Drug and Alcohol Dependence 200 (2019) 115–123

Contents lists available at ScienceDirect

Drug and Alcohol Dependence

journal homepage: www.elsevier.com/locate/drugalcdep

Full length article

Trends in binge drinking and alcohol abstention among adolescents in the US, 2002-2016

Trenette Clark Goings[a,*], Christopher P. Salas-Wright[b], Faye Z. Belgrave[c], Erik J. Nelson[d], Jaroslaw Harezlak[d], Michael G. Vaughn[e,f]

[a] School of Social Work, University of North Carolina at Chapel Hill, Chapel Hill, NC, 27599, United States
[b] School of Social Work, Boston University, 264 Bay State Rd, Boston, MA, 02215, United States
[c] Department of Psychology, Virginia Commonwealth University, 806 West Franklin Street, Box 842018, Richmond, VA, 23284, United States
[d] Department of Epidemiology and Biostatistics, Indiana University School of Public Health-Bloomington, 1025 E. 7th Street, Bloomington, IN, 47405, United States
[e] School of Social Work, College for Public Health and Social Justice, Saint Louis University, 3545 Lafayette Ave, St. Louis, MO, 63104, United States
[f] Graduate School of Social Welfare, Yonsei University, Seoul, Republic of Korea

ARTICLE INFO

Keywords:
Alcohol
Binge drinking
Adolescence
Youth
Trends

ABSTRACT

Background: Binge drinking accounts for several adverse health, social, legal, and academic outcomes among adolescents. Understanding trends and correlates of binge drinking and alcohol abstention has important implications for policy and programs and was the aim of this study. The current study examined trends in adolescent binge drinking and alcohol abstention by age, gender, and race/ethnicity over a 15-year period.

Methods: Respondents between the ages of 12 and 17 years who participated in the National Survey on Drug Use and Health (NSDUH) between 2002 and 2016 were included in the sample of 258,309. Measures included binge drinking, alcohol abstention, and co-morbid factors (e.g., marijuana, other illicit drugs), and demographic factors.

Results: Logistic regression analyses were conducted to examine the significance of trend changes by sub-groups while controlling for co-morbid and demographic factors. Findings indicated that binge drinking decreased substantially among adolescents in the US over the last 15 years. This decrease was shown among all age, gender, and racial/ethnic groups. In 2002, Year 1 of the study, 26% of 17-year-olds reported past-month binge drinking; in 2016, past-month binge drinking dropped to 12%. Findings also indicated comparable increases in the proportion of youth reporting abstention from alcohol consumption across all subgroups. Black youth reported substantially lower levels of binge alcohol use and higher levels of abstention, although the gap between Black, Hispanic and White youth narrowed substantially between 2002 and 2016.

Conclusion: Study findings are consistent with those of other research showing declines in problem alcohol- use behavior among youth.

1. Introduction

Alcohol use among adolescents living in the United States is a major social and public health problem. Recent estimates from the National Survey on Drug Use and Health (NSDUH) indicate that during 2016 more than one in five youth ages 12 to 17 years, or 22% of U.S. youth, used alcohol (Center for Behavioral Health Statistics and Quality [CBHSQ], 2017). Most high school seniors report having tried alcohol (62%) and nearly half (45%) report they have “been drunk” (Miech et al., 2015). Early alcohol use places young people on a trajectory of risk for longer-term alcohol and other drug related problems, including addiction (Aiken et al., 2018). Most adverse effects from adolescent alcohol use are due to acute intoxication from binge drinking (Miller et al., 2007). Binge drinking—consumption in a 2 -h period of five or more drinks for men and four or more drinks for women (Substance Abuse and Mental Health Services Administration [SAMHSA], 2016)—is the most common, deadly, and costly pattern of alcohol use in the U.S. (Sacks et al., 2015; Stahre et al., 2014). Adolescent binge drinking varies by gender and ethnicity/race (Center for Behavioral Health Statistics and Quality (CBHSQ), 2017). In 2016, more 30-day binge drinking episodes were reported by females 12–17 years (5.4%) than same-age males (4.4%) (Center for Behavioral Health Statistics and Quality (CBHSQ), 2017). The highest levels of binge drinking in 2016 were among youth who identified as biracial or multiracial

* Corresponding author.
E-mail address: ttclark@email.unc.edu (T. Clark Goings).

https://doi.org/10.1016/j.drugalcdep.2019.02.034
Received 4 December 2018; Received in revised form 11 February 2019; Accepted 12 February 2019
Available online 08 May 2019
0376-8716/

Table 1
Correlates and tests of trends for binge drinking during the past 30 days, 2002–2016.

	Have you had 5 or more drinks on the same occasion on at least 1 day in the past 30 days?							
	No (n = 212,680; 91.38%)		Yes (n = 21,403; 8.62%)		Correlates of Binge Drinking (Pooled Data)		Linear Test of Trend (Year-by-Year)	
	%	95% CI	%	95% CI	AOR	95% CI	AOR	95% CI
Sociodemographic Factors								
Age, years								
12	16.93	(16.70, 17.15)	1.38	(1.16, 1.60)	1.0	*referent*	**0.921**	**(0.893, 0.950)**
13	17.78	(17.57, 17.99)	3.46	(3.13, 3.79)	**1.66**	**(1.35, 2.04)**	**0.913**	**(0.895, 0.932)**
14	17.62	(17.39, 17.85)	9.26	(8.73, 9.79)	**3.39**	**(2.80, 4.11)**	**0.920**	**(0.905, 0.935)**
15	17.06	(16.84, 17.29)	18.13	(17.47, 18.79)	**5.50**	**(4.57, 6.62)**	**0.929**	**(0.919, 0.939)**
16	15.99	(15.74, 16.23)	27.89	(27.07, 28.70)	**8.38**	**(6.89, 10.19)**	**0.934**	**(0.927, 0.942)**
17	14.62	(14.43, 14.82)	39.88	(39.03, 40.73)	**13.26**	**(10.95, 16.0)**	**0.945**	**(0.939, 0.952)**
Sex								
Female	50.87	(50.59, 51.15)	46.59	(45.70, 47.47)	1.0	*referent*	**0.945**	**(0.939, 0.951)**
Male	49.13	(49.41, 48.85)	53.41	(52.53, 54.30)	**0.88**	**(0.84, 0.93)**	**0.939**	**(0.934, 0.944)**
Race/Ethnicity								
White	61.88	(61.43, 62.32)	72.16	(71.23, 73.09)	1.0	*referent*	**0.940**	**(0.935, 0.944)**
Black	16.56	(16.27, 16.85)	7.98	(7.44, 8.52)	**0.41**	**(0.37, 0.45)**	**0.968**	**(0.953, 0.983)**
Hispanic	21.56	(21.20, 21.93)	19.85	(19.06, 20.65)	**0.87**	**(0.81, 0.93)**	**0.940**	**(0.931, 0.949)**
Income								
< $20,000	17.42	(17.13, 17.71)	15.5	(14.82, 16.18)	1.0	*referent*	**0.947**	**(0.936, 0.958)**
$20,000-$49,999	31.48	(31.13, 31.83)	30.77	(29.92, 31.62)	1.02	(0.95, 1.10)	**0.943**	**(0.935, 0.951)**
$50,000-$74,999	17.49	(17.25, 17.73)	18.3	(17.57, 19.02)	**1.10**	**(1.01, 1.19)**	**0.938**	**(0.928, 0.948)**
> $75,000	33.61	(33.18, 34.03)	35.43	(34.50, 36.36)	**1.18**	**(1.09, 1.29)**	**0.938**	**(0.931, 0.944)**
Father in Household								
No	26.2	(25.91, 26.49)	28.68	(27.97, 29.40)	1.05	(0.99, 1.12)	**0.942**	**(0.937, 0.946)**
Yes	73.8	(73.51, 74.09)	71.32	(70.6, 72.03)	1.0	*referent*	**0.941**	**(0.934, 0.948)**
Comorbid Substance Use								
Marijuana Use								
No	90.66	(90.49, 90.82)	38.2	(37.35, 39.04)	1.0	*referent*	**0.930**	**(0.923, 0.936)**
Yes	9.34	(9.18, 9.51)	61.8	(60.96, 62.65)	**5.80**	**(5.52, 6.09)**	**0.944**	**(0.938, 0.951)**
Other Drug Use								
No	98.10	(98.02, 98.19)	88.74	(88.18, 89.29)	1.0	*referent*	**0.934**	**(0.929, 0.938)**
Yes	1.90	(1.81, 1.98)	11.26	(10.71, 11.82)	**1.71**	**(1.55, 1.89)**	**0.920**	**(0.907, 0.933)**

Note: The sociodemographic AOR values reflect a logistic regression of binge drinking on all of the sociodemographic correlates. The AOR estimates for the comorbid substance sue variables are a logistic regression of each variable when controlling for sociodemographic characteristics. Test of trend is the AOR for survey year (coded continuously) predicting binge drinking while controlling for sociodemographic factors.

