"Alcohol Consumption and Mortality Risks in the U.S."

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ABSTRACT

This study presents relative mortality risks by alcohol consumption level for the U.S. population, using data from National Health Interview Survey participants from 1997-2004 who were followed for mortality through 2006. It presents adjusted hazard ratios for all-cause mortality and for mortality from circulatory and external causes. We find that mortality from all causes and external causes for lifetime infrequent drinkers was much lower than the comparable mortality for never drinkers among women, suggesting that some portion of observed lower mortality for female drinkers is due to factors other than alcohol consumption. We also generally find some reduction in estimated all-cause mortality for moderate drinkers compared to infrequent drinkers. We also find increased cerebrovascular disease mortality for heavy drinkers compared to infrequent drinkers among women.

INTRODUCTION

The relationship between alcohol consumption and mortality risks presents several methodological and empirical complications. Numerous studies have found that the relationship between alcohol consumption level and overall or cardiovascular mortality resembles a u- or j-shaped curve (Poikolainen, 1995; Corrao et al., 2000; Di Castelnuovo et al., 2006; Ronksley et al., 2011). These studies have generally found that light to moderate drinkers tend to have lower mortality than non-drinkers and that heavy drinkers tend to have higher mortality. Several studies have attempted to estimate relative risks by alcohol consumption level for the US population. Thun et al. (1997) analyzed mortality follow-up from 1982 through 1991 for middle-aged and older participants in the American Cancer Society's Cancer Prevention Study II and concluded that moderate alcohol consumption was associated with slightly reduced overall mortality. Liao et al. (2000) analyzed mortality follow-up for 1988 and 1990 National Health Interview Survey (NHIS) participants through 1995 and concluded that light to moderate drinkers had lower mortality than never drinkers. Rogers et al. (2000) also analyzed mortality follow-up for 1990 NHIS participants through 1995 but did not find an association between moderate alcohol consumption and lower overall mortality. Rehm, Greenfield, and Rogers (2001) examined mortality follow-up from the 1984 National Alcohol Survey through 1995 and found that moderate alcohol consumption was generally associated with lower overall mortality. More recently, Fuller (2011) analyzed mortality follow-up from 1997 through 2000 NHIS participants through 2002 and concluded that moderate alcohol consumption was associated with lower overall and coronary heart disease mortality.

Some researchers, however, have noted common methodological problems in this field of research. Shaper (1990) noted that many studies included former drinkers in the reference category of non-drinkers, even though former drinkers often have high mortality due to alcohol-related causes. He concluded that such studies would thus tend to over-estimate any protective mortality effects of alcohol consumption. More recently, Fillmore et al. (2007) noted that many studies continued to include former drinkers or occasional drinkers with never drinkers in the reference category in their analyses. These researchers found no protective mortality effect from alcohol consumption in studies that separated these two groups from never drinkers in their analyses.

In this study, we present relative mortality hazards by alcohol consumption level for the US population using recent and extensive national health survey data linked for mortality follow-up. We find that lifetime infrequent drinkers have much lower overall and external cause mortality compared to never drinkers among women. We therefore use infrequent drinkers as the reference category in our survival analysis in order to more accurately estimate the mortality risks associated with alcohol consumption.

METHODS

We estimated mortality hazards by alcohol consumption level using NHIS data linked for mortality follow-up. The NHIS is a nationally representative household health survey of the US civilian non-institutionalized population that is conducted on an annual basis by the CDC's National Center for Health Statistics (NCHS) (2011). NHIS interviewers personally survey approximately 35,000 households each year, and one adult aged 18 or over from each household is selected to complete the Sample Adult Questionnaire. This questionnaire includes detailed questions about smoking history.

NHIS participants are followed for mortality through periodic linkage of their records with NCHS's National Death Index (MacMahon, 1983), which contains death certificate information for all US decedents since 1979, to produce the National Health Interview Survey - Linked Mortality Files (NHIS-LMF) (National Center for Health Statistics, 2010). NCHS perturbs some date- and cause-of-death information in the public-use version of the NHIS-LMF in order to prevent identification of decedents. NCHS has shown that this perturbation generally has little effect on analyses conducted with the data (National Center for Health Statistics Data Linkage Team, 2010), but it is not known what particular effect the perturbation would have in this case.

