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To cite this article: Sara E. Miller, Jennifer L. Maggs, Eric S. Cerino, Rina D. Eiden, Alyssa A. Gamaldo & David M. Almeida (2026) Longitudinal changes in alcohol use across 20 years of adulthood: a U.S. National daily diary study, *Aging & Mental Health*, 30:2, 425-435, DOI: [10.1080/13607863.2025.2567481](https://doi.org/10.1080/13607863.2025.2567481)

To link to this article: <https://doi.org/10.1080/13607863.2025.2567481>

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Longitudinal changes in alcohol use across 20 years of adulthood: a U.S. National daily diary study

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ABSTRACT

Objectives: While alcohol consumption typically declines with age, drinking trajectories may vary across indicators and individual characteristics. The current study uses daily diary methodology to describe longitudinal changes in alcohol consumption across up to 20 years.

Method: We used three waves of 8-day diary surveys from the National Study of Daily Experiences. Participants ($N=1379$; $M_{age}=49.8$ years) completed 2+ waves of telephone interviews at 10-year intervals.

Results: Multilevel regression analyses revealed declines in drinking quantity across time ($b=-0.26$; $SE=0.05$; $p<0.001$), while drinking frequency, at-risk drinking frequency ($>1/>2$ drinks per day for females/males), and likelihood of non-drinking did not change. Older age was associated with drinking more frequently overall ($b=0.003$; $SE=0.001$; $p<0.001$), greater increases in likelihood of non-drinking over time ($b=0.01$; $SE=0.01$; $p=0.007$), and stronger longitudinal declines in drinking frequency ($b=-0.002$; $SE=0.001$; $p=0.001$) and at-risk drinking frequency ($b=-0.002$; $SE=0.001$; $p<0.001$). Greater educational attainment was associated with increasing drinking frequency ($b=0.008$; $SE=0.004$; $p=0.021$), while male sex predicted stronger declines in drinking quantity over time ($b=-0.27$; $SE=0.10$; $p=0.006$).

Conclusion: Changes in alcohol consumption over time vary across drinking indicators and sociodemographic characteristics. Future research should examine why older adults reduce their drinking, as these motivators may inform alcohol reduction strategies.

ARTICLE HISTORY

Received 24 December 2024

Accepted 21 September 2025

KEYWORDS

Alcohol use; trajectories; Individual differences; daily assessment; longitudinal design

Introduction

The World Health Organization has identified the reduction of alcohol-related harm as a global health priority (Casswell & Thamarangsi, 2009). Over time, chronic alcohol use can contribute to the development of numerous health conditions, including cancer and cardiovascular disease (Rehm, 2011). Importantly, during drinking episodes, individuals are at heightened risk of alcohol poisoning, injuries, risky sexual behaviors, and memory impairment (Centers for Disease Control & Prevention, 2022). Despite these chronic and acute risks, most adults aged 50 years and older report past-year alcohol use (Han et al., 2017). A nuanced understanding of changes in drinking patterns can inform efforts to reduce alcohol-related harm and identify factors associated with increasing trajectories across adulthood (Maggs & Schulenberg, 2004). The current study uses longitudinal daily diary data to examine changes in

alcohol consumption across 20 years among a national sample of U.S. adults.

Several cross-sectional studies have documented age differences in average levels of alcohol consumption in adulthood, with older adults reporting less alcohol use than younger and middle-aged adults (Blazer & Wu, 2011; Calvo et al., 2021; Merrick et al., 2008). However, cross-sectional studies are limited to evaluating age differences in overall alcohol use patterns on a single occasion, which precludes identifying whether and how individuals' alcohol consumption changes across their lives. Seemingly lower average levels of alcohol use among older adults may reflect longstanding lower lifetime alcohol use within earlier birth cohorts carried into older adulthood (Keyes, 2022). Moreover, lower levels of alcohol use in cross-sectional studies may be related to the selective mortality of individuals with heavier drinking patterns (Brennan et al., 2010).

Longitudinal methodology addresses many of these issues by using repeated measures to survey the same participants across multiple time points. Similar to cross-sectional studies, longitudinal cohort studies generally identify increased alcohol abstinence and overall reductions in alcohol consumption as individuals move through midlife and older adulthood (Brennan et al., 2011; Karlamangla et al., 2006; Molander et al., 2010; Moore et al., 2005; Moos et al., 2009; Parekh et al., 2021; Platt et al., 2010; Shaw et al., 2011; Zhang et al., 2008). Individuals may stop or reduce their drinking with aging because of greater alcohol use sensitivity, declining health, or alcohol-medication interactions (Meier & Seitz, 2008; Moos et al., 2010). Moreover, declines in alcohol use may also accompany other age-related social and lifestyle changes (Shaw et al., 2011).

Yet, existing longitudinal studies have several methodological limitations. Participants are typically asked to recall their average alcohol use over extended time periods (e.g. past 30 days or past year) or to retrospectively report their usual alcohol use across multiple decades (e.g. Szabó et al., 2021). These methods can introduce retrospective recall bias with participants over- or under-reporting their alcohol use because of memory constraints (Merrill et al., 2020). Further, several studies utilize data from birth cohorts born during or directly after Prohibition (e.g. Moos et al., 2004), which may not be representative of more recent birth cohorts. Finally, studies with shorter lengths of follow-up (e.g. 3–5 years) or restrictive age ranges (e.g. 55–65 years) are unable to capture changes across longer periods or different age groups.

