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Educational differences in alcohol consumption and heavy drinking: An age-period-cohort perspective*

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Abstract

Background—Low socioeconomic status (SES) has been associated with lower alcohol consumption, but also with heavier drinking. To explain this contradictory relationship, we examined SES differences in drinking patterns from an age-period-cohort (APC) perspective.

Methods—Data are from seven waves of the U.S. National Alcohol Surveys from 1979 to 2010. As a proxy for SES, educational attainment was used. Past-year alcohol volume was calculated from frequency (never-to-every day) and usual quantity (1–2, 3–4, or 5–6 drinks). Past-year frequency of heavy episodic drinking was labelled as total days of 5+ drinks. Gender-stratified APC fixed-effects models were conducted controlling for demographics and adjusting for survey design and weights.

Results—Significant APC effects by education were found, but the direction varied by alcohol measure. Education and total volume were positively associated across APC. Cross-over effects for age occurred with a positive education-heavy drinking relationship in young adulthood and negative relationship in mid-adulthood. Cohort-by-education effects showed greater heavy drinking among less educated women in 1956–60 cohort and more educated men and women in younger cohorts (post-1976).

Conclusions—Higher SES is consistently associated with total volume across age, period, and cohort, but less consistently with heavy drinking. While there are currently significant intervention efforts to reduce heavy drinking in young adulthood, our study suggests the need for age-specific strategies targeting lower-SES groups in *mid*-adulthood and cohort-specific strategies for lower-SES women in the baby boomer cohort and higher-SES men and women in younger birth cohorts.

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Contributors

CKL conceptualized the study, led analysis, and wrote the first draft of the manuscript; WK and YY provided guidance on data analysis; CL, WK and NM were involved with interpretation of results and manuscript development; and all contributors reviewed and approved of the manuscript.

Conflict of Interest

No conflict declared.

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Keywords

Alcohol; Education; Age-Period-Cohort; Disparities

1. Introduction

Social inequalities have widened over time, giving way to much starker health differentials by socioeconomic status (SES) (Bleich et al., 2012; U.S. Department of Health and Human Services, 2014). How these inequalities play out with alcohol is unclear. The effect of SES on alcohol is not always in the negative direction, as with other health behaviors, but differs by drinking measure. Higher SES is associated with total alcohol consumption; while lower SES is more common with abstinence (Huckle et al., 2010; Kerr et al., 2016). Moreover, findings are mixed for heavy episodic drinking (typically 5+ drinks in one sitting) with some studies showing a positive relationship with SES and others a negative relationship (Huckle et al., 2010; Patrick et al., 2012; Substance Abuse and Mental Health Services Administration [SAMHSA], 2014).

An age, period, and cohort (APC) framework can offer a unique perspective to further understand alcohol-SES relationship by pinpointing which SES subgroups are at highest risk for alcohol consumption and heavy drinking by age (younger vs. older), over time (1950s vs. 2000s), and if there are variations by birth cohorts (Baby Boomers vs. Generations X/Y). Typically, epidemiological trends of drinking examine age trends (younger ages are at higher risk) or time period (changes in consumption over time). By employing an APC framework, we can isolate how disparities in SES may affect the alcohol-cohort relationship while accounting for alcohol-age relationship and alcohol-period relationship. If there are clear SES differences within birth cohorts, whether lower or higher SES places subgroups at elevated risk for alcohol-related harms, then we should target our prevention and intervention efforts to these groups.

The alcohol research field has benefited from an age-period-cohort approach. Age trends show total consumption and excessive drinking is highest in the early twenties and then declines with older age (SAMHSA, 2014). Trends on alcohol consumption and heavy drinking increased in the early 1980s, followed by a decline in the 1990s, and have slowly increased again in the 2000s (Kerr et al., 2013a; SAMHSA, 2014). Yet the cohort lens offers an additional aspect that traditional epidemiological studies of age or time-series overlook. Birth cohorts may experience alcohol-related risks and outcomes that differ from a prior or subsequent cohort as a result of the specific social and environmental conditions experienced by persons born in the same time and aging through the life course together (Kerr et al., 2007; Keyes et al., 2011).

