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Original Contribution

Racial and Ethnic Differences in All-Cause Mortality Risk According to Alcohol Consumption Patterns in the National Alcohol Surveys

William C. Kerr*, Thomas K. Greenfield, Jason Bond, Yu Ye, and Jürgen Rehm

* Correspondence to Dr. William C. Kerr, Alcohol Research Group, Public Health Institute, 6475 Christie Avenue, Suite 400, Emeryville, CA 94608 (e-mail: wkerr@arg.org).

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Previous studies have found J-shaped relations between volume of alcohol consumed and mortality risk in white Americans but not in African Americans, suggesting the need for studies in which race/ethnicity-defined subgroups are analyzed in separate comparable models. In the present study, the authors utilized mortality follow-up data (through 2006) on respondents from the 1984 and 1995 National Alcohol Surveys, including similar numbers of black, white, and Hispanic respondents by oversampling the minority groups. Cox proportional hazards models controlling for demographic, socioeconomic, mental health, and drug- and tobacco-use measures were used to estimate mortality risk from all causes. Findings indicated a protective effect of moderate alcohol drinking (2–30 drinks/month for women and 2–60 drinks/month for men) with no monthly $\geq$5-drink days) relative to lifetime abstention for whites only. Elevated mortality risk relative to moderate drinking was found in former drinkers with lifetime alcohol problems. Moderate drinkers who consumed $\geq$5 drinks in 1 day at least monthly were also found to have increased risk, suggesting the importance of identifying heavy-occasion drinking for mortality analyses. These differential results regarding lifetime abstainers may suggest bias from differential unmeasured confounding or unmeasured aspects of alcohol consumption pattern or may be due to genetic differences in the health impact of alcohol metabolism.

alcohol drinking; continental population groups; ethnic groups; mortality

Abbreviations: CES-D, Center for Epidemiologic Studies Depression; NAS, National Alcohol Survey.

A substantial body of literature has addressed the effects of any alcohol drinking and current volume of alcohol consumed at baseline on the risk of mortality from all causes, with findings generally confirming the J-shaped relation (1) first identified by Pearl (2), where moderate drinkers are at reduced risk of death compared with nondrinkers, while heavier drinkers are at increased risk. Numerous plausible biologic mechanisms for protective effects have been proposed (3); however, skepticism related to several key methodological issues in this literature remains (4, 5). First, poor measurement of alcohol intake and consumption patterns, especially the limited assessment of life-course drinking and abstention and patterns other than volume (average daily consumption, typically from usual quantity and frequency), has resulted in misclassification across alcohol consumption groups in most studies (5, 6). Second, the endogeneity (bidirectional causality) of alcohol consumption patterns with health conditions and problems can lead to selection bias when the main risk measure is limited to current drinking, given that most morbidity and mortality occurs at older ages when health issues have already affected many people's drinking choices, through either a reduction in quantity or quitting (7, 8). Third, a large number and wide variety of health risk factors, including tobacco smoking, use of illegal drugs, mental health conditions, aspects of diet, childhood conditions and experiences, and socioeconomic status, are related to and correlated with both current and lifetime patterns of alcohol consumption (4, 9). These fundamental issues should be addressed in order to improve the validity of comparisons of individuals in alcohol consumption pattern categories.

In addition, relations of racial, ethnic, and socioeconomic disparities in health and mortality with alcohol consumption

patterns and related social problems have received little attention (10). Most relevant to the current study are potential racial/ethnic differences in the relation between alcohol intake and mortality and morbidity outcomes. A prospective study of all-cause mortality in the First National Health and Nutrition Examination Survey cohort did not find evidence of a protective effect among blacks (11), while a separate analysis found a protective effect for whites in the same sample (12). An analysis of coronary heart disease incidence in the Atherosclerosis Risk in Communities Study (13) also found differential effects by race, with a positive relation between alcohol volume and risk for black men and a negative relation for white men. Last, in a recent prospective analysis of cardiovascular mortality in multiple US surveys, Mukamal et al. (14) reported significant protective effects with lower hazard ratio estimates for light and moderate drinking among non-Hispanic whites, but no significant effect was found among the combined minority populations.

A variety of measures of alcohol intake pattern, beyond overall volume of consumption, for both current and past drinking have been found to be related to mortality and morbidity outcomes, strongly suggesting the importance of including such measures (15). Differential effects for beverage type (16), drinking without food or mainly on weekends (17), and current and past frequency of heavy drinking occasions (18) have been reported. Most epidemiologic cohort studies have relied on alcohol volume only and have not differentiated lifetime abstainers from former drinkers, because the alcohol consumption questions have not assessed past drinking or heavy drinking occasions. Studies with detailed measures of drinking pattern, along with assessment of past-year and lifetime alcohol problems, as in the present study, are rare and offer an important opportunity to evaluate differential effects across these measures.