We used the public-use NHIS-LMF to calculate relative mortality hazards by alcohol consumption level for NHIS participants from 1997-2004 with mortality follow-up through the end of 2006. 242,397 adults aged 18 and over completed the sample adult questionnaire in these years and were eligible for mortality follow-up, and 237,859 of these individuals provided alcohol consumption information. 16,743 deaths from this latter group were identified through linkage with the National Death Index. Cox proportional hazard models were used to estimate hazard ratios by alcohol consumption level. Age was used as the time scale, and the hazard ratios were estimated with and without a set of control variables that consisted of race/ethnicity, educational attainment, marital status, family income, smoking, and body mass index (BMI). Alcohol consumption was generally categorized into six levels. "Never drinkers" reported consuming fewer than 12 drinks during their lives. "Former drinkers" had consumed at least 12 drinks in their lives but none during the previous year. "Infrequent drinkers" had consumed at least 12 drinks in their lives but never 12 in a single year and had consumed

alcohol during the previous year. "Light drinkers" were drinkers who reported drinking 1 drink a day on average on days that they consumed alcohol during the previous year. "Moderate drinkers" reported drinking 2 drinks on average and "heavy drinkers" 3 or more drinks on average on days that they consumed alcohol during the previous year. For some analyses, light, moderate, and heavy drinkers were further divided into "occasional drinkers," who reported drinking on 0-2 days per week on average during the previous year and "regular drinkers" who reported drinking on 3 or more days per week on average during the previous year. Approximately 20% of the NHIS participants did not report family income information, but NCHS imputes family income for these participants. We used these imputed values in our analyses, following the instructions for their use provided by NCHS. 3.5% of the survey participants did not have complete information for the other control variables (the variable with the most missing data was BMI (3.4% of participants)), and these participants were omitted from the adjusted analyses. Race/ethnicity was categorized as non-Hispanic white, non-Hispanic African-American, non-Hispanic other race, and Hispanic. Educational attainment was categorized as less than high school graduate, high school graduate or equivalent, and more than high school graduate. Marital status was categorized as married or cohabitating; widowed, divorced or separated; and never married. Family income was categorized as less than 100% of the poverty threshold, 100% to 149% of the poverty threshold, 150% to 199% of the poverty threshold, and 200% or more of the poverty threshold. BMI was categorized as underweight or normal (BMI < 25), overweight (25 <= BMI < 30), and obese (BMI >= 30). We evaluated the proportionality assumption of

the hazard models through tests of the scaled Rosenfeld residuals as a function of follow-up time. The proportionality assumption was generally upheld.

In addition to conducting analyses for ages 18 and over, we also conducted survival analyses for all-cause mortality for ages 50 and over, similar to the analysis presented by Fuller (2011). The results for these older ages were consistently similar to the results for all adult ages and are therefore not presented here. Reported health status was included as a control variable in some analyses of all-cause mortality. Including reported health status could help control for the effect of confounding risk factors that are not directly represented in the models (Benjamins, Hummer, Eberstein, & Nam, 2004) . It could also control away some of the effect of alcohol consumption, given that alcohol consumption could affect reported health as well as morbidity and mortality. Health status was reported for each member of the households surveyed in the NHIS. Five possible responses ("excellent, " "very good," "good," "fair," and "poor") were provided in the survey, and we treated the reported health status as a continuous variable with "excellent" being 1 and "poor" being 5.

We estimated hazard ratios for all-cause mortality and for mortality from ischemic heart disease (International Classification of Diseases, 10th Revision (ICD 10): I20-I25), cerebrovascular disease (ICD 10: I60-I69), all other circulatory diseases (the remainder of ICD 10: I00-I99), and external causes (ICD 10: V01-Y89). Among NHIS participants who reported alcohol consumption information, there were 3516 deaths from ischemic heart disease, 1041 deaths from cerebrovascular disease, 1873 deaths from other circulatory diseases, and 843 deaths from external causes. We conducted all statistical and data analyses using R version 2.10.1 (R Development Core Team, 2009) and the

survey package (Lumley, 2010). We used the appropriate NHIS-LMF sample weights and accounted for the NHIS complex survey design.

