

Frequent Binge Drinking Among US Adolescents, 1991 to 2015

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abstract

BACKGROUND AND OBJECTIVES: Scientific understanding of the forces involved in the decades-long decline of adolescent alcohol use in the United States is limited. This study examines specific changes in US adolescent frequent binge drinking (FBD) by age (variation due to maturation), period (variation across time that does not covary across age), and cohort (variation common to adolescents born around the same time).

METHODS: We analyzed nationally representative, multicohort data from 8th, 10th, and 12th grade students sampled between 1991 and 2015 from Monitoring the Future ($n = 1\,065\,022$) to estimate age, period, and cohort effects on adolescents' FBD (defined as ≥ 2 occasions of ≥ 5 drinks in a row during the past 2 weeks). Age-Period-Cohort analyses were stratified by sex, race/ethnicity, and socioeconomic status (SES). Trends in the associations between demographics and FBD across historical time were examined.

RESULTS: Decreases in FBD during adolescence were attributable to period and cohort effects independent of age variations. Birth cohorts between 1985 and 1990 showed the greatest decline in FBD. The Age-Period-Cohort results were consistent across sex, race/ethnicity, and SES, with the exception of slower declines seen among African American adolescents compared with white adolescents since 2007. We also found convergence in FBD by sex and divergence by SES.

CONCLUSIONS: Recent declines in adolescent FBD have been driven by period and cohort effects. Attention is warranted for the slower declines in FBD seen among African American adolescents since 2007, a narrowing difference by sex, and a growing gap by SES.



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WHAT'S KNOWN ON THIS SUBJECT: Alcohol use in adolescence is related to various adverse consequences. Adolescent alcohol use has declined since the 1990s in the United States, although no systematic analysis of age, period, and cohort effects on frequent binge drinking has previously been conducted.

WHAT THIS STUDY ADDS: Age, period, and cohort effects have driven decreases in adolescent frequent binge drinking. Similar patterns were observed across demographics, but African American adolescents have experienced slower declines since 2007. Sex convergence and socioeconomic status divergence were found across historical time.

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Greater alcohol use during adolescence is associated with increased likelihood of adverse correlates, including lower academic achievement,¹ risky sexual behaviors,^{2,3} psychiatric problems,^{4,5} and development of alcohol use disorder.^{6–8} Efforts have been made to reduce adolescent alcohol involvement,⁹ and overall declines have been observed in the United States since the 1990s.¹⁰ However, our understanding of the forces that may drive the historical change in adolescent drinking is limited. Existing literature on trends in alcohol use among adolescents has focused on binge drinking, defined as ≥ 5 drinks in a row.^{11,12} The number of days involved in binge drinking tends to increase by age during adolescence.¹³ Such patterns of frequent binge drinking (FBD) deserve our attention because the number of heavy drinking days is related to injury and other health consequences.^{14–17}

Trends over time in alcohol use are sometimes examined in terms of age, period, and cohort effects. Age effects refer to variation over time that is attributable to maturation, with older adolescents, for instance, more likely to engage in heavy drinking than younger adolescents.^{10,18} Independent of those age patterns, period effects refer to increases and decreases in the population mean level of drinking that are common across all adolescents and that may be attributable to policy or other social change that is ubiquitous in effect. Cohort effects, then, refer to variation over time that is common to groups of adolescents born around the same time and coming of age together through historical time. Among adults, both cohort and period effects describe long-term patterns of alcohol consumption^{19–21}; for example, binge drinking is less prevalent for those born in the 1980s²² (cohort effect), and alcohol consumption among those

of legal drinking age is influenced by changes in alcohol policy²³ (period effect). However, little attention has been paid specifically to trends in adolescent drinking despite their importance as predictors of the risk of alcohol abuse and dependence in adulthood.^{6–8,24}

By using Age-Period-Cohort (APC) analysis, the current study examined age, period, and cohort effects on changes in adolescent drinking trends, with a particular focus on FBD, defined as ≥ 2 occasions of ≥ 5 drinks in a row in the past 2 weeks.²⁵ Consuming ≥ 5 drinks is typically referred to as binge drinking or heavy episodic drinking; trends in frequent consumption (averaging once per week) of ≥ 5 drinks has not been thoroughly explored to date. Due to potential variation in alcohol use across demographic subgroups,^{11,26,27} separate analyses were conducted by sex, race/ethnicity, and socioeconomic status (SES). Specific research questions included: (1) What are the age, period, and cohort effects on FBD trends among US adolescents? (2) Are there differences in the age, period, and cohort effects across demographic subgroups? and (3) How do associations between demographic subgroups and FBD change over historical time?

