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Trends in Alcohol Consumption among Older Americans: National Health Interview Surveys, 1997–2014

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Abstract

Background—The majority of US older adults consume alcoholic beverages. The older population is projected to almost double by 2050. Substantially more drinkers are likely.

Purpose—To describe gender-specific trends (1997–2014) in prevalence of drinking status (lifetime abstention, former drinking, current drinking [including average volume], and binge drinking) among US adults ages 60+ by age group and birth cohort.

Methods—In the 1997–2014 National Health Interview Surveys 65,303 respondents ages 60+ (31,803 men, 33,500 women) were current drinkers; 6,570 men and 1,737 women were binge drinkers. Prevalence estimates and standard errors were computed by age group (60+, 60–64, 65–69, 70–74, 75–79, 80+) and birth cohort (<1925<1925–1935–1936–1945–1946–1954). Trends were examined using joinpoint regression and described as average annual percent change (AAPC: overall change 1997–2014) and annual percent change (APC: in-between infection points). Primary analyses were unadjusted. All analyses (unadjusted and adjusted for demographics/lifestyle) were weighted to produce nationally representative estimates. Statistical procedures accounted for the complex survey design.

Results—Among men ages 60+, unadjusted prevalence of current drinking trended upward, on average, 0.7% per year (AAPC, p=0.02); average volume and prevalence of binge drinking remained stable. Adjusted results were similar. Among women age 60+, unadjusted prevalence of current drinking trended upward, on average, 1.6% per year (AAPC, p<0.0001) but average volume remained stable; prevalence of binge drinking increased, on average, 3.7% per year

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(AAPC, p<0.0001). Adjusted results were similar. Trends varied by age group and birth cohort. Among men born 1946–1954 unadjusted prevalence of current drinking trended upward, on average 2.4% per year (AAPC, p=0.02); adjusted results were non-significant.

Conclusions—Our finding of upward trends in drinking among adults ages 60+, particularly women, suggests the importance of public health planning to meet future needs for alcohol-related programs.

Keywords

Aged; alcohol consumption; binge drinking; health surveys; trends

INTRODUCTION

The US population is rapidly aging. The number of Americans ages 60 years and older (60+), an estimated 67 million in 2015, is projected to reach 112 million by 2050 (US Census Bureau, 2014). In 2014, 65% of US adults ages 60–64 and 56% of those ages 65+ reported consuming alcoholic beverages (Center for Behavioral Health Statistics and Quality, 2015). Assuming that proportion remains relatively stable over time, the projected population expansion will lead to a substantial increase in the absolute number of older drinkers by 2050. This could have adverse public health consequences.

Older adults have increased sensitivity to the effects of alcohol (Vestal et al., 1977). The National Institute on Alcohol Abuse and Alcoholism (NIAAA) recommends that men and women ages 65+ limit consumption to no more than 3 drinks on any day and 7 drinks per week, with the caveat that some individuals may need to drink less or not at all depending on their health and how they are affected by alcohol (NIAAA, 2016). Drinking even within recommended limits may heighten older adults' risk for unintentional injuries including falls and motor vehicle accidents. The majority of older drinkers take one or more prescription medications (Breslow et al., 2015). Harmful interactions between alcohol and certain prescription medications may further increase their risk for unintentional injuries, toxic reactions, and fatal overdoses (Breslow et al., 2015; Castle et al., 2016; Moore et al., 2007).

Gender is an important issue to consider in the context of an aging population. Women experience alcohol-related harms at lower levels of drinking than men (NIAAA, 2016). The prevalence of drinking is increasing among older women (White et al., 2015). A recent nationally representative study conducted from 2002 to 2012 (White et al., 2015) reported upward trends in current drinking among women ages 45–64 and 65+, but not among men in those age groups. The study also reported an upward trend in the quantity of alcohol consumed on drinking days among women ages 45–64.

Age groups and birth cohorts are also important issues. Older adults are not a homogeneous population. While often characterized as being age 60+ or age 65+, they range widely in age, were born into different generations, and may drink differently based on those factors (Keyes and Miech, 2013; Kerr et al., 2009; Kerr et al., 2012; Moore et al., 2005; Zhang et al., 2008).

Descriptive epidemiologic research can provide insight into the future alcohol-related public health needs of this expanding population. However, there are few recent analyses of national data that comprehensively consider gender, age groups, and birth cohorts.

Two cross-sectional studies (Dawson et al., 2015; White et al., 2015) examined time-trends in adults ages 65+ in relation to several measures of drinking including prevalence of lifetime abstention (Dawson et al., 2015; White et al., 2015), former drinking (Dawson et al., 2015), current drinking (Dawson et al., 2015; White et al., 2015), binge drinking (Dawson et al., 2015; White et al., 2015), average volume (Dawson et al., 2015), quantity (White et al., 2015), and frequency (Dawson et al., 2015; White et al., 2015). However, the study by Dawson et al. was not gender-specific and neither study considered effects of age or birth cohorts. Three cross-sectional studies in adults ages 65+ included analyses that simultaneously considered calendar time, age, and birth cohort (age-period-cohort analyses) in relation to binge drinking (Keyes and Miech, 2013) or both average volume and binge drinking (Kerr et al., 2009; Kerr et al., 2012). However, other measures of drinking were not considered. Longitudinal studies published in the 2000s (Moore et al., 2005; Zhang et al., 2008) followed birth cohorts for 20 (Moore et al., 2005) to 50 years (Zhang et al., 2008) describing changes over time in drinking status, average volume (Moore et al., 2005; Zhang et al., 2008) and binge drinking (Zhang et al., 2008). However, one study followed participants only through 1992 (Moore et al., 2005) and the other (Zhang et al., 2008) was not conducted in a nationally representative sample. Given the potential problems related to even low-level alcohol consumption among older adults, it is important to fully understand the prevalence of drinking in that population.

The purpose of our study was to comprehensively examine, among adults ages 60+, gender-specific trends in the prevalence of lifetime abstention, former drinking, current drinking, and within current drinkers, average volume consumed and prevalence of binge drinking, by survey year, age group, and birth cohort.

METHODS

We used data from the 1997 to 2014 National Health Interview Surveys (National Center for Health Statistics, 2015a). The NHIS, conducted in-person on a continuing annual basis through the National Center for Health Statistics (NCHS), uses a stratified multistage area probability sample design to monitor the health of the US civilian non-institutionalized population. Adult response rates ranged from 80.4% in 1997 to 58.9% in 2014, averaging 68.6% across these survey years (National Center for Health Statistics, 2015b).