In this study, we utilized data from both the 1984 and 1995 National Alcohol Surveys (NAS), comprising nearly 10,000 respondents and over 1,500 deaths recorded in the National Death Index during follow-up through 2006. These surveys were very similar in design and included many identical or equivalent questions, allowing the present combined-sample analyses. Both surveys were designed for racial and ethnic group comparisons with substantial oversampling of blacks and Hispanics, such that the 3 major ethnic groups each comprised approximately one-third of the sample. This allowed separate analyses for white, black, and Hispanic respondents, permitting estimation of differential effects of alcohol pattern by racial/ethnic group and better control of confounder effects, which may vary across groups.

MATERIALS AND METHODS

The 1984 NAS comprised 5,221 adults and was conducted for the Alcohol Research Group by the Institute for Survey Research of Temple University (Philadelphia, Pennsylvania) during the period from July 1, 1984, to November 21, 1984. The 1995 NAS included 4,925 adults, and data were also collected with virtually identical methods by the same survey organization over the period from April 12, 1995, to April 30, 1996. Respondents for the 1984 NAS were chosen so as to obtain samples that were representative of the black, Hispanic, and white populations, with other racial/ethnic groups also being proportionally selected in the main sample. The samples included 1,947 blacks, 1,453 Hispanics, and 1,777 whites, as well as 44 persons of other racial or ethnic backgrounds. The response rates were 76% for blacks, 72% for Hispanics, and 73% for whites. Subjects were selected through a multistage area probability procedure from persons aged 18 years or older living in households in the 48 coterminous United States. Data were collected by trained interviewers in face-to-face interviews averaging 1 hour in length. Approximately 43% of Hispanic respondents chose to be interviewed in Spanish. The 1995 NAS was conducted between April 1995 and April 1996 and included 1,582 blacks, 1,585 Hispanics, 1,636 whites, and 122 participants of other race/ethnicity. Response rates were 77% for blacks, 77% for Hispanics, and 76% for nonblack non-Hispanics.

The mortality follow-up study was designed to determine which of the respondents in the original surveys had died during the 22-year period between the original 1984 NAS interview and the end of the follow-up period in December 2006 and during the 11-year period between the 1995 NAS and the end of follow-up. Matching of respondents with death certificate records in the National Death Index was based on last name, first name, middle initial, month, day, and year of birth, gender, race, marital status, state of residence, and state of birth. Date of death and causes of death were obtained for each positive match. There were 1,580 deaths in the combined sample, with 1,042 from the 1984 NAS and 538 from the 1995 NAS. This included 632 white, 652 black, and 291 Hispanic deaths from all causes. Outcome variables for these analyses included an indicator for ascertained death, the respondent's age (in days) at the baseline interview, and the respondent's age (in days) at death or the end of the follow-up period on December 31, 2006.

Alcohol consumption was measured through beverage-specific graduated frequency questions (19, 20). Respondents first reported the number of days on which they had consumed each of the 3 beverage types (beer, wine, and liquor) in the past year and then the relative frequency of consuming 1–2, 3–4, and 5 or more drinks on a single occasion. A separate question in which the past-year frequency of consuming 8 or more drinks on a single occasion was assessed categorically was also used to create indicators of monthly $\geq$5-drink days and monthly $\geq$8-drink days (i.e., heavy drinking occasions) in the past year. The measure of lifetime alcohol problems was derived from measures of 14 Hilton dependence symptoms and 15 tangible consequences (21). An indicator for having reported 3 or more dependence symptom items or reporting 2 or more consequences was created. Lifetime abstainers were defined as those reporting never consuming alcohol. Former drinkers were those who had previously consumed alcohol but had not had 1 drink within the past year. Occasional drinkers were defined as those reporting an average of fewer than 2 drinks per month. Moderate drinkers were defined as those who had consumed 2–30 drinks per month (for women) or 2–60 drinks per month (for men) over the past year. Heavier drinkers were defined as those consuming more than 30 (for women) or 60 (for men) drinks per month. In some models, heavier drinkers were divided into

persons consuming 30–120 (women) or 60–120 (men) drinks per month and those consuming more than 120 drinks per month. The variables used in the final models utilized lifetime alcohol problems to differentiate former and occasional drinkers with previous problems from those without previous problems and heavy-occasion drinkers from those without heavy-occasion drinking among current drinkers (22). The resulting categories were: former drinkers with no alcohol problems; former drinkers with alcohol problems; lifetime abstainers; occasional drinkers (0–2 drinks/month) with no alcohol problems; occasional drinkers with alcohol problems; moderate drinkers (2–30 (women) or 2–60 (men) drinks/month) with no ≥5-drink days monthly; moderate drinkers with ≥5-drink days monthly; heavier drinkers (≥30 (women) or ≥60 (men) drinks/month) with no ≥8-drink days monthly; and heavier drinkers with ≥8-drink days monthly.

