



As adolescents mature, they undergo complex developmental changes, especially in their brains. The widespread changes in the organization and functioning of the brain—which continue into a person’s mid-20s—bring about the cognitive, emotional, and social skills necessary for adolescents to survive and thrive. The nature of these rapid changes may also increase the adolescent brain’s vulnerability to alcohol exposure.

Patterns of Adolescent Drinking

People often begin to drink alcohol and use other substances during adolescence. About 34.4% of people ages 12 to 20 reported having tried alcohol at least once in their lifetime.¹

Although adolescents tend to drink alcohol less often than adults, they tend to drink more when they do drink. According to the 2021 National Survey on Drug Use and Health (NSDUH), approximately 8.3% of people ages 12 to 20—or 3.2 million—reported [binge drinking](#) in the past month.^{1,2}

Relationship Among Adolescent Risk-Taking, Brain Plasticity, and Drinking

Adolescents are motivated to explore and take risks. These learning experiences, complemented by the adolescent brain’s increased ability to readily change in response to experiences (also known as *brain plasticity*), are key to developing the skills and knowledge to become independent. Although this increase in brain plasticity and risk-taking can provide incredible opportunities for learning and personal growth, it also makes adolescents more vulnerable to both the short-term and long-term negative effects of alcohol.³

For example, a sizable body of research links the early initiation of alcohol use to unsafe alcohol-related behaviors.³ In general, [underage drinking](#) can lead adolescents to make poor decisions and engage in potentially harmful behavior (e.g., drinking and driving, unsafe sexual behavior, and other substance use) that can result in a range of negative consequences, such as injuries, sexual assaults, and even death.

Research suggests that the patterns in adolescent brain development may increase the likelihood of adolescents engaging in unsafe behaviors, such as alcohol use.³ For example, the systems of the brain that respond to rewards and stressors are very active in adolescence.



Drinking Levels Defined

Binge Drinking: The National Institute on Alcohol Abuse and Alcoholism (NIAAA) defines [binge drinking](#) as a pattern of drinking alcohol that brings blood alcohol concentration (BAC) to 0.08%—or 0.08 grams of alcohol per deciliter—or more. This typically happens if a woman has four or more drinks, or a man has five or more drinks, within about 2 hours. However, research shows that fewer drinks in the same time frame are necessary to reach the same BAC in adolescents (compared to adults): only three drinks for adolescent females and three to five drinks for adolescent males, depending on their age and size.¹⁰

Heavy Drinking: NIAAA defines heavy drinking for men as more than four drinks on any day or more than 14 drinks in a week and for women as more than three drinks a day or more than seven drinks per week.

Meanwhile, the areas of the brain involved in planning and decision-making (the prefrontal cortex) are the last areas to mature, typically at least into the mid-20s.⁴

Scientists have found that alcohol causes less sedation (sleepiness) and smaller impairments in balance and muscle coordination in adolescent rodents than adult rodents.³ If this research holds true for humans, it could put adolescents at even greater risk of harm from alcohol by allowing them to continue drinking and reach higher blood alcohol levels despite impairments in decision-making and impulse control.

Link Between Childhood Trauma and Later Alcohol Misuse

Research suggests that youth who have experienced childhood trauma may have disrupted growth in brain regions and patterns of connections between brain regions that may make them more likely to engage in binge drinking during adolescence.^{10,15}

Immediate Effects of Alcohol on the Brain and Behavior

In adults, drinking alcohol impairs decision-making and impulse control, and can lead to a range of negative consequences. For adolescents, drinking alcohol can make it even more difficult to control impulses and make healthy choices. In both adolescents and adults, drinking also compromises the ability to sense danger by disrupting the function of a brain region called the amygdala. Alcohol often produces rewarding feelings, such as euphoria or pleasure, that trick the brain into thinking the decision to drink alcohol was a positive one and that motivate drinking again in the future.

If a person drinks enough, particularly if they do so quickly, alcohol can produce a blackout. [Alcohol-induced blackouts](#) are gaps in a person's memory for events that occurred while they were intoxicated. These gaps happen because alcohol temporarily blocks the transfer of memories from short-term to long-term storage—a process known as *memory consolidation*—in a brain area called the hippocampus.

Alcohol-related blackouts are quite common among adolescents. In one study, 1 in 5 older adolescents who ever drank alcohol reported an alcohol-induced blackout in the previous 6 months.⁵

Even a small amount of alcohol can cause subtle memory impairment while a person is drinking. The more alcohol a person consumes, the more significant the memory impairment.⁶

Longer-Term Effects of Alcohol on the Brain and Behavior

In some people, a history of adolescent alcohol use could increase a person's likelihood of developing [alcohol use disorder](#) and is associated with mental health disorders such as anxiety and depression during adolescence and later in life.^{7,8,9}

More and more research suggests that drinking alcohol in adolescence may have significant effects on brain function. The earlier people start drinking alcohol, the more likely they are to experience a measurable impact on cognitive functions, memory, and school performance over time—perhaps even into adulthood.^{10,11}

Alcohol misuse during adolescence—generally measured by a history of binge drinking or alcohol use disorder diagnosis—has been linked to changes within and between brain regions.¹² For example, researchers have found reductions in the size of the frontal lobe (involved in planning and decision-making), hippocampus (involved in learning and memory), amygdala (involved in fear-sensing), and corpus callosum (involved in the communication between the two sides of the brain).^{10,13} Researchers have also found that heavy drinking changes the normal developmental patterns in the connections between and within brain regions, and weakens connections between brain areas that regulate emotional and cognitive functioning.^{4,13}

The good news is that the special ability of the brain to change with experience during adolescence seems to also lend itself to recovery from some alcohol-induced changes.⁴

What Can We Do?