Drinking Measures

In each survey year from 1997 to 2014 participants were asked: “In any 1 year, have you had at least 12 drinks of any type of alcoholic beverage?” “In your entire life, have you had at least 12 drinks of any type of alcoholic beverage?” “In the past year, how often did you drink any type of alcoholic beverage?” and “In the past year, on those days that you drank alcoholic beverages, on the average, how many drinks did you have?” We characterized those who consumed <12 alcoholic beverages in their lifetime as lifetime abstainers; those who consumed 12 or more drinks in their lifetime or 12 or more drinks in any 1 year, but

none in the past year as former drinkers; and those who consumed 12 or more drinks in any 1 year or in their lifetime and 1 or more drinks in the past year as current drinkers.

In regard to binge drinking, in each survey year from 1997 to 2014 men who were current drinkers were asked: “In the past year, on how many days did you have 5 or more drinks of any alcoholic beverage?” Women who were current drinkers were asked the same question through 2013 (the number of drinks was changed to 4 or more starting in 2014). Therefore, data on binge drinking are presented through 2014 for men and through 2013 for women.

Average volume measured the average number of drinks per day and was derived from the product of frequency and quantity divided by 365.25. Quantity measured, on those days when current drinkers drank, the number of drinks they had on the average. Frequency measured the number of days in the past year on which current drinkers drank any type of alcoholic beverage.

Statistical Analysis

All analyses were restricted to respondents ages 60+. Analyses of drinking status (lifetime abstention, former drinking, current drinking) pertain to the total population, whereas analyses of binge drinking and average volume pertain to current drinkers only. Respondents with missing information on drinking status were included in a separate category but are not shown in the results. Current drinkers with missing information on binge drinking were treated as non-binge drinkers. About 1% of current drinkers with missing information on either quantity or frequency were excluded from analyses of average volume. Analyses were performed separately for men and women using the combined 18-year NHIS data.

Prevalence estimates and standard errors for drinking status, binge drinking, and average volume were computed for adults ages 60+ across survey years. We used joinpoint regression by applying the National Cancer Institute Joinpoint Regression Program desktop version 4.3.1.0 (https://surveillance.cancer.gov/joinpoint/) to examine possible nonlinear trends by fitting the simplest joinpoint regression to the natural logarithm of estimates, weighted by the square of the estimate divided by variance at each year, and back transformed to obtain the slopes on the prevalence scale. Selection of joinpoints was based on the permutation test at an overall significance level of 0.05 (Kim et al., 2000). The level of statistical significance (p-value) based on the permutation test does not account for correlation across years of survey due to the same primary sampling units that were used between years (Botman et al., 2000; Parsons et al., 2014). Therefore, the p-values should be considered as approximately correct. The slope estimates from log-linear segments were used to estimate annual percent changes (APC) and average annual percent changes (AAPC). APC was presented for each line segment connected at the joinpoint(s). In the presence of multiple line segments, AAPC was presented for the average of the APCs over the whole period weighted by the length of the APC interval. In the case of single line segments, AAPC was identical to APC.

Prevalence estimates and standard errors for trends in drinking status as well as binge drinking among current drinkers were computed for 5-year age categories through age 80+ and 4 birth cohorts (<1925<1925–1935–1936–1945–1946–1954 [leading edge of baby

boomer cohort]). Trends were examined using joinpoint regression and summarized as APC and AAPC as mentioned above. We also examined birth cohorts by age group, where only individuals falling within each age group during the study period (1997–2014) were considered to address confounding between birth cohort and age group; for example, individuals in the earlier birth cohorts are also older at any given point in time.

To control for differences in covariate distributions over time we produced adjusted predictive margins for prevalence and means using multinomial logistic regression (Hosmer and Lemeshow, 2000) to predict drinking status and binge drinking categories, and multiple linear regression to predict average volume including its quantity and frequency components (Graubard and Korn, 1999). Covariates were race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, other), census region (Northeast, Midwest, South, West), education (≤high school, >high school), marital status (married or cohabiting, not married or cohabiting), and smoking status (never, former, current). Unknown or multiple race (0.2%) was grouped with the "other" category; unknown education (1.2%) was grouped with the "≤high school" category; unknown marital status (0.4%) was grouped with the "not married or cohabiting" category; and unknown smoking status (0.9%) was grouped with the "never" category. We decided, a priori, to present results of unadjusted analyses as our primary findings. Estimates of the prevalence of alcohol consumption in the US population are typically reported as unadjusted estimates. Analyses adjusted for demographics and lifestyle covariates were also performed. Adjusted results are noted as appropriate and presented as supplemental materials.

All analyses were weighted to produce nationally representative estimates. Apart from the joinpoint regression, all other analyses were performed using Stata statistical software (StataCorp LP, 2015) that accounts for the complex survey design of NHIS in the calculation of standard errors and 95% confidence intervals (CI) and in significance testing. All tests of significance were two-tailed, with the level of significance set at 0.05. For better visual presentation, selected estimates and fitted joinpoint regression lines for age 60+ are displayed as figures.

Between 1997 and 2014, 552,837 sample adults ages 18+ completed the NHIS, an average of 30,713 respondents per year. Our final analytic sample included 147,096 respondents who were age 60+. Of these, 42,353 (9,367 men and 32,986 women) were lifetime abstainers, 36,253 (16,692 men and 19,561 women) were former drinkers, and 65,303 (31,803 men, 33,500 women) were current drinkers. Within the current drinkers (excluding 3,043 women who were current drinkers in 2014), 13.3% of respondents reported binge drinking on at least one day in the past year (6,570 men [1997–2014] and 1,737 women [1997–2013]).

RESULTS

Trends in unadjusted prevalence of lifetime abstention and current drinking, including binge drinking, are presented below by gender, by age group, and by birth cohort. We also present results for birth cohorts stratified by age groups. No statistical tests were conducted for comparisons between genders or among age groups or birth cohorts. Observed differences

between these groups noted in the results below were based on non-overlapping confidence intervals.

Lifetime Abstention

Between 1997 and 2014, among adults ages 60+, prevalence of lifetime abstention was stable (i.e., no significant trend based on AAPC) among men and declined among women, on average, 1.3% per year (AAPC p=0.006) (Table 1, Figure 1). However, there were inflection points between those years representing in-between changes in the direction of trends. Among men, prevalence of lifetime abstention was stable between 1997 and 2000 followed by a decrease of, on average, 2.2% per year through 2014 (APC p=0.0008). Among women, prevalence was stable between 1997 and 1999 followed by a decrease of, on average, 2.1% per year through 2014 (APC p<0.0001).

