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Binge Drinking, Other Substance Use, and Concurrent Use in the U.S., 2016–2018

Marissa B. Esser, PhD, MPH¹, Cassandra M. Pickens, PhD, MPH², Gery P. Guy Jr, PhD, MPH², Mary E. Evans, MD, MPH²

¹Division of Population Health, National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention, Atlanta, GA.

²Division of Overdose Prevention, National Center for Injury Prevention and Control, Centers for Disease Control and Prevention, Atlanta, GA.

Abstract

Introduction: The use of multiple substances heightens the risk of overdoses. Multiple substances, including alcohol, are commonly found among people dying of overdoses. However, associations between alcohol use and the use of a range of other substances are often not assessed. Therefore, this study sought to examine associations between drinking patterns (e.g., binge drinking) and other substance use in the U.S., the concurrent use of alcohol and prescription drug misuse, and how other substance use varies by binge drinking frequency.

Methods: Past 30-day alcohol and other substance use data from the 2016–2018 National Survey on Drug Use and Health were analyzed among 169,486 U.S. respondents aged 12 years, analyzed in 2020.

Results: The prevalence of other substance use ranged from 6.0% (non-drinkers) to 24.1% (binge drinkers). Among people who used substances, 22.2% of binge drinkers reported using substances in two additional substance categories. Binge drinking was associated with 4.2 (95% CI: 3.9, 4.4) greater adjusted odds of other substance use compared with non-drinking. Binge drinkers were twice as likely to report concurrent prescription drug misuse while drinking than non-binge drinkers. The prevalence of substance use increased with binge drinking frequency.

Conclusions: Binge drinking was associated with other substance use and concurrent prescription drug misuse while drinking. These findings can guide the implementation of a comprehensive approach to prevent binge drinking, substance misuse, and overdoses. This might include population-level strategies recommended by the Community Preventive Services Task Force to prevent binge drinking (e.g., increasing alcohol taxes, regulating alcohol outlet density).

Corresponding author: Marissa B. Esser, PhD, 4770 Buford Hwy NE, Mailstop S107-6, Atlanta, GA 30341. Phone: 770-488-5463; Fax: 770-488-5965; messer@cdc.gov.

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Introduction

More than 67,000 people died by drug overdose in the United States in 2018.¹ Polysubstance use (i.e., the use of multiple psychoactive substances) is common among people dying of overdoses, including co-occurring use of opioids and benzodiazepines, cocaine, methamphetamine,² or alcohol.^{3,4} Concurrent use of alcohol with other substances (e.g., opioids and benzodiazepines) heightens the risk of fatal and nonfatal overdoses by affecting the central nervous system and increasing respiratory distress, by changing the metabolism of alcohol or the other substance, or both.^{5,6} One study found that alcohol contributed to 15% of opioid-related deaths in 2017.⁴ Another study showed that about 22% of emergency department (ED) visits due to prescription drug misuse also involved alcohol.⁷ The estimated proportion of ED visits related to prescription drug misuse involving alcohol was higher than the estimated proportion involving any single substance, including illicit substances.

Studies on alcohol as a correlate of health risk behaviors and adverse outcomes have shown that people who drink excessively, including binge drinking (consuming 5 drinks for males or 4 drinks for females, on an occasion, increasing one's blood alcohol concentration to 0.08 g/dL) are more likely to report other substance use.^{8–10} This increases the chance of overdose,⁶ engaging in risky sexual behavior,¹¹ experiencing violence and incurring injuries,¹² and developing chronic diseases.¹³ However, binge drinking is seldom assessed as a risk factor for the use of a wide range of other substances. One such study among youth aged 12–17 years found that binge drinkers were almost 10 times more likely than non-drinkers to report marijuana use and almost 8 times more likely to report use of illicit substances other than marijuana.¹⁴

Studies have documented polysubstance use among specific populations.^{15,16} However, further research could help to characterize the association between binge drinking and other substance use in the general U.S. population, which might contribute to the development of a comprehensive approach for preventing excessive alcohol use and substance misuse, and potentially drug overdoses involving alcohol too. Therefore, the primary objective of this study was to examine associations between drinking patterns and the use of a range of other psychoactive or illicit substances including cannabis (referred to as marijuana), prescription pain reliever misuse, heroin, prescription tranquilizers, stimulants, and hallucinogens in the U.S. This study also assesses the concurrent use of alcohol and misuse of prescription drugs (i.e., pain relievers, tranquilizers, sedatives, stimulants) and how other substance use varies by the frequency of binge drinking.

