Aging and Generational Effects on Drinking Behaviors in Men: Results from the Normative Aging Study

ROBERT J. GLYNN, PHD, GLEN R. BOUCHARD, SM, JOSEPH S. LOCASTRO, PHD, AND NAN M. LAIRD, PHD

Abstract: The effects of aging on alcohol consumption behaviors are unclear because of confounding with period and cohort effects. In 1973, 1,859 male participants in the Normative Aging Study, born between 1892 and 1945, described their drinking behaviors by responding to a mailed questionnaire. In 1982, 1,713 of the participants in this study responded to a similar questionnaire. We used multivariate techniques, adjusting regression coefficients for the correlations between repeated responses of the same individuals, to assess the effects of birth cohort and aging on mean alcohol consumption level, on the prevalence of problems with drinking, and on the prevalence of averaging three or more drinks per day. Older men drank significantly less than younger men at both times yet there was no tendency for men to decrease their consumption levels over time. Each successively older birth cohort had a prevalence of problems with drinking estimated to be 0.037 lower than the prevalence of the next youngest cohort (95 per cent confidence interval: 0.029–0.045), yet there was no decrease in drinking problems over nine years. Interpretation of these findings requires consideration of the changes in attitudes as well as the increases in per capita consumption occurring in the United States throughout the 1970s. Results suggest that aging is not as important a factor in changes in drinking behaviors as generational or attitudinal changes. (*Am J Public Health* 1985; 75:1413–1419.)

Introduction

The extent to which alcohol consumption behaviors are modified as people age is unclear. National surveys of community-dwelling individuals have consistently found more non-drinkers and fewer heavier and problem drinkers among the elderly than among the young.[1] Prevalences of problem drinking in national surveys[1,2] are highest among men aged 21–34 with rates about 2.5–3.0 times those of men over age 65. From a clinical perspective, age-specific prevalences of patients in treatment facilities because of alcoholism are highest in the age-group 40–49 with a rate 3 to 4 times greater than those aged 61–70.[3]

Suggestions drawn from cross-sectional surveys that aging modifies drinking behaviors are limited because of potential cohort differences, differential mortality and differential subject selection.[4,5] Cohort differences, which in cross-sectional studies are inseparable from age differences, occur when one generation consistently drinks less (or more) than a preceding generation. Having lived through Prohibition is one potential source of a generational effect on drinking behaviors. Differential mortality clouds the interpretation of age differences found in cross-sectional studies because alcoholics are more likely to die at younger ages. Additionally, older problem drinkers are more likely to be cognitively impaired or institutionalized; hence they are less likely to be selected or to be able to participate in a community survey. Differential mortality and selection would also tend to bias an analysis of several cross-sectional surveys of different populations at different times. Although all study designs are limited because the main effects of age, period, and cohort are not distinguishable,[5,6] a longitudinal study allows for a clearer description of the effects of aging on alcohol consumption behaviors.

The goal of this report is to examine whether average alcohol consumption and rates of problems with drinking decline with age or whether differences between generations are more likely attributable to historical effects on socialization. The report describes the drinking behaviors of a population of men who responded to mailed questionnaires in 1973 and again in 1982. Multivariate techniques are used to assess the effects of birth cohort and time on average alcohol consumption and the prevalence of drinking problems.

From the Normative Aging Study, Veterans Administration Outpatient Clinic, Boston; the Psychology Service, VA Medical Center, Boston; and the Department of Biostatistics, Harvard School of Public Health. Address reprint requests to Robert J. Glynn, PhD, Normative Aging Study, VA Outpatient Clinic, 17 Court Street, Boston, MA 02108. This paper, submitted to the Journal January 28, 1985, was revised and accepted for publication June 24, 1985.

Methods

Population

The Normative Aging Study is a longitudinal study of aging initiated in 1963 and located at the Veterans Administration Outpatient Clinic in Boston.[7] Participants were recruited through radio and newspaper advertisements and by appeals to companies whose employees were likely to remain in the Boston area (e.g., insurance companies and local police and fire departments). Volunteers were screened according to health criteria at entry in order to provide a population initially free of any serious medical conditions.[8] In particular, volunteers were excluded from participation if they had a history or a finding upon examination of such conditions as heart disease, diabetes, cancer, cirrhosis, pancreatitis, peptic ulcer, gout, or recurrent asthma, bronchitis or sinusitis. Those with either systolic blood pressure greater than 140 mm Hg or diastolic blood pressure greater than 90 mm Hg were also disqualified. Alcohol consumption and alcohol-related problems were not among the screening criteria, but several of the disqualifying conditions mentioned above are related to heavy alcohol use. Many alcoholics have no medical complications and thus would not have been excluded. With these criteria, the study enrolled 2,280 community-dwelling men born between 1884 and 1945. Participants are occupationally heterogeneous and evenly divided between blue- and white-collar jobs. They tend to be of slightly higher social class levels than the general population from which they were drawn. Ethnically, the population accorded fairly closely with the distribution found in the Boston area at the time of subject selection. However, only 2 per cent of the participants are Black, which is lower than the 3.7 per cent Black adult male population in the Boston metropolitan area.[9] A detailed description of the Normative Aging Study population and the study protocol is available elsewhere.[10]

The population for the current study was the 2,100

Normative Aging Study participants who were active in the study in June 1973 and who were born after 1891. In 1973, these men ranged in age from 28 to 82 years. Of the 180 original Normative Aging Study participants who were excluded, 123 dropped out of the study, 52 died before June 1973, and five others were born before 1892. These five oldest participants were excluded so that the population could be partitioned into six birth cohorts of equal length, each containing a substantial number of men.