(7.7%), with the lowest levels found among Black (2.8%) and Asian youth (2.8%). Among White youth, binge drinking was 5.5% and among Hispanic youth, binge drinking was 4.8%. (Center for Behavioral Health Statistics and Quality (CBHSQ), 2017).

Adolescent binge drinking has been linked with several adverse outcomes, including sexual risk, interpersonal violence, criminal activity, injury, and mortality from automobile accidents (Hingson and Zha, 2018; Jennings et al., 2015). Binge drinking also compromises adolescents' academic engagement and performance (An et al., 2017; Patte et al., 2017).

While a small but significant number of youth engage in binge drinking, the majority of youth 12–17 years (90.1%) abstain from alcohol (Center for Behavioral Health Statistics and Quality (CBHSQ), 2017). Similar to variations in rates of binge drinking, alcohol abstinence varies by age and race/ethnicity; however, abstinence rates vary little by gender. Among youth 12–17 years, past-month abstinence was similar for males and females at 90.7% and 90.1%, respectively (Substance Abuse and Mental Health Services Administration (SAMHSA, 2016). In addition, SAMHSA reported abstinence rates for this sample of adolescents by ethnicity: Asian (95.1%), Black (92.8%), Hispanic (91.1%), and White (89.1%). As expected, abstinence varied considerably by age. Abstinence rates were highest among youth 12–13 years (98%) and showed a decline with increasing age, with rates of about 92% among youth 14–15 years, and around 80% among 16–17 year olds (Substance Abuse and Mental Health Services Administration (SAMHSA, 2016).

Recently, adolescents have shown an increase in age of initiation of use of substances and overall declines in use of alcohol and other substances (Han et al., 2017). This decline has co-occurred with increases in anti-drug norms (Salas-Wright and Vaughn, 2016) and decreases in other problem behaviors such as delinquency (Office of Juvenile Justice and Delinquency Prevention, 2018; Salas-Wright et al., 2017a). Similar to recent declines in other types of substance use, we seek to investigate whether a decline exists in adolescent binge drinking and whether this decline differs by subgroups.

Studies using data from different national data sets (e.g., NSDUH, Monitoring the Future, Youth Risk Behavior Survey) have reported declines in adolescent binge drinking (Chen et al., 2015; Chung et al., 2018). Researchers using NSDUH data found overall rates of adolescent binge drinking among 12–20 year old's decreased from 18.6% in 2001 to 13.8% in 2013 (Chen et al., 2015). A more recent study by Jang et al. (2017) examined trends in binge drinking from 1991 to 2015 using a national sample of students in Grades 8, 10, and 12 from the Monitoring the Future (MTF) study. MTF defined binge drinking as more than two occasions within 2 weeks when more than five drinks were consumed consecutively. Youth younger than 13 years were not included in the analysis. Jang et al. found that between 1991 and 2015, the frequency of binge drinking decreased among all grade levels. Notably, African American youth in the MTF had the lowest rates of binge drinking among all racial groups but also showed a lower decline in binge-

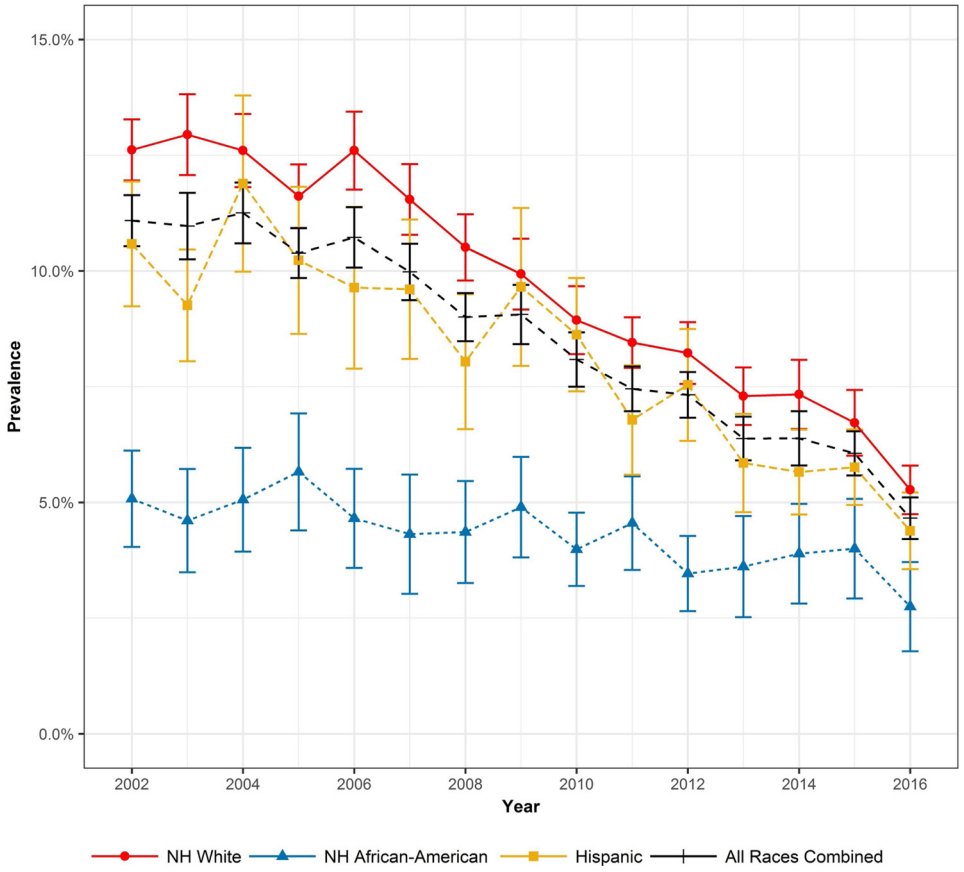

Fig. 1. Prevalence of binge drinking among adolescents during the past 30 days by race/ethnicity, 2002-2016. Note: The definition of binge drinking for women changed in 2015–2016 from five drinks on a single occasion to four drinks. The definition for males did not change over the study period.

drinking frequency than other racial groups. In addition, Jang et al. found convergence over time in binge drinking by gender and divergence by socioeconomic status (SES). Gender convergence was due to boys reporting greater decline in binge drinking than girls. SES divergence was such that over time, students with higher SES engaged in less binge drinking than their lower SES counterparts.

The current study builds on the authors' prior work and Jang et al.'s (2017) study by (a) using the most current NSDUH dataset, which includes a nationally representative sample of youth ages 12–17 years; (b) using the more recent SAMHSA (2016) definition of binge drinking, which accounts for gender differences (defined as 5 or more drinks for men and 4 or more drinks for women), (c) using a more inclusive measure of binge drinking than that used in the Jang et al. study that defines the time period for binge drinking as drinking on one or more occasions over the past 30 days); and (d) providing for a more sensitive analysis of age, gender, and race/ethnicity differences.

