

Common insecticide used in homes associated with delayed mental development of young children

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When the EPA phased out the widespread residential use of chlorpyrifos and other organophosphorus (OP) insecticides in 2000-2001 because of risks to child neurodevelopment, these compounds were largely replaced with pyrethroid insecticides. But the safety of these replacement insecticides remained unclear, as they had never been evaluated for long-term neurotoxic effects after low-level exposure. In the first study to examine the effects of these compounds on humans and the first evaluation of their potential toxicity to the developing fetal brain, scientists of the Columbia Center for Children's Environmental Health at Columbia University's Mailman School of Public Health found a significant association between piperonyl butoxide (PBO), a common additive in pyrethroid formulations, measured in personal air collected during the third trimester of pregnancy, and delayed mental development at 36 months. Findings from the study are online in the journal, *Pediatrics*.

The study was conducted with a subset of 725 pregnant women participating in a prospective longitudinal study of black and Dominican women living in upper Manhattan and the South Bronx underway at the Columbia Center for Children's Environmental Health (CCCEH). The insecticide permethrin was selected for the evaluation because it is one of the most common pyrethroid insecticides used in U.S. homes, as well as the most commonly sold pesticide, according to a nationally representative sample. PBO, a chemical that is added to insecticides to

increase efficacy was also selected for evaluation. Any detection of PBO in air is a marker of a pyrethroid insecticide application.

In all, 342 women were studied for permethrin exposure in personal air during pregnancy; 272 for permethrin in maternal and umbilical cord plasma; and 230 were evaluated for exposure to PBO. To collect the air samples, mothers from the CCCEH Mothers and Newborns cohort wore a small backpack holding a personal ambient air monitor for 48 hours during the third trimester of pregnancy.

The children of these mothers were evaluated for cognitive and motor development at age three. CCCEH researchers used the Bayley Scales of Infant Development. In evaluating the results, researchers controlled for gender, gestational age, ethnicity, maternal education and intelligence, quality of the home environment, and prenatal exposure to environmental tobacco smoke and chlorpyrifos.

PBO was detected in the majority of personal air samples (75%). While the results demonstrate that a significant prenatal exposure to permethrin in personal air and/or plasma was not associated with performance scores for the Bayley Mental Developmental Index or the Psychomotor Developmental Index at 36 months, children who were more highly exposed to PBO in personal air samples (≥ 4.34 ng/m³) scored 3.9 points lower on the Mental Developmental Index than those with lower exposures.

"This drop in IQ points is similar to that observed in response to lead exposure," said Megan Horton of the Mailman School of Public Health and lead researcher. "While perhaps not impacting an individual's overall function, it is educationally meaningful and could shift the distribution of children in the society who would be in need of early intervention services".

The researchers point out that environmental and biological monitoring of pyrethroid insecticides present certain challenges. "We know most pyrethroid insecticides are difficult to measure in the air because they are not volatile and are difficult to measure in bodily fluids because they are rapidly metabolized, and these difficulties may prevent us from seeing significant associations with neurodevelopmental outcomes," noted Dr. Horton. "Because PBO is volatile and permethrin is not volatile, we would not expect to find a strong association between the two compounds. With the exception of the increased odds of motor delay in the lowest PBO exposure group, prenatal exposure to PBO seems to have an impact on cognitive rather than motor development, which is quite worrisome because mental development scores are more predictive of school readiness."

As this is the first study of these compounds, the results should be considered preliminary but, Dr. Horton notes, they do - raise a cautionary red flag about the use of these chemicals during pregnancy. And, she adds, research at the Columbia Center for Children's Environmental Health, indicates that "integrated pest management and the non-spray application of lower toxicity pesticides are viable alternatives to the use of these spray pesticides for pest control."

"This is an important study with potentially broad public health implications," according to Dr. Robin Whyatt, Mailman School professor of clinical [environmental health](#) sciences and a co-deputy director at the CCCEH. "Further, it identifies a critical need for additional research."

Provided by Columbia University's Mailman School of Public Health

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