METHODS

Sample

Monitoring the Future has conducted nationally representative cross-sectional surveys of 8th-, 10th-, and 12th-grade students annually since 1991, with $\sim 45\,000$ adolescents included per year.¹⁰ Approximately 420 public and private schools are sampled each year in a multistage, random sampling design with replacement, with a maximum of 350 students from each school; schools typically participate for 2 years. Student response rates on self-administered questionnaires

range from 79% to 91%. Almost all nonresponse is due to absenteeism; $\sim 1\%$ of students refuse to participate. A detailed description of design and procedures is provided elsewhere.¹⁰

The current study includes all adolescents who provided valid responses for alcohol-use items from 1991 through 2015 (92.3% of the total sample). Due to low numbers of cases, adolescents < 13 years and > 19 years of age were excluded (1.8%), as were those who did not provide their age (2.0%). The final analytic sample included 1 065 022 adolescents (379 992 in 8th grade, 360 961 in 10th grade, and 324 069 in 12th grade).

Measures

Alcohol Use

Our primary analysis examined past 2-week binge drinking (ie, ≥ 5 drinks in a row). The survey queried, “Think back over the last 2 weeks. How many times have you had ≥ 5 drinks in a row? (A ‘drink’ is a bottle of beer, a glass of wine, a wine cooler, a shot glass of liquor, or a mixed drink).” FBD was defined as ≥ 2 occasions of binge drinking in the past 2 weeks (1 = Yes, 0 = No). Sensitivity analyses were conducted to test the usefulness of our definition of FBD; we varied the definition of FBD as (1) ≥ 1 occasions, and (2) ≥ 6 occasions in the past 2 weeks. Furthermore, supplemental analyses were conducted to examine changes in occasional/heavy drinking (1 = drinking in the past 30 days and up to 1 occasion of binge drinking in the past 2 weeks; 0 = no drinking in the past 30 days). A survey question “On how many occasions have you had alcoholic beverages to drink during the last 30 days?” was used in combination with the binge drinking question.

Demographics

APC models were stratified by several demographic covariates. Race

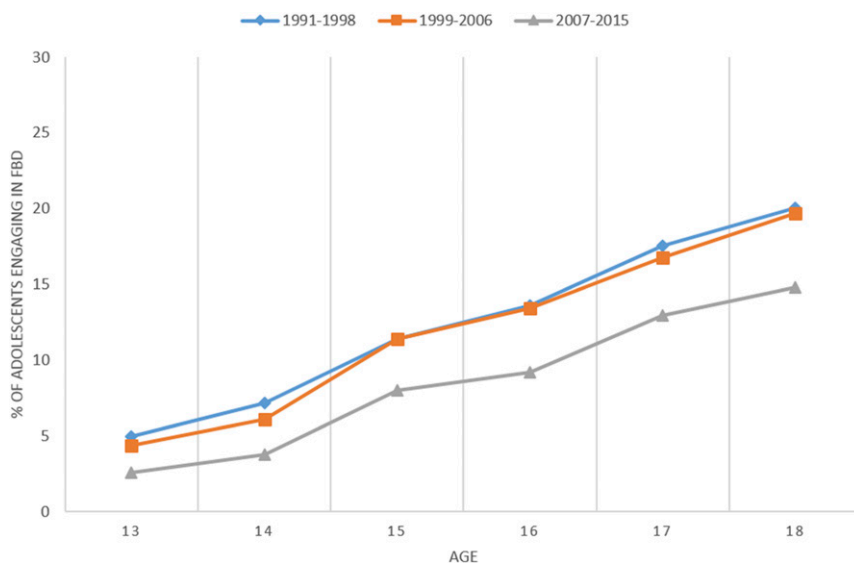


FIGURE 1
Percentage of adolescents engaging in FBD by age and historical period.

and ethnicity were self-reported by respondents who were allowed to select multiple categories. We categorized respondents into: white, African American, Hispanic, and other race/ethnicity. Those who reported >1 category were included in the other race/ethnicity category. SES was operationalized as parental education based on the highest level achieved by either parent: some college or more compared with high school or less. Analyses were also stratified by respondent self-identified sex (boy or girl).

Statistical Analysis

APC models were estimated by using the Clayton and Schiffler approach.^{28,29} This approach iteratively estimates models incorporating age, period, and cohort effects; the best-fitting model is selected based on model fit statistics (by using likelihood-based deviance along with degrees of freedom). The approach is iterative because the simultaneous linear effects of age, period, and cohort cannot be directly estimated (due to a linear dependence across the 3 variables). The Clayton and Schiffler approach first includes a linear effect of age and then the sum of period and cohort effects (ie, drift),

which only identifies the extent to which trends over time increase or decrease. Period and cohort effects are then estimated as nonlinear deviations around the total linear change. We chose the year 1986 as the reference birth cohort because it was in the midpoint of the cohort distributions, and we chose 2007 as the reference period because it was a changing point in the overall rate of alcohol use. The APC modeling was conducted by using “*apc.fit*” in the “*Epi*” package in the R software (www.r-project.org/).