The aim of the present study was to examine trends in binge drinking using current national data from the NSDUH collected between 2002 and 2016 to systematically examine the trends in binge drinking and alcohol abstention by age, gender, race/ethnicity, and correlates of adolescent binge drinking and abstention. This analysis not only provided a high level of specificity but also provided information critical to assessing disparities in binge drinking among key subgroups. An in-depth understanding of the trends and correlates of binge drinking among adolescents in the United States is critical to informing prevention programming and policy issues. *Given the downward trends in other problem behaviors identified in recent studies, we expect another important problem behavior, binge drinking, to be part of this phenomenon.* We also expect an increase in alcohol abstention.

2. Material and methods

2.1. Data and sample

This study combined data from individual waves of the NSDUH collected from 2002 to 2016. The NSDUH is a nationally representative, cross-sectional household survey conducted annually in all 50 U.S. States and the District of Columbia. The NSDUH provides national estimates for alcohol and drug use and a wide array of constructs related to behavioral health risk. Led by SAMHSA, the NSDUH samples from civilian, noninstitutionalized U.S. residents ages 12 and older using a multi-stage probability sampling design (Center for Behavioral Health Statistics and Quality (CBHSQ), 2017). In contrast to school-based studies of adolescent risk (Miech et al., 2018), the NSDUH's household design allows for the inclusion of both youth who are enrolled in school and youth who have dropped out of school. While response rates for screening have declined somewhat in recent years (91% in 2002 to 83% in 2014), the conditional response rate among participants in 2014 was similar to that of the late 1990s (Czajka and Beyler, 2016). The response rate in 2015–2016 for adolescent participants, ages 12 to 17, was 77% (Center for Behavioral Health Statistics and Quality (CBHSQ), 2017). A detailed description of the NSDUH design and methodology is available elsewhere (Substance Abuse and Mental Health Services Administration (SAMHSA, 2018b).

We included adolescent respondents between the ages of 12 and 17 who participated in the NSDUH between 2002 and 2016 (n = 258,309). To ensure stable subgroup estimates, we restricted the sample to include only non-Hispanic White (henceforward, "White"), non-Hispanic Black/African American (henceforward, "Black") and Hispanic adolescents. This restriction yielded a final sample of 234,083 adolescents for analysis. This study was exempt from Institutional

Table 2
Prevalence binge drinking and abstention among adolescents, by subgroup.

	Binge Drinking						Alcohol Abstention					
	2002-2004		2014-2016		Δ *pp*	% change	2002-2004		2014-2016		Δ *pp*	% change
	%	95% CI	%	95% CI			%	95% CI	%	95% CI		
Total	11.10	10.72-11.49	5.70	5.41-6.00	−5.4	−48.65	81.88	81.48-82.28	89.46	89.04-89.89	7.58	9.26
Subgroups												
Age, years												
12	0.98	0.73-1.23	0.42	0.24-0.61	−0.56	−57.14	97.49	97.03-97.94	98.98	98.66-99.30	1.49	1.53
13	2.55	2.15-2.94	0.80	0.53-1.07	−1.75	−68.63	93.74	92.97-94.52	97.59	97.09-98.10	3.85	4.11
14	6.94	6.09-7.80	2.44	1.93-2.95	−4.5	−64.84	86.40	85.37-87.43	94.42	93.55-95.29	8.02	9.28
15	12.52	11.54-13.49	5.54	4.82-6.27	−6.98	−55.75	78.72	77.64-79.80	88.98	87.95-90.02	10.26	13.03
16	18.55	17.38-19.72	9.60	8.77-10.44	−8.95	−48.25	70.96	69.74-72.18	83.20	82.13-84.27	12.24	17.25
17	27.78	24.59-26.97	14.78	13.8-15.72	−13.00	−46.80	63.09	61.81-64.37	74.75	73.45-76.04	11.66	18.48
Sex												
Female	10.54	9.99-11.09	5.76	5.32-6.20	−4.78	−45.35	81.46	80.85-82.06	88.96	88.28-89.64	7.50	9.21
Male	11.65	11.17-12.12	5.65	5.30-6.00	−6.00	−51.50	82.28	81.72-82.84	89.95	89.41-90.48	7.67	9.32
Race/Ethnicity												
White	12.72	12.25-13.19	6.45	6.09-6.80	−6.27	−49.29	79.70	79.24-80.17	88.32	87.74-88.89	8.62	10.82
Black	4.91	4.24-5.59	3.55	2.98-4.13	−1.36	−27.70	89.58	88.74-90.41	92.30	91.53-93.08	2.72	3.04
Latino	10.59	9.75-11.44	5.26	4.76-5.76	−5.33	−50.33	83.15	82.25-84.05	90.42	89.71-91.14	7.27	8.74
Income												
< $20,000	9.49	8.75-10.23	4.98	4.23-5.73	−4.51	−47.52	85.09	84.07-86.10	91.23	90.56-91.90	6.14	7.22
$20-$39,999	10.87	10.14-11.60	5.32	4.80-5.84	−5.55	−51.06	82.06	81.22-82.90	90.04	89.31-90.77	7.98	9.72
$40-$74,999	11.90	11.07-12.72	5.95	5.09-6.81	−5.95	−50.00	81.01	79.96-82.06	89.00	87.90-90.11	7.99	9.86
≥ $75,000	11.89	11.24-12.54	6.19	5.74-6.65	−5.7	−47.94	80.19	79.38-81.00	88.47	87.78-89.16	8.28	10.33
Father in Home												
No	10.85	10.44-11.27	5.48	5.15-5.80	−5.37	−49.49	82.19	81.75-82.62	89.83	89.40-90.27	7.64	9.30
Yes	11.82	11.06-12.58	6.35	5.82-6.88	−5.47	−46.28	80.99	80.06-81.92	88.41	87.64-89.18	7.42	9.16
Comorbid Substance Use												
Marijuana Use												
No	5.06	4.78-5.35	2.23	2.01-2.45	−2.83	−55.93	89.44	89.06-89.81	94.64	94.35-94.93	5.2	5.81
Yes	44.20	42.66-45.75	29.30	27.70-30.9	−14.90	−33.71	40.47	39.07-41.87	54.30	52.64-55.96	13.83	34.17
Other Drug Use												
No	10.31	9.95-10.67	4.47	4.18-4.77	−5.84	−56.64	82.79	82.41-83.16	91.06	90.62-91.50	8.27	9.99
Yes	45.14	41.11-49.18	24.72	22.7-26.73	−20.42	−45.24	43.15	39.00-47.30	64.75	62.43-67.08	21.60	50.06

Note. Δ *pp* = percentage point change from 2002 to 2004 to 2014-2016.% change determined by dividing the *pp* change by the 2002–2004 prevalence estimate.

Review Board review from the first author's home institution because the data are publicly available and do not contain personally identifiable information.

2.2. Measures

2.2.1. Binge drinking

Binge drinking was defined as consuming five or more drinks on the same occasion on at least one day in the past 30 days (0 = *no binge*, 1 = *binge*). In this definition, *occasion* indicates having consumed the requisite number of drinks at the same time or within a couple hours. In 2015, the definition of binge drinking for females changed to at least *four* drinks on the same occasion while the definition for males remained at five drinks (Center for Behavioral Health Statistics and Quality (CBHSQ), 2016). As a result, SAMHSA suggested researchers begin a "new baseline" for prevalence estimates for binge drinking among females and in the general population (both genders combined). Therefore, we conducted supplemental tests to compare results using the 2002–2014 and 2002–2016 combined data files (see the Supplemental Analyses subsection). We also examined abstinence from alcohol use, which was defined as no use in the previous 30-day period (0 = non-abstinent, 1 = *abstinent*). Abstinence refers simply to no alcohol consumption whatsoever during the previous 30-day period.

2.2.2. Co-morbid substance use and risk behavior

In addition to alcohol use, we examined reported use of marijuana and other illicit drugs (e.g., cocaine, opioids) during the past 30 days (yes, no).

2.2.3. Sociodemographic factors

We included a number of sociodemographic factors commonly examined in NSDUH trend studies, using categories provided by SAMHSA in the NSDUH codebook: *age* in years (continuous), *gender* (female, male), *race/ethnicity* (White, Black, and Hispanic), *annual household income* (less than $20,000, $20,000-$49,999, $50,000-$74,999, and $75,000 or higher), and the *presence of a respondent's father in the household* (yes, no). Prior research has established that each of these demographic factors are important correlates of adolescent risk behavior (Arthur et al., 2002; Salas-Wright et al., 2016b).