Gender, age, and race/ethnicity were self-identified. In terms of race/ethnicity, 98% of respondents were non-Hispanic black (black), non-Hispanic white (white), or Hispanic. The remaining 2%, including Native Americans, Pacific Islanders, and Asians (among others), were included in the reference group in the models utilizing the full sample and were dropped from the race/ethnicity-specific models. Control variables were created for highest educational attainment, region of the United States, being born in the United States, and marital status. The Center for Epidemiologic Studies Depression (CES-D) Scale (23) was used to identify persons with depression, defined as a score of 16 or higher (24). Tobacco use was described by an indicator for having smoked on at least 1 occasion monthly in the past year at baseline interview. Use of illegal drugs was described by 2 variables: use of cannabis in the past year and any use of uppers, cocaine, amphetamines, downers, codeine, methadone, hallucinogens, or heroin/opium in the past year. Impulsivity was measured using the 3-item Impulsive Cognitive Style Scale (25), a summative scale using unit item weighting. Household income was self-reported in dollar categories for each survey. The midpoint of each category was deflated to 1983 dollars using the Consumer Price Index and recategorized, with a missing category used to identify (but include in the analyses) the substantial number of respondents who did not report their household income. Other variables with missing data were age ($n = 63$), country of birth ($n = 6$), date of birth ($n = 72$), impulsivity ($n = 42$), CES-D score ($n = 45$), and lifetime drinking status ($n = 14$), with some overlap, such that a total of 152 respondents and 28 deaths were excluded from the analyses.

Cox proportional hazards models were fitted in Stata 10 (26) with age as the time scale in survival models with both right- and left-censoring. Age is a more appropriate measure than the more common time since interview for survey-based prospective studies, because exposure to the risk variable (in this case, alcohol pattern) begins before the interview takes place, such that all cases are left-censored. The calculation of hazards in these models estimates hazards using persons who are the same age rather than the same number of years from interview. Models using age as the time scale more directly and effectively control for the effect of age, which is probably the most important confounding variable, on mortality risk (27, 28). The models also incorporated robust estimates of standard errors accounting for the clustering by primary sampling units utilized in the survey design. Tests of the proportionality of the hazards using Schoenfeld and scaled Schoenfeld residuals were performed on the final models, and baseline hazards were stratified for variables where proportionality was violated. The final models satisfied the proportionality assumption.

RESULTS

Characteristics of the sample, in terms of the included alcohol variables and potential confounders, are presented in Tables 1 and 2. Table 1 shows mainly the percentages of each listed group in the sample and in each of the 3 race/ethnicity-defined subgroups. The white, black, and Hispanic respondents differed with regard to most measures. For example, whites had the highest levels of income and education, fewer lifetime abstainers, more lifetime alcohol problems, and more illegal drug use. In the black group, there were fewer married respondents, more persons living in the South, and the highest proportion of smokers. The Hispanic group had the lowest educational levels, a high proportion born outside the United States, and the lowest levels of current smoking and cannabis use. Table 2 presents an alternate view of the sample characteristics by alcohol consumption group. Generally, the variables showed 2 patterns across drinking-level groups: increasing and U-shaped. For example, smoking and cannabis use increased dramatically as drinking got heavier, while mean age declined. The U-shaped pattern can be seen for the income and education variables, where the lowest incomes and educational levels are seen in nondrinkers and in the heaviest drinkers. These patterns illustrate how potential confounders of the alcohol-mortality relation are not distributed evenly across alcohol consumption groups.

Table 3 shows results from unadjusted proportional hazards models predicting all-cause mortality according to volume-defined drinking and detailed drinking categories incorporating problem and pattern measures. In the volume-based groups, no drinking groups were found to be at increased risk of death compared with moderate drinkers. In the detailed pattern groups, ex-drinkers and occasional drinkers who reported having a lifetime alcohol problem, moderate drinkers who consumed ≥5 drinks in 1 day at least monthly, and heavy drinkers who consumed ≥8 drinks in 1 day at least monthly were found to be at significantly elevated risk in comparison with moderate drinkers with no monthly ≥5-drink days. In the white group, increased risk was seen among ex-drinkers, current heavy drinkers consuming ≥8 drinks in a day monthly, and occasional drinkers with lifetime alcohol problems. In the black group, significantly elevated risk was seen for moderate drinkers who consumed ≥5 drinks in a day at least monthly. Former drinkers were strongly differentiated by lifetime alcohol problems, with elevated risk being seen among persons with alcohol problems and reduced risks among persons without alcohol problems. In the Hispanic group, former drinkers were at increased risk and moderate drinkers with monthly ≥5-drink days were at increased risk.

