Longitudinal Patterns and Predictors of Alcohol Consumption in the United States

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Objectives. We examined demographic predictors of longitudinal patterns in alcohol consumption.

Methods. We used mixed-effects models to describe individual alcohol consumption and change in consumption with age, as well as the associations between consumption and birth year, national alcohol consumption, and demographic factors, among 14 105 adults from the National Health and Nutrition Examination Survey I Epidemiologic Follow-Up Study.

Results. Alcohol consumption declined with increasing age, and individual consumption mirrored national consumption. Higher consumption was associated with male gender, being White, being married, having a higher educational level, having a higher income, being employed, and being a smoker. Faster age-related decline in consumption was associated with earlier cohorts, being male, being married, having a lower educational level, and being a smoker.

Conclusions. Compared with alcohol consumption among earlier cohorts, that among recent cohorts declined more slowly with increasing age, suggesting that negative health effects of alcohol could increase in the future. (*Am J Public Health.* 2005;95:458–465. doi:10.2105/AJPH.2003.019471)

Alcohol consumption has substantial positive and negative effects on physical, mental, and social health.[1] Older adults and women (who constitute the majority of the older population) have increased health risks associated with alcohol use because of age-related physiological changes and gender-related metabolic differences that increase sensitivity to alcohol.[2–4] Given the progressive aging of the US population,[5] researchers need to understand how drinking behavior changes with age to better predict the effect of alcohol on public health.

US cross-sectional surveys reveal that compared with younger adults, older adults more often are nondrinkers and less often are heavy drinkers.[6–12] Furthermore, after early adulthood, there is an association between older age and lower alcohol consumption.[8] However, an apparent association between age and alcohol use observed in cross-sectional data may be an artifact of cohort or period effects.[7] Longitudinal data allow age, cohort, and period effects to be separated, but few studies have examined such data for drinking trends.[7,9–11,13,18–21] Those studies have yielded conflicting findings about whether and how age, cohort, and period influence drinking over time. Furthermore, the studies have been limited by small sample sizes, narrow age ranges, small geographic areas, failure to consider period effects, nonrandom selection of respondents, or data from as few as 2 time points.[7–11,13,18–21]

We used data from the first National Health and Nutrition Examination Survey (NHANES I), conducted in 1971–1975,[22,23] and its follow-up surveys, conducted between 1982 and 1992,[24–27] to answer the following questions regarding alcohol consumption among US adults: (1) How does drinking behavior (drinking vs abstention) change over time? (2) What are the differences in demographic characteristics among people with different longitudinal drinking patterns? (3) How do age, period, and cohort influence alcohol consumption over time? (4) What demographic factors predict level of alcohol consumption and rate of change in alcohol consumption with increasing age? Answers to these questions will inform estimates of the effect of alcohol on the health of the aging US population.

METHODS

Data Set and Study Sample

NHANES I was administered between 1971 and 1974,[22,23] and the study population was augmented with an additional national sample in 1974–1975. The survey included a national probability sample of more than 20 000 noninstitutionalized and nonmilitary US citizens aged 1–74 years with oversampling of men and women aged 65 years and older, women of childbearing age, and men and women living in high-poverty areas. The NHANES I Epidemiologic Follow-Up Survey (NHEFS) was a longitudinal survey of individuals aged 25–74 years at baseline in NHANES I (or proxy respondents for those who had died within the previous year and those who were physically or mentally incapacitated). NHEFS had 4 follow-up surveys in 1982–1984, 1986, 1987, and 1992[24–27] that included information on alcohol use obtained in face-to-face interviews for the 1982–1984 survey and in telephone interviews for the other 3 surveys. We used the sample of 14 407 individuals aged 25–74 years at baseline and their follow-up data from the NHEFS 1982–1984, 1987, and 1992 surveys for our analyses. We excluded data from the NHEFS 1986 survey because this survey included only respondents 55 years of age or older at baseline. We also excluded from our sample individuals for whom there were no data on alcohol consumption during any (i.e., all) of the survey periods (n=302), which left us with a sample size of 14 105. Among this sample, data were obtained from proxy respondents for 954 (9%) of respondents in the 1982–1984 survey, 888 (12%) in the 1987 survey, and 1396 (20%) in the 1992 survey. We included these data because other researchers have observed that proxy data on drinking for community-based adults are generally reliable.[28] Including these proxy