In addition to estimating APC models, we examined the association between demographics and FBD in 3 historical time periods (1991 to 1998, 1999 to 2006, and 2007 to 2015) using logistic regression models stratified by the time periods.

RESULTS

Figure 1 shows the percent of adolescents engaging in FBD by age and 3 different period categories: 1991 to 1998, 1999 to 2006, and 2007 to 2015. FBD increased by age during adolescence in all time periods. The patterns were similar between 1991 to 1998 and 1999 to

2006 but decreases were observed from 2007 to 2015 for all age groups. However, Fig 1 does not provide an assessment of potential cohort effects and how cohort effects may be distinct from the overall secular trends captured in period effects.

APC Analyses of FBD

The inclusion of age, period, and cohort effects produced the best model fit for trends over time in FBD ($n = 116\,129$) versus other drinking (any drinkers and nondrinkers, $n = 948\,893$) (Supplemental Table 2). FBD increased with age (age effects in Fig 2); <5% of adolescents aged 13 to 14 years reported FBD, whereas ~20% of adolescents 18 years of age did. Regarding period effects (Fig 2), FBD has declined since 1990; the risk of adolescent FBD in 2015 was ~0.9 times the risk during the reference period, 2007. Birth cohorts born around 1990 (ie, 8th graders in 2003 to 2004, 10th graders in 2005 to 2006, and 12th graders in 2007 to 2008) had a lower risk of FBD compared with those born in the earlier and later cohorts (cohort effects in Fig 2), independent of age-related trends and the overall decrease in risk across the period.

APC Analyses by Demographics

APC analyses for FBD by sex indicate that the best-fitting models include age, period, and cohort effects separately for both boys and girls (Fig 3, Supplemental Table 2). APC results were consistent across race/ethnicity, with an exception of nonsignificant age, period, and cohort effects for Hispanic adolescents (Fig 4, Supplemental Table 3). Similarly, APC analyses were generalizable across SES (Fig 5, Supplemental Table 4).

Demographic Moderators of Alcohol Use Across Time

We divided the data into 3 time periods to estimate trends in the association of demographics

with FBD (Table 1). Tests of interaction with time periods indicated substantial variation in FBD by sex. Girls were less likely than boys to report FBD, but the effects were weakened (odds ratio [OR] from 0.58 in 1991 to 1998 to 0.71 in 2007 to 2015), showing a converging trend by sex ($P < .0001$ for interactions). Although no

significant variations were found by race/ethnicity across time periods, African American students were less likely than white students to report FBD where the effects were weakened (OR from 0.42 in 1991 to 1998 and 1999 to 2006 to 0.53 in 2007 to 2015), suggesting a convergence ($P < .0001$ for interactions between the 1999–2006 and 2007–2015 cohorts, and the 1991–1998 and 2007–2015 cohorts). Higher SES adolescents were less likely to report FBD compared with those from lower SES, and the effects were strengthened (OR from 0.83 in 1991 to 1998 to 0.79 in 2007 to 2015), suggesting a growing difference ($P < .0001$ for the comparison between the 1991–1998 and 2007–2015 cohorts).

Supplemental Analysis

APC supplemental analyses on occasional/heavy drinking (ie, any drinking in the past 30 days and up to 1 occasion of binge drinking in the past 2 weeks, $n = 238\,202$) compared with no drinking ($n = 710\,691$) revealed that the best-fitting model included age, period and cohort effects (Supplemental Table 7). As illustrated in Supplemental Fig 7, occasional/heavy drinking increased with age, and those born around 1990 had the highest decline of occasional/heavy drinking versus no drinking compared with those in the preceding and subsequent birth cohorts. Positive period effects have been observed since 2007; the decline in occasional/heavy drinking has been slower after 2007. Girls were more likely than boys to engage in occasional/heavy drinking, whereas higher SES adolescents were less likely to be involved in occasional/heavy drinking (Supplemental Table 8). In general, adolescent occasional/heavy drinking patterns were similar to FBD, with the exception of the slower declines in occasional/heavy drinking after 2007 and the greater probability of girls than boys being involved in occasional/heavy drinking.

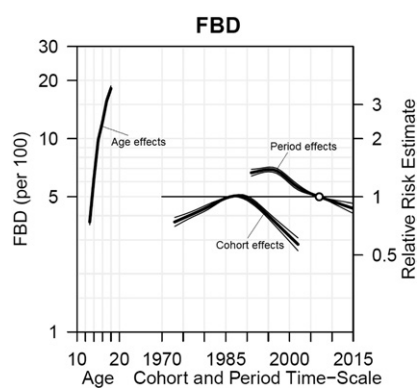


FIGURE 2

Age, period, and cohort effects on the probability of adolescents reporting FBD from 1991 to 2015 ($N = 1\,065\,022$). The cohort and period time scale contains relative risk estimates for the effect of cohort (left line) and period (right line). Thin lines indicate 95% confidence intervals. The cohort estimates are compared with a referent cohort, 1986; thus, the lines can be interpreted as the average proportion of US students' FBD, regardless of time period, compared with the average proportion in 1986. The period estimates are compared with a referent period of 2007, and thus the lines can be interpreted as the average proportion of US students' FBD in that year, regardless of cohort, compared with the average proportion in 2007.