By age group, among men, prevalence of lifetime abstention was stable between 1997 and 2014 in all age groups except the oldest where it decreased steadily, on average, 1.3% per year (AAPC p=0.02). There were no in-between changes in direction of trends except in the youngest age group (60–64) which had a decrease of, on average, 6.5% per year for 8 years starting in 2003 (APC p=0.003) followed by an increase of, on average, 16.2% per year between 2011 and 2014 (APC p=0.04). Among women, prevalence of lifetime abstention decreased between 1997 and 2014 within each age group.

By birth cohort, prevalence of lifetime abstention increased over time in men born before 1925 and in men and women born between 1925 and 1935. Prevalence remained stable in the more recent birth cohorts (1936–1945,1946–1954).

Current Drinking

Between 1997 and 2014, among adults ages 60+, prevalence of current drinking increased among men, on average, 0.7% per year (AAPC p=0.02) and among women, on average, 1.6% per year (AAPC p<0.0001) (Table 2, Figure 1). There were also in-between trends. Among men, starting in 2000, prevalence increased, on average, 1.2% per year through 2014 (APC p<0.0001). Among women, starting in 2006, prevalence increased, on average, 2.8% per year through 2014 (APC p<0.0001). The more pronounced though shorter-duration rise among women narrowed the observed (not statistically tested) gender gap in prevalence of current drinking from 17.7% in 2006 (men, 55.4%, women, 37.7%) to 12.4% in 2014 (men, 59.9%, women, 47.5%).

Among all age groups, among both men and women, prevalence of current drinking increased between 1997 and 2014, except men ages 60–64 where there was a borderline significant AAPC. Among men, prevalence was variable at ages 60–64 where it was stable between 1997 and 2005, increased, on average, 2.5% per year for 5 years (APC p=0.01) and subsequently remained stable for 4 years. Among other men's age groups, prevalence steadily increased between 1997 and 2014, on average, between 0.7% and 1.0% per year (APC ranges p=0.009 to p=0.0006). Among women, prevalence of current drinking was variable among those ages 70–74 where it was stable between 1997 and 2007 and subsequently increased, on average, 4.1% per year for 7 years (APC p=0.0007). Among

other women's age groups, prevalence steadily increased between 1997 and 2014, on average between 1.0% and 1.8% per year (APCs p<0.0001).

By birth cohort, among men, prevalence of current drinking decreased over time (<1925 and 1925–1935 birth cohorts) or remained stable (1936–1945 birth cohort), except in the baby boom cohort (1946–1954 birth cohort) where prevalence increased sharply, on average, 8.1% per year between 2006 and 2009 when they started turning age 60 (APC p=0.04) and subsequently remained stable for 5 years. Among women prevalence decreased in the two earlier cohorts and remained stable in the two more recent cohorts. When we examined birth cohorts stratified by age groups between 1997 and 2014, based on non-overlapping confidence intervals, the baby boomer cohort had, on average, the highest prevalence of current drinking among men age 60–64 and among women age 60–64 and 65–69 (Figure 2, Table S15); a caveat is that the oldest baby boomers reached age 68 in 2014, so no comparisons can be made between baby boomers and other birth cohorts in older age groups.

Binge Drinking within Current Drinkers

Between 1997 and 2014 (2013 for women), among adults ages 60+, prevalence of binge drinking was stable among men, but increased, on average, 3.7% per year among women (AAPC p<0.0001) (Table 3, Figure 1). However, among men there were in-between trends. Prevalence fell, on average, 3.2% per year between 1997 and 2003 (APC p=0.03), subsequently increased, on average, 5.7% per year between 2003 and 2009 (APC p=0.01), and finally remained stable between 2009 and 2014. The differing trajectories that were observed in men and women resulted in changing gender gaps (not statistically tested). The gap in binge drinking was 15.0% in 1997 (men, 19.9%, women, 4.9%), 11.1% in 2003 (men, 16.1%, women, 5.0%) and 14.9% in 2013 (men, 22.4%, women, 7.5%), our last year of comparable binge drinking data for men and women.

By age group, among men, prevalence of binge drinking increased between 1997 and 2014, among those ages 60–64, 70–74, and 75–79 on average, between 1.2% and 2.8% per year (AAPC ranges p=0.02 to p=0.0001). While prevalence among men ages 65–69 did not increase between 1997 and 2014, there were in-between trends. Prevalence fell, on average 10.5% per year between 1997 and 2001 (APC p=0.03) and subsequently increased, on average, 3.7% per year between 2001 and 2014 (APC p=0.0003). Among women, prevalence of binge drinking among those ages 60–64, 65–69, and 70–74 increased between 1997 and 2013, on average between 2.9% and 3.9% per year (AAPC ranges p=0.03 to p=0.0001).

By birth cohort, among men, prevalence decreased over time in all except the most recent cohort (1946–1954) where it was stable. Decreases of 9.2% and 5.7% (AAPC <0.0001 for both), respectively, were found in the <1925 and 1925–1935 birth cohorts. Among women, there were decreases in prevalence of binge drinking in the two earlier birth cohorts. Prevalence was stable in the two more recent cohorts. When we examined birth cohorts stratified by age groups between 1997 and 2014, based on non-overlapping confidence intervals, among women ages 60–64, prevalence of binge drinking was higher in the most recent birth cohort than in the 1925–1935 and 1936–1945 birth cohorts (Figure 2, Table

S15); caveats are that data on older baby boomers were not available and that sample size for binge drinkers was limited.

Average Volume

Among both men and women ages 60+, average volume consumed by current drinkers remained stable between 1997 and 2014 (Table 4). In all age groups, among both men and women, average volume was stable between 1997 and 2014. By birth cohort, among men, average volume decreased in all except the most recent cohort (1946–1954) where it was stable. The decreases were, on average, 2.5%, 1.8%, and 0.7% per year, (AAPC range p=0.03 to p=0.0001), respectively, in the <1925, 1925–1935, and 1936–1945 birth cohorts. Among women, average volume was stable in all birth cohorts. Results for the quantity and frequency components of average volume are available in Tables S1 and S2.