Methods

Study Sample

The National Survey on Drug Use and Health (NSDUH) is a nationally representative, cross-sectional household survey of the U.S. non-institutionalized civilian population aged 12 years, conducted by the Substance Abuse and Mental Health Services Administration. NSDUH uses complex multi-stage probability sampling to obtain a nationally representative sample of the U.S. population residing in the 50 states and Washington, DC. NSDUH

respondents complete in-person computer-assisted interviews. Survey questions focus on alcohol and other substance use, sociodemographic characteristics, and mental health history. Respondents receive \$30 as compensation for completing the survey. Data were pooled from the 2016, 2017, and 2018 NSDUH public use files to improve the precision of the estimates, yielding a total of 169,486 respondents. Weighted interview response rates were 68.4% in 2016, 67.1% in 2017, and 66.6% in 2018. A detailed description of the NSDUH methodology has been published elsewhere.¹⁷

Measures

Individuals' alcohol and other substance use during the past 30 days was analyzed overall and by respondents' characteristics. Respondents were categorized into three mutually exclusive drinking status categories. Non-drinking was defined as not consuming an alcoholic beverage on any day during the past 30 days. Current/non-binge drinking was defined as consuming at least 1 drink, but males not consuming ≥ 5 drinks or females not consuming ≥ 4 drinks, on an occasion during any day in the past 30 days. Binge drinking was defined as males consuming ≥ 5 drinks or females consuming ≥ 4 drinks on 1 occasion during the past 30 days. Binge drinking frequency during the previous 30 days was also assessed (1 day, 2–3 days, 4–5 days, or ≥ 6 days).

Past 30-day other substance use was defined as the use of a psychoactive or illicit substance (other than alcohol) or prescription drug misuse. Other substances assessed included marijuana, heroin, stimulants (including methamphetamine, ecstasy, cocaine or crack), and hallucinogens. Prescription pain reliever misuse (including primarily opioid pain relievers, as well as "other" prescription pain relievers), tranquilizers or sedatives, and stimulants was also examined. Prescription drug misuse was defined in the survey as use of a prescription drug without an individual's own prescription; using in greater amounts, more often, or longer than one was told to take it; or using in any other way a doctor did not direct to use it ≥ 1 time during the past 30 days. A composite measure was also created on overall use of any psychoactive or illicit substances (including prescription drug misuse), other than alcohol, based on a respondent indicating use of at least one substance.

The concurrent use of alcohol and prescription drug misuse was defined in the survey as any misuse of a prescription drug while drinking alcohol or within a couple of hours of drinking. Among a subset of the sample who reported drinking and prescription drug misuse, concurrent alcohol and prescription drug misuse was analyzed by category of prescription drug misuse, including misuse of prescription pain relievers or of other prescription drugs (i.e., tranquilizers, sedatives, stimulants).

Statistical Analysis

The prevalence of other substance use was analyzed overall, by drinking patterns, and by respondents' characteristics. Prevalence estimates were age-adjusted based on the standard 2000 U.S. population.¹⁸ Given the binomial nature of the outcome variables, multivariable logistic regression models were used to calculate adjusted odds ratios (aORs) of any other substance use and substance-specific use by drinking patterns, controlling for sex, age group, race or ethnicity, total annual family income, and past 30-day cigarette

smoking status. *A priori* decisions were made about covariates to include due to their known associations with both alcohol and substance use. Among respondents who reported consuming alcohol and prescription drug misuse, adjusted prevalence ratios (aPRs) of concurrent alcohol and prescription drug misuse use were calculated among binge drinkers relative to current/non-binge drinkers. Finally, among binge drinkers, aPRs for other substance use were calculated by binge drinking frequency.

Missing values are imputed in the NSDUH (except age and sex) using the predictive mean neighborhood approach;¹⁷ therefore, no respondents were removed due to missing data. The NSDUH analytic weights were divided by three for use in this study's three-year dataset. Analyses were conducted in 2020 using SAS and SAS-callable SUDAAN 9.4 (Cary, NC) to account for the complex survey design and survey weights. Statistical significance was based on *p*-values <0.05.

Results

Among the 169,486 respondents (female: 51.5%), 9.2% were aged 12–17 years, 12.6% were aged 18–25 years, 14.5% were aged 26–34 years, 22.4% were aged 35–49 years, and 41.3% were aged ≥50 years (data not shown). Almost two-thirds of the respondents were non-Hispanic white people (62.8%), followed by Hispanic (16.8%), non-Hispanic black (12.0%), and people of other races or ethnicities (8.4%). Overall, respondents most commonly reported having a total annual family income of <\$20,000 (38.7%), followed by 29.4% who reported a family income of \$20,000–<\$50,000; 16.2% who reported a family income of <\$20,000; and 15.7% who reported a family income of \$50,000–<\$75,000. Among all respondents, about 18.1% reported past 30-day cigarette smoking. The weighted prevalence of non-drinking was 48.9% (95% CI: 48.4, 49.3), of current/non-binge drinking was 26.8% (95% CI: 26.3, 27.2), and of binge drinking was 24.4% (95% CI: 24.0, 24.8).

The overall age-adjusted, weighted prevalence of other substance use was 11.4%, ranging from 6.0% among people who reported not drinking alcohol to 24.1% among people who reported binge drinking (Table 1). This translates to an estimated 15.7 million people who binge drank among the estimated 29.9 million people who reported other substance during the previous 30 days.

