for potential climate change–related shifts in human exposure to agricultural chemicals and pathogens in the United Kingdom [***EHP* 117:508–514; Boxall et al.**].

A number of potentially hazardous agents are associated with agricultural activities, among them pesticides, fertilizers, pharmaceuticals, plant toxins, and pathogenic bacteria and fungi. Evidence suggests these and other agents travel well beyond farming operations through various channels, resulting in potential human exposure. According to the authors, the main routes of human exposure typically are consumption of food and drinking water, with vector, aerial, and direct contact pathways of less importance for the U.K. population.



P = particulate (e.g., microbes, nanoparticles); PA = particle-associated (e.g., hydrophobic organics, ammonium, heavy metals); S = soluble contaminant (e.g., nitrates, hydrophilic pesticides); V = volatile contaminant (e.g., methane). The size of the letter reflects the importance of the pathway to the agent in question.
Source: Boxall ABA et al. *EHP* 117:508–514 (2009).

Changes in chemical use to accommodate altered crop growing cycles, increased production of naturally occurring mycotoxins, and changes in temperature and precipitation all may contribute to more widespread human exposure to agricultural agents. For instance, more or new pesticides and biocides may be required to offset altered pest activity. This, along with localized increases of dissolved phosphorus and nitrate in drain flow and floodwaters, could lead to more overall exposure via waterways.

Dust released into the atmosphere during tilling and harvesting is a key transport pathway for particulate and particle-bound contaminants, and soil dust has already been linked to a range of human health impacts. The authors predict that hotter, drier summers will lead to increased transfer of surface dust into the environment, and air- and waterborne exposures associated with dust release are likely to be of major public health significance in the future.

Although the authors anticipate a rise in human health hazards associated with climate change–driven exposures to agricultural agents, they believe this rise can likely be managed in large part through research and policy changes such as the development of targeted surveillance schemes for monitoring farm-related pathogens and chemicals, and their health effects, as well as the creation of experimental data sets and models for airborne dust transport and other exposure pathways. –Tanya Tillett