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Cocaine exposure in the womb: The brain structure is intact but development is off track

September 25 2013

Prenatal cocaine exposure affects both behavior and brain. Animal studies have shown that exposure to cocaine during in utero development causes numerous disruptions in normal brain development and negatively affects behavior from birth and into adulthood.

For ethical reasons, similar studies in humans have been more limited but some research has shown that children exposed prenatally to cocaine have impairments in attention, control, stress, emotion regulation, and memory. Research also suggests that such children may be more predisposed to initiate substance use.

Since adolescence is the typical period in life when substance use begins, researchers from the Yale University School of Medicine, led by Dr. Rajita Sinha, conducted a study to evaluate the gray matter differences and likelihood of substance use in adolescents who were cocaine-exposed prenatally versus those who were not.

To do this, they recruited 42 adolescents between the ages of 14 and 17, exposed in utero, who are part of a long-term cohort that have been followed since birth. They also studied 21 non-cocaine-exposed adolescents for comparison. All of the participants underwent structural neuroimaging scans and answered questions about their use of all kinds of illegal drugs, in addition to submitting urine samples for toxicology analyses.

What they found was concerning, but exactly what they had hypothesized. The adolescents with prenatal cocaine exposure had lower gray matter volume in key brain regions involved in emotion, reward, memory, and executive function, compared with non-exposed adolescents.

Gray matter volume was also associated with initiation of substance use. Astoundingly, each 1-mL decrease in gray matter volume increased the probability of initiating substance use by 69.6% to 83.6% depending upon the region of the brain.

"This study may have an important message for pregnant women who use cocaine. It appears that we need to take a long-term perspective on the risks associated with prenatal exposure to cocaine: people whose brains may appear structurally typical at birth may develop abnormally," said Dr. John Krystal, Editor of *Biological Psychiatry*. "While the significance of these structural changes is not clear, they merit further study."

Gray matter is the part of the nervous system that processes information, and deficits in gray matter are documented in many other disorders, including schizophrenia, anorexia, and childhood attention-deficit/hyperactivity disorder. It is important to note that, as part of the study criteria, these participants had no significant medical or mental illness and differed only in whether their mothers had used cocaine while pregnant.

"Thus, for the first time in children we see how mothers' in-utero cocaine use may translate to brain changes in the offspring that impact cognition, mood and health of the affected offspring later in life," said Sinha. "One can speculate that in the future, with additional validation, such specific brain alterations may serve as biomarkers of risk that can be targeted to prevent drug use and abuse."

More information: The article is "Prenatal Cocaine Exposure and Gray Matter Volume in Adolescent Boys and Girls: Relationship to Substance Use Initiation" by Kenneth Rando, Tara M. Chaplin, Marc N. Potenza, Linda Mayes, and Rajita Sinha (DOI: 10.1016/j.biopsych.2013.04.030). The article appears in *Biological Psychiatry*, Volume 74, Issue 7 (October 1, 2013)

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