Sensitivity Analysis

To examine the robustness of our results, we repeated the analyses with 2 alternative cut points, 1 with a lower level of frequency (≥ 1 or more binges in the last 2 weeks), and 1 with a higher level of frequency (≥ 6 binges in the last 2 weeks). Both of these cut points produced consistent APC results (Supplemental Fig 6, Supplemental Table 5). A converging gap by sex and growing disparity by SES in recent cohorts (2007 to 2015) were also found (Supplemental Table 6).

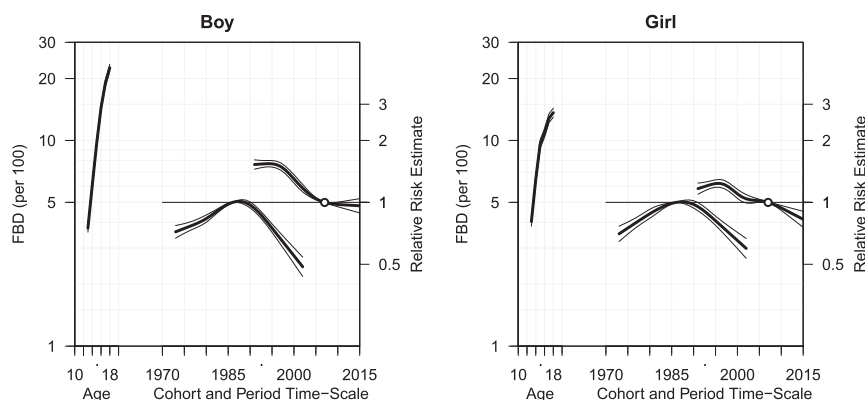


FIGURE 3

Age, period, and cohort effects on the probability of adolescents reporting FBD from 1991 to 2015, by sex.

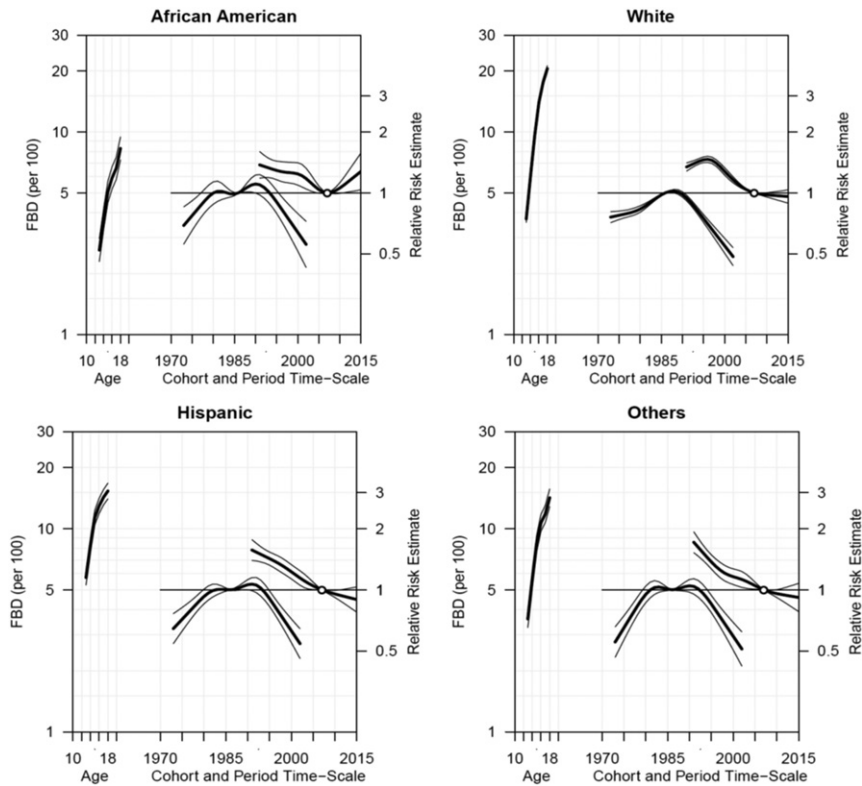


FIGURE 4 Age, period, and cohort effects on the probability of adolescents reporting FBD from 1991 to 2015, by race/ethnicity.

