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Trends in Binge and Heavy Drinking among Adults in the United States, 2011–2017

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ABSTRACT

Background: Alcohol misuse is one of the leading causes of preventable death in the United States each year. *Objectives:* In the present study, we examine trends in binge and heavy drinking. We used data from the 2011–2017 Behavioral Risk Factor Surveillance System. For trend analyses, we used logistic regression for heavy drinking and binge drinking variables. Joinpoint model analysis was conducted to identify where significant changes in trend occurred. *Results:* The trend analysis indicated that the overall prevalence of binge drinking decreased significantly from 18.3% in 2011 to 16.0% in 2014, then increased significantly to 17.0% in 2017. This trend was also found for heavy drinking, with a significant decrease from 6.6% in 2011 to 5.8% in 2014, then increased significantly to 6.2% in 2017. This trend persisted for certain subgroups; males, females, White participants, and the 35–54 age group all had a similar decrease in prevalence followed by an increase from 2014–2017. *Conclusions:* Overall, our results indicate a recent significant increase in both binge and heavy drinking among the general population.

Introduction

The misuse of alcohol has both short-term and long-term impacts on health. Immediate health effects are often the result of binge drinking (also referred as "heavy episodic drinking," or "risky single occasion drinking, which is defined as any occasion in the past 30 days when a male had 5 or more drinks, or a female had 4 or more drinks) (Centers for Disease Control and Prevention, 2018a) and include injury, violence, and alcohol poisoning (Abbey, 2002; Greenfield, 1998; Kanny et al., 2015; Smith, Branas, & Miller, 1999; World Health Organization, 2014). Heavy drinking is defined as having more than 14 drinks per week for males and 7 drinks per week for females during the past 30 days (Centers for Disease Control and Prevention, 2018b; U.S. Department of Health and Human Services, 2019). Alcohol Use Disorders (AUDs) are characterized by problem drinking that becomes severe enough to meet certain criteria outlined in the Diagnostic and Statistical Manual of Mental Disorders (National Institute on Alcohol Abuse and Alcoholism, 2019). The prolonged presence of an AUD can shorten the onset of heart disease, stroke, cancer, and liver cirrhosis (Schuckit, 2009).

The long-term health effects of alcohol misuse include heart disease, stroke, some types of cancers, dementia, depression, alcoholism, and high blood pressure (Castaneda, Sussman, Westreich, Levy, & O'Malley, 1996; Esser, 2014; International Agency for Research on Cancer, 2012; Rehm et al., 2010; World Health Organization, 2014). Alcohol intoxication can exacerbate some chronic medical conditions, especially through adverse drug reactions (Castle, Dong, Haughwout, & White, 2016; Moore, Whiteman, & Ward, 2007; Weathermon & Crabb, 1999), as well as contribute to traumatic injuries (American College of Surgeons, 2006). Anywhere between 30–50% of all trauma patients have a positive blood alcohol concentration (BAC) at the time of their admission (American College of Surgeons, 2006), with a number of studies pointing to an increasing trend of alcohol-related emergency department (ED) visits and traumatic injuries in the U.S. (Sacco, Unick, Kuerbis, Koru, & Moore, 2015; White, Hingson, Pan, & Yi, 2011) Alcohol is also a teratogen and causes fetal alcohol syndrome and other harmful effects to fetuses, including low birth weight and neurodevelopmental disorder (Streissguth et al., 1991; Warren & Foudin, 2001).

Alcohol use is highly prevalent in the United States, with 86.4% of adults (≥18 years old) in 2015 reporting drinking alcohol at some point in their lifetime and 56% reporting alcohol consumption in the last month (Substance Abuse and Mental Health Services Administration, 2015). A prior study from the Behavioral Risk Factor Surveillance System (BRFSS) found substantial increases between 2002 and 2012 for both binge drinking (7.0% to 8.2%) and heavy drinking (16.8% to 18.3%) (Dwyer-Lindgren et al., 2015). Past research among young adults also found that binge drinking decreased from 1985 through 2009, although the decrease was not apparent for Hispanics (Keyes & Miech, 2013). In 2010, binge drinking accounted for approximately three-

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quarters of the $249 billion annual economic burden associated with alcohol misuse (Sacks, Gonzales, Bouchery, Tomedi, & Brewer, 2015). Paired with the fact that alcohol misuse is the third leading cause of preventable death in the United States, the importance of this public health issue is significant (Mokdad, Marks, Stroup, & Gerberding, 2004).

Misuse of alcohol varies among subpopulations, and AUDs are more common in developed countries and affect men more than women (Saxena, 1997; Schuckit, 2006; Teesson, Baillie, Lynskey, Manor, & Degenhardt, 2006). Although the association between race/ethnicity and drinking patterns is complex and findings have been mixed, certain groups appear disproportionately affected by problem drinking. White populations and Native American populations have been found to exhibit the highest prevalence of any alcohol use and binge drinking, respectively (Chartier & Caetano, 2010). In addition, both White and Native American populations have a greater risk for AUDs compared to other groups (Chartier & Caetano, 2010). Data from the National Epidemiologic Survey on Alcohol and Related Conditions showed that Native Americans had the highest lifetime prevalence of AUDs, alcohol abuse, and alcohol dependence of all race/ethnic categories, and the White subgroup had the second-highest rates in all categories (Hasin & Grant, 2015). Black populations in the United States exhibit the highest rates of recurrent or persistent alcohol use dependence (Chartier & Caetano, 2010). Additionally, higher odds of AUD onset and persistence have been found among U.S.-born Hispanics over the age of 40, although odds were lower for non-U.S.-born Hispanics and U.S.-born Hispanics aged 30–39 (Grant et al., 2012).

Up-to-date trend analyses of alcohol misuse among demographic groups are needed to understand the trajectory of misuse and who is at greatest risk. In the present study, we used data from the Behavioral Risk Factor Surveillance System (BRFSS) to examine trends of heavy and binge drinking among U.S. adults. These analyses can help inform alcohol-use policy, interventions, and future research.

