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Alcohol Consumption Patterns, Beverage Type, and Long-Term Mortality among Women Survivors of Acute Myocardial Infarction

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Abstract

Although moderate alcohol drinkers have lower rates of incident coronary artery disease (CAD) than abstainers, much less is known about the health effects of different patterns of alcohol use in women with established CAD. In the Determinants of Myocardial Infarction Onset Study, 1,253 women hospitalized for acute myocardial infarction (AMI) in 64 centers nationwide from 1989–1996 were followed for mortality through 12/31/2007. Of the women, 761 (61%) reported abstinence in the year prior to their MI, 280 (22%) reported consumption of <1 serving/week, 75 (6%) reported consumption of 1–3 servings/week, and 137 (11%) reported consumption of 3 or more servings/week. Using Cox proportional hazards models, we investigated the associations between total weekly volume of consumption, drinking days/week, drinks/drinking day, and beverage type with 10-year mortality adjusting for clinical and socioeconomic potential confounders. Compared with abstinence, adjusted hazard ratios and 95% confidence intervals were 0.66 (0.50, 0.86) for <1 serving/wk, 0.65 (0.38, 1.11) for 1–3 servings/wk, and 0.65 (0.38, 1.11) for 3 or more servings/wk (p-trend 0.008). We found no differences by beverage type and generally inverse associations of both drinking frequency and quantity with mortality. In conclusion, in women who survive MI, moderate drinking is associated with a decreased risk of mortality, with no clear differences on the basis of pattern or beverage type. Our results suggest that women who survive MI need not abstain from alcohol, but any derived benefit would appear to occur well below currently recommended limits in alcohol consumption.

Keywords

alcohol; myocardial infarction; mortality; women

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Introduction

We studied mortality following acute myocardial infarction (AMI) as a function of weekly total alcohol consumption, consumption pattern, and beverage type, in the year prior to AMI in women enrolled in the Determinants of Myocardial Infarction Onset Study (the Onset study).¹ This multicenter, prospective cohort study included chart reviews and face-to-face interviews with patients who were hospitalized with confirmed AMI.

Methods

The first phase of the Onset Study was conducted in 45 community hospitals and tertiary care medical centers in the United States between August 1989 and September 1994 and was then expanded to 64 medical centers through September 1996. Altogether, 1,259 women enrolled in the study. We excluded patients with missing information on usual alcohol consumption (n=1) and those with a history of alcoholism who reported current abstinence (n=5), leaving 1,253 patients for analysis. The institutional review board of each center approved this protocol and all participants provided informed consent. For the analyses in this paper, approval was obtained from the Beth Israel Deaconess Medical Center Committee on Clinical Investigations.

Trained research interviewers identified all eligible patients by reviewing coronary care unit admission logs and patient charts. For inclusion, patients were required to have a creatine kinase level above the upper limit of normal for the clinical laboratory at each center, positive MB isoenzymes, an identifiable onset of pain or other symptoms typical of AMI, and the ability to complete a structured interview. Interviewers used a structured data abstraction and questionnaire form. Patients were interviewed during their initial inpatient admission for the AMI after they had been medically stabilized.

Participants reported average frequency during the past year of consumption (and corresponding numbers of drinks) of wine, beer, and liquor individually. We determined each patient's average weekly ethanol consumption from wine, beer, and liquor based upon the average ethanol content for a serving of each beverage type reported in the early 1990's (i.e., 13.2 g for beer, 10.8 g for wine, and 15.1 g for liquor). We defined a standard serving of alcohol as 13.7 g of ethanol and categorized average alcohol consumption as none, <1 serving/week, 1 to <3 servings/week, or ≥ 3 servings/week.² We also subdivided the <1 serving/week category into <1 serving/month and from 1 serving/month to <1 serving/week to assess for any dose-response pattern among the lightest drinkers. Patients who reported drinking a certain beverage type but did not say how much they drank on each occasion were assigned the median value of 1 drink/drinking occasion for each beverage type (n=70). Results were similar when these patients were excluded from analyses (results not shown).