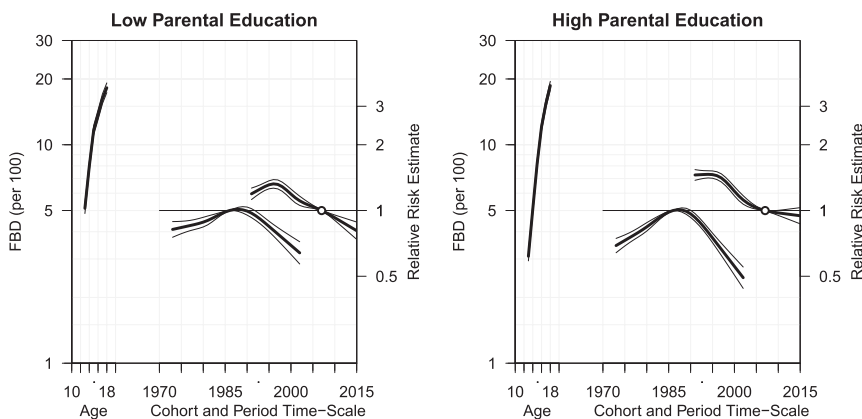


FIGURE 5 Age, period, and cohort effects on the probability of adolescents reporting FBD from 1991 to 2015, by SES.

DISCUSSION

Using nationally representative multicohort data from a large sample of adolescents, the current study systematically examines age, period, and cohort effects on FBD in the United States. First, we found that FBD decreased in recent years among all ages during adolescence,

which is consistent with previous research on declines in adolescent alcohol use.¹⁰ The trends were best described by effects attributable to period and cohort in addition to age-related variation. In other words, decreases in adolescent FBD across the past 25 years were driven by factors influencing all age groups

simultaneously as well as influences on particular birth cohorts. Since 1991, the risk of FBD has decreased among adolescents independently of age and birth cohorts. Furthermore, those born around 1990 had the highest decline of FBD compared with those in the preceding and subsequent cohorts of adolescents.

TABLE 1 ORs for Association Between Demographic Variables and Probability of FBD, by Time Periods

	1991–1998	1999–2006	2007–2015	Interactions		
	<i>n</i> = 363 178	<i>n</i> = 339 799	<i>n</i> = 362 045	1991–1998 vs 1999–2006	1999–2006 vs 2007–15	1991–1998 vs 2007–2015
Sex						
Boy	1	1	1			
Girl	0.58 (0.57–0.60)	0.65 (0.64–0.67)	0.71 (0.70–0.73)	***	***	***
Race						
White	1	1	1			
African American	0.42 (0.40–0.44)	0.42 (0.40–0.44)	0.53 (0.51–0.56)	N/S	***	***
Hispanic	1.00 (0.97–1.04)	0.97 (0.93–1.00)	0.96 (0.93–1.00)	N/S	N/S	N/S
Other	0.75 (0.72–0.77)	0.75 (0.72–0.78)	0.78 (0.75–0.81)	N/S	N/S	N/S
Parent education						
High school or less	1	1	1			
College or more	0.83 (0.82–0.85)	0.81 (0.79–0.83)	0.79 (0.77–0.81)	N/S	N/S	***
Age, y						
13–14	1	1	1			
14–15	1.40 (1.33–1.47)	1.35 (1.28–1.43)	1.44 (1.33–1.55)	N/S	N/S	N/S
15–16	2.41 (2.30–2.53)	2.84 (2.69–2.99)	3.29 (3.07–3.52)	***	***	***
16–17	2.82 (2.69–2.95)	3.28 (3.12–3.45)	3.74 (3.50–4.00)	**	**	***
17–18	4.08 (3.90–4.27)	4.49 (4.26–4.72)	5.64 (5.28–6.02)	***	***	***
18–19	4.59 (4.39–4.81)	5.18 (4.92–5.44)	6.40 (6.00–6.83)	***	***	***

95% confidence intervals are in parentheses. N/S, not significant.

** *P* < .01.

*** *P* < .001.

Factors underlying these effects may include increased public efforts to reduce the risk of underage drinking in the United States^{9,30} (eg, National Institute on Alcohol Abuse and Alcoholism Intervention Guide for Practitioners, 2015³¹), and increased levels of disapproval of heavy alcohol use among recent cohorts of adolescents.¹⁰ Furthermore, online social networking³² may affect drinking patterns among recent cohort adolescents because most young people report drinking for social motives.³³ As some research has suggested,¹¹ however, declines in alcohol use may also be attributable to an increase in preference for other drugs (eg, nonmedical use of prescription medication), although more rigorous investigation is necessary to understand the mechanisms.

Overall, APC results were consistent across diverse demographic groups with a few notable differences. Boys and higher SES adolescents experienced rapid increases in FBD by age compared with girls and lower SES adolescents, respectively. African American adolescents showed the

lowest rates of FBD among all racial groups across all ages, consistent with previous research on their delayed onset and lower prevalence of heavy drinking.^{34,35} Furthermore, although period effects have led to decreases for all racial groups, the decline in FBD among African American adolescents has been slower than among white adolescents since 2007. The recent declines in FBD among adolescents suggest that the economic recession in the late 2000s, when a population-level increase in the prevalence of FBD was observed in the United States,³⁶ may have had less of an effect on the drinking patterns of adolescents. This finding is consistent with previous research showing a weak association between state-level economy and any alcohol use among adolescents.³⁷ The slower decrease among African American adolescents, however, may indicate variations in that link.