Adjusted Results

There were some differences between unadjusted and adjusted results. For current drinking by age group, among men ages 80+ and women ages 70–74, between 1997 and 2014, current drinking increased, on average, 0.7% (AAPC p=0.009) and 1.3% (AAPC p=0.01) per year, respectively, in unadjusted analyses (Table 2) but was stable in adjusted analyses (Table S5). By birth cohort, among men in the 1946–1954 birth cohort, between 2006 and 2014, current drinking increased, on average, 2.4% per year (AAPC p=0.02) in unadjusted analyses (Table 2), but was stable in adjusted analyses (Table S5). For binge drinking, among men ages 60+, between 1997 and 2014, binge drinking was stable over time in unadjusted analyses (Table 3), but increased, on average, 1.5% per year (AAPC p=0.02) in adjusted analyses (Table S6). By birth cohort, among women in the <1925 birth cohort, binge drinking decreased in unadjusted analyses (Table 3) but was stable in adjusted analyses (Table S6). For average volume by birth cohort, among men in the <1925 and 1936–1945 birth cohorts, average volume decreased in unadjusted analyses (Table 4) but remained stable in adjusted analyses (Table S7); among women in the <1925 and 1936–1945 birth cohorts, average volume was stable in unadjusted analyses but increased in adjusted analyses. Results for adjusted quantity and frequency are available (Tables S8 and S9).

Additional results for trends in former drinking, both unadjusted and adjusted, and precise values for all estimates are available in online supplemental tables (Tables S3, S10, and S11–S20).

DISCUSSION

We used nationally representative cross-sectional data (NHIS, 1997–2014) to describe unadjusted trends in drinking among more than 147,000 older adults ages 60+ by survey year, age group (60–64, 65–69, 70–74, 75–79, 80+) and birth cohort (<1925<1925–1935–1936–1945–1946–1954). Among adults age 60 + prevalence of current drinking trended upward over time among both men and women, though the increase was considerably more marked among women; binge drinking also trended upward among women. We also observed interesting findings about baby boomers that should be interpreted with caution as our study only included the leading edge of that cohort. Namely, at the age of 60–64,

boomers of both genders appeared to have a higher prevalence of current drinking, and female boomers appeared to have a higher prevalence of binge drinking than others of the same age born into previous birth cohorts (1925–1935–1936–1945).

Our results are not directly comparable to previous studies due to numerous methodological differences including statistical differences in the examination of time-trends, calendar time covered, definition of older adults, definitions of drinking variables, and duration of drinking recall. With those caveats, our unadjusted results for current (past-year) drinking for women support those of White et al. (White et al., 2015) who reported an unadjusted upward trend in prevalence of current (past-month) drinking among women age 65+ between 2002 and 2012 in the National Survey on Drug Use and Health (NSDUH). This agreement contributes to the strength of the epidemiologic evidence supporting this potentially important observation. While our results for men differ from those of White et al. who reported no upward trend among men it should be noted that the increase we found for men was considerably weaker than for women.

While we found increasing prevalence of binge drinking among all women ages 60+, White et al. reported no increase in unadjusted binge drinking among women ages 65+. However, criteria to define binge drinking differed in their study which used data from NSDUH (5 or more drinks on the same occasion in the past 30 days) and our study which used data from NHIS (5 or more drinks on any day in the past year) were substantially different. We found no upward trend in binge drinking among all men ages 60+; neither did the study by White et al. However, we did find increases (1997–2014 with an in-between upward trend for those ages 65–69) within all age groups with the exception of the oldest age group. Age group data were not available from White et al.

We suggest caution in interpreting our observations comparing birth cohorts stratified by age groups. The oldest baby boomers in our study were age 68 in 2014, the endpoint of our study; therefore, the comparison, which was based on overlapping confidence intervals, was necessarily limited by age. Our observations on birth cohorts stratified by age groups were secondary to our main analysis, which was a study of trends in drinking among individuals ages 60+ across the NHIS 1997–2014 survey years. We performed these analyses because one of the factors contributing to trends varying over time by age group is the composition of birth cohorts. We thought it important to report these data given that baby boomers will be driving future population expansion. The baby boom cohort encompasses the years 1946–1964. In previous studies, Keyes and Miech (2013) suggest a rise in log odds of binge drinking from earlier (1910–1914) through more recent (1950–1954) birth cohorts. Kerr et al. (2009) reported that for women only, those born between 1956 and 1960 drank more heavily than cohorts born earlier. Taken together, the evidence suggests that further study of the baby boom cohort may be warranted. Future studies should monitor trends in the full cohort (1946–1964) as it matures.

Average number of drinks consumed per day remained stable over time among current drinkers ages 60+ within both genders and all age groups. Dawson et al. (2015) also reported stability for all adults ages 65+, and Kerr et al. (2012) also reported stability among older age groups. The fact that the average amount of alcohol consumed by older individuals did

not change over time, coupled with an increasing number of individuals consuming alcohol, emphasizes the need to prepare for the future public health needs of a population that potentially includes more drinkers consuming alcohol at present levels. We note, however, that our calculation of average volume was based on current drinking, and did not consider the frequency of binge drinking.

Our finding that for some outcomes, such as prevalence of binge drinking among women, which significantly increased in the three youngest age groups (60–64, 65–69, 70–74) but not the older, underscores the importance of not 'lumping' older adults into homogeneous groups. The term "older" generally is used to apply to those people ages 60+ up to the oldest age that a person is known to have survived (122 years of age, Jeanne Louise Calment) (Robine and Allard, 1998). Gerontologists have split this 60+ age range into subdivisions in order to establish less heterogeneous subgroups. However, there is no universal agreement on what the subdivisions should be. Examples of subdivisions that have been used formally or informally include: young-old (60–69), middle-old (70–79), and very-old (80+) (Forman et al., 1992) (which corresponds to the age groups used in our study); young-old (65–74), middle-old (75–84), and oldest-old (85+) (Seccombe and Ishii-Kuntz, 1991); and, old (65–84) and oldest-old (85+) (National Institute on Aging, 2007). In terms of alcohol research, the importance is not necessarily which characterization is best, but rather that some characterization is considered as studies often group together adults age 60+ or 65+.