To assess drinking patterns, we analyzed drinking frequency in drinking days/week and drinking quantity in drinks/drinking day. Patients were asked how often they drank each of the 3 beverage types individually, so for the drinking days/week analyses, we summed up the days/week that patients reported drinking beer, wine, or liquor, assuming these were drunk on separate days. As a sensitivity analysis, we made the opposite assumption: that all beverages were consumed on the same day(s). Drinking days/week were categorized into abstainers (0 days/week), <1 day/week, 1 to <3 days/week, or 3 to 7 days/week. For drinks/drinking day analyses, we again assumed that all drinks were consumed on separate days, and made the opposite assumption as a sensitivity analysis. These were categorized into ≤ 1 drinks/drinking day or >1 drink/drinking day. For the frequency and volume per drinking occasion analyses we performed a sensitivity analysis by adding total alcohol intake as a covariate. For beverage specific analyses, weekly consumption of each beverage type was

categorized into 0 drinks/week, <1 drink/week, or ≥ 1 drinks/week. As a measure of heavy episodic drinking during the preceding year, patients reported the usual frequency with which they consumed ≥ 3 drinks in 1 to 2 hours for each of the beverage types.

Other information collected included age, sex, medical history from chart review, smoking history, and prescription and nonprescription medication use. During the chart review, interviewers recorded complications of congestive heart failure or ventricular arrhythmias based on clinical diagnoses documented in medical records and all creatine kinase values available at the time of chart review. We used 1990 US census data to derive median household income from census block groups. We defined noncardiac comorbidity as any diagnosis of cancer, respiratory disease, renal failure, or stroke recorded in medical records. We derived body-mass index based upon self-reported height and weight. Patients were asked their usual frequency of heavy physical activity using a validated instrument.¹ As with previous Onset Study analyses,¹ we categorized the usual frequency of physical activity as activity ≥ 6 MET in the following frequencies: <1 time/week, 1–4 times/week, or >4 times/week.

We searched the National Death Index for deaths of Onset study participants through December 31, 2007, and requested death certificates from state offices of vital statistics records for all probable matches using a previously validated algorithm.³ Three physicians blinded to exposure data independently verified the determination of each death. Disagreements among raters were resolved by discussion. The outcome measure in all analyses was all-cause mortality after 10 years of follow-up.

We performed univariate comparisons of continuous and binary variables using ANOVA and χ^2 or Fisher exact tests, respectively. We used Cox proportional hazards models to examine the independent effect of alcohol use on mortality. We performed separate analyses for weekly total alcohol consumption, drinking days/week, drinking sessions/day, beverage-specific analyses, and heavy episodic drinking. In all models, we adjusted for age, body mass index (as linear and quadratic terms), previous AMI (yes, no, uncertain), previous congestive heart failure, previous angina, diabetes mellitus, hypertension, noncardiac comorbidity, previous medication use (aspirin, β -blockers, calcium channel blockers, digoxin, and angiotensin-converting enzyme inhibitors individually), current/previous smoking, frequency of physical activity (in 3 categories), household income (in quartiles), education (in 3 categories), marital status (married/single), race, and measures of index AMI treatment and severity (peak creatine kinase level, receipt of thrombolytic therapy, and congestive heart failure and ventricular tachycardia during hospitalization). We used indicator variables for missing education (n=26), marital status (n=15) and income (n=23). For patients missing BMI (n=16) we assigned the mean value.

We tested hazard ratios (HRs) for linear trend across alcohol consumption categories. We tested the proportionality of hazards using time-varying covariates and Schoenfeld residuals and found no significant violations. We present HRs from Cox models with 95% confidence intervals (CIs). All probability values are 2-sided.

Results

Characteristics of the women according to alcohol consumption are shown in Table 1. The median consumption in the heavier consumption group was 7.6 servings/week, and only 31 women in the study drank >14 servings/week. Higher alcohol consumption was associated with younger age, current/former smoking, higher household income, and higher educational attainment. It was inversely associated with cardiac morbidity and use of cardiac medications.