Drinking Questionnaire

In June 1973, the Normative Aging Study mailed a 15-page drinking questionnaire to its active participants. Of the 2,100 active Normative Aging Study participants born after 1891, 1,892 returned the questionnaire. For each of 16 distinct alcoholic beverages, respondents were asked to record the average number of drinks of each they were currently consuming per day, per week, per month, or per year. Average alcohol consumption, measured in drinks per year, was estimated for each respondent to be the total number of drinks of all types. All beverages were considered together because, according to the US Department of Agriculture,[11] 12 ounces of beer, 5 ounces of table wine, and 1.5 ounces of distilled spirits all contain approximately 0.60 ounces of absolute alcohol. Previous analysis of this measure found Normative Aging Study participants to have a distribution of mean consumption level quite similar to the distribution found among men in other Boston area samples as well as national samples.[12] This was the measure of alcohol consumption used for the current study. The questionnaire also assessed current alcohol consumption on two different scales: the regularity of alcohol consumption on specific days of the week; and the number of drinks of beer, wine, and distilled spirits consumed the day before completing the questionnaire together with an indication of whether this day's consumption was less, more, or about the same as usual. Thirty-three men gave clearly contradictory responses across the three assessments of average alcohol consumption level and were excluded from analysis. Thus, internally consistent questionnaires were returned by 1,859 men (89 per cent of the population for the current study).

The 1973 questionnaire contained 13 items asking about current effects of drinking. We classified respondents as drinkers with problems if they reported that alcohol was regularly affecting their physical health or psychosocial functioning. Specifically, respondents were identified as drinkers with problems if they reported any of the following effects of drinking during the past year: once or more a month—"I got drunk too often, I felt sick upon awakening, I had memory lapses or blackouts, I had the shakes, I became hostile, it made me more depressed, I hurt myself physically when drunk, it affected my health, it affected my family relationships"; or once or more a week—"I had difficulty sleeping, I was skipping meals." In addition, respondents were classified as drinkers with problems if they had been arrested for drunken driving, or for drunkenness and disturbing the peace at least once during the preceding year. Although it contains some components of a DSM-III diagnosis of alcoholism, this classification is not equivalent to a DSM-III diagnosis such as could be obtained from the recently developed National Institute of Mental Health Diagnostic Interview Schedule.[13] However, a recent review[14] has concluded that self-reports of drinking problems are a valid source of information and that drinking problems occurring in persons not undergoing treatment are of public health importance. Other studies of the validity of self-reports of drinking behaviors[15,16] have generally concluded that self-reports are basically valid although the validity of some symptoms of alcohol dependence cannot realistically be tested.

In September 1982, a revised drinking questionnaire was mailed to all active Normative Aging Study participants.[17] Questions assessing alcohol consumption levels and problems with drinking were identical to those on the earier questionnaire. Of the 2,100 men in the population of the current study, 88 had died before September 1982. Internally consistent questionnaires were returned by 1,713 (85 per cent) of the remaining 2,012 men. There were 1,566 men who responded to both surveys; 83 respondents in 1973 died before 1982; another 210 respondents in 1973 did not respond in 1982; and 147 nonrespondents in 1973 responded in 1982. Thus, 2,006 of the 2,100 men in the population (96 per cent) responded to one of the two surveys. Analyses of changes in drinking behaviors described below will compare the characteristics of respondents to only one survey with those of respondents at both times.

Statistical Analysis

Respondents were classified into six birth cohorts, each spanning nine years. The average difference in years between successive birth cohorts was thus equal to the nine-year time difference between the two surveys. The effects of birth cohort and time on mean alcohol consumption level were evaluated using multivariate linear regression with parameters estimated using a three-step procedure suggested by Ware[18] to adjust regression coefficients for repeated measures of the same individuals. Regression coefficients were first estimated by ordinary least squares ignoring the correlation between the two observations on each participant. The two-by-two variance-covariance matrix of the residuals was then calculated using the residuals from the first step. Finally, the linear regression coefficients were reestimated using Aitken's generalized least-squares estimator.[19] For this analysis, average daily alcohol consumption was transformed by log (1+ drinks per day) to normalize its distribution. We termed the transformed variable "alcoholic drinks per day (log)." This multivariate regression used all values from the 1,859 respondents in 1973 as well as the 1,713 respondents in 1982 and included indicator variables to assess the special characteristics of respondents at only one time. The possibility that specific birth cohorts had unusual longitudinal changes in their alcohol consumption over time was examined using cohort by time interaction variables.