respondents gave us alcohol consumption data for all 4 surveys for approximately 4694 of respondents (33%), from at least 3 surveys for 8114 (58%), and from 2 or more surveys for 11 374 (81%). Of our sample, 2731 (19%) had alcohol consumption data from only 1 survey.

Alcohol Variables

Similar questions about quantity and frequency of alcohol use were asked in each of the surveys. Respondents from the 1982–1984 survey were asked further questions about drinking only if they reported consuming at least 12 drinks in any 12-month period before the survey. To maintain consistency among surveys, we defined drinkers as respondents who reported consuming at least 12 drinks during the previous year and abstainers as respondents who reported consuming fewer than 12 drinks during the previous year. Our definition of abstainers is consistent with that in the National Health Interview Surveys.[20]

To describe longitudinal patterns of drinking and abstention, we created 4 categories: (1) those who were drinkers at every survey (*consistent drinkers*), (2) those who were abstinent at every survey (*consistent abstainers*), (3) drinkers who became abstinent and remained abstinent (*quitters*), and (4) *mixed pattern* respondents, including abstainers who became and remained drinkers and respondents who changed their drinking/abstention status more than once. For our analyses of drinking patterns only, we excluded respondents with only 1 observation (n=2731), leaving us with a sample size of 11 374.

To create a continuous alcohol consumption variable, we calculated the number of drinks consumed per week for each participant at each survey by multiplying the reported frequency of drinking per week by the usual number of drinks per occasion. For NHANES I, in which only categories of drinking frequency (not actual numbers) were obtained (e.g., about 1–4 times a month, about 2 or 3 times a week), we used the midpoint of each category as our estimate of drinking frequency. For surveys in which separate questions were asked for beer, wine, and liquor (1987 and 1992), we combined the beverage-specific drinking frequency and quantity variables into an overall alcohol consumption variable. Because some respondents reported consuming large amounts of alcohol, the distribution of number of drinks consumed per week in the sample was not symmetric. We therefore logarithmically transformed this variable to make its distribution symmetric. We added 1 to the "number of drinks consumed per week" variable before the log transformation to include abstainers who otherwise would have a zero value for this variable.

Demographic Variables

To investigate predictors of drinking pattern and of level of alcohol consumption and to adjust for potential confounders of age, cohort, and period effects, we examined 9 demographic variables: age, gender, race (White vs other), marital status (married vs other), education (<high school diploma vs ≥high school diploma), annual income (split at the median into 2 groups: <$7000 vs ≥$7000), employment status (working vs not working), smoking status (currently smoking vs not currently smoking), and proxy status (proxy respondent vs self-respondent).

Data Analysis

We used sampling weights from NHANES I and NHEFS to estimate distributions of drinking behaviors and demographic characteristics for the US population.[29] To obtain US population estimates, we used the SAS version 8.01 procedure PROC SURVEYMEANS (SAS Institute, Inc, Cary, NC) to take into account the complex survey design.

We calculated descriptive statistics on demographic characteristics for the entire sample and for 4 longitudinal drinking patterns (consistent drinkers, consistent abstainers, quitters, and mixed patterns). We used analysis of variance and χ^2 tests to compare demographic characteristics among respondents with these 4 drinking patterns. For each of the longitudinal drinking patterns, we also examined the percentage of respondents with changes in demographic characteristics over the survey periods, but they were not significantly different between groups.