The more we know about how alcohol affects the adolescent brain, the more we can inform the conversations about alcohol that we have with teens.

Parents and teachers play a major role in the way adolescents think about alcohol. Research demonstrates, for example, that children whose parents allow them to drink are more likely to quickly transition from their first drink to unhealthy patterns of drinking, such as binge drinking.¹⁴

Through regular conversations about alcohol and by parents being a positive role model with their own drinking, parents can shape kids' attitudes about alcohol and set them up to make healthy choices.

For more information on alcohol and the brain, please visit:
niaaa.nih.gov/publications/niaaa-resources-alcohol-and-brain

According to the Substance Abuse and Mental Health Services Administration (SAMHSA), caution should be used when comparing estimates from the 2020 and 2021 NSDUH to those from prior years due to methodological changes. Prior to the COVID-19 pandemic, data for NSDUH were collected during in-home visits, using computer-assisted techniques. The COVID-19 pandemic necessitated a delay in data collection during 2020 and the introduction of web-based data collection, with very limited in-person data collection. Because these changes in data collection coincided with the spread of the COVID-19 pandemic and any related behavioral or mental health changes, we cannot fully separate the effects of methodological changes from true changes in the outcomes. Please see the [Methodological Summary and Definitions](#) for more information.

1. SAMHSA, Center for Behavioral Health Statistics and Quality. 2021 National Survey on Drug Use and Health. Table 2.44B—Alcohol use in lifetime, past year, and past month and binge alcohol and heavy alcohol use in past month: among persons aged 12 to 20; by demographic characteristics, percentages, 2021. Available from: <https://www.samhsa.gov/data/sites/default/files/reports/rpt39441/NSDUHDetailedTabs2021/NSDUHDetailedTabs2021/NSDUHDetTabsSect2pe2021.htm#tab2.44b>
2. SAMHSA, Center for Behavioral Health Statistics and Quality. 2021 National Survey on Drug Use and Health. Table 2.44A—Alcohol use in lifetime, past year, and past month and binge alcohol and heavy alcohol use in past month: among people aged 12 to 20; by demographic characteristics, numbers in thousands, 2021. Available from: <https://www.samhsa.gov/data/sites/default/files/reports/rpt39441/NSDUHDetailedTabs2021/NSDUHDetailedTabs2021/NSDUHDetTabsSect2pe2021.htm#tab2.44a>
3. White A, Hingson R. A primer on alcohol and adolescent brain development: implications for prevention. In: Sloboda Z, Petras H, Robertson E, Hingson R, editors. Prevention of substance use: advances in prevention science. New York City, Springer Cham; 2019, p. 3-19.
4. National Academies of Sciences, Engineering, and Medicine; Health and Medicine Division; Division of Behavioral and Social Sciences and Education; Board on Children, Youth, and Families; Committee on the Neurobiological and Socio-behavioral Science of Adolescent Development and Its Applications. The promise of adolescence: realizing opportunity for all youth. Backes EP, Bonnie RJ, editors. Washington: National Academies Press; 2019. 473 p. PubMed PMID: [31449373](#)
5. Hingson R, Zha W, Simons-Morton B, White A. Alcohol-induced blackouts as predictors of other drinking related harms among emerging young adults. Alcohol Clin Exp Res. 2016;40(4):776-84. PubMed PMID: [27012148](#)
6. White AM. What happened? Alcohol, memory blackouts, and the brain. Alcohol Res Health. 2003;27(2):186-96. PubMed PMID: [15303630](#)
7. Jennison KM. The short-term effects and unintended long-term consequences of binge drinking in college: a 10-year follow-up study. Am J Drug Alcohol Abuse. 2004;30(3):659-84. PubMed PMID: [15540499](#)
8. Chassin L, Pitts SC, Prost J. Binge drinking trajectories from adolescence to emerging adulthood in a high-risk sample: predictors and substance abuse outcomes. J Consult Clin Psychol. 2002;70(1):67-78. PubMed PMID: [11860058](#)
9. Ning K, Gondek D, Patalay P, Ploubidis GB. The association between early life mental health and alcohol use behaviours in adulthood: a systematic review. PLoS One. 2020;15(2):e0228667. PubMed PMID: [32069303](#)
10. Chung T, Creswell KG, Bachrach R, Clark DB, Martin CS. Adolescent binge drinking: developmental context and opportunities for prevention. Alcohol Res. 2018;39(1):5-15. PubMed PMID: [30557142](#)
11. SAMHSA. Report to Congress on the prevention and reduction of underage drinking. Washington: U.S. Department of Health and Human Services; 2018. 165 p.
12. Tapert SF. Alcohol and the adolescent brain—human studies. Alcohol Res Health. 2004;28(4):205-12. PMID: [PMC6601673](#)
13. Phillips RD, De Bellis MD, Brumback T, Clausen AN, Clarke-Rubright EK, Haswell CC, Morey R. Volumetric trajectories of hippocampal subfields and amygdala nuclei influenced by adolescent alcohol use and lifetime trauma. Trans Psychiatry. 2021;11(1):154. PubMed PMID: [33654086](#)
14. Staff J, Maggs JL. Parents allowing drinking is associated with adolescents' heavy alcohol use. Alcohol Clin Exp Res. 2020;44(1):188-95. PubMed PMID: [31750959](#)
15. Silveira S, Shah R, Nooner KB, Nagel BJ, Tapert SF, de Bellis MD, Mishra J. Impact of childhood trauma on executive function in adolescence—mediating functional brain networks and prediction of high-risk drinking. Biol Psychiatry Cogn Neurosci Neuroimaging. 2020;5(5):499-509. PubMed PMID: [32299789](#)