Using the National Alcohol Survey (NAS), Kerr and colleagues' APC study found significantly higher heavy drinking among 1956–1960 female birth cohort, the 1976–1980 male birth cohort, and the 1981–1985 male and female birth cohorts (Kerr et al., 2009; Kerr et al., 2013a). Other APC studies have also reported increasing consumption patterns among women in younger birth cohorts and overall higher trends for both men and women in the 1980s birth cohort, but a downward shift for the 1990s cohort (Bjork et al., 2008; Keyes and

Miech, 2013; Meng et al., 2014). Several mechanisms have been suggested to explain cohort effects in drinking behaviors including social norms; social transmission of alcohol behaviors at the population level; and policies and economic factors that shape the availability of alcohol and consequences from drinking (Keyes et al., 2011; Neve et al., 1993). Using a health disparities framework, this study will extend the previous APC studies by examining whether socioeconomic status (SES) via the role of education is a potential mechanism for explaining cohort effects. While there have been significant improvements in health and overall reduced mortality over time, prior health studies have shown wider SES differences in smoking and preventable deaths among more recent birth cohorts even after accounting for age and period effects (Maralani, 2014; Masters et al., 2012; Yang, 2008). To our knowledge, no APC studies have focused on examining drinking trends by SES.

Given the paradoxical role of SES on drinking (low SES-low consumption; mixed findings of SES on heavy drinking), we aim to examine the role of SES on age-period-cohort trends in alcohol consumption and heavy drinking. Furthermore, educational attainment, as a proxy for SES, has steadily increased over time, in particular, high school graduation rates and post-secondary enrollment in the last half century (Murnane, 2013); however, widening inequalities of educational attainment and the associated health benefits of education also play a role (Walsemann et al., 2013). Using pooled data from seven cross-sectional National Alcohol Surveys (NAS) covering 1979 to 2010, the current study examines educational differences in alcohol consumption and heavy drinking by age, period, and birth cohort. We expect that educational differences in drinking behaviors are likely to be greater among younger age groups and to increase across birth cohorts rather than across time periods.

2. Material and methods

2.1 Data

The NAS is a population-based survey of randomly selected U.S. adults aged 18 years and over that is conducted approximately every five years starting in 1979. We pooled seven waves of NAS data from 1979 (n=1,772; response rate [RR]=71%), 1984 (n=5,221; RR=72%), 1990 (n=2,058; RR=70%), 1995 (n=4,925; RR=77%), 2000 (n=7,612; RR=58%), 2005 (n=6,919; RR=56%), and 2010 (n=7,969; RR=52%). Over the years, key changes have occurred in sampling design (i.e., multi-stage clustered design to random-digit-dialing in 2000), survey mode (i.e., in-person to telephone interviews in 2000 which resulted in a lower response rate), and oversampling of African Americans and Hispanics in all surveys except in 1979 and 1990 (Kerr et al., 2004; Kerr et al., 2013a). Prior methodological studies have shown no significant differences between NAS survey waves in population alcohol estimates (Greenfield et al., 2000; Midanik and Greenfield, 2003; Midanik et al., 2001), but the different survey modes may influence period effects (Kerr et al., 2004). All surveys are weighted to the U.S. adult population for the year in which the data were collected, taking into account age, gender, race/ethnicity, and geography.

2.2 Measures

2.2.1 Alcohol consumption and heavy drinking—Total alcohol consumption was measured using beverage-specific quantity-frequency measures. For each beverage type (i.e.,

wine, beer, and spirits), respondents were asked about frequency of drinking in the last 12 months from never to every day. Respondents were also asked about usual quantity, “When you drink..., how often do you have 1–2, 3–4, or as many as 5 or 6 (glasses/12-ounce cans or bottles/drinks)?” Past-year alcohol consumption was calculated by recoding responses for each beverage-specific frequency and quantity to a standard volume algorithm (in parentheses): “nearly every time” (0.9), “more than half the time” (0.7), “less than half the time” (0.3), “once in a while” (0.1), and “never” (0) (Kerr et al., 2009; Kerr et al., 2013a). Heavy episodic drinking (HED) was a count of the number of days in the past year on which 5+ drinks were consumed across each beverage type, with a maximum of 365 days (Kerr et al., 2009; Kerr et al., 2013a).

