Children in Harm's Way:
Toxic Chemicals Linked to Developmental Disabilities

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Pervasive and insidious toxicological experiments are being conducted on our nation's children, warned authors of a recent national report issued by the Greater Boston Physicians for Social Responsibility (GBPSR). One million children in the United States already have blood lead levels (10 micrograms/dl or above), which can affect their behavior and cognition. Among children examined in one study, 92% had a metabolite of the neurotoxic pesticide, chlorpyrifos, present in their urine. And according to Environmental Protection Agency (EPA) estimates, 1.16 million women of childbearing age eat sufficient amounts of mercury-contaminated fish to pose a risk of harm to their future children.

In Harm's Way: Toxic Threats to Child Development, authored by Ted Schettler, M.D., M.P.H., Jill Stein, M.D., Fay Reich Psy.D., and Maria Valenti, with additions from David Wallinga, M.D., examines the contribution of toxic chemicals to neurodevelopmental, learning and behavioral disabilities in children.

Schettler said the report, available online at www.igc.org/psr/, has both sparked a series of requests for proposals issued by the National Institute of Environmental Health Services (NIEHS) and will serve as the basis of day-long workshops to be conducted at medical colleges and centers throughout the United States.

Vast quantities of neurotoxic chemicals are released into the environment each year, the report authors said. Of the top 20 chemicals reported by the Toxics Release Inventory as released in the largest quantities into the environment during 1997, nearly three-quarters were known or suspected neurotoxicants. Nearly one billion pounds of these neurotoxicants were emitted by facilities onsite directly into the air and surface water, with the potential to be inhaled, absorbed or otherwise ingested through our food and water supplies.

Basic toxicity information is needed, according to the report authors. An estimated 80,000 chemicals are in commercial use in the United States (U.S. Environmental Protection Agency, 1998), with most of them being synthesized since World War II. Yet the GBPSR report found that basic toxicity information is missing from publicly available sources for nearly 75% of the top 3,000 high-production volume substances (Roe et al., 1997).

Lack of Neurotoxicity Data

Neurotoxicity data are even less available. While the EPA has had a validated, accepted guideline for assessing a chemical's toxicity to the nervous system in immature or developing animals since 1991, as of December, 1998, manufacturers had submitted results from this developmental neurotoxicity testing for only 12 chemicals (nine pesticides and three solvents) (Makris et al., 1998). Meanwhile, in 1999, the EPA announced a "data call-in" for 140 pesticides considered to be neurotoxic. It requires manufacturers to conduct and submit tests of acute, subchronic and developmental neurotoxicity to the EPA.

"We know from the few things that we do have a lot of data on, like, lead, mercury, alcohol and nicotine, that the developing brain is extraordinarily sensitive compared to the adult brain, and that exposures during development can have lifelong

impacts," said Schettler, a primary care physician and science director for the nonprofit Science and Environmental Health Network. "Yet, we are failing to require that kind of neurodevelopmental testing in industrial chemicals before they are marketed."

Epidemic of Disabilities

This scarcity of information about the health effects of most commonly used chemicals combined with pervasive human exposures to many toxic chemicals and seriously inadequate regulatory oversight combine to "create a global environmental threat to our children," the report authors contend.

They point to "an epidemic of developmental, learning and behavioral disabilities." Data cited in the report indicates that nearly 12 million children (17%) in the U.S. suffer from one or more learning, developmental or behavioral disabilities. Attention-deficit/hyperactivity disorder affects up to 6% of school children, while learning disabilities affect up to 10%. The incidence of autism may be as high as 2 per 1,000 children, and a California study indicated the number of children entered into the autism registry increased by 210% between 1987 and 1998 (California Health and Human Services Agency, 1998). In Brick Township, N.J., at least 42 children have been identified with autism, more than three times the estimated national average of 1 in 500. The "cluster" has prompted researchers and federal agencies to look for possible environmental causes (Johnson, 1999).

"These disabilities are clearly the result of complex interactions among genetic, environmental and social factors that impact children during vulnerable periods of development," the report authors said. "Toxic exposures deserve special scrutiny because they are preventable causes of harm."

"We have a lot of data on a relatively small number of chemical contaminants in the ambient environment which tell us they can have an impact on brain development and function," Schettler noted. "Some of them physicians are well acquainted with. We tell pregnant women not to drink alcohol or smoke, because we know that has an adverse impact on fetal brain development …But it gets pretty thin after that in terms of what physicians are aware of. They sort of know the lead story, but it is surprising how few are aware of the toxic effects of mercury on brain development and the body of data that's now emerging on pesticides, many of them commonly used in the household and on food."

This lack of awareness may be related to the fact that many of the studies have been conducted within the science of developmental neurotoxicology, said co-author Stein, who is an instructor in adolescent medicine at Harvard Medical School, a practicing physician and co-chair of the Human Health and the Environment Project.

"[Developmental neurotoxicology] is a branch of neuroscience, but it uses a language of its own, so its [research] is not readily available to many people for whom the information is of interest," said Stein. One of the report's goals, she explained, is "to summarize and transfer this very technical body of scientific literature to health care professionals and the public."