Method

Data

The BRFSS was designed by the Centers for Disease and Prevention (CDC) to collect data on noninstitutionalized residents' (age > 18) health-related risk behaviors and events, chronic health conditions, and use of preventive services. Since 2011, the BRFSS has collected participant information from all 50 states, the District of Columbia, and three U.S. territories using disproportionate stratified sampling for landlines and random sampling for cellular telephones (Centers for Disease Control and Prevention, 2013). Over 400,000 adult interviews are completed every year, making the BRFSS the largest regularly conducted health-related survey in the world. The survey measures have been empirically supported (Nelson, Holtzman, Bolen, Stanwyck, & Mack, 2001). In the current study, we restricted our analysis to 2011–2017 in order to generate comparable estimates across survey years, as the sampling frame of BRFSS changed in 2011.

Measures

Binge drinking and heavy drinking were defined differently for males and females, as is standard in the literature (Centers for Disease Control and Prevention, 2018a). The BRFSS collects information on drinking behavior in the past 30 days. Binge drinking was defined as any occasion in the past 30 days when a male had five or more drinks, or a female had four or more drinks. Heavy drinking was defined for males as having more than 14 drinks per week and seven drinks per week for females during the prior 30 days (Centers for Disease Control and Prevention, 2018b; U.S. Department of Health and Human Services & U.S. Department of Agriculture, 2015).

Age and race/ethnicity were obtained from the calculated variables in the combined BRFSS data. Age was categorized as 18–34, 35–54, and 55+. Race/ethnicity was categorized as "White, non-Hispanic," "Black, non-Hispanic," "Hispanic," and other. The other category was comprised of respondents answering "Asian, Non-Hispanic," "American Indian/ Alaskan Native, Non-Hispanic," and "Other race, Non-Hispanic". Sex, marital status, education level, and income were obtained from related survey questions. We further classified marital status as married and not married.

Statistical analysis

We generated national estimates of the prevalence of heavy drinking and binge drinking for each year of data using the entire survey participant population. Additionally, estimates were calculated for the full sample and by sex, race/ethnicity, and age subgroups separately. For trend analyses, we used logistic regression for the two dichotomous variables: heavy drinking and binge drinking. We included quadratic time and a linear variable in the logistic regression model and adjusted for sex, race/ethnicity, and age. If the quadratic term was not significant, we removed it and tested the linear term. Time variables were modeled as continuous variables. We selected the models with significant highest-order time variable as the final model. If the selected model included a quadratic time variable, we used the selected model to estimate the adjusted prevalence and standard error by year to determine the joinpoints.

Joinpoint is the point where a significant change in trends occurs. Based on the number of our data points, we set the minimum number of joinpoints to 0 and a maximum number of joinpoints to 1 (National Cancer Institute, 2019). The analysis sequentially tests from the minimum number of joinpoints to the maximum number. In each test, a grid search method is used to estimate the parameters in the null and alternative models with a Monte Carlo Permutation method used to approximate the significance of each test. Bonferroni correction was used to adjust the overall significance level of multiple hypothesis tests (Kim, Fay, Feuer, & Midthune, 2000). The same procedures were repeated for sex, race/ethnicity, and age-based subgroup analyses. All tests were two-sided, and a P-value of < 0.05 was considered significant. Joinpoint model analyses were performed using the National Cancer Institute (NCI) joinpoint software (National Cancer Institute, 2019). All other

Table 1. Results of segmented trend regression analyses resulting from the significant joinpoint for all adults and sex, race/ethnicity, age subgroups.

Binge drinking

	Joinpoint	Segment 1			Segment 2		
		β	SE(β)	p-value	β	SE(β)	p-value
All	2014	−0.042	0.004	**<.0001**	0.032	0.004	**<.0001**
Male	2014	−0.048	0.006	**<.0001**	0.019	0.006	**<.0001**
Female	2014	−0.030	0.007	**<.0001**	0.052	0.007	**<.0001**
White	2014	−0.040	0.005	**<.0001**	0.032	0.005	**<.0001**
Black	2013	−0.093	0.025	**<.0001**	0.051	0.011	**<.0001**
Hispanic	2014	−0.041	0.014	**<.01**	0.025	0.014	.08
Other		−0.022	0.008	**.01**			
18–34	2014	−0.066	0.008	**<.0001**	0.017	0.008	**.02**
35–54	2014	−0.035	0.006	**<.0001**	0.048	0.007	**<.0001**
55+		0.013	0.003	**<.01**			
Heavy drinking							
	Joinpoint	β	SE(β)	p-value	β	SE(β)	p-value
All	2014	−0.029	0.006	**<.0001**	0.034	0.006	**<.0001**
Male	2014	−0.035	0.009	**<.0001**	0.021	0.009	**.03**
Female	2014	−0.019	0.009	**.03**	0.049	0.009	**<.0001**
White	2014	−0.033	0.007	**<.0001**	0.031	0.007	**<.0001**
Black		0.027	0.011	**.01**			
Hispanic		0.015	0.011	.15			
Other		−0.022	0.013	.10			
18–34	2015	−0.054	0.009	**<.0001**	0.021	0.020	.50
35–54	2014	−0.024	0.010	**.01**	0.064	0.011	**<.0001**
55+		0.014	0.004	**.01**			

All denotes all included adults in our analyses. $p < .05$ is considered significant and presented in bold. For all analyses, we adjusted for all or some of the following variables: sex, race/ethnicity, age, marital status, education level, and income. Segment 1 included all years from the first available year up to and including the first joinpoint year. Segment 2 included all years from first joinpoint year up to and including the last year.

analyses were performed in SAS, version 9.4 (SAS Institute Inc., Cary, NC) and BRFSS sampling weights, sampling stratification, and primary sampling units were used to account for the complex sample design of the survey.