2.3. Statistical analysis

We examined trends in binge drinking and abstinence among adolescents between 2002 and 2016. Specifically, we conducted logistic regression analysis to examine the significance of trend changes among adolescent binge drinkers with adjustment for the aforementioned sociodemographic and co-morbid substance-use factors. In all analyses, survey year was included as a continuous independent variable following the trend analysis method utilized by the Centers for Disease Control and Prevention (2014). Our approach is also consistent with high-impact trend studies (Ogden et al., 2006) and recent studies that used NSDUH data (Salas-Wright et al., 2017a). Prevalence estimates and regression analyses were computed using survey data functions available in the survey package (Lumley, 2017) in R version 3.4.0 (R Core Team, 2017). This system implements a Taylor series linearization to adjust standard errors of estimates for complex survey sampling design effects including clustered multistage data.

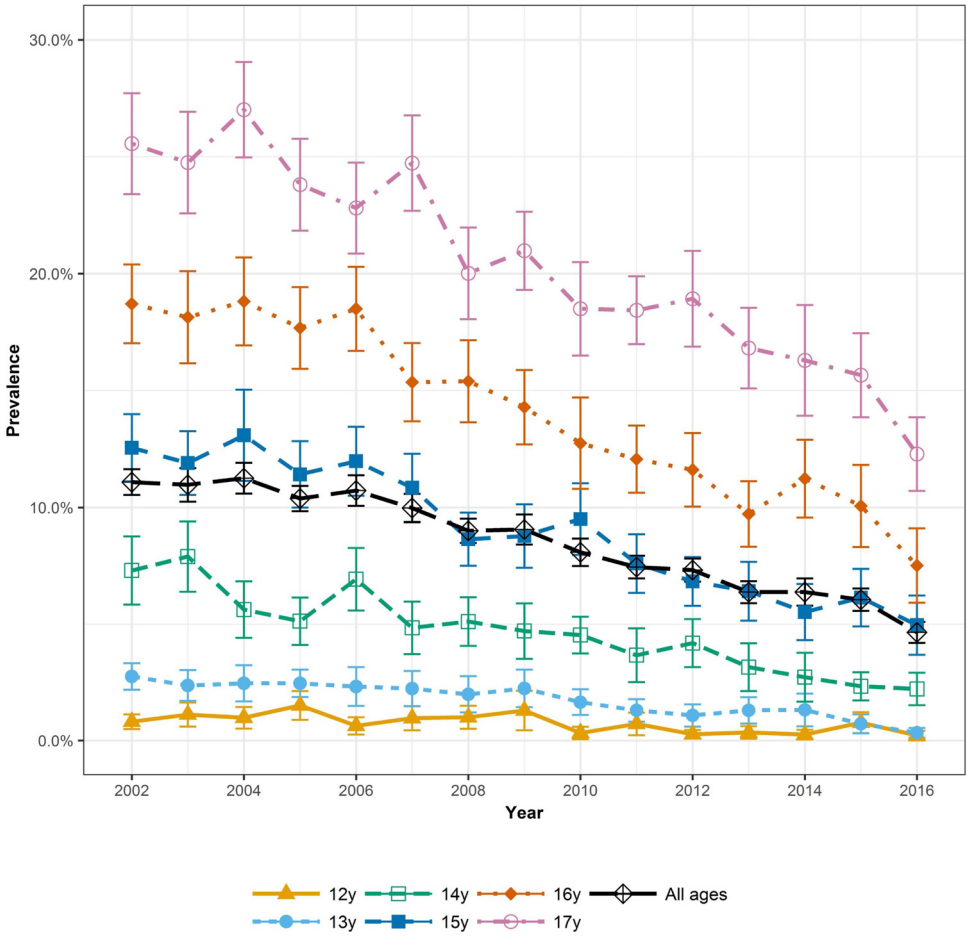

Fig. 2. Prevalence of binge drinking among adolescents during the past 30 days by age, 2002-2016. Note: The definition of binge drinking for women changed in 2015–2016 from five drinks on a single occasion to four drinks. The definition for males did not change over the study period.

3. Results

3.1. Binge drinking

The prevalence of past 30-day binge drinking among U.S. adolescents ages 12 to 17 decreased significantly from 11.1% in 2002 to 4.7% in 2016 (adjusted odds ratios (AOR) = 0.947; 95% confidence interval (CI) = 0.940, 0.955), reflecting a 58% proportional decline among adolescents in general. This downward trend was observed for all sociodemographic and substance-use subgroups examined, even when controlling for age, gender, race/ethnicity, family income, and father in household (see Table 1). Notably, the AOR for the test of trend were between 0.910 and 0.950 for every subgroup examined, with the exception of Black youth (AOR = 0.968; 95% CI = 0.953, 0.93). Supplemental analyses showed declining trends in binge drinking among Native American (AOR = 0.908; 95% CI = 0.867, 0.951) and multiracial youth (AOR = 0.954; 95% CI = 0.928, 0.979). While not significant at $p < .05$, we also saw evidence that rates of binge drinking may also be declining among Asian youth (AOR = 0.965; 95% CI = 0.929, 1.003).

As shown in Fig. 1 and Table 2, the prevalence of binge drinking among Black youth was substantially lower than that of White and Hispanic youth during the 2000s, and, as compared with these groups, binge drinking among Black youth declined more gradually over time. As such, we see a notable convergence in the prevalence of binge drinking across racial/ethnic groups, with differences ceasing to be significant between Hispanic and Black youth beginning in 2014. The difference in prevalence between White and Black youth remained significant across all survey years, but narrowed substantially over time (Δ in 2002 = 7.5, Δ in 2016 = 0.9).

Table 1 also displays the sociodemographic and substance use correlates of binge drinking. Youth reporting binge drinking were significantly more likely to be older. As shown in Fig. 2, we found a clear age gradient; although the prevalence of binge drinking declined over time for all ages, rates were consistently higher among youth in the older age groups. However, given the overall downward trend, we did find that the difference in the prevalence of binge drinking among 12 and 17-year-old participants narrowed substantially over time (Δ in 2002 = 24.7, Δ in 2016 = 4.4). We also found the likelihood of binge drinking was greater among youth in higher income households ($50,000–74,999 [AOR = 1.10; 95% CI = 1.01, 1.19]; $75,000+: [AOR 1.18; 95% CI = 1.09, 1.29]) and among youth reporting use of marijuana (AOR = 5.80; 95% CI = 5.52, 6.09) and other illicit drugs (AOR = 1.71; 95% CI = 1.55, 1.89). Males were significantly less likely than females to binge drink (AOR = 0.88; 95% CI = 0.84, 0.93), and both Black (AOR = 0.41; 95% CI = 0.37, 0.45) and Hispanic (AOR = 0.87; 95% CI = 0.81, 0.93) youth were less likely to binge drink than White youth.

3.2. Alcohol abstention

Shifting from binge drinking to abstention from alcohol use, we found the rate of abstinence from drinking among adolescents increased significantly from 81.9% in 2002 to 90.7% in 2016 (AOR = 1.048; 95% CI = 1.042, 1.055). As shown in Table 3, this increasing trend in abstinence was observed among all sociodemographic and substance-use subgroups while controlling for sociodemographic confounds. As was the case with binge drinking, Black youth stood out as having a distinct

Table 3
Correlates and tests of trends for abstaining from alcohol use during the past 30 days, 2002–2016.