Other substance use was more prevalent among people who binge drank than among non-drinkers and current/non-binge drinkers across all sociodemographic characteristics (Table 1). The prevalence of other substance use among males (overall: 13.6%, binge drinkers: 25.7%) was higher than among females (overall: 9.3%, binge drinkers: 21.9%). Other substance use varied by age group, ranging from 5.8% among people aged ≥50 years to 23.4% among people aged 18–25 years. However, among people who reported binge drinking, the prevalence of other substance use decreased with age, from 53.2% among people aged 12–17 years to 12.8% among people aged ≥50 years. Other substance use was least prevalent among Hispanic or Latino people (overall: 8.4%, binge drinkers: 19.2%) and most prevalent among non-Hispanic black people (overall: 12.7%, binge drinkers: 27.4%). Regardless of drinking pattern, the prevalence of other substance use decreased as family income increased. People with public health insurance had the highest prevalence of other

substance use (overall: 14.8%, binge drinkers: 30.4%). Other substance use was generally more prevalent in large metropolitan counties (overall: 11.7%, binge drinkers: 25.0%) than in nonmetropolitan counties (overall: 10.2%, binge drinkers: 20.7%), but the prevalence of other substance use was similar by rural or urban status among non-drinkers and current/non-binge drinkers.

For all categories of other substance use, substance use was more prevalent among binge drinkers than non-drinkers and current/non-binge drinkers (Table 1). Overall, 9.8% reported marijuana use, ranging from 4.9% among non-drinkers to 21.3% among binge drinkers. Marijuana use was the most common other substance used across all drinking categories. The use of other substances without marijuana use was also more prevalent among binge drinkers (3.8%) than non-drinkers (1.2%) and current/non-binge drinkers (1.5%). Approximately 1.2% reported prescription pain reliever misuse, ranging from 0.8% among non-drinkers to 2.4% among binge drinkers. About 1.7% reported stimulant use, including prescription stimulant misuse, ranging from 0.7% among non-drinkers to 4.2% among binge drinkers.

Among the 22,957 people who reported substance use and binge drinking, 22.2% reported using substances in two additional substance categories. Furthermore, among people who reported substance use and binge drinking during the previous 30 days, 70.3% reported that marijuana was the only other substance used, 13.0% reported other substance use without marijuana use, and 16.8% reported the use of marijuana and at least one other substance (data not shown).

Compared with non-drinking and controlling for sex, age group, race or ethnicity, total annual family income, and past 30-day cigarette smoking status, current/non-binge drinking was associated with 2.3 (95% CI: 2.2, 2.5) greater adjusted odds of other substance use, whereas binge drinking was associated with 4.2 (95% CI: 3.9, 4.4) greater odds (Figure 1). Binge drinking was associated with an increase in the adjusted odds of other substance use for each of the substance categories, except heroin, with the largest increase in odds for cocaine or crack use (aOR: 8.6, 95% CI: 6.6, 11.3) and hallucinogen use (aOR: 6.8, 95% CI: 5.3, 8.7).

Among a subset of 1,506 drinkers who reported prescription pain reliever misuse, 41.1% reported prescription pain reliever misuse while drinking alcohol (Table 2). Among the 2,130 drinkers who reported other prescription drug misuse, 45.6% reported other prescription drug misuse while drinking. Compared with current/non-binge drinking, binge drinking was associated with an increased prevalence of prescription pain reliever misuse while drinking (aPR: 2.4, 95% CI: 1.8, 3.2) and other prescription drug misuse while drinking (aPR: 2.1, 95% CI: 1.6, 2.7).

The prevalence of other substance use increased with past 30-day binge drinking frequency, overall and for each specific substance category, except for heroin (Table 3). The aPRs for other substance use increased significantly from 1.3 (95% CI: 1.2, 1.3) among people who binge drank on 2–3 days, to 1.5 (95% CI: 1.4, 1.6) among people who binge drank on 4–5 days, to 1.9 (95% CI: 1.8, 2.0) among people who binge drank on 6 days, compared with

those who binge drank on 1 day. This general pattern was also found for binge drinking frequency and concurrent prescription pain reliever misuse while drinking.

Discussion

The study findings indicate that binge drinking among U.S. adolescents and adults was associated with more than 4 times greater adjusted odds of other substance use than non-drinking – and even greater odds of cocaine, crack, or hallucinogen use. This is especially concerning because nearly one-quarter of people reported past-month binge drinking. Binge drinkers were also at least twice as likely to report concurrent prescription drug misuse while drinking alcohol compared with drinkers who did not binge drink. The likelihood of reporting concurrent prescription pain reliever misuse while drinking generally increased with binge drinking frequency. These findings are consistent with a study of approximately 1,800 people who used opioids daily that found the 12% who reported concurrent use of alcohol and opioids were 9 times more likely to be classified as risky drinkers based on the Alcohol Use Disorders Identification Test than people who did not use alcohol and opioids concurrently.¹⁹ The concurrent use of alcohol with prescription drug misuse increases the chance of overdose and death, and this is particularly disconcerting among people who are binge drinking frequently.^{3,8}

This study found that more than half (15.7 million) of the estimated 29.9 million people aged 12 years who used other substances during the previous month also binge drank. Among binge drinkers, characteristics associated with the highest prevalence of other substance use were being male; aged 12–17 years; non-Hispanic black; a household income of less than \$20,000; public health insurance; and living in a large metropolitan county. The finding that other substance use was highest among adolescents aged 12–17 years who reported binge drinking is consistent with another study that found that high intensity binge drinking among 12th grade students was associated with prescription drug misuse.¹⁰ However, the overall prevalence of other substance use among all people in this age group (about 7%) was lower than among people in most other age groups (e.g., about 23% among people aged 18–25 years and about 18% among people aged 26–34 years). This can be explained in part because most (about 90%) people aged 12–17 years reported not drinking alcohol during the previous month, and only 5% reported binge drinking.