Results

Binge drinking

Table 1 reports result from the joinpoint analysis, which shows that a significant binge-drinking trend occurred in 2014. Similar results were found in all subgroup analyses, except among Black adults who had a significant change in 2013. The results indicated that the overall prevalence of binge drinking decreased significantly from 18.3% in 2011 to 16.0% in 2014, then increased significantly to 17.0% in 2017. Among males, binge drinking rates decreased significantly from 24.5% in 2011 to 21.4% in 2014, then increased significantly to 22.1% in 2017 (Figure 1). Females had the same pattern as the prevalence of binge drinking decreased significantly from 11.4% in 2011 to 10.9% in 2014, then increased significantly to 12.1% in 2017.

Figure 2 shows national estimates of the prevalence of adult (age ≥ 18) binge and heavy drinking by race/ethnicity from 2011–2017. The prevalence of binge drinking in White and Hispanic adults decreased significantly from 2011 (18.9% and 19.9%, respectively) to 2014 (16.8% and 17.1%), and White adults rates then increased significantly to 17.8% in 2017. The prevalence of binge drinking in Black adults decreased significantly from 14.5% in 2011 to 11.8% in 2013, then increased significantly to 13.4% in 2017. For those same years, binge drinking prevalence in all other race/ethnicity groups decreased significantly from 15.0% to 13.6%.

Figure 3 presents national estimates of the prevalence of adult (age ≥ 18) binge drinking and heavy drinking by age

from 2011–2017. The prevalence of binge drinking increased significantly for the 55+ age group over the 7-year period. The prevalence of binge drinking decreased significantly for the 35–54 age group between 2011 (18.8%) to 2014 (16.9%), then increased significantly in 2017 (18.8%). The prevalence of binge drinking in the 18–34 age group decreased significantly from 29.7% in 2011 to 25.4% in 2014, then increased significantly to 26.3% in 2017.

Heavy drinking

A significant heavy drinking trend occurred in 2014 (Table 1) for most subgroups, except those aged 18–34 had a significant drinking trend in 2015, a year later than the other subgroups. Heavy drinking prevalence significantly decreased from 6.6% in 2011 to 5.8% in 2014, and then subsequently increased again in 2017 to 6.2%. The prevalence of heavy drinking in males decreased significantly from 7.6% in 2011 to 6.5% in 2014, then increased to 6.8% in 2017. Among females, heavy drinking prevalence decreased significantly from 5.7% in 2011 to 5.1% in 2014 and increased in 2017 to 5.7%.

In Figure 2, results show that similar to the general population, the prevalence of heavy drinking in White adults decreased significantly from 7.6% in 2011 to 6.7% in 2014, then increased significantly to 7.1% in 2017. The prevalence of heavy drinking increased significantly over the 7-year period in Black adults from 4.4% to 4.5%. No significant trend was found in Hispanic and other race/ethnicity groups. Figure 3 shows that the prevalence of heavy drinking increased significantly for the 55+ age group over the 7-year period. The prevalence of heavy drinking decreased significantly for the 35–54 age group between 2011 (6.5%) and 2014 (5.8%), then increased significantly in 2017 (6.7%).
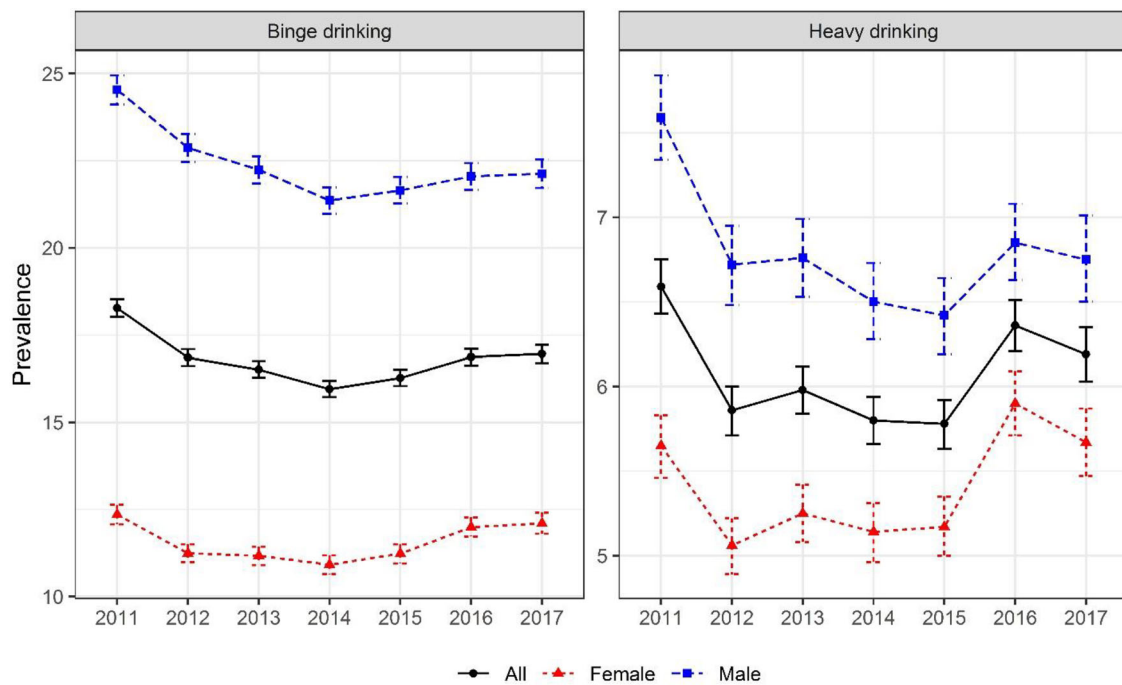
Figure 1. National estimates of the prevalence (and 95% confidence interval) of heavy drinking and binge drinking for adults(age ≥ 18), by sex, in the United States, 2011–2017.
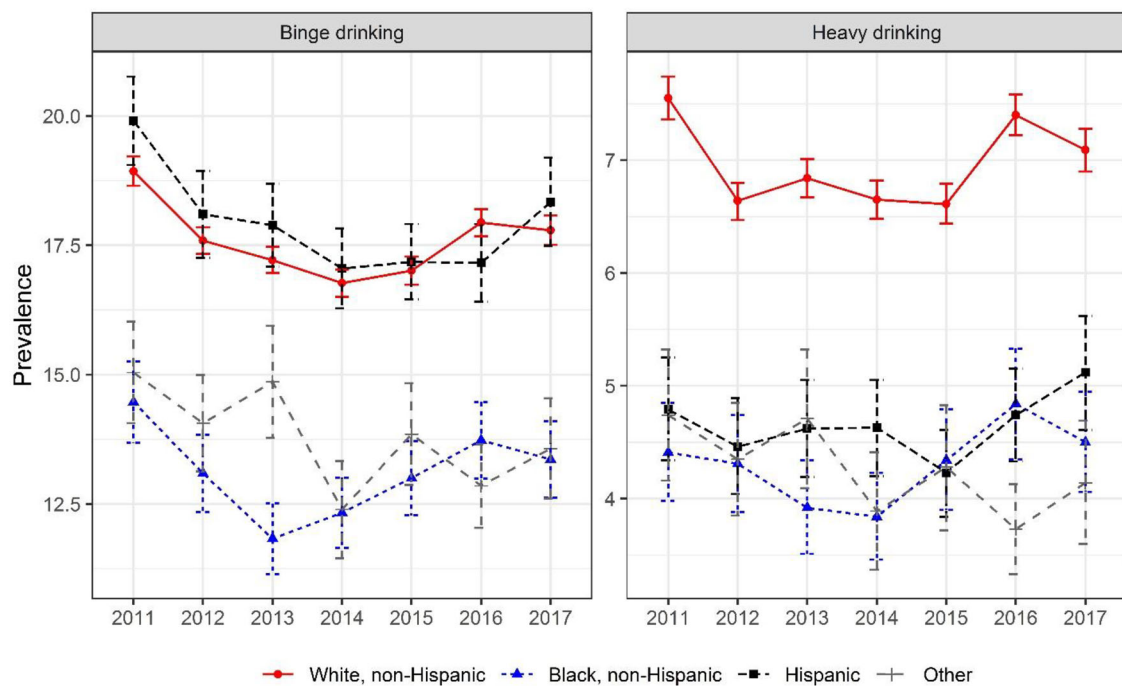