To estimate the age effect while controlling for cohort and period effects, we modeled individual alcohol consumption (log of number of drinks per week +1 to include abstainers) as a linear function of age, birth year (cohort effect), and US per capita alcohol consumption (period effect). For ease of interpretation of the model coefficients, age was centered at a reference age, chosen as the mean age of the sample at the first survey (57 years), and birth year was centered at a reference birth year, chosen as the mean birth year of the sample (1925). The US per capita consumption of alcohol during the year each respondent was surveyed was included in the model to capture the period effect on alcohol consumption.[30] We also included proxy status in the models, because a substantial number of respondents (n=3962; 22%) required a proxy respondent at least once during the survey periods. To minimize complexity, we did not use sampling weights in the models.

We fit 3 versions of a mixed effects model[31,32] in which the intercept (alcohol consumption when individual age=the reference age) and slope (rate of change in alcohol consumption with increasing age, i.e., age effect) were modeled as random effects, whereas birth year, US per capita alcohol consumption, and proxy status were modeled as fixed effects. In addition, we included an age×birth year interaction term to model modification of the age effect by birth year. In the first model, no other covariates were included. In the second model, we included 7 demographic covariates (gender, race/ethnicity, marital status, education, income, employment, and smoking status) measured at baseline, as well as change from baseline in the following 4 covariates: marital status, income, employment, and smoking status, all treated as fixed effects. Educational level was assessed only at baseline; therefore, we could not include change in education in the model. In the third model, we also included interaction terms for age×baseline covariates (also modeled as fixed effects) to examine the influence of demographic factors on the rate of change in alcohol consumption with increasing age.

We explored 5 covariance structures to assess which structure best described the nature of the correlation between repeated observations for individual subjects. Choice of structure had little effect on model estimates and confidence intervals. We therefore present results for the model that assumed no correlation between repeated observations (beyond the correlation implied by the random intercept and slope). Throughout our analysis, we

TABLE 1—Demographic Characteristics of US Population at Baseline (1971–1975), by Drinking Patterns Over Time (n = 11 374): NHANES I and NHEFS

	% (95% Confidence Interval)				
	All	Consistent Drinkers (n = 4891)	Consistent Abstainers (n = 3526)	Quitters (n = 2047)	Mixed Patterns (n = 910)
Age, mean, y	47.24 (46.81, 47.68)	42.06 (41.49, 42.63)	53.42 (52.70, 54.13)	47.53 (46.81, 48.26)	43.66 (42.54, 44.78)
Gender					
Female	52 (51, 54)	41 (39, 43)	70 (68, 72)	51 (49, 54)	59 (55, 63)
Male	48 (46, 49)	59 (57, 61)	30 (28, 32)	48 (46, 51)	41 (37, 45)
Race					
White	89 (88, 90)	93 (92, 94)	88 (86, 90)	87 (86, 89)	91 (88, 94)
Other	11 (10, 12)	7 (06, 08)	12 (10, 14)	13 (11, 14)	9 (06, 12)
Marital status					
Married	79 (78, 80)	85 (83, 86)	76 (74, 77)	77 (75, 80)	83 (81, 86)
Other than married	21 (20, 22)	15 (14, 17)	24 (23, 26)	23 (20, 25)	17 (14, 19)
Education					
< High school	38 (36, 40)	21 (20, 23)	53 (50, 55)	43 (40, 47)	29 (25, 33)
≥ High school	62 (60, 64)	79 (77, 80)	47 (45, 50)	57 (53, 60)	71 (67, 75)
Annual income, $					
< 7000	29 (27, 31)	14 (12, 15)	44 (41, 46)	31 (28, 34)	22 (18, 25)
≥ 7000	71 (69, 73)	86 (85, 88)	56 (54, 59)	69 (66, 72)	78 (75, 82)
Employment					
Working	85 (84, 86)	95 (94, 96)	77 (75, 79)	85 (83, 87)	91 (89, 93)
Not working	15 (13, 16)	5 (04, 06)	23 (21, 25)	15 (13, 17)	09 (07, 11)
Smoking status					
Smoker	36 (34, 37)	41 (39, 43)	19 (17, 21)	42 (39, 45)	32 (28, 37)
Nonsmoker	64 (63, 66)	59 (57, 61)	81 (79, 83)	58 (55, 61)	68 (63, 72)

assumed that data were missing at random. Mixed models optimize use of available data, because data from only 1 time point for each variable is needed for analysis.[33]