In this study, binge drinking was associated with increased odds of other substance use, both overall and for all substance categories except heroin, after controlling for factors that could affect the relationship between alcohol and substance use. Moreover, increasing binge drinking frequency was associated with a significant increase in the prevalence of other substance use for all substance categories, except heroin. In contrast, in a study of approximately 1,000 people who participated in harm reduction programs in Ohio or Kentucky, one-third reported concurrent use of alcohol, heroin, and prescription opioids during the previous three months, and these individuals were also more likely to report using other substances compared with individuals who did not report concurrently using alcohol with heroin or prescription opioids.²⁰ The finding that binge drinking was not significantly associated with heroin use in this study may be due, in part, to the relatively small sample

of people in the general population who reported binge drinking and using heroin in the past month.

The use of multiple substances was relatively common, such that among people who reported substance use, one in six of them who binge drank also reported using marijuana and another substance during the previous month. Marijuana was the most common substance reported regardless of respondents' drinking pattern. Another study found that the prevalence of simultaneous alcohol and marijuana use was almost double the prevalence of using both substances within the previous 12 months but not using them concurrently, suggesting that people commonly use marijuana while drinking alcohol.²¹ While more research is needed to further our understanding of the effects of concurrent alcohol and marijuana use (such as on impaired-driving and the risk of motor vehicle crashes), adverse outcomes associated with excessive alcohol use may be exacerbated by marijuana use (e.g., memory loss, low-birthweight of offspring).²²

Limitations

There are several limitations of this study. First, the study only assessed the concurrent use of alcohol with prescription drug misuse because data were not available on concurrent alcohol and other substance use, such as marijuana or other illicit substances. Second, data were self-reported, which may lead to underestimates of binge drinking and other substance use due to social desirability and recall biases. Third, the study findings represent the non-institutionalized U.S. population and may not be generalizable to certain populations that may have high rates of alcohol and other substance use, including active duty military personnel, homeless individuals, or people in institutional facilities (e.g., prisons, nursing homes, mental institutions).^{23,24}

Conclusions

This study shows that binge drinking is associated with use of a range of other substances, as well as prescription drug misuse while drinking alcohol. These findings emphasize the potential of more widespread implementation of evidenced-based strategies recommended by the Community Preventive Services Task Force to reduce excessive alcohol use (including binge drinking) such as increasing alcohol taxes²⁵ and regulating alcohol outlet density.²⁶ Research has shown that youth alcohol use is correlated with adult drinking,²⁷ and that effective population-level policies to reduce the availability and accessibility of alcohol, and increase its price, could be part of a comprehensive approach for preventing excessive drinking and other substance use among youth and adults.^{28–30}

In addition, comprehensive approaches could integrate strategies to prevent other substance use and prescription drug misuse, including safer opioid prescribing practices for adults with chronic pain³¹ and motivational interviewing for substance use in clinical settings.³² Furthermore, the U.S. Preventive Services Task Force recommends screening and brief intervention to reduce excessive alcohol use among adults,³³ which can be administered in-person or using electronic devices.³⁴ Healthcare providers could screen for excessive alcohol use before prescribing certain prescription drugs that can interact with alcohol, such

as opioids.³⁵ Scores from alcohol screening may also help in identifying people who might benefit from further assessments pertaining to use of other substances.³⁶

The current study documents the increased likelihood for people who binge drink to use a range of other substances and to concurrently misuse prescription drugs while drinking. This provides important context for other research indicating that poisonings (primarily drug overdoses) that involve high blood alcohol concentration levels are the leading acute cause of alcohol-attributable deaths in the U.S.³⁷ Multi-faceted, evidence-based prevention strategies could be implemented more widely to reduce excessive drinking and other substance use, as well as drug overdoses involving alcohol.