2.2.2 Educational attainment—Education was grouped into less than high school (<HS), high school graduate or equivalent (HS), some college (SC), and college graduate or higher (college+). With rising levels of education in the 20th century, the value of education and its benefits on overall earnings and occupational attainment have changed such that the distinction between <HS and HS graduate is more important among earlier birth cohorts, while college enrollment (SC) and college completion (college+) are more important for later birth cohorts (Mare, 1995). However, it is difficult to convert education to a standardized value across birth cohorts, so we make the assumption that education has the same meaning across time similar to previous APC studies (Masters et al., 2012; Wilson et al., 2011). In preliminary analyses, we found distinct differences in alcohol patterns between SC and college+, especially for women; thus, we maintain SC and college+ as separate categories.

2.2.3 Age-period-cohort—Age, period, and cohort were based on respondents’ age, NAS year, and respondents’ birth year. Age was grouped into seven categories starting with 21–24 and 25–30 year olds (to represent peak alcohol use in young adulthood), and then ten-year age groups thereafter until the oldest group of 71+. Given the skewed variation of alcohol use by age, with younger age groups at higher ranges and older age groups at lower ranges, we used the mid-point of 41–50 age group as the reference. Period is represented by the seven NAS years with 2010 as the reference. Birth cohort was categorized into 15 groups starting with 1900–1920, followed by five-year groupings from 1921–1925 to 1981–1985, and ending with 1986–1989. The 1956–1960 birth cohort is the reference group.

2.2.4 Covariates—To account for alcohol variations by demographics, we controlled for race/ethnicity (African-American, Asian, Hispanic, White, and Native American and all others), marital status (married, widowed, divorced/separated, and never married), religion (Catholic, no religion, and all others), employment status (employed, retired, and not employed), and annual income (\$0–20K, \$20K–40K, \$40–70K, \$70K+, missing). U.S. states were categorized into dry-to-wet environments with dryer states in the South, moderately wet states in Mid-Atlantic, Pacific Coast, and South Coast, and wetter states in New England and North Central areas (Kerr, 2010).

Given our focus on education, studies often use an age cutoff of 25 years to allow time for individuals to complete all measured levels of education (Wilson et al., 2011). However, excluding young adults (ages 18–24), a peak time for alcohol consumption and heavy

drinking, would mask an important life stage to assess APC-alcohol trends. Thus, we limited our analytic sample to respondents ages 21 and older to account for the opportunity to enter college while still being able to capture the peak period for alcohol consumption. Our final analytic sample included 18,282 female and 13,851 male respondents ages 21 years and older.

2.3 Analysis

We first conducted descriptives of gender- and education-specific trends of beverage-specific consumption and HED. We then examined goodness-of-fit statistics for APC models, which confirmed that age, period, and cohort be considered together for both alcohol outcomes. The age-period model for total volume among women was only marginally significant using the likelihood ratio test, but the overall APC model was significant.

Consistent with previous APC studies using NAS, we used a fixed-effects approach for our APC models, which makes strong assumptions that age, period, and cohort are independent from one another (Kerr et al., 2004, 2009; Kerr et al., 2013a). While a hierarchical or cross-classified random effects approach is more common in recent APC studies and addresses the independence assumption by nesting age within period and cohort (Yang and Land, 2013), this approach cannot address complex survey design and oversampling. We were able to better account for the NAS's different survey modes, sampling designs and oversampling in a fixed effects approach using Stata's survey design feature (`-svy-` command). Once we finalized our model, we ran sensitivity analyses of a cross-classified random effects model in HLM software (without adjusting for complex survey design), and obtained similar APC-education trends; however, the random effects (i.e., period and cohort) were smaller than those found in the fixed effects models.

We conducted gender-specific negative binomial regression models with log-transformed outcomes of total volume and HED days (Kerr et al., 2004, 2009; Kerr et al., 2013a), which allowed for count data where the conditional variance exceeds the conditional mean as is the case with the over-dispersion of non-drinkers (e.g., zero volume or no HED days) (Rosner, 2006). We estimated a series of adjusted models posing separate interaction terms of age-education, period-education, and cohort-education. Then, the predicted values for total volume and HED were calculated and plotted separately for each interaction term. Analyses were conducted in Stata/SE version 13, and accounted for survey weights and changes in sampling design across the pooled data files (Stata Corp., 2013).