RESULTS

Table 1 presents the distribution of demographic and health characteristics for NHIS participants by alcohol consumption level. Women, African-Africans, and persons with low education and income were more likely to be never drinkers than men, whites, and persons with higher education and income. Women were also more likely to be lifetime infrequent drinkers than men. The proportion of study participants who were light or moderate drinkers generally increased with greater education and income. Men and younger study participants were more likely to be heavy drinkers than women and older individuals.

Table 2 presents all-cause hazard ratios by alcohol consumption level for men and women. Among women, infrequent drinkers had much lower mortality than never drinkers in the adjusted analysis without reported health status, even though the level of alcohol consumption among infrequent drinkers (who reported never having consumed 12 drinks in a single year) would suggest that this difference in mortality was not due primarily to alcohol consumption but rather to other unobserved differences between the two groups. The adjusted hazard ratio (HR) for infrequent drinkers compared to never drinkers, for example, would be 0.67 (95% Confidence Interval (CI) = 0.60, 0.75). We therefore set infrequent drinkers as the reference group in the analyses in order to identify mortality differences for drinkers that were generally associated with alcohol consumption. The table shows that for all ages former drinkers had higher mortality than infrequent drinkers for both men (HR = 1.36, 95% CI = 1.19, 1.56) and women (HR =

1.58, 95% CI = 1.41, 1.77), in the adjusted analyses without health status. For men, estimated mortality hazards for regular light drinkers (HR = 0.82, 95% CI = 0.70, 0.96) and moderate drinkers (HR = 0.87, 95% CI = 0.75, 1.01) were somewhat lower than hazards for infrequent drinkers. Male regular heavy drinkers, on the other hand, had higher mortality (HR = 1.27, 95% CI = 1.09, 1.49). Female occasional moderate drinkers had lower mortality compared to infrequent drinkers (HR = 0.80, 95% CI = 0.69, 0.93), although female regular heavy drinkers had much higher mortality (HR = 1.63, 95% CI = 1.29, 2.06). The inclusion of reported health status in the analyses tended to produce adjusted hazard ratios that were closer to 1.

Table 3 presents adjusted hazard ratios by alcohol consumption level for circulatory and external causes of death. Female never drinkers had much higher mortality from external causes than female lifetime infrequent drinkers (HR = 2.06, 95% CI = 1.15, 3.69), even though the direct effect of alcohol consumption might be expected to produce a slight increase in deaths from these causes, which include accidents, motor vehicle deaths, homicides, and suicides. These results for external causes were generally similar when reported health status was included in the analysis (HR = 1.90, 95% CI = 1.06, 3.42) (results not shown). These results strongly suggest that some of the observed increase in overall mortality for never drinkers compared to infrequent drinkers among women is due to factors other than alcohol consumption. Male never drinkers did not have a similar increase in mortality from external causes compared to infrequent drinkers (HR = 0.85, 95% CI = 0.48, 1.49), which is consistent with the lack of an increase in overall mortality for never drinkers compared to infrequent drinkers among men.

For circulatory causes, female former drinkers had higher ischemic heart disease mortality compared to infrequent drinkers (HR = 1.78, 95% CI = 1.37, 2.32). Light and moderate drinkers generally had lower estimated mortality hazards for ischemic heart disease when compared to infrequent drinkers, with the hazard ratio for male moderate drinkers being 0.68 (95% CI = 0.50, 0.91) and hazard ratio for female light drinkers being 0.75 (95% CI = 0.56, 1.01). These estimates are consistent with results from meta-analyses of studies analyzing alcohol consumption and coronary heart disease mortality risk (Corrao, Rubbiati, Bagnardi, Zambon, & Poikolainen, 2000) and overall mortality risk (Di Castelnuovo et al., 2006), which found reduced mortality risk from these causes for women at lower alcohol levels compared to men. For cerebrovascular disease, female never, former, and heavy drinkers had higher mortality compared to infrequent drinkers. These results are consistent with previous research that has found increased stroke risk for female heavy drinkers (Reynolds et al., 2003; Patra et al., 2010). Female never and male and female former drinkers also had higher mortality for the remaining circulatory causes compared to infrequent drinkers.