Trajectories of alcohol use across the life course can also vary in direction and magnitude depending on the dimension of alcohol use assessed (Britton et al., 2015; Leggat et al., 2022). Both the quantity of alcohol consumption and patterns of consumption, particularly infrequent but heavy drinking, contribute to the health consequences of alcohol use (Room et al., 2005). Drinking more on a single occasion increases the risk of experiencing acute alcohol-related consequences, such as fall injuries and alcohol-induced memory loss (Taylor et al., 2010; Wetherill & Fromme, 2016), and even relatively low amounts of alcohol consumption may carry health risks for older adults because of age-related reductions in alcohol tolerance, greater prescription medication use, and comorbid health conditions (Kuerbis et al., 2014). Over the longer term, chronic alcohol consumption is linked to 60+ medical conditions (Room et al., 2005). Accordingly, studies with single-indicator, mentally aggregated measurements of alcohol use, such as usual quantity or frequency, may not capture potentially harmful changes in drinking behavior that are revealed across other indicators. For instance,

drinking frequency is often found to increase in older adulthood despite overall reductions in drinking quantity on drinking days (Britton et al., 2015; Molander et al., 2010; Szabó et al., 2021; Wilsnack et al., 2009).

Individual differences in drinking behavior

Sociodemographic characteristics may also influence changes in alcohol use throughout adulthood. Regarding chronological age, some evidence suggests alcohol use declines faster later in life (McEvoy et al., 2013; Moore et al., 2005), yet others find no age moderation of drinking trajectories (Brennan et al., 2010; Platt et al., 2010). Cohort differences may complicate these patterns of change. For example, birth cohorts born after World War II typically have higher rates of alcohol use across the life course compared to earlier-born cohorts (Keyes, 2022). As such, recent evidence has been accumulating of increased prevalence of alcohol use, quantity and frequency of alcohol use, binge drinking, and alcohol use disorders among older adults since members of the Baby Boom generation (i.e. born between 1946 and 1964) began entering older adulthood (Breslow et al. 2017; Dawson et al., 2015; Han et al., 2017).

There are also conflicting findings on how biological sex relates to trajectories of drinking behavior. Across adulthood, females are less likely to be current drinkers, report lower quantity and frequency of alcohol use, and are more likely to stop drinking than males (Erol & Karpyak, 2015; Wilsnack et al., 2009). Yet, the biological sex gap in alcohol consumption among older drinkers has narrowed (Breslow et al. 2017; Han et al., 2017). Accordingly, where some studies observe faster age-related declines in alcohol use among females compared to males (Karlamangla et al., 2006; Molander et al., 2010), others find the opposite with males starting at higher levels of alcohol consumption and declining faster across time (Brennan et al., 2010, 2011; Leggat et al., 2022; McEvoy et al., 2013; Moore et al., 2005). Additional examination is thus needed to explore how biological sex relates to longitudinal changes in alcohol consumption.

Regarding education, having a higher education level may slow declines in alcohol consumption across time. Education serves as a proxy measure of social position and suggests one's access to various material (e.g. income, safe neighborhoods) and non-material (e.g. knowledge, skills) resources (Zajacova & Lawrence, 2018). In general, higher education level is associated with greater quantity and frequency of drinking during adulthood (Collins, 2016). Moreover, studies have observed slower declines, or even increases, in alcohol consumption with age among those of higher attained education

(Molander et al., 2010; Moore et al., 2005; Platt et al., 2010).

Current study

The current study builds upon existing research by utilizing daily diary methodology to assess longitudinal change in various indicators of alcohol consumption across three waves of daily diary surveys from the National Study of Daily Experiences. Daily diary methodology involves the repeated assessment of experiences and behaviors once per day across multiple days. This methodology enhances measurement quality compared to traditional survey methods by surveying participants in their own environments and by limiting recall to the past 24h, rather than requiring participants to mentally aggregate their usual alcohol consumption over longer time frames (Bolger et al., 2003; Leigh, 2000). Given these strengths, emerging studies are utilizing multiple waves of daily diary surveys spaced across time to capture changes in daily experiences across adulthood (Almeida et al., 2023; Cerino et al., 2024). While previous studies have taken this approach to evaluate changes in drinking behavior among college-aged samples (e.g. O'Grady et al., 2011), there has been limited application among middle-aged and older adult samples.

This study uses three bursts of daily assessments of alcohol use in a 20-year longitudinal study of U.S. adults. We advance previous research by using a more ecologically valid method for assessing alcohol consumption that minimizes retrospective recall bias, including a broader age range, and capturing longitudinal changes across multiple indicators of alcohol use over a 20-year period. The primary study aims are to (1) document longitudinal changes in alcohol consumption (i.e. non-drinker status, drinking frequency, drinking quantity, and at-risk drinking frequency), and (2) assess how socio-demographic factors predict initial levels and changes in alcohol use over time. We hypothesized that, first, across the 20-year study period, likelihood of non-drinking would increase, drinking quantity would decrease, drinking frequency would increase, and frequency of at-risk drinking would decrease. Second, we hypothesized that older age at the start of the study, male sex, and lower educational attainment would predict greater likelihood of non-drinking and stronger declines in alcohol consumption across time.