We fitted Cox proportional hazards models for the detailed drinking groups including all of the confounding variables

Table 1. Characteristics of a Sample of Respondents to the 1984 and 1995 National Alcohol Surveys by Race/Ethnicity, 1984–2006[a]

	Race/Ethnicity			
	All (n = 9,994)	White (n = 3,387)	Black (n = 3,454)	Hispanic (n = 3,011)
No. of deaths	1,552	627	635	285
Mean age, years	42.5	46.2	42.3	38.6
% from the 1995 National Alcohol Survey	48.8	48.2	45.1	52.7
Male gender	42.6	44.1	38.8	45.3
Race/ethnicity				
Non-Hispanic black	34.6			
Hispanic	30.1			
Non-Hispanic white	33.9			
Other	1.4			
Education				
Less than high school	35.5	20.4	35.9	52.3
High school graduation	31.8	35.0	34.0	26.0
Some college	19.9	23.6	20.4	15.2
College graduation	12.8	21.0	9.6	6.5
Region of the United States				
Northeast	17.9	19.6	16.9	17.0
Midwest	16.7	26.4	18.1	4.4
South	44.0	35.0	57.2	39.5
Pacific	16.4	11.3	7.0	32.2
Rocky Mountains	5.0	7.7	0.8	6.9
Born in the United States	82.4	95.9	96.0	53.1
Marital status				
Married	53.0	61.6	38.4	59.6
Divorced/widowed	26.0	23.7	32.6	21.2
Never married	21.0	14.6	28.9	19.2
Depression[b]	17.9	15.1	20.0	18.5
Impulsivity scale[c]	1.09	1.27	1.02	0.96
Household income, 1983 dollars				
0–<10,000	38.2	20.4	49.4	46.0
10,000–<20,000	23.9	23.4	21.6	27.0
20,000–<40,000	22.2	33.0	16.6	16.3
40,000–<60,000	6.0	10.9	3.8	3.1
≥60,000	1.8	3.9	0.5	0.7
Missing data	7.9	8.4	8.1	7.0
Use of tobacco and other substances				
Current smoker[d]	30.1	31.1	33.5	25.2
Illegal drugs (past year)[e]	10.5	15.2	7.8	8.2
Cannabis (past year)	7.7	8.6	8.7	5.5

Table continues

for the combined 1984 and 1995 NAS samples and for each race/ethnicity subgroup to determine which of these were essential for our final models. Additional analyses utilizing only the volume-defined alcohol categories and gender-specific analyses were also conducted, but results are not presented. Cannabis use in the past year at baseline was not found to have any significant effect on mortality risk, with an overall hazard ratio close to 1. Because of these differential patterns in the effects of alcohol and other confounders, we next constructed parsimonious models for each group, retaining only variables that were significant at the 90% confidence level and in some cases combining categories within the

Table 1. Continued

	Race/Ethnicity			
	All (n = 9,994)	White (n = 3,387)	Black (n = 3,454)	Hispanic (n = 3,011)
Alcohol consumption[f]				
Ex-drinker	16.5	16.1	17.1	16.5
Lifetime abstainer	23.7	16.1	27.0	28.0
Current drinker, average no. of drinks/month				
0–<2 (occasional)	13.1	13.8	12.6	13.0
2–<30 (women) or 2–<60 (men) (moderate)	33.9	38.8	30.7	32.4
30–<120 (women) or 60–<120 (men) (heavier)	8.4	10.7	7.8	6.6
≥120 (heavy)	4.3	4.5	4.8	3.5
Lifetime alcohol problem	18.5	21.9	15.4	18.5

[a] All data are percentages except those for number of deaths, mean age, and impulsivity scale.
[b] Center for Epidemiologic Studies Depression Scale (23) score of 16 or higher.
[c] Impulsivity was measured using the 3-item Impulsive Cognitive Style Scale (25).
[d] Smoking on at least 1 occasion monthly in the past year at baseline interview.
[e] Any use of uppers, cocaine, amphetamines, downers, codeine, methadone, hallucinogens, or heroin/opium.
[f] Lifetime abstainers reported no lifetime drinking. Ex-drinkers reported no past-year drinking but at least 1 drink in their lifetime. Current drinking groups were based on the beverage-specific frequencies shown. The measure of lifetime alcohol problems was derived from measures of 14 Hilton dependence symptoms and 15 tangible consequences (21). An indicator for having reported 3 or more dependence symptom items or reporting 2 or more consequences was created.

confounding variables. The specification of these models also included stratification of baseline hazards for variables where the proportionality assumption was found to be violated.