DISCUSSION

In this study, we have used recent and extensive national health interview survey linked for mortality follow-up to estimate relative mortality risks by alcohol consumption level, controlling for some confounding risk factors. We have generally found somewhat lower overall mortality for moderate drinkers compared to lifetime infrequent drinkers and higher mortality for former drinkers and regular heavy drinkers. These results are generally similar by sex. We also found some evidence that light and moderate drinkers had lower ischemic heart disease mortality compared to infrequent drinkers and that

former drinkers had higher mortality from this cause. We also found that among women that never, former, and heavy drinkers had higher cerebrovascular disease mortality than infrequent drinkers.

This study has numerous advantages compared to previous research on mortality risks by alcohol consumption level for the US population. One advantage is its use of more recent and extensive national health survey data. Rehm, Greenfield, and Rogers (2001), for example, only analyzed data for approximately 500 deaths and 5000 participants in the 1984 National Alcohol Study. Fuller (2011) analyzed NHIS data linked for mortality follow-up, but only had approximately one-third of the mortality follow-up and deaths as this study. Other advantages of our study result from its specific categorizations of alcohol consumption and controls for confounding factors. Thun et al. (1997), for example, calculated relative risks for drinkers compared to never drinkers, but excluded from their analysis former drinkers or infrequent drinkers who consumed alcohol fewer than three times per week. Rogers et al. (2000) did not conduct their analysis separately by sex, even though the results presented here indicate that the mortality effects of alcohol consumption can vary by sex.

We generally found among US women that lifetime infrequent drinkers tended to have lower overall mortality than never drinkers. The magnitude of this difference, as well as a similar difference for mortality from external causes, suggests that it is caused by factors beyond just alcohol consumption. Liao et al. (2000) found similar results in earlier and less extensive data from 1988 and 1990 NHIS cohorts. They found that lifetime infrequent drinkers had lower overall adjusted mortality compared to never drinkers among women (Relative Risk [RR] = 0.81, 95% CI = 0.72-0.91), but not

necessarily among men (RR = 0.94, 95% CI = 0.77-1.14). Interestingly, Liao et al. found that the only group among women who had lower estimated mortality risk than infrequent drinkers were drinkers who consumed on average less than one drink per day (RR compared to never drinkers = 0.72, 95% CI = 0.64-0.82). It appears that much of the observed differences in adjusted mortality risks for never drinkers and infrequent drinkers for US women may be caused by residual confounding by unaccounted for risk factors. As Table 1 indicates, never drinkers and infrequent drinkers differ in many important demographic and health characteristics. Never drinkers are more likely to be African-American or Hispanic and have less education and income than infrequent drinkers. There is likely also variation among alcohol consumption groups for other influential but unobserved mortality risk factors. It is reasonable to assume that these characteristics account for some portion of the remaining observed mortality differences between alcohol consumption groups. These characteristics could include differences in diet, nutrition, and safety; access to health care and health insurance; and degree of social integration and interaction.

It is thus likely that the adjusted estimates presented here are still affected by residual confounding from unobserved and unmeasured mortality risk factors. We have tried to control for the most important risk factors in our analyses, but the results for external causes for women show that other differences in health and socioeconomic characteristics may still bias our estimates of the association between alcohol consumption and mortality. Similarly, the inclusion of reported health status in our analyses tended to move the estimated hazard ratios toward 1. To some extent, use of reported health status may help control for the effects of other unobserved mortality risk

factors, although it could also control for some of the effects of prior alcohol consumption. In general, these results suggest that the actual hazard ratios associated with alcohol consumption are closer to 1 than the adjusted results from our principal analyses would suggest.