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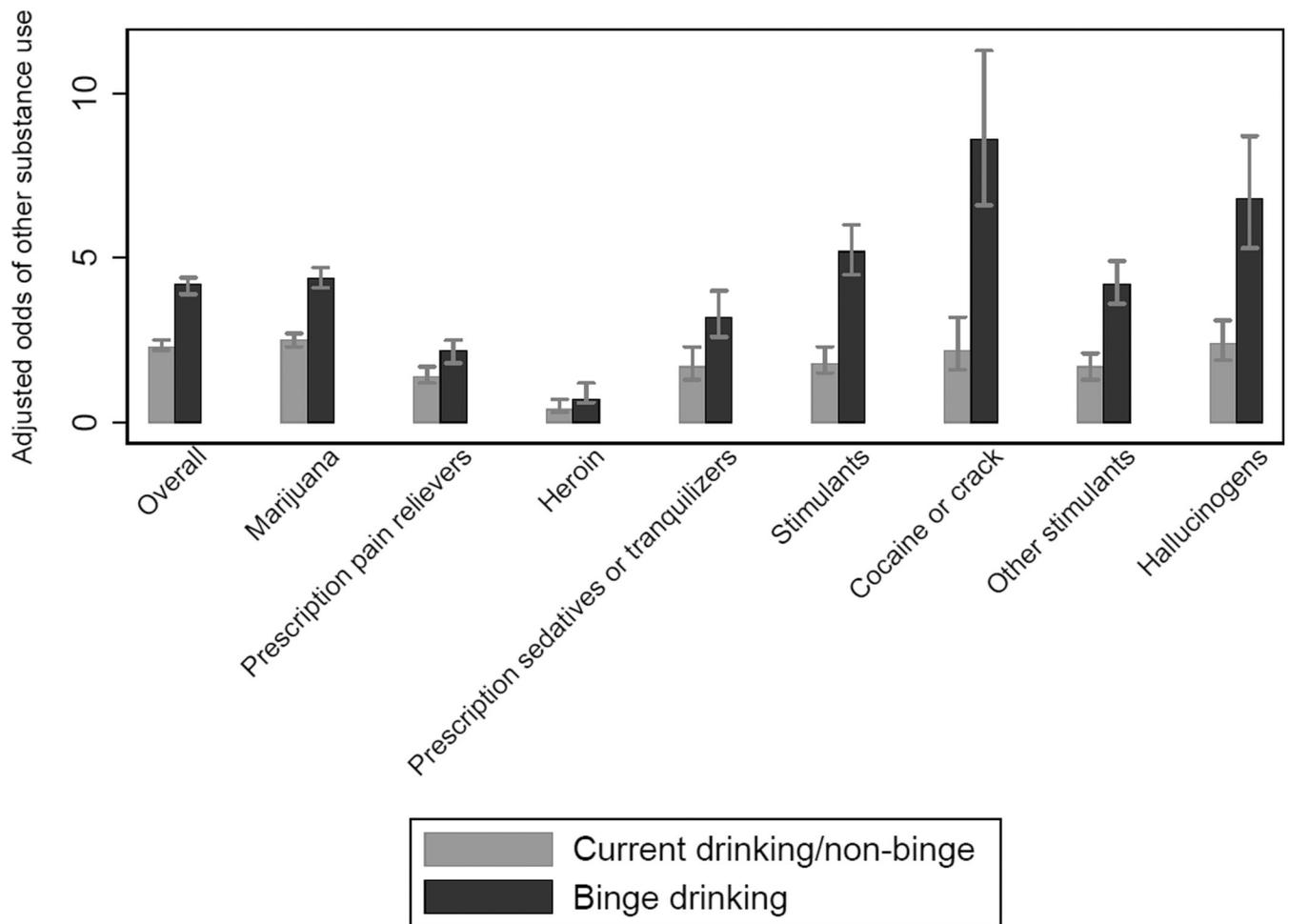


Figure 1.

Adjusted odds^a of other substance use by drinking pattern

^a Multivariable logistic regression models adjusted for sex, age group, race or ethnicity, total annual family income, and cigarette smoking in the past 30 days. The bars show the adjusted odds of substance use by drinking pattern compared with non-drinkers and the 95% confidence intervals are shown at the top of each bar.

Table 1. Prevalence of past 30-day substance use by drinking pattern and respondent characteristics^a

Characteristics	Overall (n = 169,486)		Non-drinking ^b (n = 92,481)		Current/non-binge drinking ^c (n = 34,991)		Binge drinking ^d (n = 42,014)	
	Weighted %	(95% CI)	Weighted %	(95% CI)	Weighted %	(95% CI)	Weighted %	(95% CI)
Any other substance use^e								
Overall, unadjusted	11.0	(10.8, 11.2)	5.4	(5.2, 5.6)	9.7	(9.3, 10.2)	23.7	(23.1, 24.2)
Age group, years								
12–17	7.4	(7.0, 7.8)	4.0	(3.7, 4.2)	26.5	(23.6, 29.4)	53.2	(50.5, 55.9)
18–25	23.4	(23.0, 23.8)	10.2	(9.7, 10.7)	22.6	(21.3, 23.9)	39.6	(38.6, 40.5)
26–34	17.7	(17.2, 18.2)	9.3	(8.7, 10.0)	14.8	(13.7, 15.9)	28.0	(26.9, 29.1)
35–49	10.8	(10.3, 11.2)	6.2	(5.7, 6.7)	8.8	(8.1, 9.5)	18.9	(17.9, 19.9)
50	5.8	(5.4, 6.1)	3.3	(3.0, 3.6)	5.9	(5.1, 6.6)	12.8	(11.7, 13.9)
Age-adjusted^f								
Overall	11.4	(11.2, 11.6)	6.0	(5.8, 6.2)	12.3	(11.9, 12.8)	24.1	(23.5, 24.7)
Sex								
Male	13.6	(13.2, 13.9)	7.8	(7.5, 8.1)	14.5	(13.7, 15.3)	25.7	(24.9, 26.6)
Female	9.3	(9.1, 9.6)	4.6	(4.4, 4.9)	10.4	(9.8, 11.0)	21.9	(21.0, 22.8)
Race or ethnicity								
White, non-Hispanic	12.5	(12.3, 12.8)	7.4	(7.1, 7.8)	11.9	(11.3, 12.5)	24.5	(23.9, 25.2)
Black, non-Hispanic	12.7	(12.0, 13.4)	6.0	(5.4, 6.7)	17.9	(16.4, 19.6)	27.4	(25.3, 29.6)
Hispanic or Latino	8.4	(7.8, 9.0)	4.0	(3.4, 4.6)	11.0	(10.0, 12.2)	19.2	(17.6, 20.9)
Other ^g	8.5	(7.9, 9.2)	3.9	(3.3, 4.5)	11.9	(10.4, 13.5)	25.0	(23.5, 26.6)
Education^h								
Less than high school	15.2	(14.4, 16.0)	9.1	(8.1, 10.1)	21.3	(18.6, 24.2)	26.4	(24.8, 28.0)
High school graduate	16.5	(15.8, 17.1)	8.8	(8.2, 9.5)	18.9	(17.7, 20.2)	26.6	(25.4, 27.8)
Some college	17.0	(16.4, 17.7)	9.2	(8.5, 10.0)	15.5	(14.5, 16.6)	26.5	(25.3, 27.8)
College graduate	12.6	(12.1, 13.1)	4.1	(3.5, 4.8)	8.3	(7.7, 9.0)	22.6	(21.5, 23.7)
Family income (annual)								