3. Results

Overall, education and abstinence had an inverse relationship (See Table 1). Less educated groups had higher abstinence compared to more educated groups. Women with more education had higher alcohol consumption, and in particular, consumed significantly more wine and spirits. No significant educational differences were found for women's beer consumption and HED. Among men, a significant and positive education relationship was evident for wine, a negative relationship for beer, and no significant relationship for spirits. Yet for HED, men with college+ had the fewest heavy drinking days compared to their less-educated counterparts.

3.1 Alcohol consumption

Estimates from gender-stratified, adjusted APC models for past year alcohol consumption are shown in Table 2. After controlling for education and covariates, overall consumption was highest in young adulthood and gradually declined with age for both genders. Period effects showed higher consumption in 1979 and 1984 compared to more recent years. Younger male birth cohorts (1971–1985) consumed more alcohol than older male cohorts.

Figure 1 presents findings from female APC-education interaction models. Across APC, college+ women have the highest alcohol consumption, followed by SC, HS, and <HS, after controlling for covariates. For age, the largest educational gaps in women's consumption were evident in the twenties and again in the fifties. Over time, education differences in women's consumption were widest in 1979; they then reduced during the 1990s, and widened again slightly during the 2000s. Finally, education-cohort differences were smallest for birth cohorts 1900–1925 and 1956–1970, and largest for those born after 1971.

In contrast to the bivariate relationships, the adjusted APC models for men revealed higher consumption among college+ men and lower consumption among <HS men compared to HS men (See Table 2). Figure 2 shows the APC-education interaction effects for men. College+ men have the highest consumption for each age group, but statistically significant effects for college+ were found only among older men (ages 51+). Educational differences in consumption were larger in 1979 and 1984, grew smaller during the 1990s, and widened again by 2010. Alcohol consumption was similar between education groups across most of the early birth cohorts, but started to differentiate among those born after 1975. Educational differences were widest among men in more recent birth cohorts with college+ men reporting higher consumption.

3.2 Heavy Episodic Drinking (HED)

Table 3 presents estimates from gender-stratified, adjusted APC models for number of HED (5+) days in the past year. HED was highest for young women (ages 21–30) and lowest for older women (ages 51+). There were no differences by age among men. HED was most frequent in 1979 and 1984, and gradually declined over time, but this trend was only statistically significant for men. Statistically significant cohort effects showed less HED among older cohorts for both genders, and more HED days among younger male cohorts with statistically significant effects for the 1971–1985 cohorts.

The interaction effects of APC and education are plotted in Figure 3 using estimates from adjusted APC-education interaction models. Across the life course, statistically significant interactions were found such that college+ women had more HED days in young adulthood (ages 21–30) and during their 50s, compared to all other education groups. Over time, educational differences were widest in 1984, converged in 1995 and 2000, and grew wider again after 2005. While HS women had more HED days in the 1990s, women with SC or college+ had the most HED days in 2005 and 2010. Cohort effects also showed an education cross-over trend among women. Women with <HS in the 1956–1960 birth cohort had the most HED, a difference that subsequently reversed, where women with the same education born in the 1970–1980s had the least HED. The education-HED differential has widened

among more recent cohorts born since 1971, and is primarily driven by the dramatic increase in HED days among college+ women.

The interaction effects of education and APC revealed cross-over effects for men and HED. Greater HED was found among college+ men in their 20s, but less among college+ men at older ages. The SC group had the most HED at ages 25–30 and 31–40, but after 40s, educational differences were minimal. Period trends showed that HS men had the greatest amount of heavy drinking during the 1980s–1990s, but this trend converged and educational differences were insignificant in 2005 and 2010. For older birth cohorts, educational differences in HED were minimal, but grew larger after the 1941–1946 cohorts. Specifically, <HS men had the most HED days among the 1941–1950 cohorts while college+ men had the fewest. However, this pattern was reversed in the 1976–1985 cohorts where <HS had the fewest. Among the 1976–1980 cohorts, SC and college+ had the most. Similar to women, the education-HED differential for men was widest in more recent birth cohorts primarily due to the difference between <HS and college+ groups.

4. Discussion

This study furthers alcohol-related disparities research by considering education as an influential factor in differentiating alcohol patterns over the life course by age, over time from 1979 to 2010, and by birth cohort in the U.S. In summary, we found significant APC effects by education. Education and total volume were positively associated across APC. However, crossover effects for education and HED were found. For age, there was a positive education-heavy drinking relationship in young adulthood and negative relationship in mid-adulthood. Cohort-by-education effects showed greater heavy drinking among less educated women in 1956–1960 cohort and more educated men and women in younger cohorts (1976–1985). We discuss these findings further below.