Methods

Sample and procedures

The National Study of Daily Experiences (NSDE) is a subset of the survey of Midlife in the United States

(MIDUS), which is a national longitudinal study of the health and wellbeing of American adults. Respondents in each wave of MIDUS were randomly selected to participate in the NSDE daily diary project. Across eight consecutive evenings in each wave, respondents completed short daily telephone interviews. There were three waves of NSDE daily assessments in 9 to 10-year intervals with each wave distributing data collection across the calendar year. The three waves included: NSDE 1 ($N=1499$; 1996–1997; ages 25–74), NSDE 2 ($N=2022$; 2004–2009; ages 33–84), and NSDE 3 ($N=1236$; 2017–2019; ages 39–93). The current paper uses data from participants with complete baseline covariate data who completed 2+ waves ($N=1379$), resulting in a total of 24,273 daily interviews. Compared to excluded participants, included participants were older at baseline ($t(2580)=4.27$; $p<0.001$), more educated ($t(2723)=7.93$; $p<0.001$), more likely to be white ($\chi^2(1)=12.35$; $p<0.001$), and less likely to be abstainers ($\chi^2(1)=81.39$; $p<0.001$). The MIDUS and NSDE studies were reviewed and approved by the IRBs at the University of Wisconsin-Madison and the Pennsylvania State University, respectively. All participants provided written informed consent.

Measures

Alcohol use

Participants were asked at each daily interview, "Counting a drink as a bottle of beer, a glass of wine, or a shot of liquor, how many drinks did you have in the past 24h (or since we spoke yesterday)?" Several wave-level alcohol use variables were then constructed. A dichotomous *non-drinking* variable reflected if any alcohol use was reported on any diary day during that wave (1=No; 0=Yes). *Drinking quantity* reflected the average number of drinks reported per drinking day for that wave. *Drinking frequency* was the proportion of days during the wave with any alcohol use (ranging from 0=No days to 1=All days). *Frequency of at-risk alcohol use* was defined as the proportion of days in the wave in which participants reported exceeding drinking guidelines of ≤ 2 drinks per day for males or ≤ 1 drink per day for females (ranging from 0=No days to 1=All days) (National Institute on Alcohol Abuse & Alcoholism, 2024). The aggregate alcohol use variables were positively correlated: drinking quantity with frequency ($r=0.09$), drinking quantity with at-risk drinking frequency ($r=0.35$), and drinking frequency with at-risk drinking frequency ($r=0.67$).

Baseline moderating variables

Baseline variables were assessed at the first wave of data collection for participants. Moderating variables

included *age* and *biological sex* (1=Male, 0=Female). Participant reports of their highest level of education (1=No school/some grade school to 12=Advanced or Professional Degree) were converted into a continuous measure of *years of education* (e.g. high school diploma = 12years; bachelor's degree = 16years; doctorate degree = 20years) where higher values indicated more years of education. There was a strong positive correlation ($r=0.97$) between the original and recoded education measures.

Other baseline covariates

Additional baseline characteristics related to alcohol consumption among older adults (Kuerbis et al., 2014) were also assessed *via* self-report. Race was coded as 1=White or 0=Others (Black/African American, Native American or Alaska Native, Asian, Pacific Islander, and Other). *Marital status* indicated if participants were currently 1=Married/cohabitating or 0=Not married/cohabitating. *Number of chronic conditions* was a sum score reflecting the total number of chronic health conditions participants reported experiencing in the past 12 months from a list of 30 common chronic conditions (range = 0–17). *Physical health* was assessed with a single question asking, "Would you say your physical health is excellent, very good, good, fair, or poor?" (recoded to 1=Poor through 5=Excellent, so that higher ratings reflected better perceived physical health). *Depression* (1=Met diagnostic criteria; 0=Did not meet diagnostic criteria) was measured using the Composite International Diagnostic Interview Short Form (CIDI-SF; Kessler et al., 1998). *Religiosity* ("How religious are you?"; 1=Very to 4=Not at all) was reverse coded so that higher scores reflected higher levels of religiosity. Substance use indicators included *smoking* ("Do you smoke cigarettes regularly now?"; 1=Yes, 0=No) and *alcohol-related problem* status, which was measured using four items of the CIDI-SF: emotional/psychological problems from use, alcohol craving, great deal of time using, and tolerance (Kessler et al., 1998). If participants endorsed any of the four items in the past 12 months, they were coded as having experienced at least one alcohol-related problem (1=Yes; 0=No). *Illicit drug use* reflected any use in the past 12 months of inhalants, marijuana/hash, cocaine, LSD/other hallucinogens, or heroin (1=Yes; 0=No).

Data analysis

Descriptive statistics were first computed followed by bivariate analyses to examine associations between key study variables. The assumption of normality for continuous study variables was assessed using visual inspection of histograms and Q-Q plots. We then implemented two-level multilevel models using SAS

Proc Mixed and Proc Glimmix. In this framework, Level 1 variables consisted of the between-wave variables (wave, alcohol use), nested within the Level 2 between-person variables (e.g. sex). Intraclass correlation coefficients from unconditional linear mixed models were used to determine within-person and between-person variation in alcohol consumption. Restricted Maximum likelihood estimation (REML) was used due to missing data and attrition across days and waves of assessment. This method leverages all available data under the assumption of missing at random. Continuous predictor variables were mean-centered. An alpha level of 0.05 was used to determine statistical significance.