Characteristics	Overall (n = 169,486)		Non-drinking ^b (n = 92,481)		Current/non-binge drinking ^c (n = 34,991)		Binge drinking ^d (n = 42,014)	
	Weighted % (95% CI)	Weighted % (95% CI)	Weighted % (95% CI)	Weighted % (95% CI)	Weighted % (95% CI)	Weighted % (95% CI)	Weighted % (95% CI)	
<\$20,000	14.9 (14.4, 15.4)	8.3 (7.8, 8.8)	21.6 (19.7, 23.7)	29.7 (28.1, 31.4)				
\$20,000–\$50,000	12.1 (11.8, 12.5)	6.4 (6.1, 6.7)	15.4 (14.6, 16.3)	25.8 (24.6, 27.0)				
\$50,000–\$75,000	10.7 (10.2, 11.2)	5.3 (4.7, 6.0)	11.8 (10.9, 12.8)	23.1 (21.5, 24.9)				
\$75,000	10.0 (9.6, 10.3)	4.5 (4.2, 4.9)	9.6 (9.0, 10.3)	21.6 (20.7, 22.5)				
Health insurance ^e								
Private	10.0 (9.8, 10.2)	4.5 (4.2, 4.8)	10.2 (9.7, 10.8)	22.0 (21.4, 22.6)				
Public	14.8 (14.3, 15.3)	8.9 (8.5, 9.4)	20.4 (19.0, 21.8)	30.4 (29.0, 31.8)				
Other	11.2 (10.0, 12.6)	5.8 (4.8, 7.0)	14.3 (10.8, 18.6)	21.5 (18.2, 25.2)				
None	14.6 (12.9, 16.6)	8.4 (5.9, 11.7)	16.7 (14.5, 19.0)	27.4 (25.4, 29.5)				
Rural or urban status ^f								
Large metropolitan	11.7 (11.4, 12.0)	5.8 (5.5, 6.2)	12.5 (11.8, 13.2)	25.0 (24.2, 25.9)				
Small metropolitan	11.4 (11.0, 11.9)	6.4 (5.9, 6.8)	12.6 (11.7, 13.7)	23.8 (22.9, 24.7)				
Nonmetropolitan	10.2 (9.6, 10.8)	6.2 (5.6, 6.7)	11.0 (9.9, 12.2)	20.7 (19.4, 22.1)				
Past 30-day cigarette use								
No	7.9 (7.7, 8.1)	3.7 (3.5, 4.0)	9.6 (9.1, 10.1)	18.8 (18.1, 19.6)				
Yes	28.4 (27.7, 29.2)	20.0 (19.0, 20.9)	29.4 (27.7, 31.1)	35.5 (34.2, 36.9)				
Substance-specific use								
Marijuana ^k	9.8 (9.6, 10.0)	4.9 (4.7, 5.1)	11.0 (10.6, 11.5)	21.3 (20.8, 21.9)				
Misuse of prescription pain relievers ^l	1.2 (1.1, 1.3)	0.8 (0.8, 0.9)	1.0 (0.9, 1.2)	2.4 (2.2, 2.7)				
Heroin ^m	0.2 (0.2, 0.2)	0.2 (0.2, 0.3)	0.1 (0.1, 0.1)	0.3 (0.2, 0.4)				
Misuse of prescription tranquilizers or sedatives ⁿ	0.8 (0.7, 0.8)	0.4 (0.4, 0.5)	0.7 (0.6, 0.8)	1.9 (1.7, 2.1)				
Stimulants ^o	1.7 (1.6, 1.8)	0.7 (0.6, 0.8)	1.1 (1.0, 1.3)	4.2 (4.0, 4.5)				
Cocaine or crack ^p	0.8 (0.7, 0.8)	0.2 (0.1, 0.3)	0.3 (0.3, 0.4)	2.0 (1.8, 2.2)				
Other stimulants (including misuse of prescription stimulants) ^q	1.2 (1.1, 1.2)	0.5 (0.5, 0.6)	0.9 (0.7, 1.0)	2.8 (2.6, 3.0)				
Hallucinogens ^r	0.6 (0.5, 0.6)	0.2 (0.1, 0.2)	0.5 (0.4, 0.6)	1.6 (1.4, 1.8)				

