

ORIGINAL ARTICLE

## Adverse psychosocial outcomes associated with drug use among US high school seniors: a comparison of alcohol and marijuana

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### Abstract

**Objectives:** There is debate about whether marijuana (cannabis) use is more dangerous than alcohol use. Although difficult to make objective comparisons, research is needed to compare relative dangers in order to help inform preventive efforts and policy. **Methods:** Data were analyzed from a nationally representative sample of high school seniors in the Monitoring the Future study (2007–2011; Weighted  $n = 7437$ ; modal age: 18) who reported lifetime use of alcohol or marijuana. Students were asked to indicate whether they experienced various adverse psychosocial outcomes resulting from use of each substance. We examined which outcomes were more prevalent for each substance. **Results:** Compared to alcohol use, marijuana use was more commonly reported to compromise relationships with teachers or supervisors, result in less energy or interest, and result in lower school or job performance. Compared to marijuana use, alcohol was more commonly reported to compromise relationships with friends and significant others; it was also reported to lead to more regret (particularly among females), and driving unsafely. Marijuana users were more likely to report no adverse outcomes. Females and white students were more likely to report various adverse outcomes and higher frequency use of each substance also increased occurrences of reported adverse outcomes. **Conclusions:** Marijuana and alcohol are associated with unique adverse psychosocial outcomes. Outcomes differ by sex and race/ethnicity, and perception or experience of outcomes may also be related to legal status and associated stigma. Public health interventions may be more effective by focusing on harm reduction strategies for these drug-specific outcomes.

### Keywords

Adolescents, adverse outcomes, alcohol, cannabis, marijuana

### History

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### Introduction

Growing public support for more liberal marijuana laws (e.g. legalization) (1–3) has led to public debate about whether marijuana is “safer” than other substances, such as alcohol. Supporters of more liberal marijuana policy have received considerable attention with their thesis that marijuana is safer than alcohol (4), and Nutt and colleagues published a well-publicized report suggesting that alcohol ranks among the most dangerous substances when comparing the harms of various licit and illicit drugs, including marijuana (5). Moreover, in January 2014, President Obama stated he was not convinced that marijuana is “more dangerous” than alcohol (6), and in April 2014, results from a national survey of adults found that compared to marijuana, alcohol is viewed as a bigger threat to health (15% vs. 69%) and society (23% vs. 63%) (7).

Despite this recent change in views toward marijuana use, the harms of use as compared to alcohol use are not well understood. This is of particular concern with regard to adolescents, as alcohol and marijuana are the two most commonly used psychoactive substances in this age group (8–10). Nearly half (45.5%) of high school seniors have used marijuana in their lifetime and 68% have used alcohol (11). Adolescents’ perceptions of risk differ depending on the substance and frequency of use. In 2013, 15% of 12th graders reported that using marijuana once or twice was risky, while 10% of high school seniors perceived use of one or two alcoholic drinks as risky. Conversely, 40% of adolescents viewed regular use of marijuana as risky compared to 62% of adolescents who perceived risk in having 4–5 drinks nearly every day. In order to develop effective prevention strategies, research is needed to compare the harms associated with marijuana and alcohol use.

In models of global disease burden, alcohol use disorders are estimated to account for 17.7 million disability-adjusted life years (DALYs) (7.4%), while cannabis is significantly lower, accounting for 2 million DALYs (0.08%) (12).

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In contrast to the approach of global burden of disease, several researchers have attempted to create a single measure of ‘‘harmfulness’’ based on multiple criteria (5,13,14). In a study conducted by Nutt and colleagues, drugs were evaluated on 16 criteria, such as drug-specific mortality, dependence, loss of relationships, crime, family adversities, and economic cost. Such rankings have consistently found that alcohol is more harmful and less beneficial than marijuana (5,15,16). However, rankings based on aggregate measures have been criticized, as they do not fully account for the variable nature of harm (e.g. violence vs. addiction), utilize non-objective valuations, or consider potential benefits (17,18). Calls have been made for more multidimensional analyses of harm (17,19).

There is evidence supporting associations between alcohol and marijuana use with negative outcomes in multiple domains, including poor academic performance and attainment, decreased intellectual functioning and memory, reduced occupational productivity, driving impairment and traffic accidents, impaired psychological functioning (e.g. mood disorders) and impacted social relationships (20–22). Yet, we are not aware of studies that have examined adverse psychosocial outcomes and their association with marijuana versus alcohol use. We thus have an incomplete understanding of the relative harms of each substance on adolescents.

Because of this gap in the literature, this study investigates various adverse psychosocial outcomes of two of the most commonly used psychoactive substances among adolescents, alcohol and marijuana, using a large, nationally representative sample of high school seniors. Findings of this study will contribute to the ongoing debate on marijuana policy and its perceived harm when compared to alcohol.

## Methods

### Design

Data were examined from Monitoring the Future (MTF), an annual survey of high school students in approximately 130 public and private schools throughout 48 states in the US (23). Schools were selected through a multi-stage random sampling procedure: geographic areas were selected, then schools within geographic areas, and then students within selected schools. Variables for select constructs are divided into six survey forms, which are distributed randomly. This study examines data collected through Form 3, which assesses self-reported psychosocial adverse outcomes resulting from use of alcohol and marijuana. Analyses focused on data collected from high school seniors in the most recent five cohorts with available data (2007–2011).

### Variables

Students were asked to report their age (provided by MTF as <18 vs.  $\geq 18$  years of age), sex, and race and ethnicity (i.e. white, black, Hispanic), and they were asked about frequency of use of alcohol and marijuana in their lifetime. Students were asked, ‘‘On how many occasions have you had alcoholic beverages to drink – more than just a few sips?’’ and ‘‘On how many occasions (if any) have you used marijuana (weed, pot) or hashish (hash, hash oil) in your lifetime?’’ Possible responses for these questions were: 0 occasions, 1–2

occasions, 3–5 occasions, 6–9 occasions, 10–19 occasions, 20–39 occasions, and  $\geq 40$  occasions. Alcohol and marijuana frequency variables were recoded into lifetime use (ever used), used  $\geq 10$  times and used  $\geq 40$  times. Variables were also trichotomized into: (1) used 1–9 times, (2) 10–39 times, and (3)  $\geq 40$  times. For alcohol and marijuana, students were asked, ‘‘Has your use of [substance name] ever caused any of the following problems for you?’’ and they checked off ‘‘yes’’ or ‘‘no’’ to 16 various outcomes (15 adverse outcomes and 1 item assessing whether none of the 15 outcomes occurred).