The results of these final models are presented in Table 4. A major difference between the groups was the finding of an increased risk of death for lifetime abstainers in relation to moderate drinkers with no monthly ≥5-drink days among whites but not among blacks or Hispanics or in overall analyses. The white group also differed in showing an elevated risk of death among occasional drinkers, both with and without lifetime problems, and a significantly elevated risk among heavier drinkers with monthly ≥8-drink days. White former drinkers were also found to be at increased risk. In the Hispanic group, significantly elevated risks were seen only for former drinkers without alcohol problems. Former drinkers also showed significant effects among black respondents, but risks were strongly differentiated by lifetime drinking-problem status, with increased risks for those with problems and decreased risk among those without problems. A significantly increased risk was also found for the group of moderate drinkers with monthly ≥5-drink days in the model for black respondents and in the overall model. Other important differences were also seen across the groups. Being married was protective in the black group only. Tobacco smoking was not significant in the Hispanic group and had the largest effect in the white group. Use of illegal drugs other than cannabis was found to be a significant mortality risk factor in the overall model and for the Hispanic group.

DISCUSSION

Our results illustrate the complexity of alcohol's relation with mortality risk. A key finding was the increased risk among lifetime abstainers in the white racial/ethnic group only. Potential explanations for this differential result include beverage and pattern differences within the drinking groups beyond those included here, differential correlations between drinking pattern and health behaviors or risk factors not included in these analyses, and genetic differences in alcohol's effects. A similar finding of differential effects of alcohol for different ethnic groups can also be found for coronary heart disease, with there being no protective effect of moderate consumption in black Americans (13, 29), even though the impact of moderate consumption was clearly protective in whites in the same studies (13, 29), as well as in a recent meta-analysis (30). More research into the reasons for these ethnic differences is necessary, not only with respect to all-cause mortality but also with respect to coronary heart disease mortality.

Former drinkers and occasional drinkers were also found to be at differential mortality risk across racial/ethnic groups and by past alcohol problem status. Among Hispanic respondents, former drinkers were at increased risk while occasional drinkers were not, potentially indicating "sick quitter" effects (7). Among black respondents, former drinkers with alcohol problems were at elevated risk, while former drinkers without problems were at reduced risk. For white respondents, a very different pattern was found. Former drinkers were at a similar magnitude of increased risk regardless of past

Table 2. Characteristics of a Sample of Respondents to the 1984 and 1995 National Alcohol Surveys According to Volume-based Alcohol Consumption Group, 1984–2006[a]

	Alcohol Consumption Category[b]					
			Current Drinker (Average No. of Drinks/Month)			
	Lifetime Abstainer (n = 2,372)	Ex-Drinker (n = 1,651)	Occasional (0–<2) (n = 1,297)	Moderate (2–<30 (Women) or 2–<60 (Men)) (n = 3,397)	Heavier (30–<120 (Women) or 60–<120 (Men)) (n = 844)	Heavy (≥120) (n = 433)
No. of deaths	489	331	183	392	106	51
Mean age, years	47.5	46.1	41.3	39.2	39.3	36.7
% from the 1995 National Alcohol Survey	51.7	51.9	49.0	47.9	41.3	43.0
Male gender	26.1	38.3	28.7	55.2	48.6	79.4
Race/ethnicity						
Non-Hispanic black	39.3	35.8	33.4	31.2	31.9	38.6
Hispanic	35.6	30.2	29.8	28.8	23.6	24.5
Non-Hispanic white	23.0	33.1	35.5	38.7	43.0	35.6
Other	2.1	0.9	1.3	1.3	1.5	1.3
Education						
Less than high school	51.1	41.1	28.6	25.9	28.7	36.6
High school graduation	28.1	31.3	34.7	33.1	30.8	37.4
Some college	14.4	18.0	22.4	23.3	23.8	16.1
College graduation	6.4	9.6	14.3	17.7	16.7	9.9
Region of the United States						
Northeast	13.4	20.3	19.8	19.0	17.9	18.2
Midwest	11.2	17.7	17.7	18.5	22.0	14.8
South	58.2	41.4	42.3	38.5	37.4	37.6
Pacific	13.9	15.0	16.2	17.9	18.0	21.2
Rocky Mountains	3.3	5.5	4.1	6.1	4.6	8.1
Born in the United States	78.9	83.5	82.0	83.7	88.4	90.3
Marital status						
Married	51.1	50.5	55.5	55.7	51.4	47.8
Divorced/widowed	30.7	30.0	26.4	21.9	23.2	21.0
Never married	18.2	19.6	18.1	22.4	25.4	31.2
Depression[c]	19.1	21.5	17.0	15.1	16.1	25.2
Impulsivity scale[d]	0.77	0.98	1.05	1.23	1.40	1.63
Household income, 1983 dollars						
0–<10,000	51.3	44.0	35.8	29.6	30.0	38.0
10,000–<20,000	21.6	22.2	25.2	25.3	24.9	26.3
20,000–<40,000	13.5	19.5	25.1	27.5	25.9	21.9
40,000–<60,000	2.4	4.2	5.8	8.6	9.3	6.9
≥60,000	0.5	0.8	1.6	2.5	3.6	2.8
Missing data	10.7	9.4	6.5	6.5	6.2	4.2
Use of tobacco and other substances						
Current smoker[e]	12.9	24.3	26.8	37.1	50.6	63.3
Illegal drugs (past year)[f]	5.7	12.4	12.2	11.7	13.0	9.5
Cannabis (past year)	0.8	2.1	3.5	10.8	18.0	35.8