Figure 2. National estimates of the prevalence (and 95% confidence interval) of heavy drinking and binge drinking for adults(age ≥ 18), by race/ethnicity, in the United States, 2011–2017.

In the 18–34 age group, no trend was found for heavy drinking between 2015 and 2017 but the prevalence decreased significantly between 2011 and 2015.

Discussion

Misuse of alcohol has numerous short- and long-term health effects and both significant morbidity and mortality are linked to alcohol misuse as well (Abbey, 2002; Castaneda et al., 1996; Greenfield, 1998; International Agency for Research on Cancer, 2012; Kanny et al., 2015; Rehm et al., 2010; Smith et al., 1999; World Health Organization, 2014). Given the substantial health and financial (Sacks et al., 2015) burdens caused by alcohol misuse, it is important to continually monitor trends of binge and heavy drinking. In the present study, we examined trends in binge and heavy drinking among adults in the United States from 2011 to 2017. In addition, an analysis of trends in binge and heavy
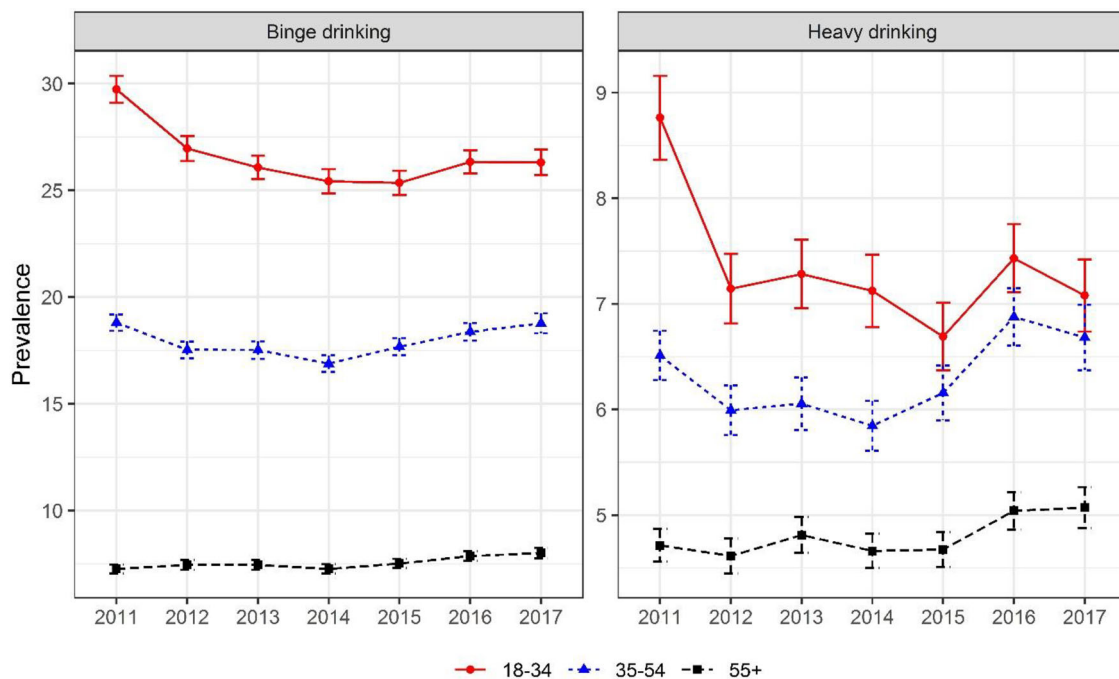
Figure 3. National estimates of the prevalence (and 95% confidence interval) of heavy drinking and binge drinking for adults(age ≥ 18), by age, in the United States, 2011–2017.

drinking in subpopulations was also performed. Overall, the prevalence of both binge and heavy drinking decreased significantly from 2011 to 2014 and then increased significantly through 2017. A prior national report found no change in national rates of ethanol consumption from all alcoholic beverages from 2014 to 2015 (Haughwout & Slater, 2017), though 30 states had increased consumption in that time frame (Haughwout & Slater, 2017). Another study indicated an overall increase in per capita consumption of ethanol from all alcoholic beverages from 2015 to 2016 (Haughwout & Slater, 2018). These studies suggest that alcohol misuse was not increasing at a steady rate from 2014 to 2017.