### Analyses

We first examined whether there were differences in adverse outcomes in those who used both alcohol and marijuana ( $n=4249$ ) compared to those who used only alcohol ( $n=2949$ ) or only marijuana ( $n=240$ ). Z-tests were computed to compare the proportions of students who reported on each of the 16 outcomes (24). We then examined whether there were significant differences in reported outcomes between alcohol and marijuana by lifetime frequency subgroups: (1) used ever, (2) used  $\geq 10$  times, and (3)  $\geq 40$  times. Subgroups were examined in this manner first in order to not restrict the upper limit of use. We then examined frequency of use, but in a trichotomous manner (i.e. used 1–9 times, 10–39 times,  $\geq 40$  times). Rao-Scott Chi-square tests were computed to compare frequency of use (of alcohol and marijuana separately) for each outcome. The 16 outcomes were then examined again using chi-square tests to assess potential differences by race, ethnicity and sex. These analyses were conducted to determine whether outcomes differed by these key characteristics while considering the study’s complex survey design (25). After examining these characteristics in relation to outcomes in a bivariable manner, we then examined these three independent variables (sex, race and ethnicity, and frequency of use) with design-based multiple logistic regression models controlling for age. The 16 outcomes served as separate dichotomous outcomes for alcohol and marijuana. Each independent variable was entered into each model and was associated with an adjusted odds ratio (AOR) and 95% confidence interval (CI). AORs between alcohol and marijuana covariates were also compared. Even though there was not a high degree of overlap between the 16 self-reported outcomes (presented in *Results*), we utilized a Bonferroni correction for all analyses ( $\alpha = 0.05/16 = 0.003$ ). Analyses were design-based for complex survey data (26), weighted according to the study’s sampling scheme and conducted using SAS 9.3 and Mplus 6.12 software.

### Results

Table 1 presents sample characteristics and a breakdown of frequency of alcohol and marijuana use. The majority of the sample was  $\geq 18$  years of age or white; 96.8% used alcohol and 60.4% used marijuana in their lifetime. Total number of reported adverse outcomes tended to increase as frequency of use increased; however, the sum scores presented are only for descriptive purposes. We did not compute statistical tests for total number of outcomes because the groups were not independent and because weight of seriousness of outcomes could not be taken into account. Prior to comparing separate

Table 1. Demographic characteristics of sample by frequency of lifetime alcohol and marijuana use.

	Full sample <i>n</i> = 7437 %	Alcohol			Marijuana		
		Lifetime use <i>n</i> = 7198 %	Used ≥ 10 times <i>n</i> = 4420 %	Used ≥ 40 times <i>n</i> = 2057 %	Lifetime use <i>n</i> = 4489 %	Used ≥ 10 times <i>n</i> = 2443 %	Used ≥ 40 times <i>n</i> = 1516 %
Demographics							
Age							
<18	42.4	42.5	41.7	39.1	41.5	41.0	38.8
≥18	56.3	56.2	56.9	59.4	57.1	57.4	59.6
Missing	1.3	1.3	1.4	1.5	1.4	1.6	1.6
Sex							
Male	46.9	46.5	49.9	54.9	49.2	53.8	58.4
Female	49.1	49.5	45.7	40.6	46.4	41.6	37.1
Missing	4.0	4.0	4.4	4.6	4.4	4.7	4.6
Race/Ethnicity							
White	63.2	64.0	68.3	71.8	62.9	66.6	66.9
Black	9.8	9.2	7.0	5.0	10.2	8.7	8.7
Hispanic	14.3	14.3	13.2	12.6	13.9	11.2	11.0
Missing	12.7	12.4	11.5	10.6	12.9	13.4	13.4
Lifetime use							
Alcohol	96.8	100.0	100.0	100.0	94.7	96.8	97.2
Marijuana	60.4	59.0	73.9	84.4	100.0	100.0	100.0
Adverse outcomes (Total)							
Alcohol M (SD)	1.5 (2.4)	1.5 (2.4)	2.1 (2.7)	2.5 (2.9)	1.9 (2.6)	2.0 (2.6)	2.0 (2.6)
Median	0.0	0.0	0.6	1.2	0.3	0.6	0.6
Marijuana M (SD)	1.0 (2.1)	1.0 (2.1)	1.3 (2.4)	1.7 (2.7)	1.6 (2.5)	2.2 (2.9)	2.4 (3.0)
Median	0.0	0.0	0.0	0.0	0.0	0.6	0.8

The range for total number of adverse outcomes in each cell was 0–15.

Table 2. Comparison of percentages indicating adverse outcomes according to who used either both drugs or only one drug.

	Alcohol			Marijuana		
	Alcohol and marijuana ( <i>n</i> = 4249) %	Only alcohol ( <i>n</i> = 2949) %	Z	Marijuana and alcohol ( <i>n</i> = 4249) %	Only marijuana ( <i>n</i> = 240) %	Z
Caused you to behave in ways that you later regretted	45.1	23.7	18.5***	12.8	5.6	3.4**
Hurt your relationship with your parents	13.5	6.9	9.0***	13.2	4.7	3.9**
Hurt your relationship with your spouse, fiancée, or girlfriend/boyfriend	15.3	8.3	8.9***	11.3	4.1	3.4**
Hurt your relationships with your friends	10.7	6.8	5.7***	8.4	5.9	1.4
Hurt your relationships with teachers or supervisors	2.6	1.2	4.3***	3.1	2.6	0.6
Involved you with people you think are a bad influence on you	14.5	8.2	8.2***	21.0	12.2	3.3**
Hurt your performance in school and/or on the job	7.1	3.4	6.6***	10.9	2.4	4.2***
Caused you to be less interested in other activities than you were before	6.8	2.6	8.1***	12.5	3.7	4.0***
Caused you to be less stable emotionally	11.7	5.1	9.6***	7.2	3.4	2.3
Caused you to have less energy	10.3	5.2	7.8***	21.9	9.4	4.7***
Interfered with your ability to think clearly	27.2	15.5	11.6***	21.7	6.8	5.6***
Had other bad psychological effects	3.9	1.2	6.8***	5.1	2.1	2.1
Caused your physical health to be bad	5.8	2.0	7.9***	5.0	1.5	2.3
Caused you to drive unsafely	13.3	3.1	14.9***	6.7	1.9	2.8
Gotten you into trouble with the police	8.3	2.0	11.4***	5.0	1.4	2.7
Caused you none of the above problems	10.8	13.0	-2.9	14.1	13.0	0.5

Utilizing the Bonferroni correction, \*\* $p < 0.001$ , \*\*\* $p < 0.0001$ .

adverse outcomes in the full sample, we first tested whether adverse outcomes differed between who used both drugs and who used only alcohol or only marijuana. All alcohol-related outcomes were significantly more prevalent among those who also had used marijuana in their lifetime (Table 2). Half of marijuana-related outcomes were more prevalent among those who also have used alcohol.