Characteristics	Overall (n = 169,486)	Non-drinking ^b (n = 92,481)	Current/non-binge drinking ^c (n = 34,991)	Binge drinking ^d (n = 42,014)
	Weighted % (95% CI)	Weighted % (95% CI)	Weighted % (95% CI)	Weighted % (95% CI)
Other substance use with no marijuana use	1.8 (1.7, 1.9)	1.2 (1.1, 1.3)	1.5 (1.3, 1.7)	3.8 (3.5, 4.2)

CI, Confidence interval

^aSample sizes are unweighted and prevalence estimates are weighted.

^bDid not consume an alcoholic drink on any day in past 30 days, including lifetime abstainers.

^cConsumed 1 alcoholic drink on 1 day but did not consume 5 drinks (males) or 4 drinks (females), on an occasion, on 1 day in the past 30 days.

^dConsumed 5 drinks (males) or 4 drinks (females), on an occasion, on 1 day in the past 30 days.

^eIncludes the use of 1 substance other than alcohol or tobacco, including the use of marijuana, misuse of prescription pain relievers, heroin, misuse of prescription tranquilizers (including benzodiazepines) or sedatives, stimulants (including methamphetamine, cocaine, ecstasy, misuse of prescription stimulants), or hallucinogens.

^fAge-adjusted based on the 2000 U.S. population, unless otherwise noted.

^gIncluding Asian, American Indian, Alaskan Native, Native Hawaiian or other Pacific Islander, or more than one race or ethnicity.

^hIncludes adults aged 18 years only.

ⁱRespondents could indicate more than one type of health insurance. If private health insurance was indicated as well as another type of health insurance, respondents were placed in the private category. Public includes Medicaid, Medicare, Children's Health Insurance Program (CHIP), CHAMPUS, TRICARE, CHAMPVA, the VA, or military health insurance.

^jBased on the "Rural/Urban Continuum Codes" developed in 2013 by the U.S. Department of Agriculture. Large metropolitan counties have a total population > 1 million. Small metropolitan counties have a total population below 1 million. Nonmetropolitan areas include both counties in metropolitan statistical areas and counties outside of metropolitan and micropolitan statistical areas.

^kUsed marijuana or hashish in the past 30 days.

^lUsed a prescription pain reliever without a prescription of your own; used in greater amounts, more often, or longer than you were told to take it; used in any other way a doctor did not direct you to use it 1 time in the past 30 days.

^mUsed heroin in the past 30 days.

ⁿUsed a prescription tranquilizer (including benzodiazepines) or sedative without a prescription of your own; used in greater amounts, more often, or longer than you were told to take it; used in any other way a doctor did not direct you to use it 1 time in the past 30 days.

^oUsed a stimulant (including methamphetamine, ecstasy, or cocaine or crack) or misused a prescription stimulant in the past 30 days.

^pUsed cocaine, including crack or powder, in the past 30 days.

^qUsed methamphetamine in the past 30 days, used ecstasy in the past 30 days, or misused a prescription stimulant in the past 30 days.

^rHallucinogen use in the past 30 days.

Table 2. Concurrent substance use among people who reported drinking alcohol and prescription drug misuse

Category of prescription drug misuse	Overall Weighted % ^a (95% CI)	Drinking pattern		Prevalence ratios of reporting prescription drug misuse while drinking among those who binge drink relative to those who do not binge drink			
		Current/non-binge drinking ^{a,b} Weighted % (95% CI)	Binge drinking ^{a,c} Weighted % (95% CI)	Crude (95% CI)	P-value	Adjusted ^d (95% CI)	P-value
Prescription pain reliever misuse while drinking ^e	41.1 (36.8, 45.6)	22.0 (16.3, 29.0)	50.0 (42.7, 57.4)	2.5 (1.8, 3.5)	<0.0001	2.4 (1.8, 3.2)	<0.0001
Other prescription drug misuse while drinking ^f	45.6 (40.8, 50.5)	25.9 (19.7, 33.2)	53.4 (47.0, 59.7)	3.7 (2.5, 5.3)	<0.0001	2.1 (1.6, 2.7)	<0.0001

CI: Confidence intervals

Boldface indicates statistical significance (p<0.05).

^aPrevalence estimates are weighted and age-adjusted based on the 2000 U.S. population.

^bConsumed 1 alcoholic drink on 1 day but did not consume 5 drinks (males) or 4 drinks (females), per occasion, on 1 day in the past 30 days.