Regarding the trends in the association between demographics and drinking over historical time, the analyses revealed substantial convergence in FBD by sex in more recent time periods. The convergence

resulted from greater declines in boys' FBD than in girls' FBD among recent cohorts of adolescents, as shown in the cohort effects from APC analyses. In fact, this finding is consistent with growing evidence of a convergence in the sex gap for alcohol initiation and progression to alcohol problems both in the United States and elsewhere.^{10,38–41} Furthermore, trends in other risk behaviors are increasing faster among adolescent girls in the United States than among boys, including preference for risky activities.⁴² Changes in sex roles⁴³ and a shift in the targeting of alcohol marketing to young female consumers⁴⁴ may have contributed to this narrowing sex gap. Although the causes are speculative, we provide evidence of greater declines in FBD among boys than girls born in recent cohorts.

The analyses also found growing discrepancy by SES in FBD among adolescents in the United States. That is, higher SES adolescents were less likely than those from a lower SES to engage in FBD, and the strength of the association is growing in more recent time periods. These findings

are in contrast to some previous research on the positive association between binge drinking and SES.⁴⁵ The FBD group in the current study includes those who engage in binge drinking ≥ 2 times in the past 2 weeks, whereas previous research referred to any binge episode.^{46,47} Other research⁴⁸ has found mixed results by grade in the association between SES and drinking, in which the prevalence of binge drinking is higher for 8th and 10th graders from lower SES despite the opposite association for 12th graders. A study of high-intensity drinking of ≥ 15 drinks in a row found a higher incidence among lower SES 12th graders.⁴⁹ Our findings add evidence that lower SES students may be at greater risk of problematic drinking.⁴⁹ More detailed research is needed to understand the SES effect and risky drinking among adolescents.

Regarding race and ethnicity, we found a convergence between African American and white adolescents, especially in recent years, despite the fact that African American adolescents typically show unique drinking patterns (eg, delayed onset of heavy drinking^{34,35}).

This finding may again point to the slower declines in heavy drinking among African American adolescents, although future research is needed to understand the changing mechanisms of this convergence.

Despite the declines in FBD, supplemental analyses reveal that the decrease in occasional/heavy drinking among adolescents has been slower in recent years, regardless of their age and birth cohorts. The occasional/heavy drinking group is, however, substantially heterogeneous, including those who have had only 1 drink in the last 30 days and those who have engaged in binge drinking once in the last 2 weeks. Additional research is warranted for those who drink to a lesser degree.

The current study has several limitations. First, alcohol use may vary within categories of use (eg, beverage types^{21,33,48}). Second, the Monitoring the Future data do not include those who drop out of secondary schools; however, this concern is somewhat alleviated because dropout rates have been declining in the United States.⁵⁰ Third, APC models do not explicate

the mechanisms underlying APC effects.

CONCLUSIONS

Declines in FBD among adolescents are attributable to age, period, and cohort effects, with variations by demographics. These declines likely reflect successful intervention attempts to reduce alcohol use among adolescents. However, practitioners should take note that these effects have not been equal across demographic groups, particularly with regard to slower declines among African American adolescents (compared with white adolescents). Screening for alcohol use and FBD in particular remains important. The narrowing difference by sex but the growing gap by SES also deserve close attention by researchers and practitioners.

ABBREVIATIONS

APC: age-period-cohort
FBD: frequent binge drinking
OR: odds ratio
SES: socioeconomic status

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REFERENCES

1. Krohn MD, Lizotte AJ, Perez CM. The interrelationship between substance use and precocious transitions to adult statuses. *J Health Soc Behav.* 1997;38(1): 87–103
2. Bryan A, Ray LA, Cooper ML. Alcohol use and protective sexual behaviors among high-risk adolescents. *J Stud Alcohol Drugs.* 2007;68(3): 327–335
3. Tapert SF, Aarons GA, Sedlar GR, Brown SA. Adolescent substance use and sexual risk-taking behavior. *J Adolesc Health.* 2001;28(3):181–189
4. Kandel DB, Johnson JG, Bird HR, et al. Psychiatric disorders associated with substance use among children and adolescents: findings from the Methods for the Epidemiology of Child and Adolescent Mental Disorders (MECA) Study. *J Abnorm Child Psychol.* 1997;25(2):121–132
5. Miller JW, Naimi TS, Brewer RD, Jones SE. Binge drinking and associated health risk behaviors among high school students. *Pediatrics.* 2007;119(1):76–85
6. Grant BF, Dawson DA. Age at onset of alcohol use and its association with DSM-IV alcohol abuse and dependence: results from the National Longitudinal Alcohol Epidemiologic Survey. *J Subst Abuse.* 1997;9:103–110
7. DeWit DJ, Adlaf EM, Offord DR, Ogborne AC. Age at first alcohol use: a risk factor for the development of alcohol disorders. *Am J Psychiatry.* 2000;157(5):745–750
8. Schulenberg JE, Patrick ME, Kloska DD, Maslowsky J, Maggs JL, O'Malley PM. Substance use disorder in early midlife: a national prospective study on health and well-being correlates and long-term predictors.