Among White participants, as with the general population, the prevalence of both binge and heavy drinking decreased significantly from 2011 to 2014 and then increased significantly through 2017. The same trend was found for binge drinking among Black participants. In contrast to their White counterparts, Black adults had significant increases in heavy drinking from 2011 to 2017. This result is in keeping with prior studies reporting disparate alcohol use by race/ethnicity (Chartier & Caetano, 2010). It has been suggested that higher rates of alcohol use among Black populations, in part, may be due to the socioeconomic disadvantages and discrimination they face (Chartier & Caetano, 2010). One study found that when compared with White adults, Black adults reported higher rates of poverty, unfair treatment, racial stigma, and general disadvantages; these disadvantages were associated with problem drinking (Mulia, Ye, Zemore, & Greenfield, 2008). The Hispanic group had similar rates of binge drinking, but lower rates of heavy drinking compared to White respondents. Discrimination experiences have also been linked with a greater risk of alcohol-related issues among both Hispanic/Latino college students (Cheng & Mallinckrodt, 2015) and

Latino immigrants in the United States (Salas-Wright et al., 2018).

Although the 18–34 age range followed the trend of decrease between 2011 and 2015 followed by an increase through 2017 for binge drinking, heavy drinking decreased from 2011 to 2015 without any subsequent significant increase. This age range showed consistently higher rates of both binge and heavy drinking compared to the other age groups. A possible explanation for this is the inclusion of college-age students in the age group, who have consistently displayed high rates of alcohol misuse (Krieger, Young, Anthenien, & Neighbors, 2018; O'Malley & Johnston, 2002). This age range includes individuals who are underage (18–20 years old) and are not legally allowed to drink alcohol. Research has established that underage first-year college students are especially susceptible to alcohol use, with a source finding that they account for a third of all alcohol-related deaths in college (O'Grady, Cullum, Tennen, & Armeli, 2011; Paschall, Grube, Thomas, Cannon, & Treffers, 2012). It remains unclear how changes in environmental factors including societal norms about substance use may have impacted trends in excessive drinking, although it has been previously established that norms and beliefs are strong predictors of current drinking and frequent heavy drinking (Brooks-Russell, Simons-Morton, Haynie, Farhat, & Wang, 2014; Caetano & Clark, 1999; O'Grady et al., 2011; Paschall et al., 2012). A recent study found that weekly alcohol use among U.S. 11-, 13-, and 15-year-olds declined between 2002 and 2010 (Looze et al., 2015), possibly influenced by a variety of factors including prevention approaches (Simons-Morton et al., 2009). As this population ages, it is possible that the rates of binge and heavy drinking for the 18–34 age group may be impacted (Looze et al., 2015).

The 35–54 age group had a decrease in both binge and heavy drinking from 2011 to 2014 with a subsequent increase through 2017. There was a significant increase in the prevalence of binge drinking and heavy drinking from 2011 to 2017 among the 55+ age group. This result is in keeping with a prior NSDUH study reporting a significant increase in prevalence of past-month binge drinking among older adults who self-reported "poor/fair" health or had multiple chronic diseases (Han, Moore, Sherman, Keyes, & Palamar, 2017). Studies have also shown at-risk drinking was associated with a higher mortality rate in older men with multiple chronic conditions (Moore et al., 2006). It may be beneficial for older adults to drink less given their low tolerance level of alcohol, especially among those with comorbidities (Cigolle, Langa, Kabeto, Tian, & Blaum, 2007; Moore et al., 2006).

The prevalence of both binge and heavy drinking among males and females decreased significantly from 2011 to 2014 and then increased significantly through 2017. We found that men had higher rates of binge and heavy drinking than women. This is consistent with findings showing that males were more likely to use alcohol, and drink excessively when compared to females (Nolen-Hoeksema, 2004; U.S. Department of Health and Human Services & U.S. Department of Agriculture, 2015). While the difference in rates of binge drinking remained consistent throughout the study period, the difference in rates of heavy drinking between males and females appeared to lessen in 2015. Similar to our findings, prior studies found that the prevalence of past-year alcohol use increased starting in 2000/2001, and was particularly pronounced among women (Grant et al., 2017; Grucza et al., 2018). In contrast to our findings, a meta-analysis found that binge drinking rates also increased, particularly among women (Grucza et al., 2018). Although, it is important to note that several methodological changes in the surveys used in the meta-analysis may have impacted their results.

Our findings that alcohol misuse increased from 2014 to 2107 highlight the need for improved alcohol misuse prevention efforts. There are several population-level prevention strategies, including screening service and reducing alcohol outlet density, which could be useful in lowering excessive alcohol consumption. The US Preventive Service Task Force recommended screening and Behavioral Counseling Interventions in a primary care setting, which is positively associated with reduced unhealthy alcohol use (US Preventive Services Task Force, 2018). Additionally, reducing alcohol outlet density could be beneficial given evidence suggests that greater alcohol outlet density was associated with higher alcohol consumption and related mental harms, injuries, crime, and violence (Campbell et al., 2009; Rowland et al., 2014, 2016).

Limitations of this study include the self-report nature of the survey, which consists of the possibility of inaccurate recall. This study focused solely on national trends and, therefore, did not investigate any state-specific policies that may have contributed to the observed patterns. Another limitation of the study is that we were not able to investigate drinking trends among Native American populations, which have historically shown high rates of alcohol-related issues (Beauvais, 1998). There was an insufficient sample size to include Native Americans as a separate group, and we combined into the "Other" race/ethnicity category. This study also had several strengths, including the use of a large population-based sample. The study was able to identify key demographic differences in binge and heavy drinking.