For Aim 1, we first evaluated change in the likelihood of non-drinking across the three waves for the full study sample ($N=1379$; Multilevel Logistic Regression). We then used Multilevel Linear Regression models to evaluate longitudinal changes in alcohol consumption among adults who reported alcohol use in at least one wave (non-abstainers; $n=856$). The socio-demographic, health, psychosocial, and substance use covariates were included as between-person (Level 2) covariates predicting baseline non-drinking and levels of alcohol consumption. For example, we utilized the following model to assess change in drinking frequency across the study period:

$$\text{Level 1: (DrinkingFrequency)}_{ij} = \tau_{0i} + \tau_{1i}(\text{Wave})_{ij} + e_{ij}$$

$$\begin{aligned} \text{Level 2: } \beta_{0i} = & \gamma_{00} + \gamma_{01}(\text{Age})_i + \gamma_{02}(\text{Sex})_i + \gamma_{03}(\text{Race})_i \\ & + \gamma_{04}(\text{Marital Status})_i + \gamma_{05}(\text{Education})_i \\ & + \gamma_{06}(\text{Chronic Conditions})_i + \gamma_{07}(\text{Depression})_i \\ & + \gamma_{08}(\text{Perceived Health})_i + \gamma_{09}(\text{Religiosity})_i \\ & + \gamma_{010}(\text{Smoking})_i + \gamma_{011}(\text{Alcohol-Related Problems})_i \\ & + \gamma_{012}(\text{Illicit Drug Use})_i + u_{0i} \end{aligned}$$

$$\tau_{1i} = \tau_{10} + u_{1i}$$

In this model, longitudinal change in drinking frequency across waves (j) for person i is represented by γ_{10} . Covariates serve as between-person variables predicting drinking frequency at baseline. Random effects for the residual (e_{ij}), intercept (u_{0i}), and wave (u_{1i}) were included to allow for unexplained variation in drinking frequency (residual), variation in drinking frequency between individuals (intercept), and variability in the effect of time on drinking frequency between individuals (wave slope), respectively. Likelihood ratio tests were conducted to assess whether inclusion of the random effect for wave (u_{1i}) significantly improved model fit.

For Aim 2, we evaluated how longitudinal change in alcohol use varied across between-person moderators of age, biological sex, and years of education.

The alcohol use outcomes and models were the same as for Aim 1. Simple slopes analysis and regions of significance testing using the Johnson-Neyman technique (Johnson & Neyman, 1936; Rast et al., 2014) were conducted to probe significant interactions.

Results

Demographics and descriptive statistics

Descriptive information on study baseline characteristics by abstainer status is summarized in Table 1. At baseline, participants were on average aged 49.8 years (range = 24–81), 44% were male, and 88% were white. Of non-abstainers, 59% ($n=505$) reported exceeding alcohol use guidelines on at least one

sampled day at any wave. Descriptive statistics of the aggregate measures of alcohol use across waves and bivariate correlations among between-person study variables are provided in Table 2 and Supplementary Table 1, respectively. Unconditional multilevel models showed significant within-person and between-person variation in measures of alcohol consumption (Supplementary Figure 1).

Changes in non-drinking status

Results examining Aim 1, longitudinal changes in non-drinking status, are provided in Table 3 (Model 1). Model 1 was estimated with the wave effect fixed across individuals, as inclusion of the random slope for time led to model non-convergence. At baseline, likelihood of non-drinking was higher among

Table 1. Descriptive statistics of baseline study variables by abstainer status.

Variable	Abstainers ($n=523$) <i>M(SD)</i> or <i>n(%)</i>	Non-abstainers ($n=856$) <i>M(SD)</i> or <i>n(%)</i>	<i>p</i> -value	Combined sample ($N=1379$)	
				<i>M(SD)</i> or <i>n(%)</i>	Range
Age, <i>M(SD)</i>	51.34(11.68)	48.83(12.04)	<.001	49.78(11.96)	24–81
Male sex, <i>n(%)</i>	188(36)	414(48)	<.001	602(44)	0,1
White, <i>n(%)</i>	432(83)	787(92)	<.001	1219(88)	0,1
Years of Education, <i>M(SD)</i>	14.12(2.46)	14.88(2.45)	<.001	14.59(2.48)	6–20
Married or cohabitating, <i>n(%)</i>	369(71)	660(77)	.007	1029(75)	0,1
Depression, <i>n(%)</i>	64(12)	93(11)	.44	157(11)	0,1
Perceived Health, <i>M(SD)</i>	2.99(1.09)	3.11(1.18)	.04	3.07(1.15)	1–5
Chronic Conditions, <i>M(SD)</i>	2.67(2.53)	2.09(2.10)	<.001	2.31(2.29)	0–17
Religiosity, <i>M(SD)</i>	3.07(0.82)	2.80(0.87)	<.001	2.90(0.86)	1–4
Alcohol-related problem, <i>n(%)</i>	9(2)	69(8)	<.001	78(6)	0,1
Illicit drug use, <i>n(%)</i>	16(3)	65(8)	<.001	81(6)	0,1
Smoking, <i>n(%)</i>	72(14)	129(15)	.51	201(15)	0,1

Note. Baseline characteristics reported at first wave. Non-abstainers reported alcohol use in at least one wave of daily assessments.

Table 2. Descriptive statistics for alcohol consumption and age at each wave of daily assessments among non-abstainers ($n=856$).