	Abstention from alcohol use during the past month							
	No (n = 35,936; 14.66%)		Yes (n = 198,147; 85.34%)		Correlates of Abstention (Pooled Data)		Linear Test of Trend (Year-by-Year)	
	%	95% CI	%	95% CI	AOR	95% CI	AOR	95% CI
Demographic Factors								
Age, years								
12	2.01	(1.80, 2.23)	17.92	(17.68, 18.16)	1.0	*referent*	**1.076**	**(1.053, 1.100)**
13	5.07	(4.73, 5.42)	18.52	(18.30, 18.74)	**0.54**	**(0.47, 0.61)**	**1.084**	**(1.067, 1.100)**
14	11.22	(10.76, 11.69)	17.87	(17.63, 18.11)	**0.29**	**(0.26, 0.33)**	**1.077**	**(1.064, 1.089)**
15	19.24	(18.71, 19.78)	16.80	(16.57, 17.02)	**0.19**	**(0.17, 0.22)**	**1.066**	**(1.058, 1.075)**
16	26.74	(26.17, 27.30)	15.34	(15.09, 15.59)	**0.14**	**(0.12, 0.15)**	**1.063**	**(1.055, 1.070)**
17	35.71	(35.07, 36.34)	13.55	(13.37, 13.74)	**0.09**	**(0.08, 0.10)**	**1.046**	**(1.040, 1.053)**
Sex								
Female	49.93	(49.23, 50.62)	48.73	(48.45, 49.01)	1.0	*referent*	**1.053**	**(1.048, 1.059)**
Male	50.07	(49.38, 50.77)	51.27	(50.99, 51.55)	**1.35**	**(1.30, 1.40)**	**1.054**	**(1.049, 1.059)**
Race/Ethnicity								
White	69.79	(69.05, 70.53)	61.55	(61.11, 62.00)	1.0	*referent*	**1.056**	**(1.052, 1.060)**
Black	10.62	(10.18, 11.06)	16.72	(16.42, 17.01)	**1.62**	**(1.52, 1.73)**	**1.027**	**(1.017, 1.037)**
Hispanic	19.59	(18.97, 20.21)	21.73	(21.35, 22.11)	**1.10**	**(1.04, 1.16)**	**1.056**	**(1.048, 1.064)**
Income								
< $20,000	15.07	(14.59, 15.55)	17.63	(17.33, 17.94)	1.0	*referent*	**1.048**	**(1.039, 1.057)**
$20-$49,999	30.86	(30.21, 31.52)	31.51	(31.15, 31.88)	**0.89**	**(0.84, 0.94)**	**1.053**	**(1.046, 1.060)**
$50-$74,999	18.21	(17.63, 18.79)	17.45	(17.20, 17.70)	**0.82**	**(0.76, 0.87)**	**1.056**	**(1.047, 1.065)**
> $75,000	35.86	(35.15, 36.56)	33.40	(32.91, 33.84)	**0.74**	**(0.70, 0.79)**	**1.058**	**(1.052, 1.065)**
Father in Home								
No	71.38	(70.82, 71.94)	26.04	(25.74, 26.33)	**0.91**	**(0.87, 0.95)**	**1.055**	**(1.051, 1.059)**
Yes	28.62	(28.06, 29.18)	73.96	(73.67, 74.26)	1.0	*referent*	**1.051**	**(1.044, 1.058)**
Substance Use								
Marijuana Use								
No	48.74	(48.09, 49.39)	92.56	(92.40, 92.71)	1.0	*referent*	**1.064**	**(1.059, 1.069)**
Yes	51.26	(50.61, 51.91)	7.44	(7.29, 7.60)	**0.18**	**(0.17, 0.19)**	**1.051**	**(1.045, 1.058)**
Other Drug Use								
No	91.33	(91.92, 91.73)	98.32	(98.24, 98.40)	1.0	*referent*	**1.060**	**(1.056, 1.064)**
Yes	8.67	(8.27, 9.08)	1.68	(1.60, 1.76)	**0.63**	**(0.56, 0.70)**	**1.083**	**(1.068, 1.098)**

Note: The sociodemographic adjusted odds ration (AOR) values reflect a logistic regression of abstention on all of the sociodemographic correlates. The AOR estimates for the substance sue variables are a logistic regression of each variable when controlling for sociodemographic characteristics. Test of trend is the AOR for survey year predicting abstinence while controlling for sociodemographic factors.

overall rate of abstinence and a more gradual trend change (see Fig. 3 and Table 2). Specifically, we found the rate of abstinence was greater among Black than White youth across all survey years. Although the prevalence of abstinence was no different between Black and Hispanic youth between 2013 and 2016, for the years between 2002 and 2012, Black youth tended to have greater levels of abstinence as compared with Hispanic youth. We also found the odds ratio for the test of trends in abstinence among Black youth was the only AOR smaller than 1.040 and one of only three AORs smaller than 1.050 (along with youth in households earning less than $20,000 per year and youth age 17).

In terms of the sociodemographic and substance use correlates of abstinence from alcohol consumption, we found the likelihood of abstinence was inversely related to age and household income (see Table 3). We also found youth who reported abstention from drinking were less likely to use marijuana (AOR = 0.18; 95% CI = 0.17, 0.19) and other illicit drugs (AOR = 0.63; 95% CI = 0.56, 0.70). Abstainers were more likely be male (AOR = 1.35; 95% CI = 1.30, 1.40) and to be Hispanic (AOR = 1.10; 95% CI = 1.04, 1.16) or Black (AOR = 1.62; 95% CI = 1.52, 1.73).

3.3. Supplemental analyses

3.3.1. Change in definition of binge drinking for women, 2015–2016

In 2015, SAMHSA implemented a partial redesign of the NSDUH, including a change in the definition of binge drinking for females (the classification shifted from five to four drinks on a single occasion, in keeping with the guidelines of the National Institute on Alcohol Abuse and Alcoholism, [n.d.]). As such, we conducted supplemental analyses to ensure that combining the 2002–2014 and 2015–2016 data would not bias our overall results. Specifically, we plotted the year-by-year prevalence estimates for binge drinking for males (unaffected by the design change) and females, and present the estimates for alcohol abstention by gender as a comparison. We also conducted all multivariate analyses for a males-only sample and for the full sample using only the 2002–2014 data (available upon request) as points of comparison to the results of the male/female combined 2002–2016 data.

In conducting these supplemental analyses, we observed a slight increase in binge drinking among females in 2015 and noted that the point estimates for females in 2015–2016 were greater than those for males (the only time this occurs between 2002 and 2016; see Fig. 4). However, we also found that (a) the results for the male-only sample were highly consistent with those combining male and female respondents. Additionally, we found that (b) the association between binge drinking and sociodemographic/substance use factors and (c) tests of trend did not change in significance, direction, or magnitude when we included the 2015–2016 data. Based on these findings, we concluded the use of the combined 2002–2016 data on binge drinking was justified and that use did not bias our results. Nevertheless, we have been careful to note the difference in 2015–2016 measurement in all trend figures, and suggest that caution be exercised in evaluating the point estimates for binge drinking in 2015–2016. We also note that there was no change in the measurement of alcohol abstinence, and that the pattern of findings for this construct was highly consistent with those of binge drinking.