Conclusion

Data from a nationally representative survey were used in this study to investigate trends in adult binge and heavy drinking. Binge and heavy drinking decreased between 2011 and 2014, and had a significant increase between 2014 and 2017. This trend held for many subgroups, including males, females, White participants, and the 35–54 age group. Black adults and the 55+ age group had significant increases in heavy drinking across the 7-year period. Likewise, the prevalence of binge drinking increased significantly in the same period for the 55+ age group. Overall, our results indicate a recent significant increase in both binge and heavy drinking among the general population with similar results found in subgroup analyses.

Disclosure statement

The authors report no conflicts of interest.

References

Abbey, A. (2002). Alcohol-related sexual assault: A common problem among college students. *Journal of Studies on Alcohol, Supplement*, s14, 118–128. doi:10.15288/jsas.2002.s14.118

American College of Surgeons. (2006). Statement on Insurance. Alcohol-related injuries, and trauma centers. American College of Surgeons. Retrieved February 26, 2019, from https://www.facs.org/about-acs/statements/55-alcohol-trauma.

Beauvais, F. (1998). American Indians and alcohol. *Alcohol Health and Research World*, 22(4), 253–259.

Brooks-Russell, A., Simons-Morton, B., Haynie, D., Farhat, T., & Wang, J. (2014). Longitudinal relationship between drinking with peers, descriptive norms, and adolescent alcohol use. *Prevention Science*, 15(4), 497–505. doi:10.1007/s11121-013-0391-9

Caetano, R., & Clark, C. L. (1999). Trends in situational norms and attitudes toward drinking among whites, blacks, and hispanics: 1984–1995. *Drug and Alcohol Dependence*, 54(1), 45–56. doi:10.1016/S0376-8716(98)00148-3

Campbell, C. A., Hahn, R. A., Elder, R., Brewer, R., Chattopadhyay, S., Fielding, J., … Middleton, J. C. (2009). The effectiveness of limiting alcohol outlet density as a means of reducing excessive alcohol consumption and alcohol-related harms. *American Journal of Preventive Medicine*, 37(6), 556–569. doi:10.1016/j.amepre.2009.09.028

Castaneda, R., Sussman, N., Westreich, L., Levy, R., & O'Malley, M. (1996). A review of the effects of moderate alcohol intake on the treatment of anxiety and mood disorders. *J Clin Psychiatry*, 57(5), 207–212.

Castle, I. J. P., Dong, C., Haughwout, S. P., & White, A. M. (2016). Emergency department visits for adverse drug reactions involving alcohol: United States, 2005 to 2011. *Alcoholism: Clinical and Experimental Research*, 40(9), 1913–1925. doi:10.1111/acer.13167

Centers for Disease Control and Prevention. (2013). The BRFSS data user guide. Retrieved from https://www.cdc.gov/brfss/data_documentation/pdf/UserguideJune2013.pdf.

Centers for Disease Control and Prevention. (2018a). Alcohol and public health - Frequently asked questions. Retrieved February 13, 2019, from https://www.cdc.gov/alcohol/faqs.htm.

Centers for Disease Control and Prevention. (2018b). Fact sheets - Alcohol use and your health. Retrieved February 15, 2019, from https://www.cdc.gov/alcohol/fact-sheets/alcohol-use.htm.

Chartier, K., & Caetano, R. (2010). Ethnicity and health disparities in alcohol research. *Alcohol Research & Health : The Journal of the National Institute on Alcohol Abuse and Alcoholism*, 33(1–2), 152–160.

Cheng, H.-L., & Mallinckrodt, B. (2015). Racial/ethnic discrimination, posttraumatic stress symptoms, and alcohol problems in a longitudinal study of Hispanic/Latino college students. *Journal of Counseling Psychology*, 62(1), 38–49. doi:10.1037/cou0000052

Cigolle, C. T., Langa, K. M., Kabeto, M. U., Tian, Z., & Blaum, C. S. (2007). Geriatric conditions and disability: The health and retirement study geriatric conditions and disability. *Annals of Internal Medicine*, 147(3), 156–164. doi:10.7326/0003-4819-147-3-200708070-00004

Dwyer-Lindgren, L., Flaxman, A. D., Ng, M., Hansen, G. M., Murray, C. J. L., & Mokdad, A. H. (2015). Drinking patterns in US counties from 2002 to 2012. *American Journal of Public Health*, 105(6), 1120–1127. doi:10.2105/AJPH.2014.302313

Esser, M. B. (2014). Prevalence of alcohol dependence among US adult drinkers, 2009–2011. *Preventing Chronic Disease*, 11, e206. doi:10.5888/pcd11.140329

Grant, B. F., Chou, S. P., Saha, T. D., Pickering, R. P., Kerridge, B. T., Ruan, W. J., … Hasin, D. S. (2017). Prevalence of 12-month alcohol use, high-risk drinking, and DSM-IV alcohol use disorder in the United States, 2001–2002 to 2012–2013: Results from the national epidemiologic survey on alcohol and related conditions. *JAMA Psychiatry*, 74(9), 911–923. doi:10.1001/jamapsychiatry.2017.2161

Grant, J. D., Vergés, A., Jackson, K. M., Trull, T. J., Sher, K. J., & Bucholz, K. K. (2012). Age and ethnic differences in the onset, persistence and recurrence of alcohol use disorder. *Addiction*, 107(4), 756–765. doi:10.1111/j.1360-0443.2011.03721.x

Greenfield, L. A. (1998). *Alcohol and crime: An analysis of national data on the prevalence of alcohol involvement in crime.* Report prepared for the Assistant Attorney General's National Symposium on Alcohol Abuse and Crime. Washington, DC: U.S. Department of Justice. Retrieved from https://bjs.gov/content/pub/pdf/ac.pdf.