- Subst Abuse*. 2016;9(suppl 1):41–57
9. Komro KA, Toomey TL. Strategies to prevent underage drinking. *Alcohol Res Health*. 2002;26(1):5–14
 10. Miech RA, Johnston LD, O'Malley PM, Bachman JG, Schulenberg JE. *Monitoring the Future National Survey Results on Drug Use, 1975-2015. Secondary School Students*. Vol 1. Ann Arbor, MI: Institute for Social Research, The University of Michigan; 2016. Available at: <http://monitoringthefuture.org/pubs.html#monographs>
 11. Keyes KM, Miech R. Age, period, and cohort effects in heavy episodic drinking in the US from 1985 to 2009. *Drug Alcohol Depend*. 2013;132(1–2):140–148
 12. Patrick ME, Terry-McElrath YM, Kloska DD, Schulenberg JE. High-intensity drinking among young adults in the United States: prevalence, frequency, and developmental change. *Alcohol Clin Exp Res*. 2016;40(9):1905–1912
 13. Masten AS, Faden VB, Zucker RA, Spear LP. Underage drinking: a developmental framework. *Pediatrics*. 2008;121(suppl 4):S235–S251
 14. Merline A, Jager J, Schulenberg JE. Adolescent risk factors for adult alcohol use and abuse: stability and change of predictive value across early and middle adulthood. *Addiction*. 2008;103(suppl 1):84–99
 15. Swahn MH, Simon TR, Hammig BJ, Guerrero JL. Alcohol-consumption behaviors and risk for physical fighting and injuries among adolescent drinkers. *Addict Behav*. 2004;29(5):959–963
 16. McCambridge J, McAlaney J, Rowe R. Adult consequences of late adolescent alcohol consumption: a systematic review of cohort studies. *PLoS Med*. 2011;8(2):e1000413
 17. Oesterle S, Hill KG, Hawkins JD, Guo J, Catalano RF, Abbott RD. Adolescent heavy episodic drinking trajectories and health in young adulthood. *J Stud Alcohol*. 2004;65(2):204–212
 18. Patrick ME, Schulenberg JE. How trajectories of reasons for alcohol use relate to trajectories of binge drinking: National panel data spanning late adolescence to early adulthood. *Dev Psychol*. 2011;47(2):311–317
 19. Kerr WC, Greenfield TK, Bond J, Ye Y, Rehm J. Age, period and cohort influences on beer, wine and spirits consumption trends in the US National Alcohol Surveys. *Addiction*. 2004;99(9):1111–1120
 20. Kerr WC, Greenfield TK, Bond J, Ye Y, Rehm J. Age-period-cohort modelling of alcohol volume and heavy drinking days in the US National Alcohol Surveys: divergence in younger and older adult trends. *Addiction*. 2009;104(1):27–37
 21. Kerr WC, Greenfield TK, Ye Y, Bond J, Rehm J. Are the 1976-1985 birth cohorts heavier drinkers? Age-period-cohort analyses of the National Alcohol Surveys 1979-2010. *Addiction*. 2013;108(6):1038–1048
 22. Keyes KM, Grant BF, Hasin DS. Evidence for a closing gender gap in alcohol use, abuse, and dependence in the United States population. *Drug Alcohol Depend*. 2008;93(1–2):21–29
 23. Wagenaar AC, Salois MJ, Komro KA. Effects of beverage alcohol price and tax levels on drinking: a meta-analysis of 1003 estimates from 112 studies. *Addiction*. 2009;104(2):179–190
 24. Moss HB, Chen CM, Yi HY. Early adolescent patterns of alcohol, cigarettes, and marijuana polysubstance use and young adult substance use outcomes in a nationally representative sample. *Drug Alcohol Depend*. 2014;136:51–62
 25. Schulenberg J, O'Malley PM, Bachman JG, Wadsworth KN, Johnston LD. Getting drunk and growing up: trajectories of frequent binge drinking during the transition to young adulthood. *J Stud Alcohol*. 1996;57(3):289–304
 26. Caetano R, Clark CL. Trends in alcohol consumption patterns among whites, blacks and Hispanics: 1984 and 1995. *J Stud Alcohol*. 1998;59(6):659–668
 27. Caetano R. Alcohol-related health disparities and treatment-related epidemiological findings among whites, blacks, and Hispanics in the United States. *Alcohol Clin Exp Res*. 2003;27(8):1337–1339
 28. Clayton D, Schifflers E. Models for temporal variation in cancer rates. II: age-period-cohort models. *Stat Med*. 1987;6(4):469–481
 29. Clayton D, Schifflers E. Models for temporal variation in cancer rates. I: age-period and age-cohort models. *Stat Med*. 1987;6(4):449–467
 30. Spoth R, Greenberg M, Turrissi R. Preventive interventions addressing underage drinking: state of the evidence and steps toward public health impact. *Pediatrics*. 2008;121(suppl 4):S311–S336
 31. National Institute on Alcohol Abuse and Alcoholism (NIAAA). *Alcohol Screening and Brief Intervention for Youth: A Practitioner's Guide*. Publication No. 11-7805. Bethesda, MD: National Institutes of Health; 2015
 32. Reich SM, Subrahmanyam K, Espinoza G. Friending, IMing, and hanging out face-to-face: overlap in adolescents' online and offline social networks. *Dev Psychol*. 2012;48(2):356–368
 33. Kuntsche E, Knibbe R, Gmel G, Engels R. 'I drink spirits to get drunk and block out my problems...' beverage preference, drinking motives and alcohol use in adolescence. *Alcohol*. 2006;41(5):566–573
 34. Grant JD, Vergés A, Jackson KM, Trull TJ, Sher KJ, Bucholz KK. Age and ethnic differences in the onset, persistence and recurrence of alcohol use disorder. *Addiction*. 2012;107(4):756–765
 35. Wagner EF, Lloyd DA, Gil AG. Racial/ethnic and gender differences in the incidence and onset age of DSM-IV alcohol use disorder symptoms among adolescents. *J Stud Alcohol*. 2002;63(5):609–619
 36. Bor J, Basu S, Coutts A, McKee M, Stuckler D. Alcohol use during the great recession of 2008-2009. *Alcohol*. 2013;48(3):343–348
 37. Arkes J. Does the economy affect teenage substance use? *Health Econ*. 2007;16(1):19–36
 38. Keyes KM, Li G, Hasin DS. Birth cohort effects and gender differences in alcohol epidemiology: a review and synthesis. *Alcohol Clin Exp Res*. 2011;35(12):2101–2112