We examined cohort and time effects on the prevalence of two dichotomous variables: 1) problems with drinking; and 2) average daily consumption of three or more drinks per day. Analyses were performed using the weighted least-squares approach described by Grizzle, Starmer and Koch[20] and extended to longitudinal data by Koch, *et al.*[21] Because some subgroups of the population contained no men reporting problems or average consumption of three or more drinks per day, 0.05 was added to all cells to allow for estimates of the variance-covariance matrix. All analyses used the Matrix Procedure in the SAS statistical package.[22] The goodness of fit of these models was assessed by the chi square test recommended by Grizzle, Starmer and Koch.[20] Models were fit to account for differences in rates across 28 subgroups. These 28 rates within subgroups were: six rates in 1973 specific to birth cohorts among respondents to both surveys; six rates in 1982 specific to birth cohorts among respondents

TABLE 1—Mean Number of Alcoholic Drinks per Year within Birth Cohorts (1,859 respondents in 1973; 1,713 respondents in 1982)

Year of Birth	1973 Survey N	1973 Survey Mean (s.d.) Drinks in 1973	1982 Survey N	1982 Survey Mean (s.d.) Drinks in 1982
1892–1900	33	287.8 (456.8)	17	169.2 (345.4)
1901–1909	95	351.6 (464.6)	76	293.8 (389.4)
1910–1918	357	388.0 (496.7)	337	427.3 (621.2)
1919–1927	706	420.4 (559.1)	683	414.5 (569.6)
1928–1936	562	512.6 (569.0)	503	477.8 (526.0)
1937–1945	106	475.8 (517.2)	97	456.5 (539.7)

to both surveys; five rates in 1973 among respondents in 1973 who were deceased in 1982 (no respondents in 1973 from the youngest birth cohort were deceased in 1982); six rates in 1973 among respondents in 1973 who were alive in 1982 but did not respond; and five rates in 1982 among the five birth cohorts that had men responding in 1982 only (no nonrespondent in 1973 from the oldest cohort responded in 1982). Weighted least squares analyses took account of the intercorrelations between responses of the same individuals over time.

Results

Mean numbers of alcoholic drinks consumed per year in 1973 and 1982 within six birth cohorts are shown in Table 1. Data from men responding to only one of the surveys were included in this Table. Reading down either column reveals a trend for younger men to report heavier drinking at each time. An exception to this trend at both times was the youngest cohort who drank less than the group born nine years earlier. Reading across each row, five of the six cohorts had lower mean alcohol consumption levels in 1982 compared to 1973. A notable exception was the group born between 1910 and 1918 whose mean consumption was 39.3 drinks per year higher in 1982. Aging effects cannot be assessed accurately from this Table because individuals responding to only one survey are not identified.

Mean alcohol consumption levels by birth cohort and time for respondents to both surveys are shown in Table 2. Among these 1,566 men, there were clear trends at both times for the younger cohorts to be drinking more. However, only the two oldest cohorts markedly decreased their consumption over time. Men born between 1910 and 1918 increased their consumption by an average of 52.5 drinks per year. The overall mean number of drinks for the 1,566 men rose slightly from 428.5 drinks per year in 1973 to 433.8 drinks per year in 1982.

Comparing the amount consumed in 1982 by each cohort born after 1900 to the amount consumed by the next oldest cohort in 1973 when that cohort was the same age, the 1982 amounts are in each case larger. For example, men born between 1901 and 1909 were drinking on average 303.7 drinks per year in 1982 compared to the 191.1 drinks per year consumed by men born between 1892 and 1900 when they were the same age. Cross-sectional trends for older men to be drinking less were contradicted by an overall longitudinal stability in drinking levels. Although it provides data at two times on the same population, this Table is limited because it does not include data from men responding to only one survey.

TABLE 2—Mean Number of Alcoholic Drinks per Year within Birth Cohorts (1,566 respondents in both 1973 and 1982)

Year of Bith	N	1973 Survey Mean (s.d.) Drinks in 1973	1982 Survey Mean (s.d.) Drinks in 1982
1892–1900	17	191.9 (346.3)	169.2 (345.4)
1901–1909	69	391.6 (501.5)	303.7 (402.2)
1910–1918	310	386.1 (482.5)	438.6 (637.9)
1919–1927	627	423.1 (564.4)	415.5 (575.0)
1928–1936	455	470.2 (515.8)	477.0 (526.5)
1937–1945	88	475.1 (528.6)	476.5 (552.8)

Results of a multivariate regression, with drinks per day (log) regressed on birth year and time and coefficients adjusted for the repeated measures of the same individuals, are summarized in Table 3. In this model, birth cohort was entered as a six-level interval scale variable with scores ranging from 1, for those born between 1937 and 1945, to 6, for those born between 1892 and 1900. Other predictors entered in this model were an indicator of the time of measurement (0 = 1973, 1 = 1982) and indicator variables for respondents in 1973 who were deceased in 1982, for others responding only in 1973, and for those responding only in 1982. The ratio of a parameter estimate to its standard error gives a measure of the significance of each variable. A ratio of 1.96 or greater is required for significance at the 0.05 level. The interpretation of the birth cohort effect is that for two men born nine years apart the man born nine years earlier is estimated to drink 0.068 less drinks per day on the log scale than the younger man. By contrast, the estimated effect of the passage of nine years is for a man to decrease his drinking by only 0.008 drinks per day (log).