Percentages of adverse outcomes tended to increase as frequency of use increased (Table 3; formal statistical tests presented in Table 4). Compared to marijuana, behaving in ways one regrets was significantly higher for alcohol at all

frequencies of use. A similar, but weaker, significant difference was found with alcohol use being more closely associated with driving unsafely and feeling less stable emotionally. Compared to alcohol, students consistently reported marijuana to be associated with involvement with people who are a “bad influence” and with having less energy or less interest in activities. Marijuana use was also more closely associated with decreased work/school performance, bad psychological effects, and hurt relationships with parents, teachers or supervisors, compared to alcohol. However, marijuana users were also consistently more likely

Table 3. Comparison of percentages indicating each adverse outcome by frequency of lifetime use.

	Lifetime use								
	Used <math>\geq 10</math> times		Used <math>\geq 40</math> times						
	Alcohol ( <i>n</i> = 7198) %	Marijuana ( <i>n</i> = 4489) %	Z	Alcohol ( <i>n</i> = 4420) %	Marijuana ( <i>n</i> = 2443) %	Z	Alcohol ( <i>n</i> = 2057) %	Marijuana ( <i>n</i> = 1516) %	Z
Caused you to behave in ways that you later regretted	36.3	12.4	28.3***	48.1	15.9	26.5***	54.9	16.2	23.5***
Hurt your relationship with your parents	10.8	12.7	-3.1*	14.4	19.5	-5.6***	18.5	23.5	-3.6**
Hurt your relationship with your spouse, fiancée, or girlfriend/boyfriend	12.5	10.9	2.6	17.3	15.0	2.5	22.0	16.4	4.2***
Hurt your relationships with your friends	9.1	8.3	1.5	12.1	10.6	1.8	14.8	10.6	3.7**
Hurt your relationships with teachers or supervisors	2.0	3.1	-3.7***	2.9	4.5	-3.4**	3.4	5.8	-3.5**
Involved you with people you think are a bad influence on you	11.9	20.5	-12.6***	15.0	25.0	-10.2***	17.0	23.9	-5.1***
Hurt your performance in school and/or on the job	5.6	10.5	-9.7***	7.9	16.5	-10.9***	10.4	19.5	-7.7***
Caused you to be less interested in other activities than you were before	5.1	12.0	-13.6***	6.9	18.6	-14.8***	9.3	22.3	-10.8***
Caused you to be less stable emotionally	9.0	7.0	3.7**	11.6	9.5	2.8	14.0	10.6	3.0*
Caused you to have less energy	8.2	21.2	-20.2***	10.5	30.3	-20.7***	12.8	33.1	-14.6***
Interfered with your ability to think clearly	22.4	20.9	2.0	28.8	27.2	1.4	30.8	26.3	2.9
Had other bad psychological effects	2.8	5.0	-6.0***	3.8	6.6	-5.2***	4.8	6.2	-1.9
Caused your physical health to be bad	4.3	4.8	-1.4	5.9	6.7	-1.3	8.2	7.7	0.5
Caused you to drive unsafely	9.1	6.4	5.3***	13.7	9.3	5.4***	19.9	8.8	9.1***
Gotten you into trouble with the police	5.7	4.8	2.0	8.4	8.3	0.1	13.4	11.8	1.4
Caused you none of the above problems	11.7	14.0	-3.7**	10.2	13.8	-4.5***	7.7	13.8	-5.9***

Utilizing the Bonferroni correction, \**p* < 0.003, \*\**p* < 0.001, \*\*\**p* < 0.0001.

Table 4. Comparison of percentages indicating each adverse outcome by frequency of lifetime use.

	Alcohol lifetime frequency			Marijuana lifetime frequency			$\chi^2_{1S}$
	1-9 times, % ( <i>n</i> = 2778)	10-39 times, % ( <i>n</i> = 2363)	$\geq 40$ times, % ( <i>n</i> = 2057)	1-9 times, % ( <i>n</i> = 2046)	10-39 times, % ( <i>n</i> = 927)	$\geq 40$ times, % ( <i>n</i> = 1516)	
Caused you to behave in ways that you later regretted	17.6	42.2	54.9	8.1	15.5	16.2	43.3***
Hurt your relationship with your parents	5.2	10.7	18.5	4.5	13.2	23.5	191.7***
Hurt your relationship with your spouse, fiancée, or girlfriend/boyfriend	4.7	13.2	22.0	5.9	12.7	16.4	72.2***
Hurt your relationships with your friends	4.3	9.7	14.8	5.4	10.7	10.6	27.5***
Hurt your relationships with teachers or supervisors	0.6	2.5	3.4	1.4	2.4	5.8	38.4***
Involved you with people you think are a bad influence on you	7.0	13.3	17.0	15.2	26.9	23.9	49.9***
Hurt your performance in school and/or on the job	2.0	5.6	10.4	3.3	11.5	19.5	170.9***
Caused you to be less interested in other activities than you were before	2.2	4.8	9.3	4.2	12.4	22.3	196.2***
Caused you to be less stable emotionally	4.8	9.6	14.0	4.1	7.6	10.6	41.4***
Caused you to have less energy	4.6	8.4	12.8	10.3	25.7	33.1	209.7***
Interfered with your ability to think clearly	12.3	27.0	30.8	13.3	28.7	26.3	94.7***
Had other bad psychological effects	1.2	2.9	4.8	3.0	7.2	6.2	23.3***
Caused your physical health to be bad	1.6	4.0	8.2	2.5	5.1	7.7	37.1***
Caused you to drive unsafely	1.9	8.3	19.9	3.0	10.0	8.8	52.6***
Gotten you into trouble with the police	1.5	4.1	13.4	0.7	2.7	11.8	180.1***
Caused you none of the above problems	14.1	12.3	7.7	14.4	13.7	13.8	0.3

Rao-Scott Chi-squares each contain 2 degrees of freedom. Utilizing the Bonferroni correction, \*\*\**p* < 0.0001.

to report no problems associated with use, compared to alcohol.