Variable	Wave 1 ($n=501$)		Wave 2 ($n=856$)		Wave 3 ($n=639$)	
	<i>M(SD)</i>	Range	<i>M(SD)</i>	Range	<i>M(SD)</i>	Range
Age	45.6(12.2)	24–73	54.2(11.4)	34–83	62.2(10.4)	43–90
Drinking frequency	0.35(0.33)	0–1	0.40(0.35)	0–1	0.37(0.36)	0–1
Drinking quantity	2.32(2.35)	1–20	2.17(1.61)	1–20	1.68(0.98)	0.5–8
At-risk drinking Frequency	0.14(0.23)	0–1	0.15(0.24)	0–1	0.12(0.24)	0–1

Note. Non-abstainers reported alcohol use in at least one wave of daily assessments.

Table 3. Multilevel logistic regression predicting change in non-drinking status across 20 years ($N=1379$).

Parameter	Model 1: Non-drinking status			
	<i>b</i>	<i>SE</i>	<i>p</i> -value	Odds ratio
Fixed effects				
Intercept	1.25	0.20	<.001	–
Wave	0.07	0.06	.23	1.07 (0.96, 1.20)
Age	0.005	0.005	.27	1.01 (1.00, 1.01)
Male sex	–0.34	0.11	.002	0.71 (0.58, 0.88)
White	–0.83	0.18	<.001	0.44 (0.31, 0.62)
Education	–0.10	0.02	<.001	0.90 (0.87, 0.94)
Married/cohabitating	–0.28	0.13	.027	0.76 (0.59, 0.97)
Depression	0.09	0.17	.61	1.09 (0.78, 1.53)
Perceived health	–0.02	0.05	.62	0.98 (0.89, 1.07)
Chronic conditions	0.07	0.02	.003	1.08 (1.03, 1.13)
Religiosity	0.26	0.06	<.001	1.30 (1.15, 1.47)
Alcohol-related problem	–1.27	0.25	<.001	0.28 (0.17, 0.46)
Illicit drug use	–0.82	0.24	<.001	0.44 (0.28, 0.71)
Smoking	–0.01	0.16	.94	0.99 (0.73, 1.35)
Level 2 random effects				
Intercept			1.45(0.14)	

Table 4. Multilevel linear models assessing change in alcohol use across 20 years among non-abstainers ($n=856$).

Parameter	Model 2: Drinking quantity			Model 3: Drinking frequency			Model 4: At-risk drinking frequency		
	<i>b</i>	<i>SE</i>	<i>p</i> -value	<i>b</i>	<i>SE</i>	<i>p</i> -value	<i>b</i>	<i>SE</i>	<i>p</i> -value
Fixed effects									
Intercept	2.08	0.22	<.001	0.19	0.04	<.001	0.06	0.03	.021
Wave	−0.26	0.05	<.001	0.006	0.009	.45	−0.01	0.01	.25
Age	−0.008	0.005	.062	0.003	0.001	<.001	0.0004	0.001	.50
Male sex	0.34	0.10	.001	0.11	0.02	<.001	−0.02	0.01	.25
White	0.17	0.20	.39	0.10	0.04	.009	0.05	0.03	.060
Education	−0.05	0.02	.017	0.007	0.004	.088	−0.002	0.003	.40
Married/cohabitating	−0.28	0.12	.027	0.02	0.02	.31	0.01	0.02	.46
Depression	−0.11	0.17	.53	−0.003	0.03	.92	−0.01	0.02	.76
Perceived health	−0.12	0.04	.007	−0.003	0.008	.72	−0.004	0.006	.45
Chronic conditions	−0.01	0.03	.63	−0.001	0.005	.77	−0.002	0.003	.55
Religiosity	0.01	0.06	.85	−0.03	0.01	.022	−0.01	0.01	.17
Alcohol-related problem	0.99	0.19	<.001	0.22	0.04	<.001	0.24	0.03	<.001
Illicit drug use	0.47	0.20	.019	0.07	0.04	.054	0.08	0.02	.002
Smoking	0.32	0.15	.034	0.02	0.03	.55	0.07	0.02	<.001
Level 2 random effects									
Intercept		1.19			0.04			0.03	
Wave		–			–			0.003	
Covariance		–			–			−0.002	
Level 1 Residual									
		1.54			0.07			0.02	

Note. Non-abstainers reported alcohol use in at least one wave of daily assessments.

participants who were female, non-white, lower education, not married/cohabitating, and among those who reported more chronic conditions, greater religiosity, no alcohol-related problems, and no illicit drug use. On average, likelihood of non-drinking did not change across the 20 years ($OR=1.07$; 95% CI: 0.96, 1.20).

Change in alcohol use indicators among non-abstainers

Results of models evaluating changes in the other three alcohol use indicators among non-abstaining adults are shown in Table 4. For drinking quantity (Model 2), the random slope for wave was excluded from the final model due to non-convergence. Covariates linked with reporting more drinks on drinking days at baseline included male sex, lower education, not being married/cohabitating, poorer perceived health, endorsing at least one alcohol-related problem, illicit drug use, and smoking. Across the 20-year study period, average number of drinks per drinking occasion declined ($b=-0.26$; $SE=0.05$; $p<0.001$).

For drinking frequency (Model 3), model fit tests indicated that including the random slope did not significantly improve the model fit ($\chi^2_{diff}(2) = 3.5$, $p=0.17$), suggesting that there was not substantial variation in the effect of time on drinking frequency. Covariates linked with drinking more frequently at baseline included older age, male sex, white race, lower religiosity, and reporting any alcohol-related problems. Drinking frequency did not change across the two decades on average ($b=0.01$; $SE=0.01$; $p=0.45$).