[a] All data are percentages except those for number of deaths, mean age, and impulsivity scale.
[b] Lifetime abstainers reported no lifetime drinking. Ex-drinkers reported no past-year drinking but at least 1 drink in their lifetime. Current drinking groups were based on the beverage-specific frequencies shown.
[c] Center for Epidemiologic Studies Depression Scale (23) score of 16 or higher.
[d] Impulsivity was measured using the 3-item Impulsive Cognitive Style Scale (25).
[e] Smoking on at least 1 occasion monthly in the past year at baseline interview.
[f] Any use of uppers, cocaine, amphetamines, downers, codeine, methadone, hallucinogens, or heroin/opium.

Table 3. Unadjusted Hazard Ratios for Mortality According to Alcohol Consumption as Defined by Volume and Detailed Pattern, Overall and by Race/Ethnicity, 1984 and 1995 National Alcohol Surveys, 1984–2006

Alcohol Consumption Category	Race/Ethnicity															
	All				Black				Hispanic				White			
	No. of Respondents	No. of Deaths	HR	95% CI	No. of Respondents	No. of Deaths	HR	95% CI	No. of Respondents	No. of Deaths	HR	95% CI	No. of Respondents	No. of Deaths	HR	95% CI
Consumption volume																
Ex-drinker			1.14	0.97, 1.32			0.71*	0.56, 0.91			1.44*	1.03, 2.01			1.50*	1.20, 1.87
Lifetime abstainer			0.99	0.86, 1.13			0.84	0.68, 1.04			0.85	0.64, 1.12			1.19	0.95, 1.48
Current drinker, drinks/month																
0–<2 (occasional)			0.96	0.81, 1.13			0.76	0.56, 0.91			0.72	0.48, 1.08			1.28	0.99, 1.64
2–<30 (women) or 2–<60 (men) (moderate)			1.00				1.00				1.00				1.00	
30–<120 (women) or 60–<120 (men) (heavy)			0.99	0.78, 1.27			0.95	0.68, 1.33			1.05	0.57, 1.94			1.06	0.73, 1.56
≥120 (heavy)			1.40*	0.97, 2.00			1.28	0.75, 2.19			1.08	0.40, 2.90			1.51	0.87, 2.62
Consumption pattern[a]																
Former drinker, no alcohol problem	1,373	273	1.08	0.92, 1.27	518	89	0.62*	0.48, 0.80	414	60	1.47*	1.02, 2.12	429	124	1.47*	1.16, 1.87
Former drinker, alcohol problem	278	58	1.96*	1.44, 2.65	73	25	2.21*	1.39, 3.51	84	12	2.47*	1.41, 4.31	118	21	1.76*	1.08, 2.87
Lifetime abstainer	2,372	489	1.02	0.89, 1.17	934	226	0.86	0.70, 1.08	844	96	0.92	0.69, 1.23	546	161	1.19	0.95, 1.49
Current drinker, drinks/month																
0–<2, no alcohol problem	1,170	163	0.94	0.80, 1.11	403	61	0.79	0.59, 1.07	352	24	0.78	0.50, 1.19	401	78	1.17	0.91, 1.50
0–<2, alcohol problem	127	20	1.66	1.02, 2.69	30	6[b]	0.75	0.36, 1.55	35	2[b]	1.03	0.27, 4.01	60	12	4.15*	1.99, 8.64
2–<30 (women) or 2–<60 (men), no ≥5-drink days	1,909	248	1.00		676	92	1.00		398	29	1.00		807	126	1.00	
2–<30 (women) or 2–<60 (men), ≥5-drink days	246	30	2.11*	1.40, 3.17	44	12	2.63*	1.55, 4.48	132	13	1.98*	1.09, 3.61	68	5[b]	2.38	0.93, 6.11
≥30 (women) or ≥60 (men), no ≥8-drink days	817	109	1.03	0.82, 1.29	284	41	1.01	0.72, 1.43	171	15	1.20	0.68, 2.11	352	53	1.03	0.72, 1.48
≥30 (women) or ≥60 (men), ≥8-drink days	460	141	1.55*	1.13, 2.14	152	24	1.29	0.80, 2.07	134	32	1.18	0.57, 2.44	165	16	2.33*	1.39, 3.89

Abbreviations: CI, confidence interval; HR, hazard ratio.