Comparing outcomes further by frequency of use, all adverse outcomes for both alcohol and marijuana use increased significantly as frequency of use increased (Table 4). However, the only outcome that did not change by frequency of use was reporting that there were no problems occurring from marijuana use. For alcohol use, driving unsafely, behaving in ways in which one regrets, getting into trouble with the police and hurting one’s relationship with a significant other greatly increased with frequency of use (all  $ps < 0.0001$ ). Hurting one’s relationship with parents, hurting school or job performance, experiencing decreased interest in activities, having less energy and trouble with the police all greatly increased with frequency of marijuana use (all  $ps < 0.0001$ ).

White students reported significantly higher rates of various adverse outcomes as compared to black and Hispanic students (Table 5). The most significant differences by alcohol use were for engaging in behavior that one regrets, inability to think clearly and driving unsafely (all  $ps < 0.0001$ ). There were far fewer racial/ethnic differences with regard to marijuana use, but white students were more likely to report use interfering with ability to think clearly and unsafe driving ( $ps < 0.0001$ ). However, white students were also more likely to report no adverse outcomes associated with marijuana use, compared to black and Hispanic students.

There were also numerous significant differences by sex for both drugs (Table 6) with females more likely to report most adverse outcomes related to alcohol and marijuana use compared to males. Females were particularly more likely to report engaging in behaviors they regretted, feeling less stable emotionally and thinking less clearly due to alcohol use (all  $ps < 0.0001$ ). Sex differences were generally not as large for marijuana, but females were more likely to report less energy and less emotional stability, and more psychological effects compared to males (all  $ps < 0.0001$ ).

While there were numerous significant differences by race and sex, frequency of use was found to be dependent on these factors (data not presented in tables). Specifically, white students were more likely to report more frequent alcohol use (i.e.  $\geq 40$  times) and black and Hispanic students were more likely to report less frequent use (i.e. 1–9 times) ( $\chi^2_{rs}(4) = 95.9, p < 0.0001$ ); results were similar for marijuana ( $\chi^2_{rs}(4) = 40.2, p < 0.0001$ ). Males were also more likely to report more frequent alcohol use (i.e.  $\geq 40$  times) and females were more likely to report less frequent alcohol use (i.e. 1–9 times) ( $\chi^2_{rs}(2) = 76.5, p < 0.0001$ ); results were similar for marijuana ( $\chi^2_{rs}(2) = 65.8, p < 0.0001$ ). To control for these differences, we computed multivariable models.

Females were at higher odds for reporting the majority of adverse outcomes, while controlling for race and ethnicity and frequency of use (Table 7). Racial or ethnic minorities (most often black students) were at decreased odds for many adverse outcomes, and this “protective” effect tended to be more pronounced for alcohol than marijuana. With regard to frequency of use, the higher the frequency of use, the higher the odds of reporting an adverse outcome. In particular, the relationship between frequent alcohol use (used  $\geq 40$  times) and regret (AOR = 6.66) was stronger

Table 5. Comparison of adverse outcomes resulting from lifetime use of alcohol and marijuana by race and ethnicity.

	Alcohol				Marijuana			
	Black % (n = 668)	Hispanic % (n = 1029)	White % (n = 4607)	$\chi^2_{rs}$	Black % (n = 459)	Hispanic % (n = 624)	White % (n = 2825)	$\chi^2_{rs}$
Caused you to behave in ways that you later regretted	18.8	28.6	41.1	137.3***	10.4	9.1	13.1	7.3
Hurt your relationship with your parents	4.0	10.7	12.1	42.8***	8.2	12.1	13.5	8.6
Hurt your relationship with your spouse, fiancée, or girlfriend/boyfriend	5.6	10.1	14.2	51.2***	6.7	10.2	11.6	8.7
Hurt your relationships with your friends	4.3	8.0	10.2	28.3***	4.6	7.8	9.2	10.2
Hurt your relationships with teachers or supervisors	0.8	2.1	2.1	5.4	2.9	4.2	2.6	2.2
Involved you with people you think are a bad influence on you	5.3	9.1	13.3	49.5***	14.7	18.8	22.1	12.1*
Hurt your performance in school and/or on the job	2.7	5.5	5.7	10.1	9.4	10.2	10.0	0.1
Caused you to be less interested in other activities than you were before	3.3	5.0	5.2	4.5	9.1	12.6	11.0	4.3
Caused you to be less stable emotionally	5.6	7.7	9.5	12.1*	6.6	7.8	6.8	0.5
Caused you to have less energy	5.5	6.7	8.5	8.4	15.6	17.7	22.8	14.2**
Interfered with your ability to think clearly	8.4	15.1	26.3	152.2***	14.0	15.0	22.6	27.4***
Had other bad psychological effects	1.7	2.5	2.9	3.2	3.5	4.3	5.3	3.1
Caused your physical health to be bad	2.6	3.4	4.4	5.5	2.9	4.5	5.0	2.8
Caused you to drive unsafely	3.8	6.0	10.9	63.0***	3.4	2.4	7.7	47.6***
Gotten you into trouble with the police	2.0	4.3	6.8	38.1***	2.9	3.2	5.5	9.1
Caused you none of the above problems	8.2	9.8	12.8	13.9**	7.9	10.9	16.5	28.7***

Rao-Scott Chi-squares each contain 2 degrees of freedom. Utilizing the Bonferroni correction, \* $p < 0.003$ , \*\* $p < 0.001$ , \*\*\* $p < 0.0001$ .

Table 6. Comparison of adverse outcomes resulting from use of alcohol and marijuana by sex.

	Alcohol			Marijuana		
	Male % (n = 3348)	Female % (n = 3564)	$\chi^2_{FS}$	Male % (n = 2209)	Female % (n = 2084)	$\chi^2_{FS}$
Caused you to behave in ways that you later regretted	31.4	41.9	61.4***	11.0	14.4	7.9
Hurt your relationship with your parents	8.8	13.0	23.4***	12.3	13.2	0.5
Hurt your relationship with your spouse, fiancée, or girlfriend/boyfriend	9.6	15.6	42.9***	9.0	13.1	13.2**
Hurt your relationships with your friends	6.7	11.7	39.1***	6.8	10.3	12.8**
Hurt your relationships with teachers or supervisors	1.8	2.3	1.6	2.1	4.1	10.0*
Involved you with people you think are a bad influence on you	8.9	15.1	48.9***	17.6	24.4	22.0***
Hurt your performance in school and/or on the job	4.6	6.5	8.6	10.0	11.2	1.1
Caused you to be less interested in other activities than you were before	3.6	6.4	21.3***	10.3	14.0	10.5*
Caused you to be less stable emotionally	4.1	13.7	159.5***	4.6	9.9	33.5***
Caused you to have less energy	7.1	9.3	8.8	17.9	25.6	28.8***
Interfered with your ability to think clearly	18.8	26.6	45.9***	17.9	25.0	24.8***
Had other bad psychological effects	1.7	3.8	22.4***	3.1	7.1	27.7***
Caused your physical health to be bad	3.2	5.3	13.7**	3.8	6.0	8.2
Caused you to drive unsafely	9.9	8.6	2.7	5.9	7.1	2.1
Gotten you into trouble with the police	6.3	5.4	2.2	5.8	4.1	5.3
Caused you none of the above problems	11.8	11.6	0.1	15.7	12.4	7.3