Grucza, R. A., Sher, K. J., Kerr, W. C., Krauss, M. J., Lui, C. K., McDowell, Y. E., … Bierut, L. J. (2018). Trends in adult alcohol use and binge drinking in the early 21st-century United States: A meta-analysis of 6 national survey series. *Alcoholism: Clinical and Experimental Research*, 42(10), 1939–1950. doi:10.1111/acer.13859

Han, B. H., Moore, A. A., Sherman, S., Keyes, K. M., & Palamar, J. J. (2017). Demographic trends of binge alcohol use and alcohol use disorders among older adults in the United States, 2005–2014. *Drug and Alcohol Dependence*, 170, 198–207. doi:10.1016/j.drugalcdep.2016.11.003

Hasin, D. S., & Grant, B. F. (2015). The National Epidemiologic Survey on Alcohol and Related Conditions (NESARC) waves 1 and 2: Review and summary of findings. *Social Psychiatry and Psychiatric Epidemiology*, 50(11), 1609–1640. doi:10.1007/s00127-015-1088-0

Haughwout, S. P., & Slater, M. E. (2017). *Surveillance Report #108 Apparent per capita alcohol consumption: National, state, and regional trends, 1977–2015.* U.S. Department of Health and Human Services, National Institute on Alcohol Abuse and Alcoholism. Retrieved May 31, 2019, from https://pubs.niaaa.nih.gov/publications/surveillance108/CONS15.htm.

Haughwout, S. P., & Slater, M. E. (2018). *Surveillance Report #110 Apparent per capita alcohol consumption: National, state, and regional trends, 1977–2016.* U.S. Department of Health and Human Services, National Institute on Alcohol Abuse and Alcoholism. Retrieved May 31, 2019, from https://pubs.niaaa.nih.gov/publications/surveillance110/CONS16.htm.

International Agency for Research on Cancer. (2012). Personal habits and indoor combustions: A review of human carcinogens, Volume 100E. Retrieved February 15, 2019, from https://monographs.iarc.fr/iarc-monographs-on-the-evaluation-of-carcinogenic-risks-to-humans-17/.

Kanny, D., Brewer, R. D., Mesnick, J. B., Paulozzi, L. J., Naimi, T. S., & Lu, H. (2015). Vital signs: Alcohol poisoning deaths - United States, 2010–2012. *MMWR.* 63, 1238–1242. Retrieved from https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6353a2.htm?s_cid=mm6353a2_w.

Keyes, K. M., & Miech, R. (2013). Age, period, and cohort effects in heavy episodic drinking in the US from 1985 to 2009. *Drug and Alcohol Dependence*, 132(1–2), 140–148. doi:10.1016/j.drugalcdep.2013.01.019

Kim, H. J., Fay, M. P., Feuer, E. J., & Midthune, D. N. (2000). Permutation tests for joinpoint regression with applications to cancer rates. *Statistics in Medicine*, 19(3), 335–351. doi:10.1002/(SICI)1097-0258(20000215)19:3<335::AID-SIM336>3.0.CO;2-Z

Krieger, H., Young, C. M., Anthenien, A. M., & Neighbors, C. (2018). The epidemiology of binge drinking among college-age individuals in the United States. *Alcohol Research: Current Reviews*, 39(1), 23–30.

Looze, M. D., Raaijmakers, Q., Bogt, T. T., Bendtsen, P., Farhat, T., Ferreira, M., … Pickett, W. (2015). Decreases in adolescent weekly alcohol use in Europe and North America: Evidence from 28 countries from 2002 to 2010. *The European Journal of Public Health*, 25(suppl 2), 69–72. doi:10.1093/eurpub/ckv031

Mokdad, A. H., Marks, J. S., Stroup, D. F., & Gerberding, J. L. (2004). Actual causes of death in the United States, 2000. *JAMA*, 291(10), 1238–1245. doi:10.1001/jama.291.10.1238

Moore, A. A., Giuli, L., Gould, R., Hu, P., Zhou, K., Reuben, D., … Karlamangla, A. (2006). Alcohol use, comorbidity, and mortality. *Journal of the American Geriatrics Society*, 54(5), 757–762. doi:10.1111/j.1532-5415.2006.00728.x

Moore, A. A., Whiteman, E. J., & Ward, K. T. (2007). Risks of combined alcohol/medication use in older adults. *The American Journal of Geriatric Pharmacotherapy*, 5(1), 64–74. doi:10.1016/j.amjopharm.2007.03.006

Mulia, N., Ye, Y., Zemore, S. E., & Greenfield, T. K. (2008). Social disadvantage, stress, and alcohol use among Black, Hispanic, and White Americans: Findings from the 2005 U.S. national alcohol survey. *Journal of Studies on Alcohol and Drugs*, 69(6), 824–833. doi:10.15288/jsad.2008.69.824

National Cancer Institute. (2019) Number of joinpoints. Joinpoint Help System 4.7.0.0. Retrieved February 11, 2019, from https://surveillance.cancer.gov/help/joinpoint/setting-parameters/method-and-parameters-tab/number-of-joinpoints.

National Institute on Alcohol Abuse and Alcoholism. (2019). Alcohol use disorder. Retrieved May 30, 2019, from https://www.niaaa.nih.gov/alcohol-health/overview-alcohol-consumption/alcohol-use-disorders.

Nelson, D. E., Holtzman, D., Bolen, J., Stanwyck, C. A., & Mack, K. A. (2001). Reliability and validity of measures from the Behavioral Risk Factor Surveillance System (BRFSS). *Soz Preventivmed*, 46(Suppl 1), S3–S42.