Finally, for at-risk drinking frequency (Model 4), including the random effect for wave significantly

Table 5. Parameter estimates of multilevel linear and logistic models of moderators of change in alcohol use across 20 years.

Models	<i>b</i>	<i>SE</i>	<i>t</i> -value	<i>p</i> -value
Non-drinking status^a				
Wave*Age	0.01	0.005	2.73	.007
Wave*Sex	0.004	0.11	0.03	.97
Wave*Education	−0.05	0.02	−1.92	.054
Drinking quantity^b				
Wave*Age	−0.004	0.004	−1.04	.30
Wave*Sex	−0.27	0.10	−2.76	.006
Wave*Education	0.001	0.02	0.07	.95
Drinking frequency^b				
Wave*Age	−0.002	0.001	−3.28	.001
Wave*Sex	−0.004	0.02	−0.22	.82
Wave*Education	0.008	0.004	2.31	.021
At-risk drinking frequency^b				
Wave*Age	−0.002	0.001	−3.70	<.001
Wave*Sex	−0.02	0.01	−1.53	.13
Wave*Education	0.0008	0.002	0.34	.74

Note. Covariates included in all models.

^a $N=1379$.

^bSample subset to non-abstainers ($n=856$). Non-abstainers reported alcohol use in at least one wave of daily assessments.

improved the model fit ($\chi^2_{diff}(2) = 7$, $p=0.03$), suggesting that people differed in their change in at-risk drinking frequency across time. Covariates related to exceeding drinking guidelines more frequently at baseline included alcohol-related problems, illicit drug use, and smoking. At-risk drinking frequency did not change on average across the study period ($b=-0.01$; $SE=0.01$; $p=0.25$).

Moderation analyses

Table 5 summarizes the results of the multilevel models assessing moderation of changes in alcohol consumption across the 20-year study period.

Baseline age

Baseline age significantly moderated longitudinal changes in non-drinking status ($b=0.01$; $SE=0.01$;

$p=0.007$), frequency of drinking ($b=-0.002$; $SE=0.001$; $p=0.001$), and frequency of at-risk drinking ($b=-0.002$; $SE=0.001$; $p<0.001$). The likelihood of not drinking any alcohol during the 8-day assessment only increased over the two decades among adults older than 51 years at baseline. For drinking frequency, the simple slopes of age moderation across the 20 years are illustrated in Figure 1. Drinking frequency increased across time among younger adults (<38 years at baseline; slope $ps<0.05$), remained stable among middle-aged groups (38–48 years; slope $ps>0.05$), and decreased among older-aged groups (>48 years; slope $ps<0.05$). Similarly, as shown in Supplementary Figure 2, frequency of at-risk drinking increased across time for younger adults (<33 years; slope $ps<0.05$), remained stable among middle-aged groups (33–49 years; slope $ps>0.05$), and decreased among comparatively older-aged adults (>49 years; slope $ps<0.05$). Finally,

the general tendency in the sample for drinking quantity to decline across the 20 years did not vary as a function of age at baseline.

Biological sex

Biological sex significantly moderated longitudinal change in drinking quantity ($b=-0.27$; $SE=0.10$; $p=0.006$), such that declines were significant for males ($b=-0.39$; $SE=0.07$; $p<0.001$) but not females ($b=-0.12$; $SE=0.07$; $p=0.11$).

Education

Education significantly moderated change in drinking frequency across time ($b=0.01$; $SE=0.004$; $p=0.021$). Simple slopes analysis was conducted among those with less education ($-1SD$; e.g. 'High School Diploma'), average years of education ($M=14$ years; e.g. '2-Year College Degree'), and more education ($+1SD$; e.g.