RESULTS

Longitudinal Patterns of Drinking and Abstention

We examined patterns of alcohol consumption over the survey periods and observed that consistent drinkers were the largest group (n=4891; 43%), followed by consistent abstainers (n=3526; 31%), quitters (n=2047; 18%), and those having mixed longitudinal patterns of drinking (n=910; 8%). Various longitudinal patterns of drinking were related to differences in baseline age, gender, marital and employment status, income, educational level, and smoking status ($P<.01$ for each) (Table 1). For example, compared with consistent drinkers, consistent abstainers were older, more often female, less often White, and less often married; had lower educational levels and lower incomes; were more often unemployed (e.g., retired, homemaker, student); and were more likely to be nonsmokers. Furthermore, lower proportions of consistent drinkers and respondents with mixed patterns of drinking required a proxy respondent at least once during the survey periods (10% and 17%, respectively) compared with consistent abstainers and quitters (38% and 32%, respectively).

Predictors of Alcohol Consumption

In all 3 mixed effects models, we found evidence for age and period effects on alcohol consumption (Table 2). On average, people drank less with the passage of time—an age effect. We found no difference in average alcohol consumption at the reference age (57 years) by cohort (birth year). During periods of higher US per capita alcohol consumption, individual alcohol consumption was also higher—a period effect. Those respondents who required proxy respondents drank less than respondents without proxies. We found a positive age×birth year interaction, indicating that the decline in alcohol consumption with increasing age was smaller in more recent birth cohorts—a cohort modification of the age effect.

The scale factors listed in Table 2 help to quantitatively describe the magnitude of these effects on alcohol consumption. For our analyses, we refer to the alcohol consumption variable (number of drinks per week +1) as the alcohol consumption index. For instance, according to model 1, after adjustment for birth year and per capita alcohol consumption, alcohol consumption fell by 11% with every decade of aging (scale factor=0.89). Thus, aging by 20 years would decrease alcohol consumption by 21% (0.89×0.89=0.79). The presence of a statistically significant interaction between age and cohort indicated that later cohorts decreased their alcohol consumption more slowly compared with

TABLE 2—Baseline Predictors of Alcohol Consumption[a]: National Health and Nutrition Examination Survey I (1971–1992)

