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Chronic alcohol and marijuana use during youth can compromise white-matter integrity

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Chronic use of alcohol and marijuana during youth is associated with poorer neural structure, function, and metabolism, as well as worsened neurocognitive abilities into later adolescence and adulthood. This may be due to biological and psychosocial transitions occurring during adolescence that impart increased vulnerability to neurotoxic influences. A study of longitudinal changes in fiber tract integrity associated with adolescent alcohol and marijuana use during 1.5 years supports previous findings of reduced white-matter integrity in these youth.

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

"Research has shown differences in the brains of teens who use alcohol and marijuana as compared to teens who do not use these drugs or report only very infrequent, minimal use," said Joanna Jacobus, postdoctoral fellow at the University of California, San Diego as well as corresponding author for the study. "Alcohol and marijuana may have a negative impact by altering important cellular communication in the brain, preventing development of new healthy cells, and/or causing inflammation, which can adversely impact healthy brain development in many ways. For example, the results can lead to changes in brain structure such as volume, and function such as activity."

"The areas of the brain that are composed mostly of connecting axons have been termed 'white matter,' since these areas appear white in color," added Duncan Clark, associate professor of psychiatry at the

University of Pittsburgh Medical Center. "However, prior research has not clearly demonstrated that this white matter disorganization is caused by alcohol or marijuana use. In some studies where adolescents are studied only once, white matter disorganization may have been present prior to alcohol or marijuana use."

"The teen brain is continuing to develop, so many neural systems are not yet fully matured, as compared to adults' brains," said Jacobus. "Brain connections important for inhibiting risky behaviors are still forming, and some youth are more likely to choose immediate effects, such as alcohol or marijuana use, over long-term benefits."

Clark agreed. "Maturation of the brain during adolescence is thought to be the foundation for self-control," he said. "The developing adolescent brain, compared to the fully developed adult brain, is also probably more vulnerable to alcohol neurotoxicity. Adolescents are vulnerable to loss of control and, when this loss of control involves substance use, excessive or risky substance use can have adverse consequences."

For 18 months, the researchers followed 92 adolescents (63 males, 29 females), ages 16 to 20 years, divided into two groups: 41 with extensive alcohol and marijuana use histories by mid-adolescence, and 51 with consistently minimal if any substance use. Participants were part of an ongoing longitudinal study of substance use in adolescence with teens recruited from local schools from 2005 to 2007. Both groups received diffusion tensor imaging and detailed substance use assessments, along with toxicology screening, at baseline and 18-month follow-ups – 182 scans in all – as well as interim substance-use interviews every six months.

"We found evidence for poorer white matter tissue health in teens who engage in heavy alcohol and marijuana use compared to those who abstain," said Jacobus. She noted that white matter, the "information

highway of the brain," allows for quick and efficient communication between brain regions. Compromised white matter can mean slower cognitive processing and poorer cognitive performance such as memory, attention, and decision-making.

"As to whether there were differences in these teens before they began using alcohol and marijuana is difficult to determine, but we found that increasing alcohol use over 1.5 years in late adolescence was related to a decline in white matter health 18 months later, supporting a negative effect of alcohol use on the brain despite potential pre-existing differences," Jacobus said.

"White matter organization was particularly compromised in an area called the superior longitudinal fasciculus," added Clark. "This is one of the major connection roadways in the brain. When the connections between brain areas are severely damaged, those areas of the brain cannot properly function. While the more subtle deficit shown here may impair functioning, the degree of deficit involved is not likely to be obvious in day-to day functioning. However, we are concerned that even these subtle deficits in brain microstructure may lead to diminished self-control."

"Our findings underscore that early initiation of alcohol and marijuana use can have negative implications on the brain" said Jacobus. "We hope this information can be communicated to teens to help them understand why drinking during adolescence is discouraged. In the future, biomarkers such as tissue health may help identify teens that are particularly vulnerable for engaging in riskier behaviors such as drinking."

Provided by Alcoholism: Clinical & Experimental Research