Rao-Scott Chi-squares each contain 1 degree of freedom. Utilizing the Bonferroni correction, \* $p < 0.003$ , \*\* $p < 0.001$ , \*\*\* $p < 0.0001$ .

( $p < 0.0001$ ) than the relationship between frequent marijuana use and regret (AOR = 2.29). Similarly, there was a stronger relationship between frequent alcohol use (used  $\geq 40$  times) and hurt relationship with friends (alcohol AOR = 4.44, marijuana AOR = 2.24,  $p < 0.003$ ), and driving unsafely (alcohol AOR = 13.17, marijuana AOR = 3.00,  $p < 0.0001$ ) as compared to frequent marijuana use. Compared to alcohol, frequent marijuana use was less likely to lead to any adverse outcomes (alcohol AOR = 0.85, marijuana AOR = 0.44,  $p < 0.001$ ) after controlling for sex, race and ethnicity.

## Discussion

An increase in positive public opinion toward marijuana has led to a greater interest in whether marijuana is more or less harmful than other substances. This is of particular concern for adolescent populations, where preventive strategies are often targeted to curb initiation and potentially related damaging effects. Previous studies have made an effort to rank the ‘‘harmfulness’’ of various substances (5,13–16,27); however, while this approach is informative, it has been controversial as a means to guide public discourse due to the variable risk associated with different harmful behaviors (17,18,28). In contrast, this study directly compared various self-reported adverse psychosocial outcomes among student users of alcohol and marijuana, the two most prevalent psychoactive substances used by US high school seniors (23). Using a young, nationally representative sample, our findings suggest that (1) marijuana users are less likely to report any adverse psychosocial outcomes; and (2) certain psychosocial outcomes and behaviors are more consistent with marijuana use and others are more consistent with alcohol use. Furthermore, our results provide important new insights into the relationship between demographic characteristics, frequency of use and adverse psychosocial outcomes.

Compared to alcohol use, marijuana use was more consistently reported to hurt relationships with parents and with teachers or supervisors. However, the reason for this

association is unclear. While detrimental relationship effects may stem directly from behaviors or symptoms associated with use, they might also be due to the stigma associated with illicit drug use. For example, in a recent MTF report, 49% of seniors reported disapproval toward adults trying marijuana once or twice, yet only one in four high school seniors indicated that they disapprove of trying one or two drinks of alcohol (11). Although marijuana is the least stigmatized illicit drug (23,29), marijuana users are more likely than those who drink alcohol to face negative perceptions (23,30,31), possibly even more so from authoritative figures. Likewise, compared to alcohol, marijuana use was more associated with reports of being involved with ‘‘bad’’ influences. This was not unexpected as marijuana use is illegal and thus peers who use or sell may also be subject to the disapproval and/or stigma aforementioned. However, frequent users of alcohol and marijuana had identical odds for reporting such involvement, after controlling for other demographic variables.

Despite differing legal status of these two substances, we did not find a significant difference with regard to general lifetime use and trouble with police. However, controlling for demographic variables, frequent (i.e. used  $\geq 40$  times) marijuana users were 23 times more likely to report getting into trouble with the police (compared to alcohol, AOR = 9.83). It is unknown whether getting into trouble with police was related to behavior while high on marijuana or a direct result of marijuana possession. As a controlled substance, mere possession of marijuana may have a greater likelihood of significant legal consequences compared to an age-restricted, unscheduled substance such as alcohol, so this was not unexpected. Smoking marijuana also tends to leave a strong odor, which can easily draw attention to authorities. However, while previous studies have found arrest disparities with regard to marijuana-related arrests (32–35), we found no racial differences with regard to getting in trouble with police because of marijuana use. However, future studies should further examine whether there are differences by urban versus non-urban areas.

Table 7. Multivariable logistic regression models delineating correlates of adverse outcomes resulting from alcohol and marijuana use.