The results presented here also suggest that many studies, including those not looking specifically at the US population, may have overestimated the protective mortality effects of alcohol consumption. This would be particularly true if these studies used never drinkers as their reference category. Di Castelnuovo et al. (2006), for example, presented a meta-analysis of 34 studies analyzing the relationship between alcohol intake and mortality and concluded that moderate alcohol consumption was associated with lower overall mortality. Unfortunately, none of the 56 analyses in these studies exclusively used lifetime infrequent drinkers as their reference category. In fact, Di Castelnuovo et al. specifically excluded four studies from the meta-analysis because these studies did not use their lowest alcohol consumption level as the reference category in their analyses. More than half (30) of the analyses considered by Di Castelnuovo et al. used never drinkers as the reference group. Another 14 used non-drinkers, consisting of never drinkers and former drinkers, as the reference group, even though results presented here indicate that former drinkers tend to have the highest mortality of any alcohol consumption group. 12 analyses used all infrequent drinkers, consisting of current and former infrequent drinkers, as the reference group. Unfortunately, Di Castelnuovo et al. pooled together the 26 studies using non-drinkers or all infrequent drinkers as the reference groups for their regression analysis, thus making it impossible to know if the

observed protective mortality effect of moderate alcohol consumption was reduced when infrequent drinking was used as the reference category.

This study is subject to certain limitations due to the methodological complications involved in analyzing the relationship between alcohol consumption and mortality. Some studies have categorized drinking frequency and intensity in ways that differ slightly from the categories presented here, and these differences in categorization could produce slightly different estimates of mortality risk. The use of lifetime infrequent drinkers as the reference category could conceivably underestimate any protective mortality effect of alcohol consumption, although any such effect would generally be very small given the very low levels of alcohol consumed by these individuals. It should also be noted that this study has generally estimated the lifetime cumulative effects of alcohol consumption on mortality risk. The particular effects of alcohol consumption during the follow-up period could be further isolated by the inclusion of reported health status and baseline health conditions such as heart disease as control variables in the analysis. Alcohol consumption information was reported at baseline in the study, and drinking behavior among survey participants may have differed before and after this point. Further study is also needed into the causes of the large mortality differences between US female never and lifetime infrequent drinkers that have been observed here and in previous research.

In general, the methods used here should provide an improved understanding of the relative mortality risks of alcohol consumption in the US. The patterns of mortality risk that we have identified here are consistent with previous analysis of NHIS data (Liao, McGee, Cao, & Cooper, 2000). The magnitude of mortality differences that we

have estimated are consistent with previous results from meta-analyses (Corrao, Rubbiati, Bagnardi, Zambon, & Poikolainen, 2000, Di Castelnuovo et al., 2006), which have typically found maximum mortality reductions associated with alcohol consumption of around 20%. The results presented here suggest that some previous research may have overestimated the reductions in mortality risk associated with alcohol consumption in this population. Some analyses, for example, have found that never or infrequent drinkers have more than 60% or 70% higher mortality than occasional or moderate drinkers. Our analysis indicates that differences of this magnitude may be somewhat overstated. Even so, our study is also subject to data limitations concerning alcohol consumption and unobserved mortality risk factors, and care should also be taken in interpreting the results presented here.

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ibution of alcohol consumption levels among 1997-2004 National Health Interview Survey Sample Adult Questionnaire participants
characteristics