The estimated coefficient of birth cohort in the model summarized in Table 3 supports the frequently observed finding from cross-sectional studies that older men drink less than younger men. A 95 per cent confidence interval (CI) for the estimated difference in mean daily alchohol consumption (log) between two men from contiguous birth cohorts was (-0.0481, -0.0873). This interval is far removed from the null value and gives bounds on the cross-sectional age difference in alcohol consumption level. A 95 per cent CI for the estimated decline in mean daily consumption over nine years was (−0.0187, 0.0027). This interval tightly encloses the null value indicating that over the nine years between surveys there was little change in mean consumption level. The contrast between these two intervals illustrates the extent to which longitudinal changes fell short of the cross-sectional differences. Although there were clear differences between cohorts in mean consumption, birth cohort did not account

TABLE 3—Multivariate Linear Regression of Drinks per Day (assessed as log(1+drinks/day)) on Time and Interval Scaled Birth Cohort (1,859 respondents in 1973; 1,713 respondents in 1982)

Variable	Regression Coefficient	Standard Error
Intercept	0.816	0.032
Birth cohort	−0.068	0.010
Time 2	−0.008	0.011
Deceased at time 2	0.049	0.045
Living time 2 nonrespondent	0.059	0.030
Time 1 nonrespondent	−0.048	0.036

R square = 0.0126

TABLE 4—Percentages of Men Reporting Drinking Problems and Average Daily Consumption of Three or More Alcoholic Drinks (1,859 respondents in 1973; 1,713 respondents in 1982)

	Per Cent Reporting in 1973			Per Cent Reporting in 1982		
Birth Year	N	Drinking Problems	Average 3 or More Drinks/Day	N	Drinking Problems	Average 3 or More Drinks/Day
1892–1900	33	3.0	12.1	17	0.0	5.9
1901–1909	95	4.2	11.6	76	2.6	5.2
1910–1918	357	5.9	11.5	337	7.4	13.1
1919–1927	706	9.8	12.0	683	9.7	12.6
1928–1936	562	16.2	17.4	503	17.5	16.7
1937–1945	106	19.8	17.9	97	18.6	15.5

for a large percentage of the variance in consumption. The model accounted for only 1.3 per cent of the variance in drinks per day (log).

Consideration of the effects of response at only one time allows for some control of the influence of selective response. Controlling for birth cohort, respondents in 1973 who were dead in 1982 were estimated to be drinking 0.049 more drinks per day on the log scale in 1973, compared to those who responded in 1982. Other respondents in 1973 who did not respond in 1982 were estimated to be drinking an average of 0.059 more drinks per day (log) in 1973, compared to the 1973 levels of respondents to both surveys. Nonrespondents in 1973 who responded in 1982 were estimated to be drinking less in 1982 than respondents in 1982 who also responded in 1973. It is unclear whether these respondents in 1982 only had decreased their drinking over time or had consistently consumed less alcohol. Only the coefficient for those nonrespondents in 1982 who were still alive was relatively large compared to its estimated standard error.

Additional multivariate regression models fit to the data summarized in Table 1 used indicator variables for birth cohorts to assess possible non-linear effects of birth cohort on consumption and included cohort by time interaction variables to evaluate cohort-specific changes in consumption over time (estimated coefficients not shown). Results indicated that differences between cohorts in mean drinks per day (log) were approximately linear. Five of the six cohorts were estimated to decrease their mean consumption over time but the magnitude of these changes were small. None of these estimated cohort-specific time effects were large compared to their estimated standard errors. Compared to the model summarized in Table 3, use of indicator variables for birth cohort and consideration of cohort by time interactions only improved the R square by .0021. There was no strong evidence against the hypothesis that men in different cohorts change about the same over time and that this change is very slight.

Average daily consumption is one parameter of the drinking behaviors of a population but it is not a good indicator of problematic drinking. Table 4 shows the percentages of men reporting problems with drinking and the percentages reporting average daily consumption of three or more alcoholic drinks. The prevalence of drinking problems was markedly related to birth cohort with 3 per cent of men in the oldest cohort reporting drinking problems in 1973 compared to almost 20 per cent of men in the youngest cohort. There was a similar strong monotonic increase across birth cohorts in drinking problems reported in 1982. Comparing the prevalences of drinking problems reported in 1982 to the prevalences in 1973, three birth cohorts had lower rates in 1982, one cohort had essentially identical rates at the two times, and two of the most populous cohorts had higher rates in 1982. The percentages of men averaging three or more alcoholic drinks per day was highest in the two youngest cohorts at both times. Comparing 1982 rates to those in 1973, four of the six cohorts had lower prevalences in 1982 of average daily consumption of three or more drinks but two of the most populous cohorts had higher prevalences.

TABLE 5—Weighted Least Squares Multivariate Regression of Drinking Problems on Time and Interval Scaled Birth Cohort (1,859 respondents in 1973; 1,713 respondents in 1982)

Variable	Regression Coefficient	Standard Error
Intercept	0.217	0.015
Birth cohort	−0.037	0.0039
Time 2	0.0030	0.0077
Deceased at time 2	−0.022	0.017
Living time 2 nonrespondent	0.0064	0.019
Time 1 nonrespondent	−0.014	0.021

Goodness of fit Chi square = 28.9, degrees of freedom = 22.

The percentages presented in Table 4 are based on all respondents to either of the two surveys without distinguishing those responding at only one time. Percentages of both drinking problems and average daily consumption of three or more drinks among respondents at both times were quite similar to these percentages.