	Model 1 (n = 14 105)		Model 2 With Additional Covariates (n = 12 373)[b]		Model 3 With Age Interaction (n = 12 373)	
	Regression Coefficient[c] (95% CI)	Scale Factor[d] (95% CI)	Regression Coefficient[c] (95% CI)	Scale Factor[d] (95% CI)	Regression Coefficient[c] (95% CI)	Scale Factor[d] (95% CI)
Intercept	0.56 (0.42, 0.70)		–0.00 (–0.18, 0.18)		–0.12 (–0.30, 0.06)	
Age, tens of years[e]	–0.11 (–0.12, –0.09)	0.89 (0.88, 0.91)	–0.08 (–0.10, –0.07)	0.92 (0.91, 0.94)	–0.14 (–0.17, –0.10)	0.87 (0.84, 0.90)
Birth year, tens of years[f]	0.01 (–0.01, 0.02)	1.01 (0.99, 1.02)	–0.02 (–0.04, 0.00)	0.98 (0.96, 1.00)	–0.02 (–0.04, 0.00)	0.98 (0.96, 1.00)
Per capita alcohol consumption, gal/y[g]	0.11 (0.06, 0.16)	1.12 (1.06, 1.18)	0.08 (0.02, 0.15)	1.09 (1.02, 1.17)	0.13 (0.06, 0.19)	1.13 (1.06, 1.21)
Male			0.60 (0.57, 0.63)	1.82 (1.76, 1.88)	0.58 (0.55, 0.61)	1.79 (1.73, 1.85)
White			0.09 (0.05, 0.14)	1.10 (1.05, 1.15)	0.10 (0.06, 0.15)	1.11 (1.06, 1.16)
Married			–0.16 (–0.12, –0.20)	0.85 (0.82, 0.89)	–0.12 (–0.17, –0.08)	0.88 (0.85, 0.92)
≥High school education			0.21 (0.17, 0.24)	1.23 (1.19, 1.28)	0.21 (0.17, 0.24)	1.23 (1.19, 1.27)
≥$7000 income			0.21 (0.17, 0.25)	1.23 (1.18, 1.28)	0.22 (0.18, 0.26)	1.25 (1.20, 1.30)
Working			0.06 (0.00, 0.11)	1.06 (1.00, 1.12)	0.05 (–0.01, 0.12)	1.06 (0.99, 1.12)
Smoking			0.42 (0.39, 0.46)	1.52 (1.47, 1.58)	0.39 (0.36, 0.43)	1.48 (1.43, 1.53)
Proxy respondent	–0.12 (–0.15, –0.09)	0.89 (0.86, 0.91)	–0.07 (–0.12, –0.02)	0.93 (0.89, 0.98)	–0.06 (–0.11, –0.00)	0.95 (0.97, 1.00)
Change in demographics from baseline						
Becoming married			0.00 (–0.02, 0.02)	1.00 (–0.98, 1.02)	–0.02 (–0.04, –0.00)	0.98 (0.96, 1.00)
Increase in income			–0.01 (–0.04, 0.02)	0.99 (0.96, 1.02)	0.01 (–0.03, 0.04)	1.01 (0.97, 1.04)
Becoming employed			0.06 (0.04, 0.09)	1.07 (1.04, 1.10)	0.07 (0.04, 0.09)	1.07 (1.04, 1.10)
Starting smoking			0.19 (0.16, 0.23)	1.21 (1.17, 1.25)	0.17 (0.13, 0.20)	1.18 (1.14, 1.22)
Interaction with age in decades						
Birth year (decades)	0.027 (0.022, 0.032)	1.027 (1.021, 1.033)	0.021 (0.014, 0.027)	1.021 (1.014, 1.027)	0.018 (0.010, 0.026)	1.018 (1.010, 1.026)
Male					–0.066 (–0.083, –0.050)	0.936 (0.921, 0.951)
White					0.024 (0.001, 0.047)	1.025 (1.002, 1.048)
Married					0.070 (0.049, 0.090)	1.072 (1.051, 1.052)
≥High school education					0.033 (0.015, 0.051)	1.033 (1.015, 1.052)
≥$7000 income					0.013 (–0.007, 0.033)	1.013 (0.993, 1.034)
Working					–0.0006 (–0.039, 0.028)	0.999 (0.996, 1.003)
Smoking					–0.033 (–0.052, –0.015)	0.968 (0.950, 0.986)

Note. CI = confidence interval.
[a]Alcohol consumption variable is no. drinks per week +1 (to include abstainers, who otherwise would have a zero for this variable).
[b]No. people with missing covariate data was 1732 (12.2%).
[c]Regression coefficients for predictor variables from the 3 mixed effects models for the outcome log(no. drinks per week +1)
[d]Scale factors are the mean scaling effect on weekly number of drinks associated with each predictor. They were obtained by simple exponentiation of parameter estimates. Scale factors < 1 for the main effects indicate that the predictor is associated with less drinking. Scale factors < 1 for the age interaction terms indicate that the predictor is associated with a steeper age-related decline in drinking.
[e]Age centered on the mean age of the sample at the first survey (57 years). The regression coefficient reported represents a 10-year increase in age.
[f]Birth year centered on the average birth year (1925). The regression coefficient reported represents a 10-year increase in birth year.
[g]Per capita alcohol consumption was the surrogate for period effect. The regression coefficients represent a change in individual consumption per gallon increase in the annual US per capita consumption.

earlier cohorts as they aged. For example, whereas those born in 1925 (the reference birth year) decreased their alcohol consumption by 11% for each decade of aging, those born in 1935 decreased their consumption by 9% ($0.89 \times 1.027 = 0.91$).