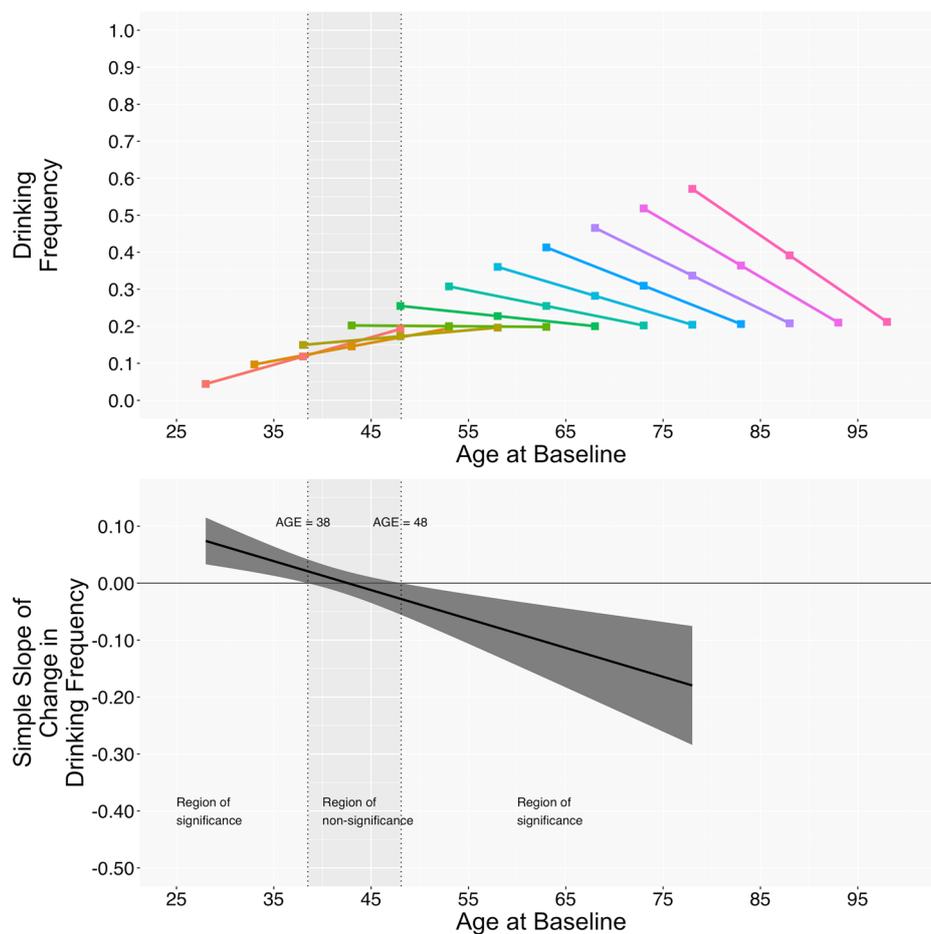


Figure 1. Longitudinal changes in alcohol use frequency across adulthood by baseline age. *Note.* Drinking frequency was calculated as the proportion of days in which any alcohol use took place (0=no days to 1=all days). Longitudinal aging-related changes in drinking frequency across the adult lifespan are depicted in the top panel. More specifically, the simple slope of change in drinking frequency is depicted in the bottom panel across varying values of age at baseline. The gray bands represent the 95% confidence interval of the simple slope of change. The vertical hatched lines denote the boundary values of baseline age where longitudinal change in drinking frequency is no longer statistically significant based on the Johnson–Neyman technique. The omnibus interaction term for baseline age moderation of longitudinal change in drinking frequency was significant ($b=-0.002$, $SE=0.001$, $p=0.001$). The plotted regions of significance indicate that younger adults below 38 years of age exhibited significant increases in their drinking frequency across 20 years (slope $ps<0.05$) and midlife and older adults above 48 years of age exhibited significant declines (slope $ps<0.05$), whereas individuals in midlife aged 38–48 years remained stable (slope $ps>0.05$).

'Master's Degree'). Drinking frequency increased across the 20-year period among those with more education ($b=0.03$; $SE=0.01$; $p=0.029$), while it remained consistent across time among those with average ($b=0.01$; $SE=0.01$; $p=0.44$) and less education ($b=-0.01$; $SE=0.01$; $p=0.26$). Education also marginally interacted with non-drinking status ($b=-0.05$; $SE=0.02$; $p=0.054$), such that adults with less education increased in their likelihood of not drinking ($b=0.18$; $SE=0.08$; $p=0.028$), but no change was observed in those with average ($b=0.07$; $SE=0.06$; $p=0.24$) or more education ($b=-0.05$; $SE=0.08$; $p=0.58$).

Discussion

Across three bursts of daily diaries spanning 20 years, U.S. adults reported drinking fewer drinks per drinking day as they got older, but indicators of frequency (ever, frequency, and frequency of exceeding guidelines) did not change on average across the study period. Trajectories of alcohol use did vary by age: People who were 51 years or older at the start of the study had increasing likelihood of not reporting any alcohol use in subsequent waves. In addition, among adults who did drink in a wave, older adults decreased across the 20 years in their frequency of drinking and of exceeding at-risk drinking guidelines. This unique design with three waves of 8-day diary surveys spanning up to 20 years of adult development and aging provides new information about longitudinal changes in alcohol use among adults.

Overall, the number of drinks adults consumed per drinking occasion declined across the study period, which is consistent with prior research using longitudinal cohort studies (Molander et al., 2010; Moore et al., 2005; Moos et al., 2004). Across the 20 years, likelihood of non-drinking and frequency of exceeding drinking guidelines did not change, but the slopes of change for both indicators were moderated by age, such that declines predominantly occurred among those in their 50s and older at the start of the study. Given that alcohol consumption did not significantly vary over time for middle-aged adults on average, future research should investigate modifiable factors driving declines in alcohol consumption during late midlife and older adulthood, with the goal of informing alcohol use reduction strategies. For example, health education may become increasingly relevant given emerging evidence around potential health risks of relatively low levels of alcohol consumption (e.g. Ortolá et al., 2024).

For alcohol use frequency, comparatively older age was linked with drinking alcohol on more days at baseline, such that an average 30-year-old non-abstainer reported drinking 1.75 days per week compared to an average 70-year-old non-abstainer

reporting 2.6 drinking days per week. Further, drinking frequency was moderated by baseline age, with drinking frequency increasing among younger adults younger than 38 years of age and declining across time among adults above 48 years of age. This drinking frequency trajectory is comparable to a study of Australian adults (15–65+ years) by Leggat et al. (2022), in which frequency of drinking peaked in midlife before declining in older age (65+ years) (Leggat et al., 2022). Thus, while consistent with previous findings that older adults demonstrate greater drinking frequency on average (Britton et al., 2015; Molander et al., 2010; Wilsnack et al., 2009), the current study replicates and builds upon this literature by suggesting stronger declines in frequency of drinking in later life. Furthermore, these findings reinforce the value of long-term longitudinal studies that include broad age ranges for capturing nuanced, age-related changes in alcohol use that may be overlooked in more limited study designs.

