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Liability of Youthful Alcohol Misuse

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The longitudinal brain imaging study by Meda *et al.* (1) conducted in 146 college freshmen (18–23 years of age at study entry) presents novel findings that confirm our concerns regarding the toll excessive drinking takes on late adolescent/early adult brain structure and function. Students volunteered for magnetic resonance imaging scanning as freshmen and 2 years later. In the interim, they completed monthly surveys regarding alcohol use, answering how often and how much they drank. Students were also asked whether and how often they had experienced “memory blackouts,” defined by answering in the affirmative, “Have you ever had blackouts when you didn’t pass out while drinking, that is, you drank enough so that the next day you couldn’t remember things you had said or done?” Some call this “drinking to oblivion,” which can occur with “extreme bingeing”—that is, consuming at least 8 drinks for women and 10 for men on a single occasion, often within a few hours (<https://www.niaaa.nih.gov/alcohol-health/overview-alcohol-consumption/moderate-binge-drinking>). The authors used this information together with reports of drinking amounts and frequency in the 2-year interval to devise an alcohol use index. They found that students with a higher alcohol use index had a greater volume loss in selective regions of the hippocampus. The functional ramifications of this relation were underscored by the additional relation: the greater the hippocampal shrinkage, the worse the performance on a memory test for learning word lists at the end of the study. Further support for alcohol as the culprit underlying hippocampal shrinkage and its most celebrated function of memory consolidation was the relation between greater hippocampal volume decline and more memory blackouts.

College drinking is a fact. According to the National Institute on Alcohol Abuse and Alcoholism (<https://pubs.niaaa.nih.gov/publications/CollegeFactSheet/CollegeFact.htm>), “almost 60 percent of college students ages 18 to 22 drank alcohol in the past month, and almost 2 out of 3 of them engaged in binge drinking during that same timeframe,” and a decade ago, an estimated 20% of college students met criteria for alcohol use disorder (<http://www.samhsa.gov/data/sites/default/files/NSDUH-DetTabs2014/NSDUH-DetTabs2014.htm#tab6-88b>, 89b) (Figure 1). In addition to physical assault, sexual assault, and academic problems, extreme drinking can cause alcohol poisoning, which has no antidote and is life-threatening (2). Yet drinking to blackout is a goal, an achievement, the prize of partying embraced more by college students than by college-age youth not attending

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college. A recent survey of individuals 18 years of age and older in the United States found that 13% reported extreme bingeing and 5% reported drinking three times the binge amount (2). The near-death experience of extreme bingers who “live to forget” puts them in jeopardy of other serious injury, including falling (commonly from balconies), drowning, and having vehicular accidents, not to mention endangering unsuspecting bystanders, a dreaded outcome emphasized by Mothers Against Drunk Driving, who note that drunk driving is the leading cause of roadway deaths (<https://www.madd.org/>).

Remarkably, a position held by a segment of parents who send their children off to college “to learn how to drink” in an apparently safe environment needs to be challenged. First, a recent large-scale study conducted in nearly 2000 Australia adolescents and their parents over a 5-year period found that youth who reported parentally supplied alcohol had higher odds ratios of bingeing, alcohol-related harm, and alcohol use disorder symptoms than youth obtaining alcohol from non-parental sources (3). Second, in the United States, the legal drinking age is 21 years; thus, the typical college student, who is 18 to 20 years of age, drinks illegally. In turn, parents, those in loco parentis, or others can be held responsible for the behavior of minors that causes alcohol-related material damage, personal injury, or death. Recognizing this liability, some colleges have banned student parties with alcohol on campus and offer education about drinking prevention, policy, and intervention to students, faculty, and administrators (e.g., <https://www.collegedrinkingprevention.gov/>).

Meda *et al.* (1) report novel, rigorously collected, prospective, quantitative data on drinking behavior, brain structural integrity, and memory performance in a large sample of college students. With longitudinal follow-up of these youth into middle and older age, they might test the hypothesis that youthful bingeing with its effects on hippocampal structure and mnemonic function increases the risk of accelerated aging and dementia. Hazardous drinking might ultimately be considered a type of closed-head injury. The effect of repeated episodes could be analogous to repeated concussions in sport that have resulted in a high incidence of chronic traumatic encephalopathy (4) or reflect other mild to severe traumatic brain injury incurred in youth that were recently found to be a significant risk factor for later-life dementia (5).