Our primary results were unadjusted. This is a practice in government agencies that report national prevalence. However, we also provided adjusted results which, based on changes in p values from significant to non-significant (or vice versa), generally were consistent with unadjusted results. Notable differences occurred among men ages 60+ where the trend in binge drinking was not significant in unadjusted analyses but was significant in adjusted analyses. It was also notable that, among men born between 1946 and 1954, the unadjusted trend in current drinking was significant but the adjusted trend was not. We would therefore place less emphasis on it. However, we would not categorically state that a non-significant adjusted result invalidates a significant unadjusted result. Many studies of population prevalence report unadjusted estimates and for comparison, the unadjusted estimates in our study are warranted. In addition, more specific to our study, the permutation test we used to determine joinpoints is more accurate for unadjusted than adjusted results because adjusted estimates are additionally correlated between joinpoints because a common regression model with the same estimated regression coefficients is used to obtain the adjusted estimates for each year of the survey.

While we have focused on overall trends between 1997 and 2014, our methodology enabled examination of in-between trends. However, recent trends are also of considerable interest for public health planning. An example is, among women, the 2.8% per year average increase in prevalence of current drinking between 2006–2014 that narrowed the observed gender gap (but was not statistically tested) between men and women. Another example is the stability of binge drinking among male current drinkers between 2009 and 2014.

Strengths of our study included the use of nationally representative survey data and the long duration of time considered (18 years). We chose to use simple transparent bivariate methods

(considering relationships between age, survey year and birth cohort effects two at a time) in conjunction with joinpoint regression methodology which allowed us to determine overall trends and to identify inflection points where trends changed direction. In addition, each survey year contained the same demographic and lifestyle variables, which enabled adjusted analyses. Alternatively, we could have applied age, period, cohort (APC) modeling (Robertson and Boyle, 1998) but did not do so because, using that method, it is not statistically possible to separately estimate and interpret individual parameters for age, period and cohort effects. Knowledge of any two components results in knowledge of the third.

Our study also had several limitations. As noted previously, our study did not capture drinking among all baby boomers, just the early part of that generation (born 1946–1954). Inherent confounding between birth cohort and age may have occurred in our main results as individuals in the earliest birth cohort are also older at any given point in time. This issue is what led us to examine birth cohorts stratified by age groups. However, in that examination, there remains the issue of period, i.e., secular effects. Among women, our results for binge drinking were truncated in 2013. The 1997–2013 NHIS defined binge drinking for men and women as 5 or more drinks per day. Starting in 2014, NHIS changed the binge drinking definition to 4 or more drinks per day for women and will continue to use that definition in future years; had we included the 2014 data for women, their binge drinking prevalence would have been artificially inflated by the lowered criterion relative to prior years. The NHIS response rate has dropped over time which can bias results and effect generalizability to the US population. However, our sample rates were adjusted for non-response which should partially compensate for these limitations. We did not separately consider alcohol beverage types (beer, wine, liquor) as no such data were available from the NHIS.

Our results are of concern given that the older population is rapidly expanding, that older individuals are more sensitive to the effects of alcohol than their younger counterparts, and that older adults are more likely to take prescription medications which can interact with alcohol to increase the risk of medication interactions, falls, and other injuries. Our results along with those of previous studies suggest the need for further research on alcohol consumption among older adults, and public health preparation to educate, screen, and treat that growing population.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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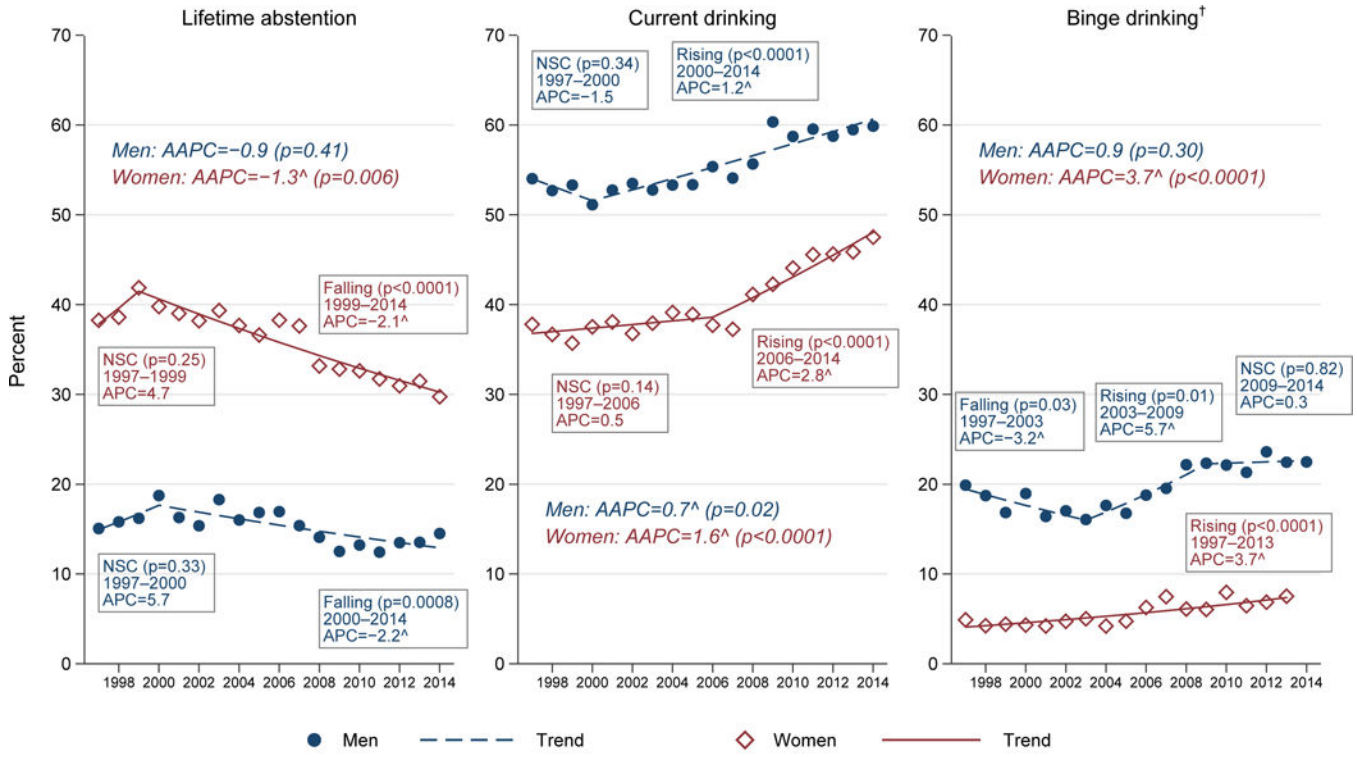

APC = annual percentage change; AAPC = average annual percentage change; NSC = non-significant change; ^ P<0.05; †among current drinkers.