The information transfer problem is compounded, Schettler said, because educators, researchers, health care providers and others are not communicating with one another. Clinicians, for example, are talking about syndromes and diagnostic categories, while toxicologists are in the laboratory looking at traits, such as attention deficits, IQ deficits and impulsive behaviors that emerge from exposures to chemicals. For understanding etiology and prevention, Schettler believes it is useful to think in terms of traits and abilities.

"When you start to do the testing of kids with mercury exposures in utero, you find you can identify specific attention deficits or memory problems or problems with language skills, those are the ones that seemed to show up at the lowest levels of exposure for mercury. Now that is worth noting without trying to say, ' Well does this kid have a syndrome we can name?' You can then start to get correlations between the animal data and the human data and …get a better handle on what are the traits that emerge from various levels of exposure at various times during development. Later, it might be useful to package them up into diagnostic categories, but to start there is to create barriers to understanding between disciplines that have not been very helpful."

Metals, Pesticides, Solvents, PCBs

The report summarizes what is known about the neurodevelopmental toxicity of metals (e.g., lead, mercury, cadmium and manganese); pesticides (e.g., organophosphates commonly used in homes and schools); some solvents (e.g. ethanol used in paints, glues and cleaning solutions); dioxin and polychlorinated biphenyls (PCBs) that bioaccumulate in the food chain; and nicotine. It also explores controversies over the potential neurodevelopmental toxicity of compounds intentionally added to drinking water and food (e.g., fluoride and certain food additives). It specifically focuses on how neurotoxic chemicals contribute to developmental delays, hyperactivity, memory loss, attention deficit, learning disabilities and aggressive behavior.

For example, the report cites studies showing that large fetal exposures to methylmercury cause mental retardation, gait and visual disturbances (Grandjean et al., 1997; Harada, 1978). The authors also note that several studies report a relationship between excessive childhood levels of manganese exposure and hyperactivity or learning disabilities (Crinella et al., 1998). Children exposed to a variety of pesticides in an agricultural community in Mexico show impaired stamina, coordination, memory and capacity to represent familiar subjects in drawing (Guillette et al., 1998). Children exposed to PCBs during fetal life showed IQ deficits, hyperactivity and attention deficits when tested years later (Jacobson and Jacobson, 1996).

Other studies reported adverse neurodevelopment impacts resulting from fetal or infant exposures to lead, including lowered intelligence and hyperactivity (Bellinger et al., 1987; Pihl and Parkes, 1977).

Currently, researchers have the most information regarding links between chemicals and learning, intelligence, attention and memory, as that has been the focus of research, said Stein.

"But increasingly, we find relationships emerging between more emotional and behavioral issues [and exposures to chemicals]," she said. "I think we are going to find there may be a toxic, and therefore, preventable contribution to disorders which are distinctly psychiatric."

She cited the progression of lead research as an example.

"When lead first emerged as a problem, which was actually in the early 1900s, we focused on the most apparent problems—coma, encephalopathy and death from lead toxicity. Over the course of several decades, it was found that lower doses of lead could cause IQ problems. More recently, the literature begins to review a strong relationship between lead and attention problems, specifically attention-deficit/hyperactivity disorder, and also with impulsiveness, aggressiveness and dysfunctional social behavior (Needleman et al., 1996; Rice, 1998).

By translating and then disseminating neurodevelopmental toxicity research, the report authors hope that physicians and other health professionals will incorporate the knowledge into their clinical practices.

"There are many ways this information is relevant and useful," Stein said. "When children, for example, come in with attention or learning problems, it is a good idea for them to be screened for exposures that may be contributing to these kinds of problems….It is worth thinking about ongoing lead or pesticide exposure in kids who are having problems."

The report authors are also developing patient handouts on toxic chemical exposure. One, "Protecting Your Child From Toxic Threats to Brain Development: Personal Guidelines for Children, Parents and Future Parents," is posted on the following website: www.igc.org/psr/protect-child.htm. It discusses ways to reduce risks from pesticides, lead, chemicals that accumulate in food, and household products, among others.

What Needs To Be Done

When asked what should be done on a national level to protect our children, Schettler, recommended three first steps.

"We need to require neurodevelopmental evaluations of industrial and other chemicals before marketing. For those that are on the market, they need to be tested," he said.

"Secondly, we have to get the medical community, teachers and others aware of the fact that exposures [to toxic chemicals] during brain development can have a lifelong impact on how the brain functions, and we know enough about many of these to take action to mitigate exposures now.… It doesn't mean that we stop modern society in its tracks and resist all development, but it does mean that there comes a point when evidence is sufficient to take precautionary action to mitigate exposure while we are still coming to a more complete understanding of what the harms might be.

"Then, of course, we need further research, which is what the government agencies are beginning to fund more of…to get a better body of knowledge about exactly how and in what ways the brain is vulnerable to exposures, so we have a better idea of how to pre-empt those from the outset," he said, acknowledging that government agencies are beginning to fund more research.

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