^cConsumed 5 drinks (males) or 4 drinks (females), per occasion, on 1 day in the past 30 days.

^dAdjusted for sex, age group, race or ethnicity, total annual family income, and cigarette smoking in the past 30 days.

^ePrescription pain reliever misuse while drinking alcohol or within a couple of hours of drinking, among people who reported having an alcoholic beverage and who reported misusing a prescription pain reliever in the past 30 days (n=1,506).

^fPrescription tranquilizer, sedative, or stimulant misuse while drinking alcohol or within a couple of hours of drinking, among people who reported having an alcoholic beverage and who reported misusing a prescription tranquilizer, sedative, or stimulant in the past 30 days (n=2,130). Age was collapsed from five age groups to two age groups (<35 and ≥35 years) to remove collinearity.

Table 3.

Adjusted prevalence ratios of other substance use by binge drinking frequency^a

Substance-specific use	1 day (n=14,141)	2-3 days (n=13,838)		4-5 days (n=6,587)		6 days (n=7,448)	
		aPR ^b (95% CI)	P-value	aPR ^b (95% CI)	P-value	aPR ^b (95% CI)	P-value
Overall ^c	Ref.	1.3 (1.2, 1.3)	<0.0001	1.5 (1.4, 1.6)	<0.0001	1.9 (1.8, 2.0)	<0.0001
Marijuana ^d	Ref.	1.3 (1.2, 1.4)	<0.0001	1.5 (1.4, 1.6)	<0.0001	1.9 (1.8, 2.0)	<0.0001
Misuse of prescription pain relievers ^e	Ref.	1.4 (1.2, 1.7)	<0.01	1.7 (1.3, 2.2)	<0.01	2.7 (2.1, 3.4)	<0.0001
Heroin ^f	Ref.	1.4 (0.7, 2.8)	0.30	1.1 (0.5, 2.4)	0.83	1.8 (0.9, 3.8)	0.10
Misuse of prescription tranquilizers or sedatives ^{g,h}	Ref.	1.3 (1.0, 1.8)	0.09	1.8 (1.3, 2.4)	<0.01	2.6 (1.9, 3.6)	<0.0001
Stimulants ⁱ	Ref.	1.5 (1.3, 1.8)	<0.0001	2.4 (2.0, 2.9)	<0.0001	3.8 (3.1, 4.6)	<0.0001
Cocaine or crack ^j	Ref.	1.5 (1.1, 2.1)	0.02	2.7 (2.0, 3.7)	<0.0001	4.9 (3.6, 6.5)	<0.0001
Other stimulants ^{h,k}	Ref.	1.5 (1.2, 1.9)	<0.01	2.3 (1.9, 2.9)	<0.0001	3.4 (2.7, 4.4)	<0.0001
Hallucinogens ^{h,l}	Ref.	1.2 (0.9, 1.6)	0.13	2.0 (1.5, 2.6)	<0.0001	2.7 (2.0, 3.7)	<0.0001
Concurrent substance use among people who reported binge drinking and prescription drug misuse^m							
Prescription pain reliever misuse while drinking	Ref.	1.6 (1.1, 2.3)	<0.01	1.7 (1.1, 2.5)	0.02	2.5 (1.8, 3.5)	<0.0001

aPR: Adjusted prevalence ratio

Boldface indicates statistical significance (p<0.05).

^aNumber of days consuming 5 drinks (males) or 4 drinks (females), per occasion, in the past 30 days.^baPRs controlled for sex, age group, race or ethnicity, total annual family income, and cigarette smoking in the past 30 days.^cIncludes the use of 1 substance other than alcohol or tobacco, including the use of marijuana, misuse of prescription pain relievers, heroin, misuse of prescription tranquilizers (including benzodiazepines) or sedatives, stimulants (including methamphetamine, cocaine, ecstasy, misuse of prescription stimulants), or hallucinogens.^dUsed marijuana or hashish in the past 30 days.^eUsed a prescription pain reliever without a prescription of your own; used in greater amounts, more often, or longer than you were told to take it; used in any other way a doctor did not direct you to use it 1 time in the past 30 days.^fUsed heroin in the past 30 days.

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^gUsed a prescription tranquilizer (including benzodiazepines) or sedative without a prescription of your own; used in greater amounts, more often, or longer than you were told to take it; used in any other way a doctor did not direct you to use it 1 time in the past 30 days.

^hAge was collapsed from five age groups to two age groups (<35 and 35 years) to remove collinearity.

ⁱUsed a stimulant (including methamphetamine, ecstasy, or cocaine or crack), or misused a prescription stimulant in the past 30 days.

^jUsed cocaine, including crack or powder, in the past 30 days.

^kUsed methamphetamine in the past 30 days, used ecstasy in the past 30 days, or misused a prescription stimulant in the past 30 days.

^lHallucinogen use in the past 30 days.

^mData are presented among people who reported prescription pain reliever misuse while drinking alcohol or within a couple of hours of drinking in the past 30 days. Data among people who reported other prescription drug misuse (i.e., tranquilizer, sedative, or stimulant misuse) while drinking alcohol or within a couple of hours of drinking were suppressed due to potentially unreliable estimates.