Underage binge drinking can create lasting brain changes

April 4 2011

Adolescents represent the majority of people who binge drink. This may come as a surprise to some, but recent surveys indicate that episodes of heavy alcohol drinking within the previous two weeks are reported by 12 percent of 8th graders, 22 percent of 10th graders, 28 percent of 12th grade seniors and 44 percent of college students.

Human adolescence, roughly between 12 to 20 years of age, marks a critical period for brain development. This is when the growth of the cortex, our gray matter, reaches a peak and is coupled with major rearrangements of neurons. Some guess that such brain remodeling during development help us adapt to life's demands as we mature toward adulthood.

"It's also a time when the brain's developing neural circuits are more sensitive to disruption," said Fulton Crews, PhD, professor of pharmacology and director of the Bowles Center for Alcohol Studies at the University of North Carolina at Chapel Hill School of Medicine. "And we and others have shown that the growing adolescent frontal cortex is much more sensitive to damage than the adult frontal cortex, given the same amount of alcohol.

"The question is, what impact does alcohol binge-drinking in the teen years have on the brain and how might that affect our lives as adults?"

For more than a decade, Crews' research has explored the mechanisms, characteristics and functional consequences of binge drinking on the

brain. His latest findings in laboratory mice, reported in the April issue of the journal *Alcoholism: Clinical and Experimental Research*, point to the kind of subtle but persistent alterations in the brain's frontal cortex that could affect decision-making and related behaviors in human adults.

Among the changes associated with adolescent alcohol binge drinking, magnetic resonance imaging (MRI) revealed smaller forebrain volume and size in adult animals. In separate reversal learning experiments, the animals also showed much less behavioral flexibility compared to those not exposed to alcohol."

Neurotransmitters are the workhorse chemicals which allow the transmission of signals from one neuron to the next across nerve endings. The study revealed reductions in the activity of some major neurotransmitter genes at 24 hours after alcohol binge in adolescent animals. As adults, the animals showed even greater reductions, averaging 73 percent.

"Our findings suggest that human individuals who drink heavily during adolescence may be more likely to have deficits in being able to adapt successfully to changing life situations as adults, possibly tied to chemical and or structural changes in the frontal cortex," Crews said. "This is the part of the brain that allows us to predict consequences of our actions, control our impulses, refine our reasoning, and evaluate long- and short-term rewards."

Crews points out that just because the brain changes observed in his experiments are subtle, implications for individuals with a binge-drinking history may be immense.

"There is no discussion about the long-term consequences of underage drinking. There's discussion about alcohol intoxication risks during this transient period of life, because it's clear that kids who are driving are

more likely to have accidents, or kill themselves, or engage in other inappropriate behaviors," he said. "But no one talks about how you might become a less intelligent, moody, or impulsive individual."

As Crews suggests, getting into an impulsive fight resulting in legal consequences, jail time, can change one's life course. "You might be more likely to tell your boss he's a jerk, and that could affect the course of your life. But while these subtle brain changes are not making you a monster, they're making you a less talented person or a person more prone to do stupid things whether you're drinking or not."

Provided by University of North Carolina School of Medicine