	Caused you to behave in ways that you later regretted				Hurt your relationship with your parents			
	Alcohol		Marijuana		Alcohol		Marijuana	
	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI
Female	2.06	(1.80, 2.36)***	1.47	(1.16, 1.87)*	1.78	(1.46, 2.17)***	1.29	(1.01, 1.63)
Black††	0.40	(0.31, 0.52)***	0.83	(0.57, 1.21)	0.38	(0.26, 0.57)***	0.67	(0.44, 1.00)
Hispanic	0.60	(0.50, 0.73)***	0.68	(0.46, 1.00)	0.93	(0.72, 1.21)	1.02	(0.72, 1.45)
Used 10–39 times‡	3.59	(3.04, 4.24)***	2.13	(1.58, 2.88)***	2.19	(1.66, 2.89)***	3.12	(2.16, 4.50)***
Used ≥40 times‡‡	6.66	(5.60, 7.93)***	2.29	(1.72, 3.04)***	4.18	(3.18, 4.49)***	6.97	(5.07, 9.58)***
	Hurt your relationship with your spouse, fiancée, or girlfriend/boyfriend				Hurt your relationships with your friends			
Female	2.22	(1.84, 2.67)***	1.85	(1.45, 2.36)***	2.16	(1.74, 2.69)***	1.84	(1.39, 2.43)***
Black	0.45	(0.32, 0.65)***	0.60	(0.40, 0.92)	0.49	(0.33, 0.72)**	0.52	(0.30, 0.88)
Hispanic	0.75	(0.58, 0.98)	0.96	(0.66, 1.38)	0.83	(0.62, 1.11)	0.91	(0.61, 1.34)
Used 10–39 times	3.10	(2.38, 4.04)***	2.25	(1.60, 3.14)***	2.60	(1.93, 3.51)***	2.17	(1.52, 3.09)***
Used ≥40 times‡	5.80	(4.48, 7.51)***	3.30	(2.45, 4.46)***	4.44	(2.29, 5.99)***	2.24	(1.61, 3.11)***
	Hurt your relationships with teachers or supervisors				Involved you with people you think are a bad influence on you			
Female	1.46	(0.95, 2.23)	2.61	(1.58, 4.31)**	2.05	(1.69, 2.48)***	1.62	(1.34, 1.97)***
Black	0.50	(0.24, 1.06)	1.21	(0.60, 2.43)	0.42	(0.29, 0.60)***	0.63	(0.46, 0.86)
Hispanic	1.12	(0.62, 2.01)	1.87	(0.97, 3.63)	0.70	(0.53, 0.92)	0.86	(0.65, 1.13)
Used 10–39 times	4.03	(2.21, 7.38)***	1.77	(0.85, 3.67)	1.99	(1.57, 2.52)***	2.06	(1.63, 2.62)***
Used ≥40 times	5.61	(3.14, 10.02)***	5.14	(2.82, 9.36)***	2.86	(2.26, 3.63)***	1.83	(1.46, 2.29)***
	Hurt your performance in school and/or on the job				Caused you to be less interested in other activities than you were before			
Female	1.88	(1.43, 2.48)***	1.36	(1.04, 1.77)	2.11	(1.59, 2.81)***	1.82	(1.43, 2.32)***
Black	0.62	(0.36, 1.09)	1.13	(0.77, 1.66)	0.84	(0.52, 1.35)	0.86	(0.59, 1.25)
Hispanic	1.08	(0.77, 1.54)	1.26	(0.87, 1.83)	1.10	(0.77, 1.56)	1.07	(0.74, 1.53)
Used 10–39 times	3.13	(2.07, 4.75)***	4.15	(2.77, 6.22)***	1.34	(1.56, 3.51)***	3.58	(2.46, 5.20)***
Used ≥40 times	6.07	(4.08, 9.03)***	7.99	(5.56, 11.49)***	4.69	(3.18, 6.93)***	7.91	(5.66, 11.06)***
	Caused you to be less stable emotionally				Caused you to have less energy			
Female	4.45	(3.45, 5.74)***	2.73	(2.00, 3.72)***	1.48	(1.18, 1.86)**	1.97	(1.61, 2.40)***
Black	0.67	(0.44, 1.03)	1.11	(0.67, 1.84)	0.80	(0.53, 1.20)	0.70	(0.51, 0.97)
Hispanic	0.86	(0.64, 1.16)	1.28	(0.83, 1.98)	0.86	(0.63, 1.17)	0.85	(0.62, 1.15)
Used 10–39 times	2.40	(1.79, 3.22)***	2.23	(1.49, 3.34)***	2.10	(1.56, 2.85)**	3.09	(2.38, 4.00)***
Used ≥40 times	4.06	(3.04, 5.41)***	3.32	(2.28, 4.82)***	3.49	(2.60, 4.69)***	4.94	(3.89, 6.27)***
	Interfered with your ability to think clearly				Had other bad psychological effects			
Female	1.80	(1.56, 2.09)***	1.71	(1.41, 2.07)***	2.37	(1.62, 3.47)***	2.62	(1.84, 3.74)***
Black†	0.30	(0.21, 0.41)***	0.61	(0.44, 0.85)	0.80	(0.41, 1.56)	0.73	(0.40, 1.33)
Hispanic	0.53	(0.42, 0.66)***	0.68	(0.50, 0.91)	0.96	(0.60, 1.55)	0.91	(0.56, 1.46)
Used 19–39 times	2.72	(2.26, 3.28)***	2.88	(2.26, 3.67)***	2.59	(1.57, 4.30)**	2.57	(1.69, 3.90)***
Used ≥40 times	3.28	(2.71, 3.97)***	2.48	(1.98, 3.11)***	4.59	(2.84, 7.44)***	2.38	(1.58, 3.59)***
	Caused your physical health to be bad				Caused you to drive unsafely			
Female	2.27	(1.65, 3.11)***	1.96	(1.36, 2.81)**	1.05	(0.86, 1.29)	1.36	(1.02, 1.83)
Black	0.81	(0.46, 1.41)	0.63	(0.35, 1.13)	0.48	(0.31, 0.75)*	0.50	(0.28, 0.87)
Hispanic	0.87	(0.55, 1.36)	1.05	(0.58, 1.90)	0.62	(0.44, 0.85)	0.33	(0.20, 0.56)***
Used 10–39 times	2.63	(1.68, 4.10)***	2.51	(1.55, 4.08)**	4.91	(3.38, 7.15)***	3.41	(2.24, 5.19)***
Used ≥40 times‡‡‡	6.25	(4.17, 9.35)***	3.76	(2.40, 5.88)***	13.17	(9.23, 18.78)***	3.00	(2.01, 4.47)***
	Gotten you into trouble with the police				Caused you none of the above problems			
Female	1.07	(0.83, 1.38)	0.92	(0.63, 1.33)	0.91	(0.76, 1.09)	0.74	(0.60, 0.93)
Black	0.41	(0.23, 0.73)*	0.62	(0.34, 1.14)	0.55	(0.39, 0.78)*	0.45	(0.31, 0.67)***
Hispanic	0.67	(0.45, 0.99)	0.70	(0.35, 1.41)	0.68	(0.51, 0.92)	0.57	(0.39, 0.82)*
Used 10–39 times	2.56	(1.64, 3.98)***	4.72	(1.96, 11.38)**	0.82	(0.66, 1.01)	0.92	(0.70, 1.22)
Used ≥40 times‡‡	9.83	(6.58, 14.70)***	21.86	(9.81, 48.72)***	0.44	(0.34, 0.56)***	0.85	(0.66, 1.10)

Comparisons groups for female, black and Hispanic, and used 10–39 and ≥40 times, are male, white, and used 1–9 times. Analyses were also adjusted by age. Utilizing the Bonferroni correction, \* $p < 0.003$ , \*\* $p < 0.001$ , \*\*\* $p < 0.0001$ . Utilizing the Bonferroni correction for significant differences between AORs in first column: † $p < 0.003$ , †† $p < 0.001$ , ††† $p < 0.0001$ . Utilizing the Bonferroni correction for significant differences between AORs in second column: ‡ $p < 0.003$ , ‡‡ $p < 0.001$ , ‡‡‡ $p < 0.0001$ .