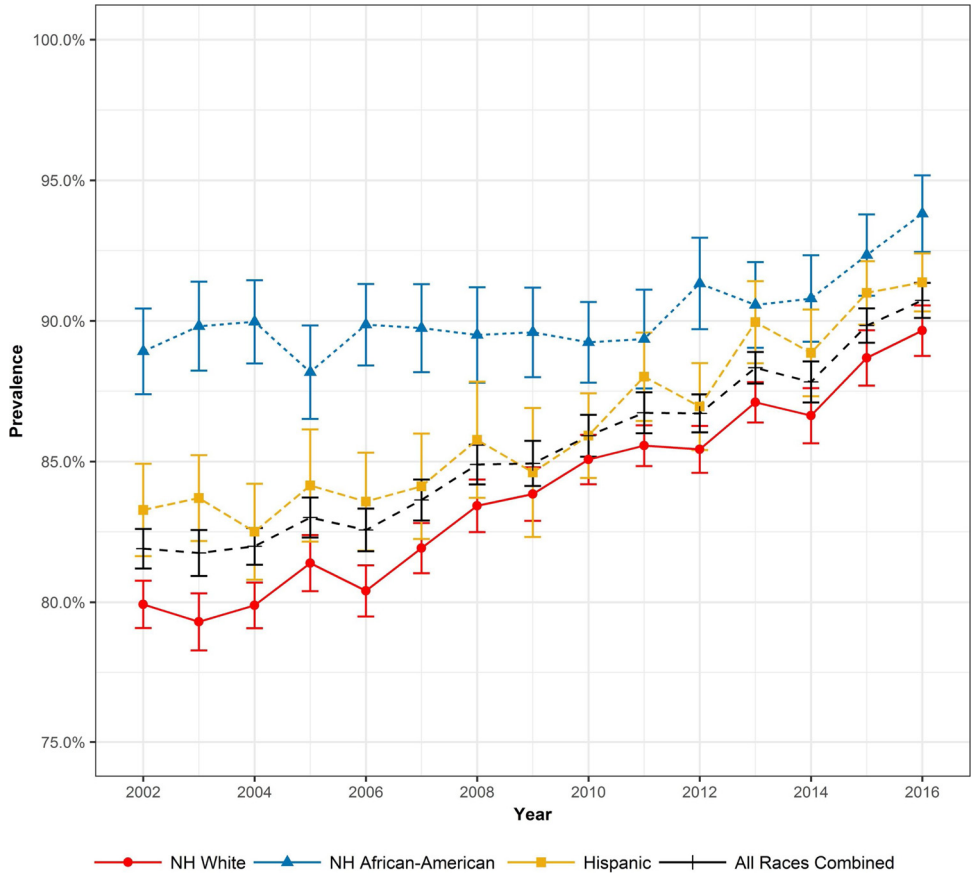

Fig. 3. Prevalence of adolescents who did not consume alcohol during the past 30 days by race/ethnicity, 2002-2016.

4. Discussion

Findings from the present study, drawing from a national survey of more than 230,000 U.S. adolescents, provide cogent evidence that rates of binge drinking among youth have decreased by more than half over the last 15 years. For instance, whereas we found that in 2002, 26% of 17-year-olds reported binge drinking in the past month, the rate of binge drinking among this age group dropped to 12% by 2016. Such findings were not unique to older adolescents; rather, we observed substantial and significant declines among youth across all age, gender, racial/ethnic, and income categories as well as among those reporting having used/abstained from using marijuana and other illicit drugs. Moreover, during the same 15-year period, we also observed substantial increases in the proportion of adolescents reporting abstention from drinking. These findings are in keeping with a growing number of national studies that have identified downward trends in adolescent substance use and problem behavior (Johnson et al., 2015; Maynard et al., 2017; Vaughn et al., 2018), and increases in anti-drug attitudes (Salas-Wright and Vaughn, 2016) and perceptions (Salas-Wright et al., 2017b, 2018). Simply put, the pronounced decrease in binge drinking rates—and increases in abstention—seem to be part of a larger story of declines in risk behavior among youth in the United States. Factors contributing to these decreases might include increased public health messages, messages via social media, school-based education, and stringent enforcement of policies and sanctions against underage drinking and drunk driving.

Although trends were observed for all sociodemographic subgroups, a unique pattern in the year-by-year prevalence of binge drinking and abstention was observed for Black youth. Several exceptional features should be noted. *First*, the prevalence of binge alcohol use among Black youth (5%) in 2002 was substantially lower than that of other youth: less than half that of Hispanic (11%) and White youth (13%). Notably, we observed the same pattern in examining rates of abstention, with Black youth standing out as having uniquely high levels of non-consumption. These findings correspond with prior research indicating that Black youth initiate alcohol use later than White and Hispanic youth and, after beginning use, are less likely to continue to use during adolescence (Malone et al., 2012). *Second*, we also noted that while declines in binge drinking were observed for all three racial/ethnic subgroups examined, the slope of the decline was significantly greater among Hispanic and White youth than among their Black counterparts. As a result, by 2016, we observed a substantial narrowing of the gap in prevalence between Black and other youth, with differences between Black and Hispanic youth ceasing to be significant as of 2014. This finding suggests that non-Black youth are ceasing to binge drink at a faster rate, and thereby, "closing the gap" with Black youth. However, since alcohol-related consequences are worst for Black youth than non-Black youth, continued attention and prevention efforts are needed for Black youth (Godette et al., 2006; Mulia et al., 2009).

We observed a similar pattern of "closing the gap" between younger and older teens. Specifically, from 2002 to 2004, we found a 26-percentage point (*pp*) difference in the rate of binge drinking between 12-year-olds (1%) and 17-year-olds (28%). From 2014–2016, this *pp* difference had dropped to 14. While rates decreased among youth of all ages, the raw declines among older teens—such as 16 and 17-year-olds—was such that the *pp* difference narrowed substantially by 2016 (to 7.5% for 16-year-olds and 12% for 17-year-olds). This pattern is noteworthy for several reasons. First, the pattern reflects a substantial decline among older teens who we know are at far greater risk of drinking to excess (Salas-Wright et al., 2016a) and experiencing serious consequences as a result (e.g., car crashes, accidents; Miller et al., 2007; Stolle et al., 2009). Such declines are likely to have a positive impact as we know that the personal and social costs associated with underage drinking are monumental, and are largely driven by violence and traffic

accidents related to inebriation (Miller et al., 2006; Pacific Institute for Research and Evaluation, 2015). The finding of a more gradual decline and less *pp* difference between younger than older teens suggest that more prevention efforts may be needed targeted to younger adolescents. The finding also speaks to the possibility that public health anti-binge drinking social norms may be targeted at (or received) more by older than younger youth. It also is a particularly noteworthy finding as the decline in binge drinking among older teens is much more pronounced than the modest declines observed for youth of the same age in terms of marijuana use. Salas-Wright et al. (2015) found that past-year marijuana use among 17-year-olds decreased from 32% in 2002 to 29% in 2013, roughly a 3 *pp* decline, which is noticeably smaller than the 13 *pp* reduction in past-month binge drinking found in the present study. This difference suggests that trends in adolescent alcohol use may be on a distinctly sharper downward trajectory than what is being observed currently for marijuana (Salas-Wright and Vaughn, 2017). Our understanding of this disparate trend would be enhanced by mixed methods research exploring the mechanisms for reductions in binge drinking and marijuana use.

Findings from our study are consistent with other studies that have found declines in binge drinking among all adolescents (Chen et al., 2015; Jang et al., 2017). For example, Jang et al. also found declines in binge drinking among all adolescents, a more gradual decline for African American youth, and convergence of binge drinking among girls and boys due to a larger decrease in binge drinking among boys. However, Jang et al. also found that higher SES was linked to less binge drinking whereas we found that higher SES was linked to more binge drinking. One reason for the divergent SES findings may be due to how SES was measured. Jang et al. used parental education (i.e., high school graduate or less or some college or more) as a proxy for SES while we used income across five income categories, which provided our study with a more sensitive measure of SES. Our finding is consistent with other studies that have linked higher SES with more binge drinking (Collins, 2016; Keyes and Hasin, 2008).

Our study findings may have several important implications for policy and practice. One implication is that, despite substantial declines in binge drinking among older teens, the differential rates between older and younger teens speak to the importance of continued prevention efforts during later adolescence. Binge drinking is down and abstinence is up among teens, but recent evidence indicates that alcohol use among adults has risen substantially in recent years (Dawson et al., 2015). Consistent with this finding are findings that binge drinking is much higher when older adolescents are included in the sample. Chen et al. (2017) found a binge drinking rate of 13.8% in 2011–2013 using NSDUH data from 12 to 20 year old's, whereas we found an overall teen rate of 5.7% with a sample of 12–17 year old's. As such, we would do well to continue to push for prevention programming and intervention services for youth across the spectrum of adolescence. Programming should be developmentally appropriate and implemented across multiple domains (e.g., individual, home, school, community, and social media) to realize best outcomes (Chung et al., 2018). Public health prevention messages via social media may be an especially desirable medium given the current widespread use of social media among youth. Narrowing differences in binge drinking among all racial/ethnic groups speaks to the utility of universal prevention programming efforts designed to reach youth in general, rather than a single high-risk ethnic/racial subgroup (Substance Abuse and Mental Health Services Administration (SAMHSA, 2018a).

