

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



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Introduction: The use of multiple substances heightens the risk of overdose. Multiple substances, including alcohol, are commonly found among people who experience overdose-related mortality. However, the associations between alcohol use and the use of a range of other substances are often not assessed. Therefore, this study examines the 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 in 2020 among 169,486 U.S. respondents aged ≥ 12 years.

Results: The prevalence of other substance use ranged from 6.0% (nondrinkers) to 24.1% (binge drinkers). Among people who used substances, 22.2% of binge drinkers reported using substances in 2 additional substance categories. Binge drinking was associated with 4.2 (95% CI=3.9, 4.4) greater adjusted odds of other substance use than nondrinking. Binge drinkers were twice as likely to report concurrent prescription drug misuse while drinking as nonbinge 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 and regulating alcohol outlet density).

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INTRODUCTION

More than 67,000 people died by drug overdose in the U.S. in 2018.¹ Polysubstance use (i.e., the use of multiple psychoactive substances) is common among people who experience overdose-related mortality, 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 by 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 visits owing to prescription drug misuse also involved alcohol.⁷ The estimated proportion of emergency department visits related to prescription drug misuse involving alcohol was higher than the estimated

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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 drinkers (those 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 nondrinkers to report marijuana use and almost 8 times more likely to report the use of illicit substances other than the use of 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 as well. Therefore, the primary objective of this study is to examine the 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 multistage probability sampling to obtain a nationally representative sample of the U.S. population residing in the 50 states and Washington, District of Columbia. 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 were analyzed overall and by respondents' characteristics. Respondents were categorized into 3 mutually exclusive drinking status categories. Nondrinking was defined as not consuming an alcoholic beverage on any day during the past 30 days. Current/nonbinge drinking was defined as consuming ≥ 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 were also examined. Prescription drug misuse was defined in the survey as the 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 the overall use of any psychoactive or illicit substances (including prescription drug misuse) other than alcohol on the basis of a respondent indicating the use of ≥ 1 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 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 on the basis of the standard 2000 U.S. population.¹⁸ Given the binomial nature of the outcome variables, multivariable logistic regression models were used to calculate the 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 on the basis of 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 were calculated among binge drinkers relative to current/nonbinge drinkers. Finally, among binge drinkers, APRs for other substance use were calculated by binge-drinking frequency.

Missing values are imputed in the NSDUH (except for age and sex) using the predictive mean neighborhood approach¹⁷; therefore, no respondents were removed because of missing data. The NSDUH analytic weights were divided by 3 for use in this study's 3-year data set. Analyses were conducted in 2020 using SAS, version 9.4, and SAS-callable SUDAAN, version 11, to account for the complex survey design and survey weights. Statistical significance was based on *p*-values of <0.05.

RESULTS

Among the 169,486 respondents (51.5% female), 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 White, non-Hispanic people (62.8%); followed by Hispanic (16.8%); Black, non-Hispanic (12.0%); and people of other races or ethnicities (8.4%). Overall, the respondents most commonly reported having a total annual family income of ≥\$75,000 (38.7%), followed by 29.4% who reported a family income of \$20,000 to <\$50,000; 16.2% who reported a family income of <\$20,000; and 15.7% who reported a family income of \$50,000 to <\$75,000. Among all the respondents, about 18.1% reported past 30-day cigarette smoking. The weighted prevalence of nondrinking was 48.9% (95% CI=48.4, 49.3), of current/nonbinge 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 use during the previous 30 days.

Other substance use was more prevalent among people who binge drank than among nondrinkers and current/nonbinge 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 Black, non-

Hispanic 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 nondrinkers and current/nonbinge drinkers.

For all categories of other substance use, substance use was more prevalent among binge drinkers than among nondrinkers and current/nonbinge drinkers (Table 1). Overall, 9.8% reported marijuana use, ranging from 4.9% among nondrinkers 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 among nondrinkers (1.2%) and current/nonbinge drinkers (1.5%). Approximately 1.2% reported prescription pain reliever misuse, ranging from 0.8% among nondrinkers to 2.4% among binge drinkers. About 1.7% reported stimulant use, including prescription stimulant misuse, ranging from 0.7% among nondrinkers to 4.2% among binge drinkers.

Among the 22,957 people who reported substance use and binge drinking, 22.2% reported using substances in 2 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 ≥1 other substance (data not shown).

Compared with nondrinking and controlling for sex, age group, race or ethnicity, total annual family income, and past 30-day cigarette smoking status, current/nonbinge 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 for 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

Table 1. Prevalence of Past 30–Day Substance Use by Drinking Pattern and Respondent Characteristics

Characteristic	Overall (n=169,486), Weighted % (95% CI)	Nondrinking ^a (n=92,481), Weighted % (95% CI)	Current/nonbinge drinking ^b (n=34,991), Weighted % (95% CI)	Binge drinking ^c (n=42,014), Weighted % (95% CI)
Any other substance use ^d				
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 ^e				
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 ^f	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 ^g				
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), \$				
<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 to <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 to <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 ^h				
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 ⁱ				
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 ^j	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 ^k	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 ^l	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 ^m	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 ⁿ	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 ^o	0.8 (0.7, 0.8)	0.2 (0.1, 0.3)	0.3 (0.3, 0.4)	2.0 (1.8, 2.2)

(continued on next page)

Table 1. Prevalence of Past 30–Day Substance Use by Drinking Pattern and Respondent Characteristics (*continued*)

Characteristic	Overall (n=169,486), Weighted % (95% CI)	Nondrinking ^a (n=92,481), Weighted % (95% CI)	Current/nonbinge drinking ^b (n=34,991), Weighted % (95% CI)	Binge drinking ^c (n=42,014), Weighted % (95% CI)
Other stimulants (including the misuse of prescription stimulants) ^d	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 ^d	0.6 (0.5, 0.6)	0.2 (0.1, 0.2)	0.5 (0.4, 0.6)	1.6 (1.4, 1.8)
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)

Note: Sample sizes are unweighted, and prevalence estimates are weighted.