Nolen-Hoeksema, S. (2004). Gender differences in risk factors and consequences for alcohol use and problems. *Clinical Psychology Review*, 24(8), 981–1010. doi:10.1016/j.cpr.2004.08.003

O'Grady, M. A., Cullum, J., Tennen, H., & Armeli, S. (2011). Daily relationship between event-specific drinking norms and alcohol use: A four-year longitudinal study. *Journal of Studies on Alcohol and Drugs*, 72(4), 633–641. doi:10.15288/jsad.2011.72.633

O'Malley, P. M., & Johnston, L. D. (2002). Epidemiology of alcohol and other drug use among American college students. *Journal of Studies on Alcohol, Supplement*, s14, 23–39. doi:10.15288/jsas.2002.s14.23

Paschall, M. J., Grube, J. W., Thomas, S., Cannon, C., & Treffers, R. (2012). Relationships between local enforcement, alcohol availability, drinking norms, and adolescent alcohol use in 50 California cities. *Journal of Studies on Alcohol and Drugs*, 73(4), 657–665. doi:10.15288/jsad.2012.73.657

Rehm, J., Baliunas, D., Borges, G. L. G., Graham, K., Irving, H., Kehoe, T., … Taylor, B. (2010). The relation between different dimensions of alcohol consumption and burden of disease: An overview. *Addiction*, *105*(5), 817–843. doi:10.1111/j.1360-0443.2010.02899.x

Rowland, B., Evans-Whipp, T., Hemphill, S., Leung, R., Livingston, M., & Toumbourou, J. W. (2016). The density of alcohol outlets and adolescent alcohol consumption: An Australian longitudinal analysis. *Health & Place*, *37*, 43–49. doi:10.1016/j.healthplace.2015.11.004

Rowland, B., Toumbourou, J. W., Satyen, L., Tooley, G., Hall, J., Livingston, M., & Williams, J. (2014). Associations between alcohol outlet densities and adolescent alcohol consumption: A study in Australian students. *Addictive Behaviors*, *39*(1), 282–288. doi:10.1016/j.addbeh.2013.10.001

Sacco, P., Unick, G. J., Kuerbis, A., Koru, A. G., & Moore, A. A. (2015). Alcohol-related diagnoses in hospital admissions for all causes among middle-aged and older adults: Trends and cohort differences from 1993 to 2010. *Journal of Aging and Health*, *27*(8), 1358–1374. doi:10.1177/0898264315583052

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. *American Journal of Preventive Medicine*, *49*(5), e73–e79. doi:10.1016/j.amepre.2015.05.031

Salas-Wright, C. P., Vaughn, M. G., Goings, T. C., Miller, D. P., Chang, J., & Schwartz, S. J. (2018). Alcohol-related problem behaviors among Latin American immigrants in the US. *Addictive Behaviors*, *87*, 206–213. doi:10.1016/j.addbeh.2018.06.031

Saxena, S. (1997). Alcohol, Europe and the developing countries. *Addiction*, *92*(s1), S43–S48. doi:10.1111/j.1360-0443.1997.tb03394.x

Schuckit, M. A. (2006). *Drug and alcohol abuse: A clinical guide to diagnosis and treatment*. New York: Springer Science & Business Media.

Schuckit, M. A. (2009). Alcohol-use disorders. *The Lancet*, *373*(9662), 492–501. doi:10.1016/S0140-6736(09)60009-X

Simons-Morton, B. G., Farhat, T., ter Bogt, T. F. M., Hublet, A., Kuntsche, E., Nic Gabhainn, S., Godeau, E., & Kokkevi, A. (2009). Gender specific trends in alcohol use: Cross-cultural comparisons from 1998 to 2006 in 24 countries and regions. *International Journal of Public Health*, *54*(S2), 199–208. doi:10.1007/s00038-009-5411-y

Smith, G. S., Branas, C. C., & Miller, T. R. (1999). Fatal nontraffic injuries involving alcohol: A metaanalysis. *Annals of Emergency Medicine*, *33*(6), 659–668. doi:10.1016/S0196-0644(99)70195-2

Streissguth, A. P., Aase, J. M., Clarren, S. K., Randels, S. P., LaDue, R. A., & Smith, D. F. (1991). Fetal alcohol syndrome in adolescents and adults. *JAMA: The Journal of the American Medical Association*, *265*(15), 1961–1967. doi:10.1001/jama.1991.03460150065025

Substance Abuse and Mental Health Services Administration. (2015). Results from the 2015 national survey on drug use and health: Detailed tables. Retrieved from https://www.samhsa.gov/data/sites/default/files/NSDUH-DetTabs-2015/NSDUH-DetTabs-2015/NSDUH-DetTabs-2015.htm#tab2-41b.

Teesson, M., Baillie, A., Lynskey, M., Manor, B., & Degenhardt, L. (2006). Substance use, dependence and treatment seeking in the United States and Australia: A cross-national comparison. *Drug and Alcohol Dependence*, *81*(2), 149–155. doi:10.1016/j.drugalcdep.2005.06.007

U.S. Department of Health and Human Services & U.S. Department of Agriculture. (2015). Appendix 9. Alcohol - 2015–2020 dietary guidelines. Retrieved September 15, 2019, from https://health.gov/dietary-guidelines/2015/guidelines/appendix-9/.

U.S. Department of Health and Human Services. (2019). Centers for disease control and prevention. Alcohol-related disease impact. Alcohol and public health: Alcohol Related Disease Impact (ARDI). Retrieved June 3, 2019, from https://nccd.cdc.gov/DPH_ARDI/default/default.aspx.

US Preventive Services Task Force. (2018). Screening and behavioral counseling interventions to reduce unhealthy alcohol use in adolescents and adults: US preventive services task force recommendation statement. *JAMA*, *320*(18), 1899–1909. doi:10.1001/jama.2018.16789

Warren, K. R., & Foudin, L. L. (2001). Alcohol-related birth defects–the past, present, and future. *Alcohol Res Health*, *25*(3), 153–158.

Weathermon, R., & Crabb, D. W. (1999). Alcohol and medication interactions. *Alcohol Research & Health: The Journal of the National Institute on Alcohol Abuse and Alcoholism*, *23*(1), 40–54.

White, A. M., Hingson, R. W., Pan, I., & Yi, H. (2011). Hospitalizations for alcohol and drug overdoses in young adults ages 18–24 in the United States, 1999–2008: Results from the nationwide inpatient sample. *Journal of Studies on Alcohol and Drugs*, *72*(5), 774–786. doi:10.15288/jsad.2011.72.774

World Health Organization. (2014). *Global status report on alcohol and health-2014*. Geneva, Switzerland: World Health Organization. Retrieved from https://apps.who.int/iris/bitstream/handle/10665/274603/9789241565639-eng.pdf?ua=1.