The interrelationship of birth cohort and drinking problems in 1973 and 1982 was evaluated using multivariate linear regression with coefficients adjusted for the repeated measures of the same individuals. Results are summarized in Table 5. Parameters in this model may be interpreted in a manner analogous to the interpretation of the parameters in the model described in Table 3. Assuming a linear effect of birth cohort on drinking problems, it was estimated that each successively older cohort had a prevalence of problems with drinking which was 0.037 lower than the next younger cohort. This large cross-sectional difference between birth cohorts is in striking contrast to the estimated slight positive increase in drinking problems over time. A 95 per cent CI for the cross-sectional difference between contiguous birth cohorts is (−0.045, −0.029); for the effect of time is (−0.005, 0.011).

Controlling for birth cohort, respondents in 1973 who were dead in 1982 reported a prevalence of drinking problems that was 0.022 lower than the prevalence in 1973 of men who also responded in 1982. Possibly men in poor health relative to others in their cohort stop drinking in a problematic fashion and this contributes to the lower problem drinking rate in 1973 among the men who died by 1982. Nonrespondents in 1982 who were still alive had slightly higher rates of drinking problems in 1973, compared to respondents in 1982. Respondents in 1982 who did not respond in 1973 reported slightly lower rates of drinking problems in 1982, compared to the rates in 1982 of the men who responded in 1973. None of these estimated differences in rates of drinking problems between respondents at only one time and respondents at both times were large compared to their estimated standard errors. Control of these selection effects does allow for a clearer description of the effects of cohort and time on problem drinking rates.

Other multivariate regression models, with the possibility of reporting drinking problems as the outcome, were fit

TABLE 6—Weighted Least Squares Multivariate Regression of Averaging Three or More Drinks per Day on Time and Interval Scaled Birth Cohort (1,859 respondents in 1973; 1,713 respondents in 1982)

Variable	Regression Coefficient	Standard error
Intercept	0.178	0.018
Birth cohort	−0.018	0.0054
Time 2	0.0064	0.0077
Deceased at time 2	−0.065	0.021
Living time 2 nonrespondent	0.048	0.027
Time 1 nonrespondent	−0.092	0.018

Goodness of fit Chi square = 49.3, degrees of freedom = 22.

using indicator variables for birth cohorts and considering cohort by time interactions. Results supported the finding of a strong monotonic decrease in rates of drinking problems across cohorts but no longitudinal decrease in problems. None of the estimated birth cohort by time interaction effects were large, implying that no cohort had a large longitudinal change in rates of drinking problems relative to the rate change in another cohort. Further evidence for the insignificance of the cohort by time interaction effects was provided by the small difference in goodness of fit statistics between a model with interactions and one without interactions (Chi square = 1.3 with 5 degrees of freedom).

Results of a weighted least squares multivariate regression of the prevalence of averaging three or more drinks per day on birth cohort and time are summarized in Table 6. A 95 per cent CI for the effect of time was (−0.009, 0.022); and for the effect of being in one older birth cohort was (−0.029, −0.007). As with the other drinking characteristics considered, changes over time in rates of averaging three or more drinks per day were small compared to the cross sectional cohort differences. In this model, the coefficients of variables describing rate differences in men responding to only one survey were large compared to their estimated standard errors. This suggests that respondents to only one survey may have different drinking behaviors than respondents to both surveys. Interpretation of all coefficients in this model is limited by the poor fit of the model.

Multivariate regression models considering categorical birth cohort effects and cohort-specific time effects on the prevalence of averaging three or more drinks per day were also fit to these data. These models gave some evidence for a lack of monotonicity in the relationship of successive birth cohorts to the prevalence of averaging three or more drinks per day. Interaction effects of birth cohort by time were generally small, so that it could not be concluded that any one cohort markedly changed over time its prevalence of averagings three or more drinks per day. The interaction terms did not substantially improve the goodness of fit of the model. None of the models fit very well, perhaps because of great variability across cohorts in rates of averaging three or more drinks per day among men in the groups responding to only one survey. These groups of respondents to only one survey were too small to allow for meaningful estimation of birth cohort by response group effects on averaging three or more drinks per day.

Another perspective on longitudinal categorical data is the consideration of intra-individual changes in status over time. Table 7 shows rates of transition into and out of problem drinking status, based on the 1,566 respondents to both surveys. Reading down the first column reveals that men in

TABLE 7—Rates of Change in Problems with Drinking among the 1,566 Respondents in both 1973 and 1982

Birth Cohort	N	Per Cent Reporting		
		New Onset*	Recovery**	Chronicity†
1892–1900	17	0.0	—††	0.0
1901–1909	69	1.5	66.7	1.5
1910–1918	310	5.1	66.7	1.9
1919–1927	627	6.2	56.9	4.5
1928–1936	348	10.8	52.3	6.8
1937–1945	88	12.5	50.0	9.1

*"New onset" drinking problems: the percentage of men reporting problems in 1982 among those reporting no problems in 1973.
**"Recovery" from drinking problems: the percentage of men reporting no problems in 1982 among those reporting problems in 1973.
†"Chronicity" of drinking problems: the percentage of men reporting problems in both 1973 and 1982.
††"Recovery" rate could not be estimated in the oldest cohort because there were no drinkers with problems in this cohort in 1973.

younger cohorts reporting no problems in 1973 were much more likely to report problems in 1982, compared to men from older cohorts. Reading down the second column reveals that men from older cohorts reporting problems in 1973 were much less likely to report problems in 1982, compared to men in younger cohorts. Rates in the third column show that reported problem drinking was much more likely to persist among men in younger cohorts. These differences between birth cohorts in changes in problem drinking status underlie the cohort differences in rates already described. A proper analysis of birth cohort and time effects on transitions between states of problem drinking would require at least one more assessment of drinking behaviors.