4.1 Alcohol consumption

Our results are consistent with prior studies indicating a positive effect of education on alcohol consumption (Huckle et al., 2010; van Oers et al., 1999) and this is consistent across age, period, and cohort. Furthermore, a positive SES gradient was found such that with each level of higher education, more alcohol was consumed in the past year for both genders. Gradients were also evident in descriptive analyses of beverage-specific consumption in different directions. Greater wine consumption was found among higher education groups and greater beer consumption among lower education groups for men. As a proxy for SES, higher education could indicate greater purchasing power for alcohol (Cerdá et al., 2011), and signal beverage preferences of wine, a more expensive drink compared to beer.

Age effects of peak alcohol consumption in young adulthood are already well-known (Chen et al., 2004; Schulenberg and Maggs, 2002); however, when taking into account education, college+ young adults had the highest consumption, although only the finding for college+ women ages 25–30 was significant. Women's rates of educational attainment have increased over time and even surpassed men's college enrollment and completion rates (Mare and Maralani, 2006; Wilson et al., 2011). Thus, increased gender equity in education and presumably greater economic independence for women may have led to more social

acceptance of drinking among higher-SES women (Keyes et al., 2008; Schmidt et al., 1990; Schmidt, 2014). Consistent with these social norms for women's drinking are alcohol marketing strategies targeting young women (Jernigan et al., 2004; Jones et al., 2017). Even though college+ men had higher consumption in young adulthood, significant educational effects were only found among college+ men in 50+ age groups, suggesting that young adulthood is a common wet environment for men regardless of education.

Cohort effects revealed minimal educational differences in alcohol consumption for women in 1956–1970 birth cohorts and men in 1946–1965 birth cohorts. This finding could reflect a time of more equal access for these birth cohorts to higher education, whether completing high school or continuing to college (Mare, 1995; Murnane, 2013). Thus, as more people received higher education within these birth cohorts, reducing educational inequalities, the differences in consumption patterns by education may also have been reduced. Kerr and colleagues have also reported increased alcohol affordability from 1950s through 2011 (Kerr et al., 2013c). Thus, birth cohorts entering young adulthood during this time of lower alcohol prices may be more accepting of favorable drinking environments or increased alcohol affordability may explain the lack of educational differences in consumption.

However, education differences in drinking increased dramatically for cohorts born after 1970 such that those with higher education had greater consumption. Within-cohort characteristics of those who are entering and completing college could be an explanation for this gap such that those with greater resources and higher family income are also those who are able to enter and graduate from college (Chetty et al., 2017; Wilson et al., 2011). Increasing educational inequalities may have extended to educational differences in alcohol consumption patterns. Economic conditions also improved in the late 1990s and early 2000s and has been suggested as a reason for higher consumption among more recent birth cohorts (Kerr et al., 2013a); however, the benefits of good economic conditions (e.g., higher employment rates and salaries) may be limited to those with higher education and result in higher consumption among this group. Finally, the National Institute of Alcohol Abuse and Alcoholism released its “Call to Action” report to address the drinking culture in U.S. colleges in 2002 when these younger birth cohorts were starting to attend college (Health and Services, 2007). Alcohol is deeply entwined with the college experience, and social norms promoting alcohol use is common in college (Neighbors et al., 2007). Thus college-goers among cohorts born after 1970 are exposed to favorable drinking norms and wetter environments that may continue after college. Future studies should test whether educational differences in consumption among more recent birth cohorts are due to drinking norms specific to social environments such as colleges.

4.2 Heavy Episodic Drinking (HED)

The relationship between education and HED depicts a more complicated picture. For both genders, there was an age-crossover effect such that higher education in young adulthood (ages 21–30) was associated with more HED, but this relationship reverses in mid-adulthood when higher education was associated with less HED. The age effects show that higher education is a driving force for HED among young adults, which could be influenced by college settings or alcohol venues such as bars/restaurants that target young adults who are

more likely to patronize these venues. HED has also been a widespread problem in college environments (DeJong et al., 2009; Hingson, 2010; Wechsler et al., 2002), and thus young adults who went to college are exposed to social norms favoring HED (Neighbors et al., 2007).