In the second model, in which we included additional demographic variables, we found age, period, and proxy status effects and cohort modification of the age effect similar to those in the first model (Table 2, columns 3 and 4). In addition, we found that men consumed more alcohol than did women. Greater alcohol consumption also was associated with being White, being unmarried, having a higher educational level, having a higher income, and smoking. Changes from baseline in employment and smoking status over the survey periods also were associated with differences in alcohol consumption. For instance, starting smoking was associated with a 21% increase in alcohol consumption, and quitting smoking was associated with a 21% reduction in alcohol consumption.

In the third model, in which we also included interaction terms for age×baseline demographic variables, we again found similar age, period, and proxy status effects and cohort modification of the age effect (Table 2, columns 5 and 6). The effects of demographic variables on alcohol consumption at the reference age were similar to effects on alcohol consumption in model 2 except for a statistically significant difference in alcohol consumption between those who did and those who did not have a change in marital status. In ad-

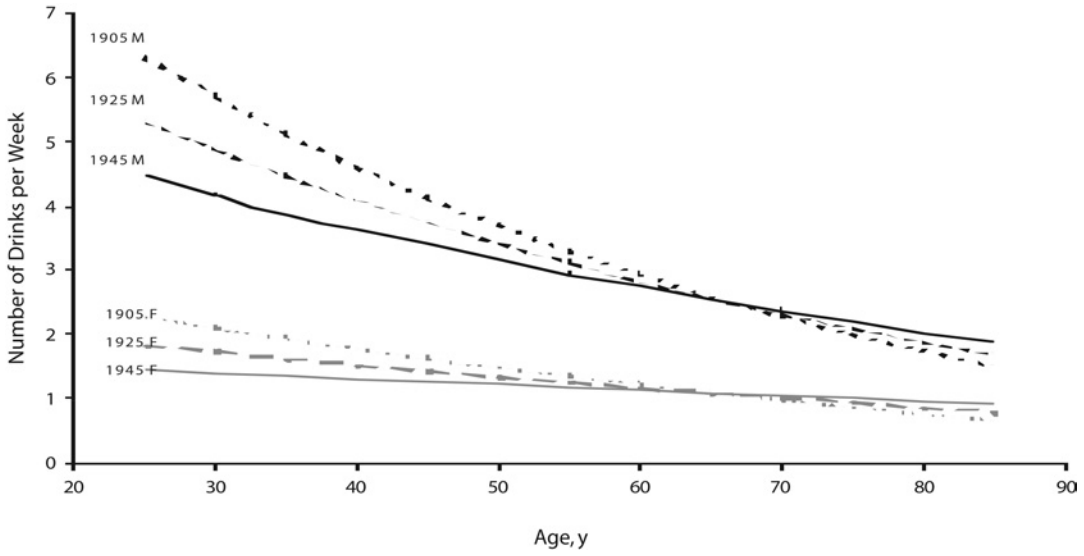
dition, many demographic variables appeared to modify the age effect. For instance, although the age-related scale factor was 0.87 for women (the reference group), for men it was $0.87 \times 0.936 = 0.81$. Thus, although men drank more than women did at the reference age, men's alcohol consumption declined 19% per decade of aging ($0.87 \times 0.936 = 0.81$), compared with a decline of 13% per decade for women. Likewise, unmarried people and smokers drank more at the reference age but reduced their drinking over time at a faster rate compared with married people and nonsmokers. By contrast, both Whites and respondents with more education drank more at the reference age but reduced their drinking more slowly compared with respondents who were non-White or who had less education. For example, compared with non-Whites (the reference group), whose alcohol consumption declined 13% with every decade of aging, the alcohol consumption index for Whites declined by 11% ($0.87 \times 1.025 = 0.89$). Income and employment status did not modify the age effect; thus, respondents who had higher incomes and who drank more at the reference age reduced their alcohol consumption over time at the same rate as did respondents who had lower incomes.