Discussion

Among volunteers in the Normative Aging Study, older men had lower mean consumption levels, reported far fewer problems related to drinking and were less likely to report averaging three or more drinks per day, compared to younger men. These cross-sectional age differences in men initially 28–82 years old were seen in both 1973 and 1982. However, over these nine years there was no tendency for age-related declines in consumption, problems with drinking or averaging three or more drinks per day. Particularly notable were the longitudinal data on rates of drinking problems in which there was a slight estimated increase in the prevalence of drinking problems of 0.003 over time even though each successively older cohort was estimated to have a prevalence 0.037 lower than the next youngest cohort.

As with most studies in psychiatric epidemiology, this study depends on self-reported information and thus may be influenced by age or time effects on reporting. It may be that men in older generations are more likely to underreport their alcohol consumption levels because they feel that drinking is less acceptable than do younger men. It is also possible that it is more acceptable to report heavier alcohol consumption in the 1980s than it was in the 1970s. We have no evidence that such effects on reporting exist. Such evidence would be difficult to obtain.

The population for this study consisted of health-screened, male volunteers in a longitudinal study of aging located in Boston. These men are not a random sample of Boston area adult males. Use of this population allows for a much higher response rate than is found in longitudinal drinking surveys of other populations. Taken together with

the uniformity of survey questions over time and the adjustment for response to only one survey, this allows for a more internally valid measurement of changes in drinking behaviors in this population. With respect to the generalizability of results, the issue is whether changes in drinking behaviors in this population at this time were different from changes in other populations. There are no clear reasons why the experience of this population would have differed from that of other similar populations. Longitudinal data from other populations are needed to address this question.

This report used multivariate statistical approaches to assess the relative impact of birth cohort and time on specific drinking behaviors. These approaches have been criticized because of difficulties with the identifiability of parameters arising from the essential relationships between the concepts of age, period, and cohort.[5,6] We believe that such models are valuable so long as care is taken in the interpretation of coefficients and information available from other sources is considered. Four advantages of the use of such models are: 1) they provide estimates of effect sizes; 2) they allow for estimation of the variability in estimates of effect size; 3) they allow for control of confounding variables; and 4) the goodness of fit of these models can be assessed.

There are two interpretations of the finding of stability within cohorts of drinking behaviors over time. One interpretation declares that male drinking behaviors are defined in youth and change little after age 30. Observed cross-sectional differences between cohorts are the result of differing availability and attitudes towards alcohol consumption during youth and young adulthood. For example, the two oldest cohorts in the present study were between 11 and 28 years old at the onset of Prohibition. The next two oldest cohorts were in their teens and early 20s during the Depression and World War II, respectively. Meyers, *et al,*[23] have described how growing up during these times could have a life-long influence on drinking behaviors. This interpretation also draws strength from the selection effects which clearly influence cross-sectional studies of several birth cohorts. In addition to the higher mortality rates among long-term heavier and problem drinkers, these individuals are less likely to be included in a community survey because they are more likely to be mentally or physically impaired, homeless, or in jail. This interpretation does not imply that no individuals change their drinking behaviors after age 30; rather, it states that within any cohort about as many people change in one direction as in the other.

The second interpretation is that strong maturational changes in drinking behaviors exist throughout the life span but these are not observed in this study because of events specific to the observation period (1973–82). For example, the natural tendency for a moderation of drinking behaviors accompanying aging may have been counterbalanced by a liberalization of attitudes towards drinking in the 1970s. There is some evidence to support this interpretation. Per capita alcohol consumption in the United States, which rose markedly through the 1960s, continued to rise in the 1970s.[24, 25] Mulford and Fitzgerald,[26] based on two cross-sectional surveys of adults in Iowa in 1961 and 1979, found greater tolerance for drinking in 1979 as well as a decline in the acceptance of two negative definitions of alcohol over time. Regardless of which of these interpretations holds, it appears that current and past availability and attitudes towards alcohol dominate maturational effects, at least for the specific drinking behaviors considered here.

The current report presents estimates of the effects of cohort and time on drinking behaviors based on longitudinal data including several cohorts of older men. Three studies based on repeated cross-sectional samples have described generational and maturational effects on drinking behaviors. Clark and Midanik[1] examined the drinking patterns reported on eight different national surveys taken between 1971 and 1979. These authors noted the relevant limitation of considering data at only two time points. They found no trends over time in either the percentage of male drinkers or the percentage of male heavier drinkers in each age group. They interpreted these findings cautiously because the different studies considered had different sampling techniques and worded questions differently. Fitzgerald and Mulford[27] interviewed comparable cros-section samples of Iowans in 1961 and 1979. They found increases over time in the mean number of drinking days per year and decreases over time in the prevalence of drinking problems and of heavier drinking. Younger cohorts had a higher prevalence of drinkers and more drinking days per year. Limitations of this study were its non-longitudinal design, the grouping of men and women together, and the consideration of all individuals over age 38 in the same cohort. Cartwright, Shaw, and Spratley[28] examined drinking data from interviews conducted in the same London suburb in 1965 and again in 1974. They found a 47 per cent increase in per capita consumption over the nine years. Considering three age groups (18–34, 35–54 and 55 or more years old), they found the oldest age group to have the lowest total alcohol consumption in 1965. Over the nine-year interval, all groups displayed large increases in total consumption, and those 55 or older in 1974 were drinking far more than those in any of the three age groups nine years earlier. This gives further evidence for the dominance of period and cohort effects over aging effects on drinking behaviors.