This trend reverses after young adulthood. The crossover effect could be due to the transition to “adult roles” (e.g., marriage, parenthood), which, regardless of education level, has been associated with a reduction in heavy and problematic drinking (Dawson et al., 2006). Alternatively, the health risks associated with HED may be more salient as one ages, and thus, higher education could reflect increased knowledge and informed decisions to engage in less HED and more healthy behaviors (Pampel et al., 2010; Rehm, 2011).

A cohort-crossover effect of education-heavy drinking is also evident. Among women in 1956–1960 birth cohort and men in 1941–1950 “baby boomer” birth cohort, the <HS group engaged in more frequent HED than higher educational groups. These cohorts entered young adulthood when alcohol had become more affordable (Kerr et al., 2013c), and affordability would have its largest impact on groups with lower SES. Although prior results for total alcohol consumption showed no educational differences by cohort, there is a potential educational difference in HED by cohort. A U.S. study found that less educated baby boomers were at higher risk for mid-life morbidity and mortality (Case and Deaton, 2015). The authors referred to the effects of growing social inequalities and financial downturns which make this birth cohort, particularly its less-educated members, less economically secure than their parents’ generation. Thus, for lower SES baby boomers, engaging in excessive alcohol use may be due to both alcohol affordability and economic stresses, and be a contributing factor to their poor health. Future studies should further investigate educational differences in drinking patterns and alcohol-related health outcomes as baby boomers age into older adulthood.

This current study extends Kerr and colleagues’ finding that the 1976–1985 birth cohorts drink more heavily than earlier birth cohorts (2013a) by showing that education is a driving factor for this trend. Results indicate that those who have entered or completed college in these birth cohorts are more likely to be heavier drinkers than their non-college going counterparts. Furthermore, compared to older cohorts, the education-HED gap is widest among these younger birth cohorts (post-1970s). College environments tend to have drinking norms favoring HED (Neighbors et al., 2007). While one might expect that college effects on HED would be consistent across cohorts, our results only show that younger birth cohorts are at higher HED risk. Future research should examine whether drinking norms in college environments have changed over time and if there is increasing HED among younger birth cohorts, especially among those with college degrees. Finally, it is important to continue tracking if the highly educated in these birth cohorts continue to drink heavily into adulthood.

Study results should be considered within the following limitations. First, this study relies on self-reported data on drinking behaviors, and thus under-reporting may lead to lower estimates (Dawson, 1998). Second, estimates for the youngest and oldest age groups (e.g., ages 21–24 and 71+), as well as youngest and oldest birth cohorts (i.e., 1986–89 and 1900–

1920) may be less reliable due to limited data from 1–2 survey waves in comparison to age/cohorts taken from 3–7 survey waves. Similar to prior NAS study (Kerr et al., 2013a), while we retain these groups in the APC models, we do not present estimates for the youngest birth cohort in the figures due to unstable estimates. Finally, our discussion points to social conditions (via norms and alcohol marketing) and economic conditions (via pricing and affordability, higher disposable incomes) that may explain study results; however, we have not conducted any empirical tests, and encourage future studies to examine these possible mechanisms to explain educational differences in drinking patterns.

5. Conclusion

Because eliminating disparities in health across socioeconomic groups is a high priority in the U.S. (USDHHS, 2014), population health programs and policies that consider increasing educational attainment are a fruitful venture. Yet health benefits afforded by higher education may have different implications across different alcohol-related behaviors. Our study showed a steady and positive relationship of education and overall alcohol consumption across ages, periods, and cohorts for men and women. Findings for HED revealed an education crossover effect by age and cohort. While age-specific interventions to reduce HED in young adulthood are bountiful, our study suggests that strategies aimed at mid-adulthood (targeting lower SES groups) and cohort-specific strategies to tackle HED of those of lower SES among the baby boomer cohorts could be most relevant.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Highlights

- Education and alcohol consumption are positively related by age, period, and cohort.
- Educational differences in heavy drinking varied by age, period and cohort.
- For women in 1956–60 birth cohort, greater heavy drinking in lower educated groups.
- In 1976–85 birth cohort, greater heavy drinking occurred in higher educated groups.

Figure 1. Alcohol consumption by APC and education for women

Notes: APC models with interaction terms for age-education, period-education, and cohort-education. Models controlled for race/ethnicity, income, employment, religion, marital status, and region. Data were adjusted with sample weights and corrected for clustering from sample design. Larger markers indicate a significant interaction term at a p-value of less than 0.05.