* $P < 0.05$.

[a] Alcohol pattern categories: former drinker with no lifetime alcohol problems; former drinker with lifetime alcohol problems; lifetime abstainer; occasional drinker (0–<2 drinks/month) with no lifetime alcohol problems; occasional drinker with lifetime alcohol problems; moderate drinker (2–<30 (women) or 2–<60 (men) drinks/month) with no days with ≥5 drinks monthly; moderate drinker with ≥5-drink days monthly; heavier drinker (≥30 (women) or ≥60 (men) drinks/month) with no days with ≥8 drinks monthly; and heavier drinker with ≥8-drink days monthly.

[b] One of the drinking groups in the each of the race/ethnicity group-specific models included fewer than 10 deaths, and results for these groups should be interpreted with caution.

Table 4. Hazard Ratios for Mortality According to Alcohol Consumption in the Final Models, Overall and by Race/Ethnicity, 1984 and 1995 National Alcohol Surveys, 1984–2006

	Race/Ethnicity							
	All		Black		Hispanic		White	
	HR	95% CI	HR	95% CI	HR	95% CI	HR	95% CI
% from the 1995 National Alcohol Survey	Strata[a]		1.30*	1.09, 1.55	Strata		Strata	
Male gender	Strata		1.58*	1.27, 1.97	1.59*	1.21, 2.09	1.43*	1.20, 1.72
Mean age, years					0.97*	0.95, 0.99		
Race/ethnicity								
Black	1.09	0.96, 1.23						
Hispanic	0.83*	0.71, 0.98						
White/other	1.00							
Region of the United States								
Midwest	Strata				1.19	0.65, 2.18	Strata	
South	Strata				1.10	0.83, 1.46		
Northeast, Pacific, or Rocky Mountains	1.00				1.00			
Education								
College graduation					1.48	0.79, 2.77		
Some college or less					1.00			
Born in the United States	1.37*	1.13, 1.66	3.39*	1.51, 7.65	Strata		1.88*	1.22, 2.91
Marital status								
Married	0.76*	0.63, 0.91	0.74*	0.56, 0.97				
Divorced/widowed	0.78*	0.64, 0.96	0.79	0.58, 1.06				
Never married	1.00		1.00					
Depression[b]	1.21*	1.06, 1.38					1.42*	1.16, 1.73
Impulsivity scale[c]					0.89	0.78, 1.03		
Household income group, 1983 dollars	Strata		Strata		Strata		Strata	
Use of tobacco and other substances								
Current smoker[d]	1.42*	1.26, 1.61	1.24*	1.02, 1.51			Strata	
Use of illegal drugs (past year)[e]	1.36*	1.16, 1.60			2.25*	1.59, 3.18	1.21	0.95, 1.54
Alcohol consumption pattern[f]								
Former drinker, no alcohol problem	1.11	0.94, 1.31	0.66*	0.53, 0.87	1.56*	1.07, 2.27	1.59*	1.25, 2.02
Former drinker, alcohol problem	1.58*	1.21, 2.07	1.76*	1.10, 2.93	1.61	0.96, 2.69	1.48	0.90, 2.42
Lifetime abstainer	1.11	0.96, 1.29	1.01	0.80, 1.28	1.03	0.74, 1.43	1.33*	1.06, 1.68
Current drinker, drinks/month								
0–<2, no alcohol problem	1.14	0.95, 1.36	0.96	0.70, 1.30	0.91	0.57, 1.46	1.39*	1.09, 1.77
0–<2, alcohol problem	1.60	0.98, 2.62	0.77[g]	0.38, 1.56	0.87[g]	0.21, 3.71	4.28*	2.36, 7.79
2–<30 (women) or 2–<60 (men), no ≥5-drink days	1.00		1.00		1.00		1.00	
2–<30 (women) or 2–<60 (men), ≥5-drink days	1.86*	1.29, 2.69	1.94*	1.16, 3.23	1.72	0.94, 3.14	1.41[g]	0.50, 4.01
≥30 (women) or ≥60 (men), no ≥8-drink days	1.03	0.83, 1.28	1.00	0.72, 1.39	1.22	0.65, 2.30	1.05	0.75, 1.48
≥30 (women) or ≥60 (men), ≥8-drink days	1.06	0.75, 1.50	0.95	0.57, 1.57	0.91	0.43, 1.95	1.98*	1.15, 3.42

Abbreviations: CI, confidence interval; HR, hazard ratio.

* $P < 0.05$.