Gordon and Kannel[29] described changes in average alcohol consumption among volunteers in the Framingham Study over 20 years between the early 1950s and the early 1970s. Average alcohol consumption increased markedly over time in each of six birth cohorts initially over 30 years old and in both men and women. The largest increases occurred in the younger men and women but cohort by time interactions were not formally tested. Average consumption increased by 49 per cent among men and by 93 per cent among women. The larger increase among women supports the hypothesis that drinking styles are converging between the sexes.[30] During the 20 years from 1952 to 1972, per capita alcohol consumption in the United States rose by 29 per cent. Results from the Framingham Study imply that this increase was due as much to increased drinking among older drinkers as to higher consumption levels among new cohorts entering the drinking population. During the 1970s, per capita consumption in the United States rose more slowly. The large increases in consumption in the Framingham population observed in the 1950s and 1960s are not inconsistent with the stability in consumption of the Normative Aging Study population during the 1970s if these national trends are kept in mind.

An important aspect of the analyses of the current study is the consideration of data from men responding to only one survey. Bergstrand, *et al,*[31] have previously described the lower participation rate of problem drinkers in sample surveys. In the Normative Aging Study data, men responding only in 1973 who were alive in 1982 had higher mean drinking levels, were more likely to average three or more drinks per day, and reported slightly more drinking problems in 1973, compared to the 1973 levels of respondents to both surveys. Men responding only in 1982 had lower mean drinking levels,

were less likely to average three or more drinks per day, and reported fewer drinking problems, compared to the 1982 levels of respondents to both surveys.

Participants in the Normative Aging Study had a great deal of variability in their reports of problems with drinking over time. Many individuals reporting problems in 1973 reported no problems in 1982 and vice versa. Clark and Cahalan[32] previously reported high transition probabilities into and out of problem drinking status among a population of men in San Francisco followed over a four-year interval. They concluded that there is no irreversible progression from mild drinking problems to alcoholism; rather, many individuals spontaneously recover from their drinking problems. Particularly high recovery rates among older drinkers with problems are supported by Zimberg[33] who reported that drinking problems are generally milder in the elderly and that the elderly are more responsive to treatment. Our study did not consider men in their early 20s; however, Fillmore and Midanik[34] have reported that these men have higher recovery rates from drinking problems compared to men in their 40s.

Our finding of little aging influence on drinking behaviors, compared to the effects of generation and period, has potential public health significance. Older men in the United States have for generations had the advantage of lower rates of drinking problems and alcoholism. If current trends continue, oncoming cohorts of older men will have sharply increased rates of drinking problems. Increased alcohol consumption, or even maintenance of life-long drinking patterns, is particularly dangerous to the elderly because of their greater susceptibility to the effects of alcohol. The elderly have decreased lean tissue and are thus less able to metabolize alcohol and they are more likely to be taking medications and are thus susceptible to drug-alcohol interactions.[35] In a controlled experiment in which blood alcohol level was adjusted for, the amount of alcohol induced impairment in task performance increased greatly with age.[36] As younger generations with more liberal drinking habits mature into later life, the longstanding lower rates of drinking problems among the elderly may be in jeopardy.

ACKNOWLEDGMENTS

This study was presented at the Annual Scientific Meeting of the Gerontological Society of America, San Antonio, November 1984. This research was supported by the Medical Research Service of the Veterans Administration and by NIH Grant GM 29745.