Figure 2. Alcohol consumption by APC and education for men

Notes: APC models with interaction terms for age-education, period-education, and cohort-education. Models controlled for race/ethnicity, income, employment, religion, marital status, and region. Data were adjusted with sample weights and corrected for clustering from sample design. Larger markers indicate a significant interaction term at a p-value of less than 0.05.

Figure 3. Heavy drinking (5+ drinks) days by APC and education among women

Notes: APC models with interaction terms for age-education, period-education, and cohort-education. Models controlled for race/ethnicity, income, employment, religion, marital status, and region. Data were adjusted with sample weights and corrected for clustering from sample design. Larger markers indicate a significant interaction term at a p-value of less than 0.05.

Figure 4. Heavy drinking (5+ drinks) days by APC and education among men

Notes: APC models with interaction terms for age-education, period-education, and cohort-education. Models controlled for race/ethnicity, income, employment, religion, marital status, and region. Data were adjusted with sample weights and corrected for clustering from sample design. Larger markers indicate a significant interaction term at a p-value of less than 0.05.

Table 1

Descriptives of Past Year Alcohol Consumption and Heavy Drinking by Education and Gender, National Alcohol Survey 1979–2010

	Abstinence Percent	Total Alcohol Volume	Mean Volume			Spirits Total Volume	Heavy Drinking (5+ drinks) Mean # of Days		Total Sample Size Unweighted n (weighted %)	
			Wine Total Volume	Beer Total Volume						
Women										
Less than HS	63.3	7.15	1.35	3.55		1.91	4.21	4,104	17.0	
HS Degree	42.4	8.95	2.50	3.57		2.50	4.87	5,602	33.0	
Some College	32.6	12.01	4.88	3.99		2.62	5.44	4,313	26.0	
College+	24.2	13.68	6.96	3.94		2.60	5.06	4,263	24.0	
Total	39.0	10.62	3.97	3.78		2.87	4.98	18,282	100.0	
p-value	p<.001	p<.001	p<.001	p=.068		p=.023	p=.906			
Men										
Less than HS	42.9	31.85	2.73	20.20		5.53	21.27	2,807	16.6	
HS Degree	30.5	31.94	3.74	22.37		6.18	25.54	3,868	30.3	
Some College	26.3	30.45	4.58	18.66		7.12	21.57	3,184	23.8	
College+	19.9	27.54	7.73	13.93		6.90	15.06	3,992	29.3	
Total	28.5	30.10	4.95	18.64		6.51	20.86	13,851	100.0	
p-value	p<.001	p=.017	p<.001	p<.001		p=.329	p<.001			

Notes: Mean values and numbers are adjusted for sample weights and corrected for clustering from sample design.

Estimates of age, period, cohort effects on total alcohol volume by gender from negative binomial regression models, National Alcohol Survey 1979–2010

Table 2

	Women (n=18,282)			Men (n=13,851)		
	IRR	p	95% CI	IRR	p	95% CI
Age						
21–24	1.37	***	1.135 1.649	1.14		0.972 1.331
25–30	1.26	**	1.085 1.458	1.10		0.968 1.240
31–40	1.14	*	1.032 1.264	1.06		0.977 1.153
41–50	Ref			Ref		
51–60	0.97		0.879 1.073	0.95		0.874 1.041
61–70	1.01		0.853 1.199	0.98		0.855 1.135
71+	0.89		0.699 1.132	0.90		0.726 1.112
Period						
1979	1.10		0.876 1.387	1.32	**	1.087 1.591
1984	1.21		0.997 1.460	1.41	***	1.195 1.659
1990	0.94		0.803 1.110	1.11		0.964 1.269
1995	1.02		0.896 1.160	1.17	**	1.050 1.304
2000	0.88	**	0.795 0.964	0.99		0.908 1.071
2005	1.04		0.962 1.120	1.02		0.956 1.092
2010	Ref			Ref		
Cohort						
1900–1920	0.97		0.687 1.383	0.80		0.607 1.044
1921–1925	0.91		0.685 1.223	0.97		0.761 1.231
1926–1930	1.11		0.872 1.425	1.01		0.816 1.245
1931–1935	1.00		0.807 1.235	1.00		0.840 1.202
1936–1940	0.97		0.798 1.175	1.05		0.900 1.224
1941–1945	0.92		0.789 1.062	0.92		0.813 1.048
1946–1950	0.98		0.873 1.096	1.03		0.945 1.133
1951–1955	0.91		0.824 1.006	0.97		0.904 1.051