Mechanisms underlying age-related declines in alcohol use were not directly evaluated here, but several explanations are possible. Developmentally, social drinking opportunities may be reduced as social networks shrink in later life (English & Carstensen, 2014). For some, life events and stressors such as retirement or bereavement may trigger declines in alcohol consumption in late midlife. In terms of health, individuals may cut back or stop drinking because of increasing health problems and prescription medication use (i.e. "sick-quitter effect"; Bergmann et al., 2013). Interestingly, people with poorer physical health reported consuming more drinks per occasion at the start of the study. Having poorer perceived health may be related to having already accumulated alcohol-related harms, or individuals may be drinking for perceived health (e.g. antioxidants) or medicinal purposes (e.g. pain management; Immonen et al., 2011). Future studies can further examine how potential changes in social drinking opportunities, life events and stressors, and objective and subjective health relate to both initial alcohol use and alcohol use trajectories.

Other sociodemographic characteristics were also found to predict longitudinal changes in alcohol use. Consistent with existing literature, greater years of education was linked with increasing drinking frequency across time (Molander et al., 2010; Moore et al., 2005; Platt et al., 2010). Those with more education may have more social opportunities for drinking, greater financial resources to purchase alcohol, and better overall health status (Zajacova & Lawrence, 2018). On the other hand, greater educational attainment was also linked with drinking less on each drinking occasion, which coincides with higher education generally being linked with more moderate patterns of alcohol use among drinkers (Towers et al., 2018).

Aligning with documented sex differences in alcohol use (Wilsnack et al., 2009), male participants reported greater average drinking quantity and frequency compared to females at the start of the study. In addition, male sex was associated with stronger declines in number of drinks per occasion over time, consistent with most other studies (Brennan et al., 2010; 2011; Leggat et al., 2022; McEvoy et al., 2013; Moore et al., 2005). These sex differences in declines in alcohol use may be partly attributed to regression to the mean, as males exhibited higher initial levels of alcohol consumption. Alternatively, greater accumulation of alcohol-related consequences (social, occupational, health) across the life course among males may contribute to more rapid reduction in drinking quantity across time.

Limitations and strengths

Several limitations are worth noting. Generalizability to more diverse samples is limited given the lack of racial and ethnic diversity in the NSDE. Alcohol use was measured via self-report and may have been influenced by social desirability biases. Each wave of the daily diary project also only consisted of eight days of data collection, so the reported alcohol use may not capture overall patterns of alcohol use for individual participants or episodes of infrequent heavy drinking (Dawson, 2003). We can view this 8-day period as a random sample of daily experiences in each participant's life. In this way, and given the large sample size and number of interview days, we expect to capture a range of typical experiences for most participants. It is possible that some participants with infrequent or erratic drinking patterns were misclassified, contributing to measurement error. Future studies with national samples and more days per participant should replicate and extend these findings. Another limitation common to longitudinal studies is the loss to follow-up over the 20 years, as the current sample may have been influenced by selective mortality of individuals with more severe patterns of alcohol use. Moreover, we used educational attainment as a proxy for socioeconomic status, but other markers, such as household income, wealth, or occupational status, can also be explored in future research. Finally, covariates were only assessed at a single time point at baseline. Future research can include time-varying covariates to explore how changes in covariates across time relate to changes in alcohol consumption.

Numerous strengths are also present. Data were from 20 years of longitudinal data from a large national adult lifespan sample of respondents aged 24–81 years at baseline. The use of daily assessments provided more precise measurement of alcohol consumption closer in time to the actual

behavior; this methodology limits retrospective recall bias while enhancing ecological validity. Another important strength was the consideration of person-level moderators, which highlighted group-level differences in initial levels and trajectories of alcohol use across adulthood. These findings on individual differences in alcohol use trajectories offer insights for developing targeted public health interventions that more effectively address alcohol use throughout adulthood.

Conclusions

Using a large national dataset surveying the daily lives of American adults, we used three waves of daily diary surveys to evaluate longitudinal change in various indicators of alcohol consumption across 20 years. Overall, the study findings revealed a decline in the number of drinks reported per drinking occasion, while the other indicators of alcohol use did not change over time. Changes in alcohol use across the 20-year period varied depending on biological sex and education. Moreover, trajectories of alcohol use varied by age, such that adults in midlife on average maintained their alcohol consumption across time, while those older at baseline demonstrated greater longitudinal declines in most of the drinking indicators. Together, these findings highlight the importance of tailoring alcohol reduction efforts to account for age, sex, and educational differences in drinking behavior over time.

Ethics approval

The MIDUS and NSDE studies were reviewed and approved by the IRBs at the University of Wisconsin-Madison and the Pennsylvania State University. All participants provided written informed consent (see <https://doi.org/10.5334/ohd.ai> and https://midus.wisc.edu/findings/midus_IRB.php).

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This work was supported by the National Institute on Aging under Grant [P01 AG020166, M3 U19 AG051426]; the National Institute on Drug Abuse under Grant (T32 DA017629); and the National Institute on Minority Health and Health Disparities under Grant [U54 MD012388].

Data availability statement

Publicly available data from the MIDUS and NSDE studies were used for this research (www.icpsr.umich.edu).

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