Figure 1.

Prevalence of lifetime abstention, current drinking, and binge drinking, ages 60 years and older, fitted with joinpoint log-linear regression: National Health Interview Survey, United States, 1997–2014.

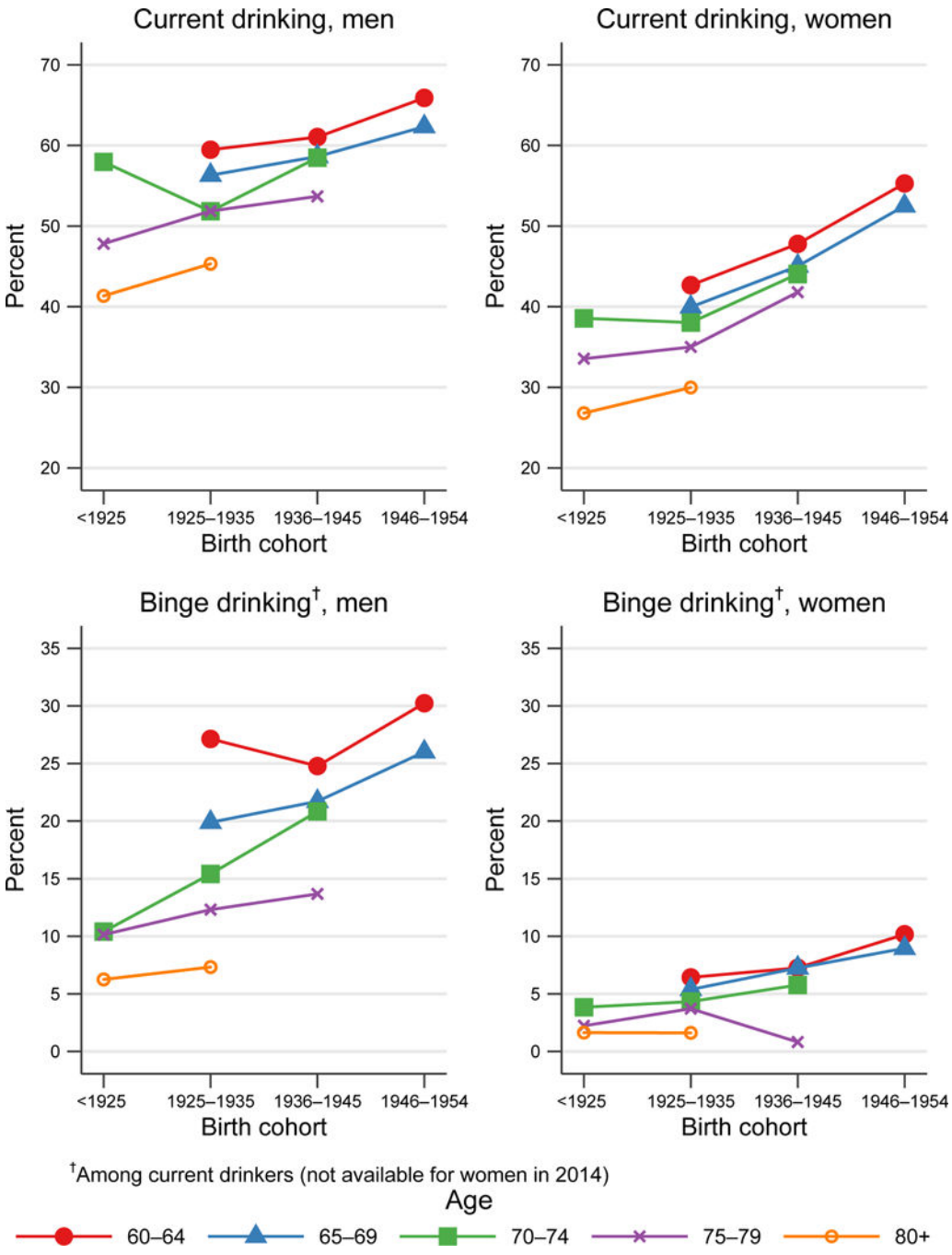

Figure 2.

Prevalence of current drinking and binge drinking for birth cohorts by age group: National Health Interview Survey, United States, 1997–2014.

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Table 1

Trends in Lifetime Abstention[a] Among Men and Women Ages 60 Years and Older Based on Average Annual Percent Change (AAPC) and Annual Percent Change (APC): National Health Interview Survey, United States, 1997–2014

	Men				Women			
Lifetime Abstention[a]	**Years {%}[b]**	**AAPC/APC[c]**	**95% CI**	***p***	**Years {%}[b]**	**AAPC/APC[c]**	**95% CI**	***p***
Age 60+	1997–2014 {15.1–14.5}	−0.9	(−2.9, 1.2)	0.41	1997–2014 {38.2–29.7}	−1.3	(−2.2, −0.4)	0.006
Trend 1	1997–2000 {15.1–18.7}	5.7	(−6.0, 18.9)	0.33	1997–1999 {38.2–41.9}	4.7	(−3.6, 13.8)	0.25
Trend 2	2000–2014 {18.7–14.5}	−2.2	(−3.3, −1.1)	0.0008	1999–2014 {41.9–29.7}	−2.1	(−2.5, −1.7)	<0.0001
By Age Group								
60–64	1997–2014 {13.5–13.4}	0.3	(−2.8, 3.4)	0.87	1997–2014 {33.4–22.7}	−2.3	(−2.8, −1.9)	<0.0001
Trend 1	1997–2003 {13.5–14.5}	2.3	(−2.7, 7.6)	0.34				
Trend 2	2003–2011 {14.5–8.2}	−6.5	(−10.1, −2.9)	0.003				
Trend 3	2011–2014 {8.2–13.4}	16.2	(1.0, 33.5)	0.04				
65–69	1997–2014 {13.6–12.5}	−0.8	(−4.7, 3.2)	0.69	1997–2014 {35.7–27.0}	−2.0	(−2.8, −1.2)	<0.0001
Trend 1	1997–2006 {13.6–17.3}	1.5	(−0.3, 3.3)	0.10				
Trend 2	2006–2009 {17.3–10.9}	−11.1	(−29.9, 12.7)	0.29				
Trend 3	2009–2014 {10.9–12.5}	1.7	(−3.1, 6.8)	0.45				
70–74	1997–2014 {13.2–13.3}	−1.4	(−2.9, 0.1)	0.07	1997–2014 {37.5–29.9}	−1.3	(−2.0, −0.7)	0.0007
75–79	1997–2014 {17.6–16.7}	−0.6	(−1.3, 0.2)	0.13	1997–2014 {38.3–33.4}	−1.0	(−1.6, −0.3)	0.006
80+	1997–2014 {20.6–19.8}	−1.3	(−2.3, −0.2)	0.02	1997–2014 {47.3–41.5}	−1.1	(−1.5, −0.8)	<0.0001
By Birth Cohort								
<1925	1997–2008 {17.5–19.4}	2.5	(0.8, 4.2)	0.0008	1997–2008 {42.1–42.1}	0.3	(−1.1, 1.9)	0.65