	Never Drinker (n=56515)	Former Drinker (n=37340)	Infrequent Drinker (n=17797)	Light Drinker (n=40147)	Moderate Drinker (n=53373)	Heavy Drinker (n=32687)
	0.156 (0.002)	0.154 (0.002)	0.048 (0.001)	0.164 (0.002)	0.207 (0.002)	0.272 (0.002)
	0.292 (0.003)	0.148 (0.001)	0.100 (0.001)	0.186 (0.002)	0.162 (0.002)	0.113 (0.002)
	0.182 (0.003)	0.155 (0.002)	0.074 (0.001)	0.195 (0.002)	0.199 (0.002)	0.195 (0.002)
ican	0.341 (0.005)	0.170 (0.003)	0.081 (0.002)	0.117 (0.002)	0.153 (0.003)	0.138 (0.003)
	0.405 (0.008)	0.108 (0.005)	0.083 (0.004)	0.146 (0.005)	0.119 (0.004)	0.138 (0.006)
	0.345 (0.004)	0.118 (0.002)	0.072 (0.002)	0.119 (0.002)	0.134 (0.002)	0.222 (0.003)
	0.362 (0.003)	0.209 (0.001)	0.061 (0.001)	0.098 (0.002)	0.099 (0.002)	0.171 (0.002)
	0.242 (0.003)	0.170 (0.001)	0.082 (0.001)	0.142 (0.002)	0.159 (0.002)	0.205 (0.002)
	0.170 (0.002)	0.119 (0.001)	0.076 (0.001)	0.221 (0.002)	0.227 (0.002)	0.187 (0.002)
overty Level						
	0.349 (0.006)	0.176 (0.003)	0.062 (0.002)	0.090 (0.002)	0.116 (0.003)	0.207 (0.005)
	0.322 (0.005)	0.195 (0.003)	0.068 (0.002)	0.106 (0.003)	0.115 (0.003)	0.193 (0.004)
	0.279 (0.005)	0.186 (0.004)	0.077 (0.002)	0.130 (0.003)	0.136 (0.003)	0.191 (0.004)
	0.166 (0.002)	0.133 (0.001)	0.079 (0.001)	0.202 (0.002)	0.217 (0.002)	0.203 (0.002)
	0.334 (0.003)	0.114 (0.001)	0.085 (0.001)	0.176 (0.002)	0.162 (0.002)	0.128 (0.002)
	0.102 (0.002)	0.150 (0.002)	0.068 (0.001)	0.123 (0.002)	0.201 (0.002)	0.357 (0.003)
	0.096 (0.002)	0.238 (0.003)	0.057 (0.001)	0.226 (0.002)	0.217 (0.002)	0.166 (0.002)
	0.235 (0.003)	0.127 (0.002)	0.072 (0.001)	0.190 (0.002)	0.191 (0.002)	0.186 (0.002)
	0.204 (0.002)	0.153 (0.002)	0.069 (0.001)	0.174 (0.002)	0.195 (0.002)	0.205 (0.002)
	0.232 (0.003)	0.190 (0.002)	0.087 (0.002)	0.150 (0.002)	0.158 (0.002)	0.183 (0.002)
	0.211 (0.002)	0.108 (0.001)	0.075 (0.001)	0.151 (0.001)	0.205 (0.002)	0.250 (0.002)
	0.253 (0.003)	0.224 (0.002)	0.074 (0.001)	0.217 (0.002)	0.147 (0.002)	0.084 (0.001)

arentheses.

Table 2. All-cause mortality hazard ratios by alcohol consumption level and sex: 1997-2004 National Health Interview Survey Sample Adult Questionnaire participants followed for mortality through the end of 2006

Alcohol Consumption Level	Males					
	Unadjusted		Adjusted		Adjusted w/ Health Status	
	HR	95% CI	HR	95% CI	HR	95% CI
Never Drinkers	1.13	0.98, 1.29	1.09	0.95, 1.26	1.06	0.92, 1.22
Former Drinkers	1.59	1.39, 1.81	1.36	1.19, 1.56	1.24	1.08, 1.43
Infrequent Drinkers	1.00		1.00		1.00	
Light Drinkers	0.90	0.79, 1.03	0.91	0.80, 1.05	0.97	0.84, 1.11
- Occasional Light Drinkers	0.95	0.82, 1.09	0.96	0.83, 1.11	0.99	0.86, 1.15
- Regular Light Drinkers	0.80	0.69, 0.94	0.82	0.70, 0.96	0.91	0.78, 1.06
Moderate Drinkers	0.91	0.79, 1.05	0.87	0.75, 1.01	0.95	0.82, 1.11
- Occasional Moderate Drinkers	0.91	0.77, 1.06	0.86	0.74, 1.02	0.92	0.78, 1.08
- Regular Moderate Drinkers	0.92	0.78, 1.08	0.88	0.75, 1.04	1.00	0.85, 1.19
Heavy Drinkers	1.36	1.18, 1.57	1.09	0.94, 1.26	1.15	0.99, 1.33
- Occasional Heavy Drinkers	1.18	1.01, 1.38	0.95	0.81, 1.11	1.01	0.86, 1.19
- Regular Heavy Drinkers	1.61	1.38, 1.88	1.27	1.09, 1.49	1.31	1.12, 1.54