4.1. Study limitations

The present study should be interpreted in light of several limitations. First, the NSDUH data, although collected over a 15-year period, are cross-sectional and no participants were interviewed more than once. Therefore, we are unable to speak to changes in binge drinking and alcohol abstention within the same individuals over time. Second, all data used in the present study were derived from respondent self-reports. As such, it is possible that some respondents under or over reported their alcohol use. Third, although the NSDUH includes a number of important sociodemographic factors, it does not provide information on the situational or contextual factors that directly relate to binge drinking or abstention from alcohol. Consequently, our study findings do not shed light specifically on what explanatory factors might be driving the downward trend in binge drinking and the increases in abstention. Finally, the NSDUH public use data file does not allow us to examine trends and correlates within particular U.S. states or cities. It is plausible that beyond national trends, the use of specific city or state data might reveal a more complex pattern of adolescent alcohol use. Future research would benefit from longitudinal cohort designs (which would enable researchers to assess within-person change), the use of multiple reporters (which would minimize reporting bias), and the inclusion of contextual/situational and geographic data that could facilitate a more nuanced understanding of trends in binge thinking and alcohol abstention.

5. Conclusions

The present study provides compelling evidence that binge drinking has decreased and abstention from alcohol consumption has increased substantially among adolescents in the United States over the last 15 years. The downward trend in binge drinking and the upward trend in abstinence were observed not only for use in general but also for an array of demographic subgroups Notably, Black youth reported substantially lower levels of binge alcohol use and higher levels of abstention, although the gaps between Black, Hispanic, and White youth narrowed substantially between 2002 and 2016. We observed a similar "closing of the gap" between younger teens (i.e., ages 12 to 13) and their older counterparts (i.e., ages 16 to 17) as differences in binge drinking/abstinence slowly decreased as rates changed substantially among older teens. Taken together, these findings suggest that fewer youth are drinking heavily and, in recent years, more youth are not drinking alcohol, indicating a convergence is taking place in the prevalence of binge drinking/abstinence across racial/ethnic and age differences. However, these findings are tempered with the fact that binge drinking has multiple adverse outcomes and prevention programming across the lifespan are still needed.

Role of funding source

Research reported in this publication was supported by the National Institute on Drug Abuse (NIDA) under Award Number K01DA035895-01 (Clark Goings, PI) and Award Number P30 DA027827 (Brody, PI). Research was also supported by the National Institute on Alcohol Abuse and Alcoholism (NIAAA) of the National Institutes of Health (NIH) under Award Number K01AA026645. The content is solely the responsibility of the authors and does not necessarily represent the official views of NIDA, NIAAA, or the NIH.

Contributors

Dr. Goings conceptualized the study and drafted the manuscript. Dr. Salas-Wright conducted the statistical analysis and contributed to writing the manuscript. Dr. Belgrave contributed to writing the manuscript. Dr. Nelson assisted with the statistical analysis. Dr. Harezlak assisted with the statistical analysis. Dr. Vaughn provided critical feedback on the conceptualization of the study and manuscript drafts.

Conflict of interest

No conflict declared.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.drugalcdep.2019.02.034.

References

Aiken, A., Clare, P.J., Wadolowski, M., Hutchinson, D., Najman, J.M., Slade, T., Bruno, R., McBride, N., Kypri, K., Mattick, R.P., 2018. Age of alcohol initiation and progression to binge drinking in adolescence: a prospective cohort study. Alcohol. Clin. Exp. Res. 2, 100–110. https://doi.org/10.1111/acer.13525.

An, B.P., Loes, C.N., Trolian, T.L., 2017. The relation between binge drinking and academic performance: considering the mediating effects of academic involvement. J. Coll. Stud. Dev. 58, 492–508. https://doi.org/10.1353/csd.2017.0039.

Arthur, M.W., Hawkins, J.D., Pollard, J.A., Catalano, R.F., Baglioni Jr., A.J., 2002. Measuring risk and protective factors for use, delinquency, and other adolescent problem behaviors: The communities that care youth survey. Eval. Rev. 26, 575–601. https://doi.org/10.1177/0193841X0202600601.

Center for Behavioral Health Statistics and Quality (CBHSQ), 2016. 2015 National Survey on Drug Use and Health: Summary of the Effects of the 2015 NSDUH Questionnaire Redesign: Implications for Data Users. Substance Abuse and Mental Health Services Administration, Rockville, MD (Accessed 02/05/19). https://www.samhsa.gov/data/sites/default/files/NSDUH-TrendBreak-2015.pdf.

Center for Behavioral Health Statistics and Quality (CBHSQ), 2017. 2016 National Survey on Drug Use and Health Public Use File Codebook. Substance Abuse and Mental Health Services Administration, Rockville, MD (Accessed 02/05/19). http://www.samhsa.gov/.

Centers for Disease Control and Prevention (CDC), 2014. Interpretation of YRBSS Trend Data. (Accessed 12 July 2016). http://www.cdc.gov/healthyyouth/yrbs/pdf/YRBS_trend_interpretation.pdf.

Chen, C.M., Yi, H.Y., Faden, V.B., 2015. Surveillance Report# 101: Trends in Underage Drinking in the United States, 1991–2013. Available at: https://pubs.niaaa.nih.gov/publications/surveillance101/Underage13.htm. (Accessed 10 April 2019). .

Chen, C.M., Yoon, Y.H., Faden, V.B., 2017. Surveillance Report# 101: Trends in Underage Drinking in the United States, 1991–2015. Available at: https://pubs.niaaa.nih.gov/publications/surveillance107/Underage15.pdf. (Accessed 10 April 2019). .

Chung, T., Creswell, K.G., Bachrach, R., Clark, D.B., Martin, C.S., 2018. Adolescent binge drinking: developmental context and opportunities for prevention. Alcohol. Res. 39, 5.

Collins, S.E., 2016. Associations between socioeconomic factors and alcohol outcomes. Alcohol. Res. 38, 83–94.

Czajka, J.L., Beyler, A., 2016. Declining Response Rates in Federal Surveys: Trends and Implications. Mathematica Policy Research, Washington, DC.

Dawson, D.A., Goldstein, R., Saha, T.D., Grant, B.F., 2015. Changes in alcohol consumption: United States, 2001–2002 to 2012–2013. Drug. Alcohol. Depend. 148, 56–61. https://doi.org/10.1016/j.drugalcdep.2014.12.016.

Godette, D.C., Headen, S., Ford, C.L., 2006. Windows of opportunity: fundamental concepts for understanding alcohol-related disparities experienced by young blacks in the United States. Prev. Sci. 7, 377–387. https://doi.org/10.1007/s11121-006-0044-3.

Han, B., Compton, W.M., Blanco, C., DuPont, R.L., 2017. National trends in substance use and use disorders among youth. J. Am. Acad. Child. Adolesc. Psychiatry 56, 747–754. https://doi.org/10.1016/j.jaac.2017.06.011.

Hingson, R.W., Zha, W., 2018. Binge drinking above and below twice the adolescent thresholds and health-risk behaviors. Alcohol. Clin. Exp. Res. 42, 904–913. https://doi.org/10.1111/acer.13627.

Jang, J.B., Patrick, M.E., Keyes, K.M., Hamilton, A.D., Schulenberg, J.E., 2017. Frequent binge drinking among US adolescents, 1991 to 2015. Pediatrics 139. https://doi.org/10.1542/peds.2016-4023.

Jennings, W.G., Piquero, A.R., Rocque, M., Farrington, D.P., 2015. The effects of binge and problem drinking on problem behavior and adjustment over the life course: findings from the Cambridge study in delinquent development. J. Crim. Just. 43, 453–463. https://doi.org/10.1016/j.jcrimjus.2015.09.002.

Johnson, R.M., Fairman, B., Gilreath, T., Xuan, Z., Rothman, E.F., Parnham, T., Furr-Holden, C.D.M., 2015. Past 15-year trends in adolescent marijuana use: differences by race/ethnicity and sex. Drug. Alcohol. Depend. 155, 8–15. https://doi.org/10.1016/j.drugalcdep.2015.08.025.