Lifetime Abstention[a]	Men				Women			
	Years {%}[b]	AAPC/APC[c]	95% CI	*p*	Years {%}[b]	AAPC/APC[c]	95% CI	*p*
Trend 1					1997–1999 {42.1–48.3}	5.9	(−2.6, 15.2)	0.15
Trend 2					1999–2008 {48.3–42.1}	−0.9	(−2.0, 0.3)	0.13
1925–1935	1997–2014 {13.6–19.7}	1.2	(0.3, 2.2)	0.02	1997–2014 {35.6–40.0}	0.7	(0.3, 1.1)	0.001
1936–1945	1997–2014 {13.0–14.0}	−0.8	(−1.7, 0.2)	0.11	1997–2014 {30.9–30.9}	−0.2	(−0.7, 0.2)	0.27
1946–1954	2006–2014 {10.7–13.0}	4.4	(−0.7, 9.8)	0.08	2006–2014 {27.9–24.0}	−1.4	(−3.2, 0.3)	0.09

Note. CI = confidence interval; p = p-value for trend

[a] Lifetime abstention: <12 drinks in lifetime.

[b] Years = range of years covered by trend and {%} = prevalence (or percentage) corresponding to the initial and last years covered by the trend.

[c] AAPC is presented for overall trends that include all joinpoint segments. APC is presented for single segments calculated by joinpoint. When there are no joinpoints, AAPC=APC.

Table 2

Trends in Current Drinking[a] Among Men and Women Ages 60 Years and Older Based on Average Annual Percent Change (AAPC) and Annual Percent Change (APC): National Health Interview Survey, United States, 1997–2014

	Men				Women			
Current Drinking[a]	**Years {%}[b]**	**AAPC/APC[c]**	**95% CI**	***p***	**Years {%}[b]**	**AAPC/APC[c]**	**95% CI**	***p***
Age 60+	1997–2014 {54.0–59.9}	0.7	(0.1, 1.3)	0.02	1997–2014 {37.8–47.5}	1.6	(1.1, 2.1)	<0.0001
Trend 1	1997–2000 {54.0–51.1}	−1.5	(−4.8, 1.8)	0.34	1997–2006 {37.8–37.7}	0.5	(−0.2, 1.3)	0.14
Trend 2	2000–2014 {51.1–59.9}	1.2	(0.9, 1.5)	<0.0001	2006–2014 {37.7–47.5}	2.8	(1.9, 3.7)	<0.0001
By Age Group								
60–64	1997–2014 {59.7–66.1}	0.6	(0.0, 1.2)	0.05	1997–2014 {44.6–56.8}	1.6	(1.3, 2.0)	<0.0001
Trend 1	1997–2005 {59.7–59.6}	0.0	(−0.6, 0.6)	0.93				
Trend 2	2005–2010 {59.6–68.4}	2.5	(0.7, 4.4)	0.01				
Trend 3	2010–2014 {68.4–66.1}	−0.6	(−2.0, 0.7)	0.32				
65–69	1997–2014 {58.2–62.3}	0.7	(0.3, 1.0)	0.0006	1997–2014 {42.4–51.1}	1.8	(1.1, 2.4)	<0.0001
70–74	1997–2014 {53.1–61.5}	1.0	(0.5, 1.6)	0.001	1997–2014 {39.9–51.1}	1.3	(0.3, 2.2)	0.01
Trend 1					1997–2007 {39.9–37.9}	−0.7	(−1.8, 0.4)	0.21
Trend 2					2007–2014 {37.9–51.1}	4.1	(2.1, 6.2)	0.0007
75–79	1997–2014 {49.3–51.9}	0.7	(0.3, 1.1)	0.002	1997–2014 {33.3–40.2}	1.0	(0.6, 1.5)	<0.0001
80+	1997–2014 {42.2–47.0}	0.7	(0.2, 1.2)	0.009	1997–2014 {26.7–29.9}	1.1	(0.7, 1.6)	<0.0001
By Birth Cohort								
<1925	1997–2008 {48.0–42.1}	−1.7	(−2.4, −0.9)	0.0006	1997–2008 {31.8–26.5}	−1.2	(−2.0, −0.5)	0.005
1925–1935	1997–2014 {57.4–48.2}	−1.0	(−1.2, −0.7)	<0.0001	1997–2014 {41.9–31.2}	−1.7	(−2.0, -1.4)	<0.0001

	Men				Women			
Current Drinking[a]	**Years {%}**[b]	**AAPC/APC**[c]	**95% CI**	***p***	**Years {%}**[b]	**AAPC/APC**[c]	**95% CI**	***p***
1936–1945	1997–2014 {60.0–58.6}	0.0	(−0.3, 0.3)	0.88	1997–2014 {48.5–47.7}	0.1	(−0.3, 0.5)	0.61
1946–1954	2006–2014 {51.5–64.9}	2.4	(0.4, 4.3)	0.02	2006–2014 {54.6–55.1}	0.3	(−0.6, 1.3)	0.41
Trend 1	2006–2009 {51.5–66.9}	8.1	(0.7, 16.0)	0.04				
Trend 2	2009–2014 {66.9–64.9}	−0.9	(−1.9, 0.1)	0.06				

Note. CI = confidence interval; p = p-value for trend

[a] Current drinking: 12 or more drinks in any 1 year or in their lifetime and had consumed one or more drinks in the past year.

[b] Years = range of years covered by trend and {%} = prevalence (or percentage) corresponding to the initial and last years covered by the trend.

[c] AAPC is presented for overall trends that include all joinpoint segments. APC is presented for single segments calculated by joinpoint. When there are no joinpoints, AAPC=APC.