Illustrations of these predicted trends in alcohol consumption are depicted graphically in Figure 1 for men and women across 3 birth cohorts. In calculating these trends, we assumed a stable per capita alcohol consumption of 2.5 gal per year, which enabled the separation of effects of demographic characteristics from the period effect and also allowed the extrapolation of these trends into the future. On average, men drank more than women did throughout their adult lives, even though men's consumption levels declined at a faster rate with increasing age compared with women's levels. By contrast, earlier cohorts drank more than did more recent cohorts at younger ages but drank less than more recent cohorts at older ages. This contrast arose because, compared with recent cohorts, alcohol consumption levels in earlier cohorts declined at a faster rate with increasing age.

DISCUSSION

In this large, population-based, longitudinal study that examined alcohol consumption among US adults at 4 time points over a 20-year period, we found that most respondents (74%) were either consistent drinkers or abstainers during the survey period. We found evidence for age and period effects and for cohort modification of the age effect in models that evaluated influences on alcohol consumption. Individual alcohol consumption declined with increasing age, individual alcohol consumption mirrored per capita alcohol consumption, and more recent cohorts had slower rates of decline with increasing age compared with earlier cohorts. Furthermore, proxy respondents reported lower alcohol consumption than did respondents without proxies. This result is not surprising, because proxy responses were obtained for respondents who had died within the past year or who were incapacitated. It is known that individuals with poor health drink less than individuals with good health.[34,35] Also, respondents who were consistent abstainers or quitters more often required proxy respondents compared with consistent drinkers and respondents with mixed patterns of drinking. Epidemiological data indicate that lifelong abstainers and drinkers who become abstinent have higher mortality rates and poorer health compared with drinkers and thus would be more likely to be deceased and to require proxy respondents.[36,37]

Alcohol consumption varied considerably by demographic characteristics. Several demographic variables were associated with



Note. Values were predicted with the following demographic covariates at baseline: White race, not married, working, nonsmoking, higher income (≥$7000), and ≥high school education. Per capita alcohol consumption was set at 2.5 gal/y. To clearly demonstrate the cohort modification of the age effect, we extrapolated alcohol consumption beyond the ages observed in the data (66–87 years for the 1905 cohort, 46–67 years for the 1925 cohort, and 26–47 years for the 1945 cohort).

FIGURE 1—Predicted longitudinal alcohol consumption in 3 birth cohorts (1905, 1925, 1945) of men (M) and women (F) from the NHANES I sample.

higher alcohol consumption: being male, being White, being unmarried, having a higher educational level and income, smoking, and not having a proxy respondent. Many of these demographic variables also predicted changes in alcohol consumption with increasing age. We observed steeper age-related decreases in alcohol consumption among earlier cohorts, men, non-Whites, respondents who were married, respondents with less education, and smokers. We found, as have previous researchers, that heavy drinkers (men, smokers) tended to reduce their drinking faster than did light to moderate drinkers.[16,19]

Our data are similar to the data of previous researchers who observed generally declining amounts of alcohol consumption with increasing age.[10,11,13,16,18,19,38] Few longitudinal studies, however, have evaluated cohort or period effects.[7,13,19] With NHANES I and NHEFS data, Blow and colleagues[19] examined age and cohort effects among 8710 respondents aged 25–75 years who had alcohol data available for all survey periods.[19] Alcohol consumption declined with age and this decline varied by cohort, with younger cohorts showing less reduction in alcohol consumption over time compared with older cohorts. However, because Blow and colleagues did not adjust for important demographic characteristics such as education and income the patterns observed may have been artifacts of confounding by socioeconomic status. In the Normative Aging Study, Levenson and colleagues examined age, cohort, and period effects with data collected at 3 time points from primarily White men residing in Boston.[13] Among 3 cohorts aged 42–72 years, only the middle cohort showed a consistent decline in alcohol consumption, whereas the other 2 cohorts showed nonlinear patterns of stability and decline. Levenson and colleagues also observed that alcohol consumption was associated with period. In an earlier study that evaluated age and cohort effects, also using data from only the first 2 time points in the Normative Aging Study, Glynn and colleagues[7] found no decline in alcohol consumption with increasing age but did observe that earlier cohorts drank consistently less than did more recent cohorts. We also found that at ages older than the reference age of 57 years, earlier cohorts (men and women) drank less than did recent cohorts; however, at younger ages, the pattern was reversed, with earlier cohorts consuming more alcohol compared with recent cohorts. None of the above studies investigated possible interactions between age and period or cohort effects.