REFERENCES

1. Clark WB, Midanik L: Alcohol use and alcohol problems among US adults: results of the 1979 national survey. *In:* Alcohol Consumption and Related Problems. Alcohol and Health Monograph No. 1. Rockville, MD: National Institute of Alcohol Abuse and Alcoholism, 1982.
2. Cahalan D, Cisin IH, Crossley HM: American Drinking Practices: A National Study of Drinking Behavior and Attitudes (Monograph No. 6). New Brunswick, NJ: Rutgers Center of Alcohol Studies, 1969.
3. Drew LRJ: Alcoholism as a self-limiting disease. Q J Stud Alcohol 1978; 29:956–967.
4. Mishara BL, Kastenbaum R: Alcohol and Old Age. New York: Grune and Stratton, 1980.
5. Glenn ND: Age, birth cohorts, and drinking: an illustration of the hazards of inferring effects from cohort data. J Gerontol 1981; 36:362–369.
6. Rodgers WL: Estimable functions of age, period, and cohort effects. Am Sociol Rev 1982; 47:774–787.
7. Bell B, Rose CL, Damon A: The Normative Aging Study: an interdisciplinary and longitudinal study of health and aging. Aging Hum Dev 1972; 3:5–17.
8. Glynn RJ, Rosner B, Silbert JE: Changes in cholesterol and triglyceride as predictors of ischemic heart disease in men. Circulation 1982; 66:724–731.
9. US Bureau of the Census: 1970 Census of Population, Vol. 1: Characteristics of the Population. Washington, DC: Govt Printing Office, 1973.
10. Bossé R, Ekerdt DJ, Silbert JE: The Veterans Administration Normative Aging Study. *In:* Mednick SA, Harway M, Finello KM (eds): Handbook of Longitudinal Research, Vol. 2: Teenage and Adult Cohorts. New York: Praeger, 1984.
11. Adams CF: Nutritive Values of American Foods in Common Units. Agriculture Research Service Agricultural Handbook No. 456. Washington, DC: Govt Printing Office, 1975.
12. Glynn RJ, LoCastro JS, Hermos JA, Bossé R: Social contexts and motives for drinking in men. J Stud Alcohol 1983; 44:1011–1025.
13. Robins L, Helzer JE, Croughan J, Williams JBW, Spitzer RL: NIMH Diagnostic Interview Schedule, Version III. Rockville MD: DHHS, National Institute of Mental Health, 1981.
14. Clark WB: Notes toward research on alcohol use and alcohol problems. *In:* Social Research Group (eds): Report on the 1979 National Survey. Berkeley: University of California School of Public Health, 1981.
15. Midanik LM: The validity of self-reported alcohol consumption and alcohol problems: a literature review. Br J Addict 1982; 77:357–382.
16. Polich JM: The validity of self-reports in alcoholism research. Addict Behav 1982; 7:123–132.
17. Glynn RJ, Bouchard GR, LoCastro JS, Hermos JA: Changes in alcohol consumption behaviors among men in the Normative Aging Study. *In:* Proceedings of the Workshop on the Nature and Extent of Alcohol Problems among the Elderly. Rockville MD: National Institute of Alcohol Abuse and Alcoholism, 1985.
18. Ware JH: Linear models for the analysis of longitudinal studies. Am Statistician 1985; 39:273–280.
19. Zellner A: An efficient method of estimating seemingly unrelated regressions and tests for aggregation bias. J Am Statist Assoc 1962; 57:348–368.
20. Grizzle JE, Starmer CF, Koch GG: Analysis of categorical data by linear models. Biometrics 1969; 25:489–504.
21. Koch GG, Landis JR, Freeman JC, Freeman DH Jr, Lehnen RG: A general methodology for the analysis of experiments with repeated measurement of categorical data. Biometrics 1977; 33:133–158.
22. SAS Institute Inc: SAS User's Guide: Statistics, 1982 Edition. Cary, NC: SAS Institute, 1982.
23. Meyers AR, Goldman E, Hingson R, Scotch N, Mangione T: Evidence for cohort or generational differences in the drinking behaviors of older adults. Int J Aging Hum Dev 1981; 14:31–44.
24. Malin H, Coakley J, Kaelber C: An epidemiologic perspective on alcohol abuse in the United States. *In:* Alcohol Consumption and Related Problems. Alcohol and Health Monograph No. 1. Rockville MD: National Institute of Alcohol Abuse and Alcoholism, 1982.
25. Mulford HA, Fitzgerald JL: Changes in alcohol sales and drinking problems in Iowa, 1961–1979. J Stud Alcohol 1983; 44:138–161.
26. Mulford HA, Fitzgerald JL: Changes in the climate of attitudes toward drinking in Iowa, 1961–1979. J Stud Alcohol 1983; 44:675–687.
27. Fitzgerald JL, Mulford HA: Maturational and generational changes in drinking behavior and attitudes in Iowa, 1961–1979. J Stud Alcohol 1983; 44:476–484.
28. Cartwright AKJ, Shaw SJ, Spratley TA: The relationships between per capita consumption, drinking patterns and alcohol related problems in a population sample, 1965–1974. Part I: increased consumption and changes in drinking patterns. Br J Addict 1978; 73:237–246.
29. Gordon T, Kannel WB: Drinking and its relation to smoking, bp, blood lipids, and uric acid: the Framingham Study. Arch Int Med 1983; 143:1366–1374.
30. Fillmore KM: "Whan angels fall": women's drinking as cultural preoccupation and as reality. *In:* Wilsnack SC, Beckman LJ (eds): Alcohol Problems in Women. New York: Guilford, 1984.
31. Bergstrand R, Vedin A, Wilhelmsson C, Wilhelmsen L: Bias due to non-participation and heterogenous sub-groups in population surveys. J Chronic Dis 1983; 36:725–728.
32. Clark WB, Cahalan D: Changes in problem drinking over a four-year span. Addict Behav 1976; 1:251–259.
33. Zimberg S: Diagnosis and treatment of the elderly alcoholic. Alcoholism 1978; 2:17–21.
34. Fillmore KM, Midanik L: Chronicity of drinking problems among men: a longitudinal study. J Stud Alcohol 1984; 45:228–236.
35. Lee PV: Drug therapy in the elderly: the clinical pharmacology of aging. Alcoholism 1978; 2:31–38.
36. Vogel-Sprott M, Barrett P: Age, drinking habits and the effects of alcohol. J Stud Alcohol 1984; 45:517–521.