[a] "Strata" indicates variables for which baseline hazards were stratified to satisfy the proportional hazards assumption.

[b] Center for Epidemiologic Studies Depression Scale (23) score of 16 or higher.

[c] Impulsivity was measured using the 3-item Impulsive Cognitive Style Scale (25).

[d] Smoking on at least 1 occasion monthly in the past year at baseline interview.

[e] Any use of uppers, cocaine, amphetamines, downers, codeine, methadone, hallucinogens, or heroin/opium.

[f] Alcohol pattern categories: former drinker with no lifetime alcohol problems; former drinker with lifetime alcohol problems; lifetime abstainer; occasional drinker (0–<2 drinks/month) with no lifetime alcohol problems; occasional drinker with lifetime alcohol problems; moderate drinker (2–<30 (women) or 2–<60 (men) drinks/month) with no days with ≥5 drinks monthly; moderate drinker with ≥5-drink days monthly; heavier drinker (≥30 (women) or ≥60 (men) drinks/month) with no days with ≥8 drinks monthly; and heavier drinker with ≥8-drink days monthly.

[g] One of the drinking groups in the each of the race/ethnicity-specific models included fewer than 10 deaths, and results for these groups should be interpreted with caution.

problems, again suggesting a general ''sick quitter'' effect, but occasional drinkers were also at increased risk, especially those with past problems. This may indicate cultural differences in which some white respondents are more likely to continue drinking infrequently at low levels in response to heath problems, rather than quitting, as was hypothesized by Shaper et al. (29) in regard to their predominantly white United Kingdom sample. The reduced risk of death among black former drinkers without lifetime problems also suggests that quitting drinking in this group may be done mainly for reasons other than poor health or health problems and could in fact be associated with a healthier lifestyle.

Our results also show the importance of heavy drinking occasions in determining mortality risk. Among moderate drinkers, a significantly increased risk of death was seen for persons who reported consuming 5 or more drinks in 1 day on a monthly basis as compared with those who did not. Elevated risks were seen in all 3 race/ethnicity groups; however, significant risk was found only in blacks. A significantly elevated risk of mortality associated with heavy drinking patterns was similarly found only for whites consuming $\geq$8 drinks in a day at least monthly. This finding clearly illustrates the difference between regular moderate drinking with a low quantity per occasion and infrequent but habitual heavy-occasion drinking in determining mortality risk.

A number of additional findings regarding control variables are also of interest. Past-year cannabis use was not associated with increased mortality risk, while use of other illegal drugs was associated with increased risk, particularly for Hispanics. The differential effects of tobacco smoking were also surprising and may partly reflect the limitation of assessing only past-year smoking at baseline. The effect of depression on mortality risk was also found to differ by subgroup, with only whites, particularly white women (analyses not shown), being at significantly increased risk of death associated with depression. The analysis of US region showed higher risks in the Midwest and South. This was probably due to the survey's lack of information on diet and obesity, which are known to differ by region in the United States (30).

This study had a number of important limitations, including those highlighted above. There are many important risk factors for all-cause mortality, and some of these may well be related to lifetime alcohol consumption patterns. Risk factors related to diet, exercise, and life-course body weight and body mass index may be particularly important and have sometimes been found to have U-shaped relations with alcohol consumption (31, 32). Additional potential confounders related to mental health and socioeconomic status may also be important, although we did control for several key aspects of these. Health status and health conditions were not assessed at baseline, so we were unable to control for these factors, nor were we able to exclude persons with serious health problems at baseline. The study also relied to some extent on retrospective reports of drinking status and alcohol problems, which may have been biased by current drinking habits and the length of time since the behavior took place (6, 20). Even current alcohol assessments may include self-reporting errors due to the varying alcohol content of different drinks and underreporting (20), although ascertainment of drinking patterns was highly detailed.

These analyses illustrate the difficulty of estimating the true associations between alcohol consumption and mortality risk. These risks appear to differ by racial and ethnic group in the United States, potentially indicating cultural differences in drinking patterns and their relations to other health risk factors and health problems. These types of differences would be expected in other countries as well. Differential risks were also found according to current drinking pattern and problems related to past drinking, aspects which are often neglected in mortality analyses. The absence of a protective effect from moderate drinking in blacks and Hispanics and the finding of this effect in whites should be investigated further. Such disparities would have important implications for advice given to major US racial/ethnic groups about drinking and for estimates of alcohol's health effects and societal costs.

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Author affiliations: Alcohol Research Group, Public Health Institute, Emeryville, California (William C. Kerr, Thomas K. Greenfield, Jason Bond, Yu Ye); and Department of Social and Epidemiological Research, Centre for Addiction and Mental Health, University of Toronto, Toronto, Ontario, Canada (Jürgen Rehm).

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