Previous research has examined demographic predictors of alcohol consumption.[15,18,19,38] Fillmore[15] examined changes in drinking at 2 time points 7 years apart and found that the incidence of weekly and daily drinking was generally greater among men aged 20–60 years than among women aged 20–60 years.[15] Blow and colleagues observed that men drank more than did women and that the age effect differed by gender.[19] Eigenbrodt and colleagues examined alcohol consumption among Blacks and Whites in 4 US communities.[18] They found that men drank more than did women and that Whites drank more than did Blacks. Consistently with these studies' findings, we observed that men drank more than did women and that Whites drank more than did other racial/ethnic groups.

Our study had several limitations. First, the sample was predominantly White, reflecting the racial/ethnic composition of the United States in 1971–1975. Because the sample contained small numbers of people in non-White racial/ethnic groups, we could not conduct analyses within those groups. Second, although the questions assessing quantity and frequency of alcohol use in this study were similar across the 4 time points we examined, some variation occurred both in the content of the questions and in whether they were asked in person or by telephone; this variation may have affected our estimates of alcohol consumption. Third, because we ignored some missing values in our classification of longitudinal patterns of drinking, some respondents classified as consistent drinkers or abstainers might actually have had mixed patterns of drinking (if, for example, they stopped or started drinking during a missed observation period). However, the missing values probably occurred at random and should not have affected our conclusions for drinking patterns.

Our study was the first large population-based longitudinal study of alcohol consumption in the United States that examined age, period, and cohort effects. We observed that even after adjustment for cohort and period effects, respondents drank less as they grew older. Moreover, the decline in drinking with increasing age was smaller in more recent birth cohorts than in earlier cohorts. It is possible that more recent birth cohorts had a smaller decline in drinking with increasing age compared with earlier cohorts, because, on average, older adults are healthier now than in the past,[39] and their drinking may decline less steeply as they age because they are in better health as well. The consumption of alcohol by older people may still increase risk of adverse health consequences owing to age-related changes in alcohol distribution, increases in brain sensitivity to alcohol, and increases in comorbidities and concomitant medication use.[40–44] Relatively little is known about the effects of alcohol consumption on older adults' health in the presence of comorbidities and concomitant medication use.[45] Also, women may be more susceptible than men to the deleterious effects of alcohol,[46] and they outnumber men at older ages.[2] Thus, the relatively higher consumption of alcohol by more recent cohorts as they age may increase risk for adverse health consequences. Although we have observed that drinking declines with age and that more recent cohorts have smaller declines in drinking compared with earlier cohorts, more work is needed to better understand the public health impact of increasing alcohol use among the aging population. ■

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Contributors

A.A. Moore developed the study, wrote the article, and participated in study design, statistical analyses, and interpretation of data. R. Gould participated in study design and data interpretation and supervised all statistical analyses. D.B. Reuben and G.A. Greendale participated in study design, and interpretation of data. M.K. Carter and K. Zhou conducted all data acquisition and analyses and assisted in data interpretation. A. Karlamangla participated in study design, statistical

analyses, and interpretation of data. All authors contributed to and reviewed the final version of the article.

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Human Participant Protection

This study received an exemption from the University of California, Los Angeles' institutional review board because the study used existing data that did not contain personal identifiers.

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