Alcohol Consumption Level	Females					
	Unadjusted		Adjusted		Adjusted w/ Health Status	
	HR	95% CI	HR	95% CI	HR	95% CI
Never Drinkers	1.45	1.30, 1.62	1.49	1.33, 1.67	1.34	1.19, 1.50
Former Drinkers	1.84	1.64, 2.05	1.58	1.41, 1.77	1.40	1.25, 1.57
Infrequent Drinkers	1.00		1.00		1.00	
Light Drinkers	0.97	0.86, 1.08	0.97	0.86, 1.09	1.01	0.90, 1.14
- Occasional Light Drinkers	0.96	0.85, 1.08	0.97	0.86, 1.10	1.00	0.88, 1.12
- Regular Light Drinkers	0.95	0.81, 1.03	0.96	0.81, 1.14	1.08	0.91, 1.28
Moderate Drinkers	1.01	0.88, 1.17	0.90	0.79, 1.04	0.98	0.85, 1.13
- Occasional Moderate Drinkers	0.90	0.78, 1.05	0.80	0.69, 0.93	0.86	0.74, 0.99
- Regular Moderate Drinkers	1.30	1.06, 1.60	1.19	0.97, 1.46	1.35	1.09, 1.67
Heavy Drinkers	1.60	1.36, 1.88	1.17	0.99, 1.38	1.19	1.02, 1.40
- Occasional Heavy Drinkers	1.37	1.14, 1.65	1.00	0.83, 1.21	1.03	0.86, 1.24
- Regular Heavy Drinkers	2.22	1.76, 2.78	1.63	1.29, 2.06	1.61	1.29, 2.02

Abbreviations: CI, Confidence Interval; HR, Hazard Ratio.

Note: Adjusted hazard ratios were estimated controlling for race/ethnicity, educational attainment, marital status, family income, smoking status, and body mass index. Adjusted hazard ratios with health status were estimated with these control variables as well as reported health status.

Table 3. Adjusted mortality hazard ratios for selected causes by alcohol consumption level and sex: 1997-2004 National Health Interview Survey Sample Adult Questionnaire participants followed for mortality through the end of 2006

Alcohol Consumption Level	Males							
	Ischemic Heart Disease		Cerebrovascular Disease		Other Circulatory Disease		External Causes	
	HR	95% CI	HR	95% CI	HR	95% CI	HR	95% CI
Never Drinkers	1.05	0.80, 1.39	1.39	0.74, 2.62	1.41	0.90, 2.20	0.85	0.48, 1.49
Former Drinkers	1.26	0.97, 1.65	1.61	0.85, 3.03	1.55	1.00, 2.40	1.62	0.94, 2.80
Infrequent Drinkers	1.00		1.00		1.00		1.00	
Light Drinkers	0.81	0.62,1.07	0.86	0.44, 1.65	1.04	0.64, 1.69	1.06	0.59, 1.91
Moderate Drinkers	0.68	0.50, 0.91	1.15	0.60, 2.19	0.82	0.51, 1.32	1.22	0.69, 2.15
Heavy Drinkers	0.92	0.69, 1.23	0.99	0.52, 1.89	1.26	0.76, 2.09	1.23	0.70, 2.16

Alcohol Consumption Level	Females							
	Ischemic Heart Disease		Cerebrovascular Disease		Other Circulatory Disease		External Causes	
	HR	95% CI	HR	95% CI	HR	95% CI	HR	95% CI
Never Drinkers	1.53	1.19, 1.97	1.65	1.21, 2.43	1.56	1.13, 2.14	2.06	1.15, 3.69
Former Drinkers	1.78	1.37, 2.32	1.97	1.32, 2.93	1.63	1.16, 2.28	1.75	0.96, 3.18
Infrequent Drinkers	1.00		1.00		1.00		1.00	
Light Drinkers	0.75	0.56, 1.01	1.33	0.90, 1.95	1.04	0.74, 1.47	1.08	0.57, 2.03
Moderate Drinkers	0.79	0.52, 1.19	1.01	0.55, 1.87	0.89	0.60, 1.32	1.75	0.97, 3.15
Heavy Drinkers	1.24	0.81, 1.89	2.09	1.20, 3.62	0.87	0.49, 1.54	1.99	1.07, 3.68

Abbreviations: CI, Confidence Interval; HR, Hazard Ratio.
Note: Hazard ratios were estimated controlling for race/ethnicity, educational attainment, marital status, family income, smoking status, and body mass index.