Keyes, K.M., Hasin, D.S., 2008. Socio-economic status and problem alcohol use: The positive relationship between income and the DSM-IV alcohol abuse diagnosis. Addiction 103, 1120–1130. https://doi.org/10.1111/j.1360-0443.2008.02218.x.

Lumley, T., 2017. Survey: Analysis of Complex Survey Samples. R Package Version 3.32. (Accessed 2 May 2019). https://rdrr.io/rforge/survey/.

Malone, P.S., Northrup, T.F., Masyn, K.E., Lamis, D.A., Lamont, A.E., 2012. Initiation and persistence of alcohol use in United States Black, Hispanic, and White male and female youth. Addict. Behav. 37, 299–305. https://doi.org/10.1016/j.addbeh.2011.11.010.

Maynard, B.R., Vaughn, M.G., Nelson, E.J., Salas-Wright, C.P., Heyne, D., Kremer, K.P., 2017. Truancy in the United States: examining temporal trends and correlates by race, age, and gender. Child. Youth. Serv. Rev. 81, 188–196. https://doi.org/10.1016/j.childyouth.2017.08.008.

Miech, R.A., Johnston, L.D., O'Malley, P.M., Bachman, J.G., Schulenberg, J.E., 2015. Monitoring the Future National Survey Results on Drug Use, 1975-2014. Volume I: Secondary School Students. Available at. Institute for Social Research, The University of Michigan, Ann Arbor, MI. http://monitoringthefuture.org/pubs.html#monographs.

Miech, R.A., Johnston, L.D., O'Malley, P.M., Bachman, J.G., Schulenberg, J.E., Patrick, M.E., 2018. Monitoring the Future National Survey Results on Drug Use, 1975–2017: Volume I, Secondary School Students. Available at. Institute for Social Research, The University of Michigan, Ann Arbor, MI. http://monitoringthefuture.org/pubs.html#monographs.

Miller, T.R., Levy, D.T., Spicer, R.S., Taylor, D.M., 2006. Societal costs of underage drinking. J. Stud. Alcohol. 67, 519–528. https://doi.org/10.15288/jsa.2006.67.519.

Miller, J.W., Naimi, T.S., Brewer, R.D., Jones, S.E., 2007. Binge drinking and associated health risk behaviors among high school students. Pediatrics 119, 76–85. https://doi.org/10.1542/peds.2006-1517.

Mulia, N., Ye, Y., Greenfield, T.K., Zemore, S.E., 2009. Disparities in alcohol-related problems among White, Black, and Hispanic Americans. Alcohol. Clin. Exp. Res. 33, 654–662.

National Institute on Alcohol Abuse and Alcoholism, n.d. Drinking levels defined. https://www.niaaa.nih.gov/alcohol-health/overview-alcohol-consumption/moderate-binge-drinking. (Accessed 2 May 2019).

Office of Juvenile Justice and Delinquency Prevention, 2018. OJJDP Statistical Briefing Book. (Accessed 12 January 18). http://www.ojjdp.gov/ojstatbb/crime/JAR_Display.asp?ID=qa05200.

Ogden, C.L., Carroll, M.D., Curtin, L.R., McDowell, M.A., Tabak, C.J., Flegal, K.M., 2006. Prevalence of overweight and obesity in the United States, 1999-2004. JAMA 295, 1549–1555. https://doi.org/10.1001/jama.295.13.1549.

Pacific Institute for Research and Evaluation, 2015. Underage Drinking in the United States. The Institute, Calverton, MD.

Patte, K.A., Qian, W., Leatherdale, S.T., 2017. Marijuana and alcohol use as predictors of academic achievement: A longitudinal analysis among youth in the COMPASS study. J. Sch. Health 87, 310–318. https://doi.org/10.1111/josh.12498.

R Core Team, 2017. R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing, Vienna, Austria. https://www.R-project.org/.

Sacks, J.J., Gonzales, K.R., Bouchery, E.E., Tomedi, L.E., Brewer, R.D., 2015. 2010 National and state costs of excessive alcohol consumption. Am. J. Prev. Med. 49, e73–e79.

Salas-Wright, C.P., Vaughn, M.G., 2016. The changing landscape of adolescent marijuana use risk. J. Adolesc. Health 59, 246–247. https://doi.org/10.1016/j.jadohealth.2016.06.018.

Salas-Wright, C.P., Vaughn, M.G., 2017. Marijuana use among young people in an era of policy change: what does recent evidence tell us? Am. J. Drug. Alcohol. Abuse 43, 231–233. https://doi.org/10.1080/00952990.2016.1226319.

Salas-Wright, C.P., Vaughn, M.G., Todic, J., Córdova, D., Perron, B.E., 2015. Trends in the disapproval and use of marijuana among adolescents and young adults in the United States: 2002-2013. Am. J. Drug. Alcohol. Abuse 41, 392–404. https://doi.org/10.3109/00952990.2015.1049493.

Salas-Wright, C.P., Gonzalez, J.M.R., Vaughn, M.G., Schwartz, S.J., Jetelina, K.K., 2016a. Age-related changes in the relationship between alcohol use and violence from early adolescence to young adulthood. Addict. Behav. Rep. 4, 13–17. https://doi.org/10.1016/j.abrep.2016.05.004.

Salas-Wright, C.P., Vaughn, M.G., Reingle Gonzalez, J.M., 2016b. Drug Abuse and Antisocial Behavior: A Biosocial Life Course Approach. Palgrave Macmillan, New York. https://doi.org/10.1057/978-1-137-55817-6.

Salas-Wright, C.P., Nelson, E.J., Vaughn, M.G., Reingle Gonzalez, J.M., Córdova, D., 2017a. Trends in fighting and violence among adolescents in the United States, 2002–2014. Am. J. Public. Health 107, 977–982. https://doi.org/10.2105/AJPH.2017.303743.

Salas-Wright, C.P., Oh, S., Clark Goings, T.T., Vaughn, M.G., 2017b. Trends in perceived access to marijuana among adolescents in the United States: 2002-2015. J. Stud. Alcohol. Drugs 78, 771–780. https://doi.org/10.15288/jsad.2017.78.771.

Salas-Wright, C.P., Oh, S., Vaughn, M.G., Muroff, J., Amodeo, M., Delva, J., 2018. Trends and correlates of perceived access to heroin among young adults in the United States, 2002-2016. Drug. Alcohol. Depend. 193, 169–176. https://doi.org/10.1016/j.drugalcdep.2018.09.009.

Stahre, M., Roeber, J., Kanny, D., Brewer, R.D., Zhang, X., 2014. Contribution of excessive alcohol consumption to deaths and years of potential life lost in the United States. Prev. Chronic Dis. 11, E109. https://doi.org/10.5888/pcd11.130293.

Stolle, M., Sack, P.M., Thomasius, R., 2009. Binge drinking in childhood and adolescence: epidemiology, consequences, and interventions. Dtsch. Arztebl. Int. 106, 595–596. https://doi.org/10.3238/arztebl.2009.0595b.

Substance Abuse and Mental Health Services Administration (SAMHSA), 2016. 2015 National Survey on Drug Use and Health (NSDUH). Table 2.19B: Alcohol Use in Lifetime, Past Year, and Past Month, by Detailed Age Category: Percentages, 2014 and 2015. SAMHSA, Rockville, MD (Accessed 12 January 2018). http://www.samhsa.gov/data/sites/default/files/NSDUH-DetTabs-2015/NSDUH-DetTabs-2015/NSDUH-DetTabs-2015.htm#tab2-19b.

Substance Abuse and Mental Health Services Administration (SAMHSA), 2018a. Prevention of Substance Abuse and Mental Illness. (Accessed 12 January 2018). https://www.samhsa.gov/prevention.

Substance Abuse and Mental Health Services Administration (SAMHSA), 2018b. What is NSDUH? (Accessed 12 January 2018). https://nsduhweb.rti.org/respweb/homepage.cfm.

Vaughn, M.G., AbiNader, M.A., Salas-Wright, C.P., Oh, S., Holzer, K.J., 2018. Declining trends in drug dealing among adolescents in the United States. Addict. Behav. 84, 106–109. https://doi.org/10.1016/j.addbeh.2018.04.006.