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

^bConsumed ≥ 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.

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

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

^eAge-adjusted on the basis of the 2000 U.S. population, unless otherwise noted.

^fIncluding Asian, American Indian, Alaskan Native, Native Hawaiian, or other Pacific Islander or more than 1 race or ethnicity.

^gIncludes adults aged ≥ 18 years only.

^hRespondents could indicate more than 1 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, CHIP, CHAMPUS, TRICARE, CHAMPVA, the VA, or military health insurance.

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

^jUsed marijuana or hashish in the past 30 days.

^kUsed 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.

^lUsed heroin in the past 30 days.

^mUsed 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.

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

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

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

^qHallucinogen use in the past 30 days.

CHAMPUS, Civilian Health and Medical Program of the Uniformed Services; CHAMPVA, Civilian Health and Medical Program of the Department of Veterans Affairs; CHIP, Children's Health Insurance Program; VA, Veteran Affairs.

prescription drug misuse, 45.6% reported other prescription drug misuse while drinking. Compared with current/nonbinge 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 and 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 >4 times greater adjusted odds of other substance use than nondrinking—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 that the 12% who reported concurrent use of alcohol and opioids were 9 times more likely to be classified as risky drinkers on the basis of the Alcohol

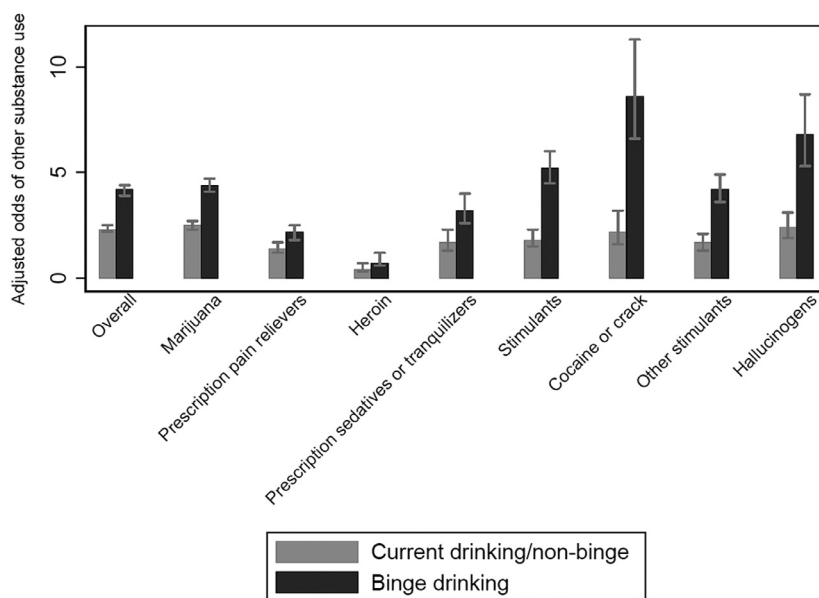


Figure 1. Adjusted odds of other substance use by drinking pattern.

Note: 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 those of nondrinkers, and the 95% CIs are shown at the top of each bar.

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 especially 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, the characteristics associated with the highest prevalence of other substance use were being male; being aged 12–17 years; being

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/nonbinge drinking, ^{a,b} Weighted % (95% CI)	Binge drinking, ^{a,c} Weighted % (95% CI)	Crude (95% CI)	<i>p</i> -value	Adjusted ^d (95% CI)	<i>p</i> -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
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

Note: Boldface indicates statistical significance ($p < 0.05$).

^aPrevalence estimates are weighted and age adjusted on the basis of 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 5 age groups to 2 age groups (<35 and ≥ 35 years) to remove collinearity.

Table 3. APRs of Other Substance Use by Binge-Drinking Frequency

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 ^a (95% CI)	p-value	APR ^a (95% CI)	p-value	APR ^a (95% CI)	p-value
Overall ^b	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 ^c	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 ^d	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 ^e	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 ^{f,g}	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 ^h	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 ⁱ	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 ^{e,j}	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 ^{e,k}	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 ^l							
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

Note: Boldface indicates statistical significance ($p < 0.05$).

Binge-drinking frequency represents the number of days consuming ≥ 5 drinks (males) or ≥ 4 drinks (females), per occasion, in the past 30 days.

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

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

^cUsed marijuana or hashish in the past 30 days.

^dUsed 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.

^eUsed heroin in the past 30 days.

^fUsed 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.

^gAge was collapsed from 5 age groups to 2 age groups (< 35 and ≥ 35 years) to remove collinearity.

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

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

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

^kHallucinogen use in the past 30 days.

^lData 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 owing to potentially unreliable estimates.

APR, adjusted prevalence ratio.

Black, non-Hispanic; a household income of $< \$20,000$; 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 for 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 for heroin. By 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 3 months, and these individuals were also more likely to report using other substances than 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, 1 in 6 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 patterns. 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 Although more research is needed to further the 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 birth weight 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 owing 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 the 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 evidence-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 drinking²⁷ 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 the use of other substances.³⁶

This 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 Multifaceted, 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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