Prenatal alcohol exposure damages white matter, the brain's connective network

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One part of the prenatal brain that may be particularly sensitive to alcohol's effects is white matter, nerve fibers through which information is exchanged between different areas of the central nervous system. A recent study has demonstrated that alcohol consumption during pregnancy can alter the microstructural integrity of developing fetal cerebral white matter in the frontal and occipital lobes of the brain. These anomalies may help to explain the executive dysfunction and visual processing deficits that are associated with gestational alcohol exposure.

Results will be published in the March issue of *Alcoholism: Clinical & Experimental Research* and are currently available at Early View.

"The brain's white matter is made up of nerve bundles that transfer information between brain regions," explained Susanna L. Fryer, a researcher at San Diego State University's Center for Behavioral Teratology and corresponding author for the study. "Optimal white-matter integrity is thought to support efficient cognition. So the finding that prenatal alcohol exposure is associated with altered white-matter integrity may help explain aspects of the cognitive and behavioral problems that individuals with fetal alcohol spectrum disorders (FASDs) commonly face."

"Several studies of FASD within the last three years have used a new magnetic resonance imaging (MRI) technique called Diffusion Tensor Imaging (DTI) to examine the brain's connective network – also known

as white matter –in ways not previously possible," added Jeffrey R. Wozniak, assistant professor of psychiatry at the University of Minnesota.

DTI, like other MRI techniques, yields measures of biological tissue status at the microstructural level, allowing scientists to see more subtle forms of damage in the prenatally exposed brain. "Yet despite their sophistication, currently available MRI tools are still very crude instruments with limited sensitivity," said Wozniak. "Abnormalities observed with these tools may represent changes to tens or even hundreds of thousands of brain cells. The fact that these relatively crude measures can actually show clear evidence of abnormalities should serve to highlight that these are actually very large-scale changes that have damaging consequences for the individual."

Fryer and her colleagues used DTI to assess white-matter microstructure in 27 youth, ranging from eight to 18 years of age. The youth were divided into two groups: with (n=15) and without (n=12) histories of heavy prenatal alcohol exposure.

"The brains of individuals with FASDs showed evidence of altered nerve fiber integrity at a microstructural level, even though total brain size was statistically equivalent between alcohol-exposed and comparison participants," said Fryer. "Also, within the alcohol-exposed group, we generally found that white-matter microstructure did not differ based on whether youth met criteria for a diagnosis of fetal alcohol syndrome (FAS). In other words, similar brain alterations and behavioral problems can occur because of prenatal alcohol exposure, with or without the facial features and physical growth insufficiency required to diagnose FAS."

"While previous studies had shown evidence of white-matter abnormalities in FASD, especially in the corpus callosum, a major

bundle of white-matter fibers connecting the right and left halves of the brain," added Wozniak, "this study also showed abnormalities in other brain regions."
Those other regions included white matter tracts in the frontal and occipital lobes of the brain.

"Among other functions, the frontal lobes are important for planning and regulating behavior at an executive level," said Fryer. "Individuals with FASDs may exhibit problems with executive functioning, which can lead to difficulty inhibiting inappropriate or maladaptive responses, impaired attention regulation, and poor judgment and decision making abilities. The occipital lobes are important for processing visual information, and disrupted white matter coherence in these regions may relate to altered visual-spatial abilities in individuals with FASDs."

"One of the most commonly asked questions of researchers in this area is 'What level of alcohol exposure is safe?,'" noted Wozniak. "Unfortunately, this question is impossible to answer for a variety of ethical and scientific reasons. Even more unfortunate is the fact that the public and some physicians conclude without scientific evidence that alcohol consumption during pregnancy is safe as long as it is not 'too much.'"

Conversely, he added, data from imaging studies of this type and from neuropsychological studies of mental skills suggests that FAS is only the tip of the iceberg. "As the technology improves, it seems clear that increasingly subtle forms of brain damage and cognitive deficits will become evident among those exposed to lower levels of alcohol, those who would not have previously been diagnosed with FAS. In other words, one cannot define a 'safe' level of alcohol exposure for the fetus."

"It is likely the cognitive and behavior problems will be the most devastating to affected individuals, and costly to society," Fryer added.

Source: Alcoholism: Clinical & Experimental Research