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Compared to alcohol, marijuana use was more commonly associated with less energy, less interest in activities, and lower performance at work or school, particularly when use was frequent. Such findings have been described in the literature previously (e.g. “amotivational syndrome”) (36,37). Marijuana was also more commonly reported to be associated with other bad psychological effects, but when use was less frequent. Bad psychological effects associated with marijuana use were more common among less frequent users – possibly because infrequent users are still unfamiliar with the substance’s effects.

Compared to marijuana users, those who reported alcohol use more commonly reported that use led to regret, and frequent use of alcohol was more often associated with harmed relationships with friends or significant others (e.g. boyfriends). Feelings of regret and hurt relationships were more likely among females. These two associations may be linked, as regret can often result from conflicts from peers. Alcohol in particular has been associated with loss of inhibitions and sexual risk behavior (38–40). Alcohol use was also more strongly associated with reports of being less stable emotionally.

Perhaps the most alarming finding was that alcohol use was significantly more likely to be associated with unsafe driving, especially among frequent users (19.9% for alcohol vs. 8.8% for marijuana). In fact, frequent users (used  $\geq 40$  times) had over 13 times the odds of reporting unsafe driving compared to marijuana (AOR = 3.0). While most adverse outcomes pertain to the student and his or her relationships, this may be the most detrimental outcome to society. It is estimated that 10.5% of high school students have driven under the influence of alcohol at some point in time (41). Motor vehicle accidents remain the leading cause of death among 10–24-year-olds, resulting in 18.6 deaths per 100 000 teens. Alcohol is also thought to contribute to 23% of fatal crashes involving 16–20-year olds (41). Although cannabinoids have been increasingly detected in fatal car crashes (2.8–12.3%), alcohol is still present in the blood of a substantial proportion of victims of motor vehicle accidents (24.7–43.7%) (42). However, other MTF studies on high school seniors have shown that marijuana use and driving may have begun to overtake driving under the influence of alcohol (43).

While many studies have examined harm resulting from substance use, this study elucidates important relationships between frequency of use and adverse outcomes. For almost all reported adverse outcomes, the frequency of the outcome increased as use of either marijuana or alcohol increased. The notable exception was that 14% of marijuana users reported no adverse psychosocial outcomes, regardless of frequency of use. This relationship supports the idea that frequent marijuana use may be less likely than alcohol use to be associated with perception of harmful psychosocial behaviors. In addition, some adverse outcomes experienced by marijuana users are likely related to marijuana policy rather than use *per se* (19,44).

### Limitations

The reported adverse outcomes were based on subjective perceptions without objective confirmation. Other outcomes

may have gone unreported if students did not feel that the behavior was risky, despite its occurrence, or if the student was unaware of the outcome (or unaware of the outcome’s potential relation to use). Others may have over-reported assuming direct relationships between use and outcomes. We also could not evaluate frequency of outcomes or the magnitude of consequences or harm to others or society. MTF did not assess common risk behaviors such as unprotected sex or dependence, and did not survey high school dropouts, potentially decreasing the generalizability of findings.

Subgroup analyses were limited to sex, race and ethnicity, and reported adverse outcomes may have been dependent upon other sociodemographic variables. We controlled for age in multivariable models, but refrained from controlling for other characteristics we did not examine earlier in a bivariable manner. It is possible that, for example, some sex or race associations would change in light of other covariates. We did find that adverse outcomes were more likely among those who reported use of both substances so future studies should further examine whether lifetime use of other drugs is related to experience of adverse outcomes in these substances. We also could not account for simultaneous use of both substances, a common occurrence among adolescents (45). Finally, a statistical correction was utilized when examining the 16 outcomes for each substance. While this correction was conservative, very few associations lost significance in light of the correction.

### Conclusions

Few studies have directly compared adverse psychosocial outcomes among adolescent users of alcohol and marijuana. Frequency of use appears to influence adverse outcomes associated with marijuana and alcohol use differently. Likewise, perception or experience of various adverse outcomes tends to differ by sex, race and ethnicity. As marijuana use gains greater acceptance among the US population, special attention should be given to the unique differences in adverse outcomes among adolescents who use marijuana and/or alcohol. This will help ensure that resources and policies aimed at preventing these behaviors are utilized in the most effective manner.

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### Declaration of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this paper.

### References

1. Palamar JJ, Ompad DC, Petkova E. Correlates of intentions to use cannabis among US high school seniors in the case of cannabis legalization. *Int J Drug Policy* 2014;25:424–435.
2. Swift A. For first time, Americans favor legalizing marijuana: Support surged 10 percentage points in past year, to 58%. Gallup



