

## Are genes and environment at root of ADHD?

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A new study indicates that cognitive and behavioral problems that underlie attention deficit hyperactivity disorder (**ADHD**) are due to a complex interplay of genes and the environment. The Cincinnati Children's Hospital Medical Center study is the first to examine how genes, toxins and gender interact to shape ADHD.

"This study shows that certain groups of children have an increased sensitivity to environmental exposures," said Tanya Froehlich, M.D., a physician at Cincinnati Children's and the study's lead author. "More studies like this one are needed to help set exposure standards that adequately protect the most susceptible members of society."

The Cincinnati Children's researchers examined the impact of lead exposure on executive function - the ability to plan and organize activities and behaviors. Executive function is impaired in individuals with ADHD. They particularly wanted to determine whether lead's effects are influenced by an individual's underlying genetic and biological makeup, including the impact of gender and variations in the DRD4 dopamine receptor gene.

The DRD4 receptor helps regulate brain levels of dopamine, a chemical in the brain that is essential for attention and cognition, and variations in DRD4's composition have been linked to ADHD.

The study findings indicate that increasing lead exposure is linked to impairment on a number of executive functions, including planning, memory span and attentional flexibility (the ability to revise one's plan or strategy in the face of obstacles or new information). However, certain genetic and biological factors seemed to predispose an individual to lead's effects. For instance, only children with certain variations of the DRD4 gene seemed vulnerable to lead's adverse effects on attentional flexibility.

"In addition, increasing lead exposure impaired performance in both planning and attentional flexibility in boys more than in girls. This suggests that, for these executive functions, boys are more vulnerable to the adverse affects of lead exposure," Froehlich said. "This is also consistent with the established fact that boys have higher rates of ADHD than girls."

The researchers studied 172 children who were enrolled in a community-based study of low levels of lead exposure. Blood lead levels were assessed during infancy and early childhood. At age 5, children took standardized, ADHD-related executive function tests.

"This study offers a model for examining how genes and environmental toxins interact to shape ADHD and demonstrates that important effects may be obscured or overgeneralized if the joint contributions of these factors are not considered," Froehlich said. "Such studies can help us understand the underlying causes of neuropsychological disorders and why certain groups may be more prone to ADHD than others."

This information was provided by Cincinnati Children's Hospital Medical Center.

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