39. Keyes KM, Martins SS, Blanco C, Hasin DS. Telescoping and gender differences in alcohol dependence: new evidence from two national surveys. *Am J Psychiatry*. 2010;167(8):969–976
40. Cheng HG, Cantave MD, Anthony JC. Taking the first full drink: epidemiological evidence on male-female differences in the United States. *Alcohol Clin Exp Res*. 2016;40(4):816–825
41. Slade T, Chapman C, Swift W, Keyes K, Tonks Z, Teesson M. Birth cohort trends in the global epidemiology of alcohol use and alcohol-related harms in men and women: systematic review and metaregression. *BMJ Open*. 2016;6(10):e011827
42. Keyes KM, Jager J, Hamilton A, O'Malley PM, Miech R, Schulenberg JE. National multi-cohort time trends in adolescent risk preference and the relation with substance use and problem behavior from 1976 to 2011. *Drug Alcohol Depend*. 2015;155:267–274
43. Inglehart R, Baker WE. Modernization, cultural change, and the persistence of traditional values. *Am Sociol Rev*. 2000;65(1):19–51
44. Mosher JF. Joe Camel in a bottle: Diageo, the Smirnoff brand, and the transformation of the youth alcohol market. *Am J Public Health*. 2012;102(1):56–63
45. Patrick ME, Wightman P, Schoeni RF, Schulenberg JE. Socioeconomic status and substance use among young adults: a comparison across constructs and drugs. *J Stud Alcohol Drugs*. 2012;73(5):772–782
46. Fillmore MT, Jude R. Defining “binge” drinking as five drinks per occasion or drinking to a .08% BAC: which is more sensitive to risk? *Am J Addict*. 2011;20(5):468–475
47. Wechsler H, Nelson TF. Binge drinking and the American college student: what's five drinks? *Psychol Addict Behav*. 2001;15(4):287–291
48. Johnston LD, O'Malley PM, Miech RA, Bachman JG, Schulenberg JE. *Demographic Subgroup Trends Among Adolescents in the Use of Various Licit and Illicit Drugs: 1975-2015*. Ann Arbor, MI: Institute for Social Research, The University of Michigan; 2016
49. Patrick ME, Schulenberg JE, Martz ME, Maggs JL, O'Malley PM, Johnston LD. Extreme binge drinking among 12th-grade students in the United States: prevalence and predictors. *JAMA Pediatr*. 2013;167(11):1019–1025
50. Stark P, Noel AM. *Trends in High School Dropout and Completion Rates in the United States: 1972–2012*. Washington, DC: US Department of Education, National Center for Education Statistics; 2015

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