2013. Available from: <http://www.gallup.com/poll/165539/first-time-americans-favor-legalizing-marijuana.aspx> [last accessed 3 May 2014].
3. Pew Research Center. Majority now supports legalizing cannabis. 2013. Available from: <http://www.people-press.org/files/legacy-pdf/4-4-13%20Marijuana%20Release.pdf> [last accessed 3 May 2014].
  4. Fox S, Armentano P, Tvert M. Marijuana is safer: so why are we driving people to drink? Vermont: Chelsea Green Publishing; 2013.
  5. Nutt DJ, King LA, Phillips LD. Drug harms in the UK: a multicriteria decision analysis. *Lancet* 2010;376:1558–1565.
  6. Miller J. Obama: Marijuana not “more dangerous” than alcohol. CBS News, 2014. Available from: <http://www.cbsnews.com/news/obama-marijuana-not-more-dangerous-than-alcohol/> [last accessed 3 May 2014].
  7. Pew Research Center. America’s new drug policy landscape. 2014. Available from: <http://www.people-press.org/files/legacy-pdf/04-02-14%20Drug%20Policy%20Release.pdf> [last accessed 28 May 2014].
  8. Degenhardt L, Chiu WT, Sampson N, Kessler RC, Anthony JC, Angermeyer M, Bruffaerts R, et al. Toward a global view of alcohol, tobacco, cannabis, and cocaine use: findings from the WHO World Mental Health Surveys. *PLoS Med* 2008;5:e141.
  9. Lisdahl KM, Gilbert ER, Wright NE, Shollenbarger S. Dare to delay? The impacts of adolescent alcohol and marijuana use onset on cognition, brain structure, and function. *Front Psychiatry* 2013; 4:53.
  10. Terry-McElrath YM, O’Malley PM, Johnston LD. Simultaneous alcohol and marijuana use among U.S. high school seniors from 1976 to 2011: trends, reasons, and situations. *Drug Alcohol Depend* 2013;133:71–79.
  11. Johnston LD, O’Malley PM, Miech RA, Bachman JG, Schulenberg JE. Monitoring the Future: national survey results on drug use, 1975–2013: overview, key findings on adolescent drug use. Ann Arbor, MI: Institute for Social Research, The University of Michigan; 2014.
  12. Whiteford HA, Degenhardt L, Rehm J, Baxter AJ, Ferrari AJ, Erskine HE, Charlson FJ, et al. Global burden of disease attributable to mental and substance use disorders: findings from the Global Burden of Disease Study 2010. *Lancet* 2013;382: 1575–1586.
  13. Nutt DJ, King LA, Saulsbury W, Blakemore C. Development of a rational scale to assess the harm of drugs of potential misuse. *Lancet* 2007;369:1047–1053.
  14. van Amsterdam J, Opperhuizen A, Koeter M, van den Brink W. Ranking the harm of alcohol, tobacco and illicit drugs for the individual and the population. *Eur Addict Res* 2010;16:202–207.
  15. Morgan CJ, Muetzelfeldt L, Muetzelfeldt M, Nutt DJ, Curran HV. Harms associated with psychoactive substances: findings of the UK National Drug Survey. *J Psychopharmacol* 2010;24:147–153.
  16. Carhart-Harris RL, Nutt DJ. Experienced drug users assess the relative harms and benefits of drugs: a web-based survey. *J Psychoactive Drugs* 2013;45:322–328.
  17. Caulkins JP, Reuter P, Coulson C. Basing drug scheduling decisions on scientific ranking of harmfulness: false promise from false premises. *Addiction* 2011;106:1886–1890.
  18. Kalant H. Drug classification: science, politics, both or neither? *Addiction* 2010;105:1146–1149.
  19. MacCoun RJ, Reuter P. Drug war heresies: learning from other vices, times, and places. Cambridge: Cambridge University Press; 2001.
  20. Brown SA, McGue M, Maggs J, Schulenberg J, Hingson R, Swartzwelder S, Martin C, et al. A developmental perspective on alcohol and youths 16 to 20 years of age. *Pediatrics* 2008;121: S290–S310.
  21. Hall W, Degenhardt L. Adverse health effects of non-medical cannabis use. *Lancet* 2009;374:1383–1391.
  22. Johnson KA, Bonn-Miller MO, Leyro TM, Zvolensky MJ. Anxious arousal and anhedonic depression symptoms and the frequency of current marijuana use: testing the mediating role of marijuana-use coping motives among active users. *J Stud Alcohol Drugs* 2009;70: 543–550.
  23. Johnston LD, O’Malley PM, Bachman JG, Schulenberg JE. Monitoring the future: national survey results on drug use, 1975–2012: Vol. I, Secondary school students. Ann Arbor, MI: Institute for Social Research, The University of Michigan; 2013.
  24. Swinscow T. Differences between percentages and paired alternatives. In: Campbell M, ed. *Statistics at square one*. London: BMJ Books; 1996.
  25. Rao J, Scott A. On Chi-squared tests for for multiway contingency tables with cell proportions estimated from survey data. *Ann Stat* 1984;12:46–60.
  26. Heeringa SG, West BT, Berglund PA. *Applied survey data analysis*. London: Chapman and Hall; 2010.
  27. Morgan CJ, Noronha LA, Muetzelfeldt M, Fielding A, Curran HV. Harms and benefits associated with psychoactive drugs: findings of an international survey of active drug users. *J Psychopharmacol* 2013;27:497–506.
  28. Room R. The dangerousness of drugs. *Addiction* 2006;101: 166–168.
  29. Palamar JJ, Kiang MV, Halkitis PN. Development and psychometric evaluation of scales that assess stigma associated with illicit drug users. *Subst Use Misuse* 2011;46:1457–1467.
  30. Resko SM. Public perceptions and attitudes toward adolescent marijuana use. *SAGE Open* 2014;4(1):1–11.
  31. Palamar JJ, Kiang MV, Halkitis PN. Predictors of stigmatization towards use of various illicit drugs among emerging adults. *J Psychoactive Drugs* 2012;44:243–251.
  32. Golub A, Johnson BD, Dunlap E. The race/ethnicity disparity in misdemeanor marijuana arrests in New York City. *Criminol Public Policy* 2007;6:131–164.
  33. Johnson BD, Golub A, Dunlap E, Sifanek SJ. An analysis of alternatives to New York City’s current marijuana arrest and detention policy. *Policing* 2008;31:226–250.
  34. Ramchand R, Pacula RL, Iguchi MY. Racial differences in marijuana-users’ risk of arrest in the United States. *Drug Alcohol Depend* 2006;84:264–272.
  35. American Civil Liberties Union. The war on marijuana in black and white. 2013. Available from: <https://www.aclu.org/sites/default/files/assets/1114413-mj-report-rfs-re11.pdf> [last accessed 28 May 2014].
  36. Hyggen C. Does smoking cannabis affect work commitment? *Addiction* 2012;107:1309–1315.
  37. Reece AS. Chronic toxicology of cannabis. *Clin Toxicol* 2009;47: 517–524.
  38. Walsh JL, Fielder RL, Carey KB, Carey MP. Do alcohol and marijuana use decrease the probability of condom use for college women? *J Sex Res* 2014;51:145–158.
  39. Stoner SA, Norris J, George WH, Morrison DM, Zawacki T, Davis KC, Hessler DM. Women’s condom use assertiveness and sexual risk-taking: effects of alcohol intoxication and adult victimization. *Addict Behav* 2008;33:1167–1176.
  40. Prause N, Staley C, Finn P. The effects of acute ethanol consumption on sexual response and sexual risk-taking intent. *Arch Sex Behav* 2011;40:373–384.
  41. Mulye TP, Park MJ, Nelson CD, Adams SH, Irwin Jr CE, Brindis CD. Trends in adolescent and young adult health in the United States. *J Adolesc Health* 2009;45:8–24.
  42. Brady JE, Li G. Trends in alcohol and other drugs detected in fatally injured drivers in the United States, 1999–2010. *Am J Epidemiol* 2014;179:692–699.
  43. O’Malley PM, Johnston LD. Driving after drug or alcohol use by US high school seniors, 2001–2011. *Am J Public Health* 2013;103: 2027–2034.
  44. Zinberg NE. *Drug, set, and setting*. New Haven: Yale University Press; 1984.
  45. Martin CS, Kaczynski NA, Maisto SA, Tarter RE. Polydrug use in adolescent drinkers with and without DSM-IV alcohol abuse and dependence. *Alcohol Clin Exp Res* 1996;20:1099–1108.