Table 3

Trends in Binge Drinking[a] Among Male and Female Current Drinkers[b] Ages 60 Years and Older Based on Average Annual Percent Change (AAPC) and Annual Percent Change (APC): National Health Interview Survey, United States, 1997–2014

	Men				Women			
Binge Drinking[a]	**Years {%}[c]**	**AAPC/APC[d]**	**95% CI**	***p***	**Years {%}[c]**	**AAPC/APC[d]**	**95% CI**	***p***
Age 60+	1997–2014 {19.9–22.5}	0.9	(−0.8, 2.6)	0.30	1997–2013 {4.9–7.5}	3.7	(2.6, 4.9)	<0.0001
Trend 1	1997–2003 {19.9–16.1}	−3.2	(−5.9, −0.5)	0.03				
Trend 2	2003–2009 {16.1–22.3}	5.7	(1.7, 9.8)	0.01				
Trend 3	2009–2014 {22.3–22.5}	0.3	(−2.7, 3.5)	0.82				
By Age Group								
60–64	1997–2014 {25.2–31.0}	1.2	(0.5, 1.9)	0.003	1997–2013 {6.5–10.9}	3.9	(2.2, 5.5)	0.0001
65–69	1997–2014 {27.2–23.9}	0.2	(−2.2, 2.6)	0.87	1997–2013 {5.4–7.3}	2.9	(0.6, 5.2)	0.02
Trend 1	1997–2001 {27.2–15.1}	−10.5	(−19.0, -1.2)	0.03				
Trend 2	2001–2014 {15.1–23.9}	3.7	(2.1, 5.4)	0.0003				
70–74	1997–2014 {13.8–19.0}	2.8	(1.6, 4.0)	0.0001	1997–2013 {5.5–8.6}	3.2	(0.3, 6.2)	0.03
75–79	1997–2014 {11.6–13.8}	2.0	(0.3, 3.7)	0.02	1997–2013 {3.3–3.3}	4.0	(−0.5, 8.8)	0.08
80+	1997–2014 {10.0–7.0}	−0.7	(−3.3, 2.0)	0.58	1997–2013 {1.7–1.0}	−1.5	(−6.6, 3.9)	0.56
By Birth Cohort								
<1925	1997–2008 {11.1–3.5}	−9.2	(−11.8, -6.5)	<0.0001	1997–2008 {3.3–0.5}	−8.8	(−16.1, -1.0)	0.03
1925–1935	1997–2014 {25.3–8.1}	−5.7	(−6.9, -4.4)	<0.0001	1997–2013 {6.0–2.3}	−4.2	(−6.5, -1.8)	0.0002
1936–1945	1997–2014 {20.8–17.6}	−1.3	(−2.2, −0.4)	0.006	1997–2013 {5.3–6.6}	−0.1	(−1.9, 1.7)	0.90
1946–1954	2006–2014 {43.7–29.2}	−2.6	(−5.4, 0.4)	0.08	2006–2013 {14.6–10.0}	−1.4	(−8.8, 6.6)	0.67

Note. CI = confidence interval; p = p-value for trend

[a] Binge drinking (among current drinkers): five or more drinks in a single day in the past year.

[b] Current drinking: 12 or more drinks in any 1 year or in their lifetime and had consumed one or more drinks in the past year.

[c] Years = range of years covered by trend and {%} = prevalence (or percentage) corresponding to the initial and last years covered by the trend.

[d] AAPC is presented for overall trends that include all joinpoint segments. APC is presented for single segments calculated by joinpoint. When there are no joinpoints, AAPC=APC.

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Table 4

Trends in Average Volume[a] Among Male and Female Current Drinkers[b] Ages 60 Years and Older Based on Average Annual Percent Change (AAPC): National Health Interview Survey, United States, 1997–2014

	Men				Women			
Average Volume[a]	**Years {mean}[c]**	**AAPC[d]**	**95% CI**	***p***	**Years {mean}[c]**	**AAPC[d]**	**95% CI**	***p***
Age 60+	1997–2014 {0.8–0.7}	−0.5	(−1.1, 0.2)	0.16	1997–2014 {0.4–0.4}	0.4	(−0.2, 1.1)	0.16
By Age Group								
60–64	1997–2014 {0.9–0.7}	−0.8	(−1.7, 0.1)	0.06	1997–2014 {0.4–0.4}	0.4	(−0.6, 1.4)	0.38
65–69	1997–2014 {0.8–0.8}	0.0	(−0.9, 0.9)	0.98	1997–2014 {0.4–0.4}	0.3	(−0.7, 1.3)	0.54
70–74	1997–2014 {0.8–0.8}	−0.3	(−1.4, 0.8)	0.55	1997–2014 {0.3–0.4}	0.6	(−0.6, 1.8)	0.33
75–79	1997–2014 {0.7–0.7}	−0.3	(−1.9, 1.4)	0.75	1997–2014 {0.4–0.4}	0.8	(−0.2, 1.9)	0.11
80+	1997–2014 {0.6–0.5}	−0.4	(−1.7, 1.0)	0.57	1997–2014 {0.3–0.4}	0.7	(−0.4, 1.8)	0.18
By Birth Cohort								
<1925	1997–2008 {0.7–0.6}	−2.5	(−4.3, −0.5)	0.02	1997–2008 {0.3–0.4}	1.7	(−0.2, 3.7)	0.08
1925–1935	1997–2014 {0.9–0.6}	−1.8	(−2.6, -1.1)	0.0001	1997–2014 {0.4–0.4}	−0.4	(−1.3, 0.5)	0.33
1936–1945	1997–2014 {0.8–0.7}	−0.7	(−1.3, −0.1)	0.03	1997–2014 {0.4–0.4}	0.9	(−0.2, 2.1)	0.11
1946–1954	2006–2014 {0.8–0.7}	−1.8	(−6.0, 2.5)	0.35	2006–2014 {0.4–0.4}	1.9	(−1.6, 5.6)	0.24

Note. CI = confidence interval; p = p-value for trend

[a] Average volume: drinks per day.

[b] Current drinking: 12 or more drinks in any 1 year or in their lifetime and had consumed one or more drinks in the past year.

[c] Years = range of years covered by trend and {%} = prevalence (or percentage) corresponding to the initial and last years covered by the trend.

[d] AAPC is presented for overall trends, which include only single segments. Because there are no joinpoints, AAPC is identical to Annual Percent Change (APC).