	Women (n=18,282)			Men (n=13,851)		
	IRR	p	95% CI	IRR	p	95% CI
1956–1960	Ref			Ref		
1961–1965	0.98		0.881	1.07		0.993
1966–1970	0.91		0.798	1.05		0.952
1971–1975	0.87		0.753	1.13	*	1.003
1976–1980	1.00		0.839	1.30	**	1.118
1981–1985	1.02		0.800	1.33	**	1.099
1986–1989	0.99		0.721	1.40	**	1.099
Education						
Less than HS	0.79	***	0.715	0.91	*	0.848
High School	Ref			Ref		
Some College	1.18	***	1.107	1.05		0.994
College +	1.31	***	1.236	1.12	***	1.062

Notes: IRR=incidence rate ratios; CI=Confidence Intervals.

* p<0.05,

** p<0.01,

*** p<.001

Models controlled for race/ethnicity, income, employment, religion, marital status, and region. Data were adjusted with sample weights and corrected for clustering from sample design.

Table 3

Estimates of age, period, cohort effects on number of heavy drinking (5+) days by gender from negative binomial regression models, National Alcohol Survey 1979–2010

	Women (n=18,282)			Men (n=13,851)		
	IRR	p	95% CI	IRR	p	95% CI
Age						
21–24	1.45		0.916 2.288	1.19		0.897 1.587
25–30	1.49	*	1.033 2.149	1.18		0.941 1.474
31–40	1.39	**	1.092 1.769	1.16		0.992 1.345
41–50	Ref			Ref		
51–60	0.73	*	0.539 0.992	0.86		0.729 1.013
61–70	0.67		0.415 1.091	0.67	**	0.502 0.900
71+	0.51		0.254 1.040	0.40	***	0.249 0.651
Period						
1979	1.20		0.667 2.141	1.63	**	1.127 2.345
1984	1.49		0.897 2.464	1.84	***	1.341 2.516
1990	1.15		0.765 1.727	1.38	*	1.073 1.775
1995	1.03		0.733 1.434	1.27	*	1.023 1.569
2000	0.81		0.631 1.049	1.01		0.864 1.176
2005	1.04		0.855 1.256	1.05		0.922 1.187
2010	Ref			Ref		
Cohort						
1900–1920	0.26	*	0.089 0.749	0.35	**	0.188 0.633
1921–1925	0.36	*	0.154 0.825	0.74		0.466 1.178
1926–1930	0.70		0.360 1.359	0.74		0.491 1.116
1931–1935	0.58		0.324 1.028	0.81		0.563 1.164
1936–1940	0.60	*	0.367 0.995	0.93		0.693 1.256
1941–1945	0.61	*	0.410 0.899	0.78	*	0.619 0.986
1946–1950	0.78		0.572 1.054	0.94		0.791 1.108
1951–1955	0.79		0.619 1.003	0.94		0.816 1.079

	Women (n=18,282)			Men (n=13,851)		
	IRR	p	95% CI	IRR	p	95% CI
1956–1960	Ref			Ref		
1961–1965	0.77	*	0.616 0.969	1.10		0.958 1.270
1966–1970	0.89		0.680 1.172	1.14		0.962 1.361
1971–1975	0.81		0.576 1.129	1.29	*	1.049 1.599
1976–1980	1.19		0.781 1.827	1.64	***	1.259 2.133
1981–1985	1.18		0.673 2.068	1.59	**	1.136 2.237
1986–1989	1.01		0.507 2.019	1.97	**	1.299 2.991
Education						
Less than HS	1.02		0.830 1.243	0.97		0.862 1.096
High School	Ref			Ref		
Some College	0.94		0.814 1.095	0.96		0.881 1.056
College +	0.92		0.788 1.084	0.83	***	0.753 0.917

Notes: IRR=incidence rate ratios; CI=Confidence Intervals.

* p<0.05,
** p<0.01,
*** p<.001

Models controlled for race/ethnicity, income, employment, religion, marital status, and region. Data were adjusted with sample weights and corrected for clustering from sample design.