Boys appear to be more vulnerable than girls to the insecticide chlorpyrifos

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A new study is the first to find a difference between how boys and girls respond to prenatal exposure to the insecticide chlorpyrifos. Researchers at the Columbia Center for Children's Environmental Health (CCCEH) at the Mailman School of Public Health found that, at age 7, boys had greater difficulty with working memory, a key component of IQ, than girls with similar exposures. On the plus side, having nurturing parents improved working memory, especially in boys, although it did not lessen the negative cognitive effects of exposure to the chemical.

Results are published online in the journal Neurotoxicology and Teratology.

In 2011, research led by Virginia Rauh, ScD, Co-Deputy Director of CCCEH, established a connection between prenatal exposure to chlorpyrifos and deficits in working memory and IQ at age 7. Earlier this year, a follow-up study showed evidence in MRI scans that even low to moderate levels of exposure during pregnancy may lead to long-term, potentially irreversible changes in the brain. The latest study, led by Megan Horton, PhD, explored the impact of sex differences and the home environment on these health outcomes.

Dr. Horton and colleagues looked at a subset of 335 mother-child pairs enrolled in the ongoing inner-city study of environmental exposures, including measures of prenatal chlorpyrifos in umbilical cord blood. When the children reached age 3, the researchers measured the home environment using the Home Observation for Measurement of the

Environment (HOME) criteria, including two main categories: 1) environmental stimulation, defined as the availability of intellectually stimulating materials in the home and the mother's encouragement of learning; and 2) parental nurturance, defined as attentiveness, displays of physical affection, encouragement of delayed gratification, limit setting, and the ability of the mother to control her negative reactions. The researchers tested IQ at age 7.

While home environment and sex had no moderating effect on IQ deficits related to chlorpyrifos exposure, the researchers uncovered two intriguing findings related to sex differences, albeit of borderline statistical strength: first, that chlorpyrifos exposure had a greater adverse cognitive impact in boys as compared to girls, lowering working memory scores by an average of three points more in boys than girls (96.5 vs. 99.8); and second, that parental nurturing was associated with better working memory, particularly in boys.

"There's something about boys that makes them a little more susceptible to both bad exposures and good exposures," says Dr. Horton. "One possible explanation for the greater sensitivity to chlorpyrifos is that the insecticide acts as an endocrine disruptor to suppress sex-specific hormones. In a study of rats, exposure to the chemical reduced testosterone, which plays a critical role in the development of the male brain."

Going forward, Dr. Horton will look at how sex and the home environment may influence the effects of prenatal exposure to other environmental toxicants, such as those found in air pollution. "I expect this information will be useful in efforts to develop new interventions to protect children from the potentially negative consequences of early exposure to harmful chemicals," says Dr. Horton.

The insecticide chlorpyrifos was widely used in homes until 2001 when

the U.S. Environmental Protection Agency restricted indoor residential use, permitting continued commercial and agricultural applications. Since that time, a drop in residential levels of chlorpyrifos has been documented by Robin Whyatt, DrPH, Co-Deputy Director of CCCEH. The chemical continues to be present in the environment through its widespread use in agriculture (food and feed crops), wood treatments, and public spaces such as golf courses, some parks, and highway medians. People near these sources can be exposed by inhaling the chemical, which drifts on the wind. Low-level exposure can also occur by eating fruits and vegetables that have been sprayed with chlorpyrifos. Although the chemical is degraded rapidly by water and sunlight outdoors, it has been detected by the Columbia researchers in many urban residences several years after the ban went into effect. Many developing countries continue to use chlorpyrifos in the home setting.

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