Animal models provide evidence that the hippocampus is particularly vulnerable to the damaging effects of high alcohol exposure during adolescence that are potentially long lasting. Among the functions disturbed is hippocampal neurogenesis, which serves to maintain structural integrity, plasticity, and circuitry. Although new neurons were formed in alcohol-exposed adolescent rats a week after a 4-day “binge,” the neurons resided in abnormal locations, suggesting compromised ability for incorporating them into functional neurocircuitry; notably, these ectopic cells occurred in rats exhibiting severe withdrawal symptoms (6). In addition, disturbed hippocampal neurogenesis can persist into adulthood in rodent models (7). Consistent with these animal studies, postmortem genetic study of human hippocampal tissue revealed downregulation of genes involved in neurogenesis of alcoholic cases relative to control subjects (8). Could anomalous hippocampal neurogenesis occur in college bingers and initiate a latent process contributing to premature age-related hippocampal shrinkage and memory decline?

As emphasized by Alcoholics Anonymous, the first step in dealing with drinking is overcoming denial. It is time to recognize that youthful drinking is highly prevalent, and that extreme bingeing is soaring with tragic outcomes. Critically, Meda *et al.* (1) provide new evidence for the need to educate youth, parents, and school administrators regarding the measurable untoward effects of young adult drinking on the brain and its functions. We have suspected and even assumed these brain structure-function-behavior relations for years, but we now have the data, which provide a solid basis for concluding that drinking heavily in college has the potential of jeopardizing scholastic success. Given their prospective investigation to date, the authors are in a unique position to extend their follow-up of these students to address questions about the possibility of recovery with no-to-low drinking, cumulative deficits with continued drinking, and postgraduate outcomes after college drinking: how long will it take to recover alcohol-related hippocampal volume loss and memory function [e.g., (9)]? What other brain systems and functions are also disrupted with initiation of heavy drinking [e.g., (10)]? What toll does extreme drinking have on college performance and postgraduate scholastic or professional achievement? Is hazardous drinking during college a risk factor for later-life dementia? Youth are smart and educable—we need to equip them with data for harm reduction and healthy living.

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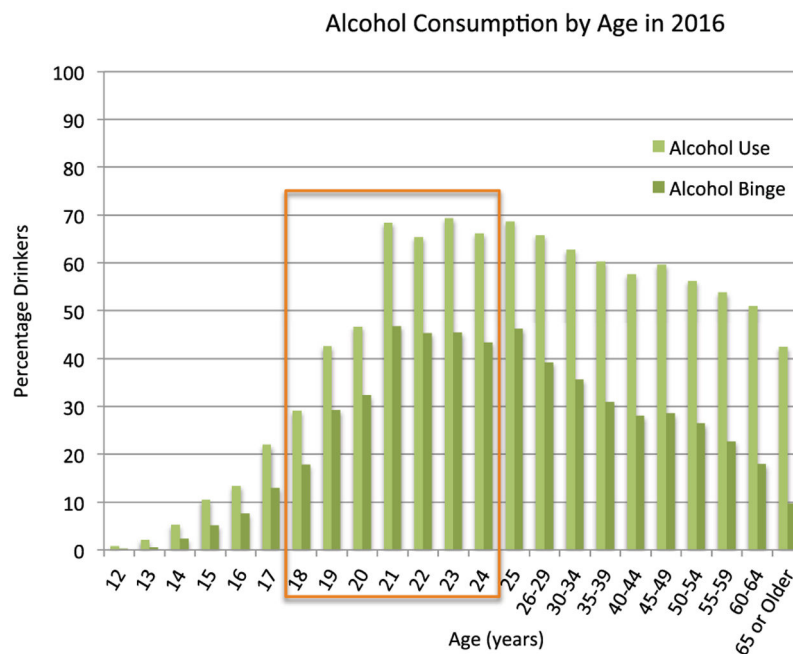


Figure 1.

Alcohol consumption by age in 2016. Bars represent percent-age of people drinking at age bands from 12 to 65 years of age and older. The light green bars denote all alcohol drinkers, and the dark green denote alcohol binge drinkers. The orange box encompasses the ages studied at baseline by Meda *et al.* (1). Data from Substance Abuse and Mental Health Services Administration, Center for Behavioral Health Statistics and Quality, National Survey on Drug Use and Health, 2015 and 2016, Table 2.20B (<https://www.samhsa.gov/data/sites/default/files/NSDUH-DETabs-2016/NSDUH-DETabs-2016.pdf>).