

dopamine system—responsible for emotional expression and cognitive function – and increase the risk of attention deficit hyperactivity disorder in children, according to a new Rutgers study.

The research published Wednesday in the *Journal of the Federation of American Societies for Experimental Biology (FASEB J.)*, by Rutgers scientists and colleagues from Emory University, the University of Rochester Medical Center, and Wake Forest University discovered that mice exposed to the pyrethroid pesticide deltamethrin in utero and through lactation exhibited several features of ADHD, including dysfunctional dopamine signaling in the brain, hyperactivity, working memory, attention deficits and impulsive-like behavior.

Attention deficit hyperactivity disorder most often affects children, with an estimated 11 percent of children between the ages of 4-17– about 6.4 million – diagnosed as of 2011. Boys are three to four times more likely to be diagnosed than girls. While early symptoms, including an inability to sit still, pay attention and follow directions, begin between the ages of 3 to 6, diagnosis is usually made after the child starts attending school full time.

Importantly, in this study, the male mice were affected more than the female mice, similar to what is observed in children with ADHD. The ADHD-like behaviors persisted in the mice through adulthood, even though the pesticide, considered to be less toxic and used on golf courses, in the home, and on gardens, lawns and vegetable crops, was no longer detected in their system.

Although there is strong scientific evidence that genetics plays a role in susceptibility to the disorder, no specific gene has been found that causes ADHD and scientists believe that environmental factors may also contribute to the development of the behavioral condition.

Using data from the Centers for Disease Control, National Health and Nutrition Examination Survey (NHANES) the study analyzed health care questionnaires and urine samples of 2,123 children and adolescents. Researchers asked parents whether a physician had ever diagnosed their child with ADHD and cross-referenced each child's prescription drug history to determine if any of the most common ADHD medications had been prescribed. Children with higher pyrethroid pesticide metabolite levels in their urine were more than twice as likely to be diagnosed with ADHD.

These findings provide strong evidence, using data from animal models and humans, that exposure to pyrethroid pesticides, including deltamethrin, may be a risk factor for ADHD, says lead author Jason Richardson, associate professor in the Department and Environmental and Occupational Medicine at Rutgers Robert Wood Johnson Medical School and a member of the Environmental and Occupational Health Sciences Institute (EOHSI).

"Although we can't change genetic susceptibility to ADHD, there may be modifiable [environmental factors](#), including exposures to pesticides that we should be examining in more detail," says Richardson.

Young children and pregnant women may be more susceptible to pesticide exposure because their bodies do not metabolize the chemicals as quickly. This is why, Richardson says, human studies need to be conducted to determine how exposure affects the developing fetus and young [children](#).

"We need to make sure these pesticides are being used correctly and not unduly expose those who may be at a higher risk," Richardson says.

More information: "Developmental pesticide exposure reproduces features of attention deficit hyperactivity disorder." *FASEB J*

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