Table 2 shows HRs for all-cause mortality after 10 years of follow up according to average weekly alcohol consumption. Alcohol consumption was associated with lower mortality in age-adjusted and fully-adjusted models, although the strength of this association was somewhat attenuated in the fully-adjusted models. We also subdivided the group of lightest drinkers into <1 serving/month and ≥ 1 serving/month but <1 serving/week, and found that there was no significant difference between abstainers and those drinking <1 serving/month (HR 0.73, 95% CI 0.43, 1.23, $p=0.23$).

The results of the 3 drinking patterns analyses: frequency, volume per drinking occasion, and beverage type, are shown in Figure 1. Panel A shows HRs for those drinking <1, <3, or 3 or more days per week, compared to abstainers, assuming that all beverage types were drunk on different days. There was no difference among the 3 patterns of weekly drinking days, and all were associated with a lower rate of mortality, compared to abstention. As a sensitivity analysis we made the opposite assumption, that all beverages were consumed on the same day(s); results were nearly identical.

Figure 1 Panel B shows the association between the number of drinks/drinking day and mortality, assuming that all beverage types were drunk on separate days. There was no difference between drinking >1 drink/drinking day versus drinking ≤ 1 drink/drinking day. When we made the opposite assumption, that all beverages were consumed on the same day(s), results were nearly identical. For the frequency and volume per drinking occasion analyses we performed a sensitivity analysis by adding total alcohol intake as a covariate; however the results were nearly unchanged.

In models including consumption of each of the 3 beverage types, there was no significant difference in HRs for the different types of drinking (Figure 1 Panel C).

In the fully adjusted models, the HR for heavy episodic drinkers compared to non-heavy episodic drinkers was 0.68 (95% CI 0.27, 1.70). However, there were only 53 women who reported binge drinking, and these women tended to be far healthier (i.e. many fewer cardiac or non-cardiac comorbidities) compared to other current drinkers.

Discussion

In this prospective cohort study of early female survivors of AMI, moderate alcohol consumption at the time of index hospitalization was associated with a decreased risk of 10-year all cause-mortality. All patterns of alcohol consumption were protective when compared to abstention, and there were no significant differences among specific beverage types or specific alcohol consumption patterns.

We know of no prior studies specifically in women that studied the relationship between alcohol consumption patterns and mortality after acute MI. However, our results are in keeping with our previous results for the first half of the Onset Study (in men and women), in which we found that moderate alcohol consumption was associated with reduced mortality after AMI.⁴

In this study, all levels of drinking days/week were inversely associated with mortality, as compared to abstainers, with no significant difference among those who drank <1, 1–3, or 3 or more days/week. The nonsignificant HRs for the patients with higher alcohol consumption likely reflect the relatively small numbers of patients in these groups. Although studies in men appear to support drinking frequency as the most important determinant of lower risk of coronary artery disease, this has not necessarily been true in women. Indeed, 2 previous studies of incident MI in women found similar magnitudes of lower risk across a range of drinking frequencies similar to ours.^{5,6} Because women have a longer effective

exposure to alcohol following intake than men given their lower gastric alcohol dehydrogenase activity,⁷ it is possible that even infrequent consumption has biological importance in women.

We found that all categories of drinks/drinking day were inversely associated with mortality compared to abstainers, but there was no clear difference between the specific numbers of drinks/day and mortality. These results are similar to those from a western New York State study, which did not find an association between drinks/drinking day and mortality, except that any number of drinks/drinking day was associated with lower risk of incident MI.⁶ However, it is important to note that the range of variability in drinks consumed per drinking day was quite limited, and hence our results do not support relaxation of the currently recommended limits on quantity of alcohol consumed by women per drinking day.

In keeping with previous findings, we did not find a significant difference in effect among the different beverage types. A recent meta-analysis of the effect of alcohol consumption on biological markers associated with risk of coronary heart disease similarly found no difference in effect across beverage types.⁸ In another meta-analysis that examined the separate effects of wine and beer on risk of cardiovascular disease, results were largely similar across beverage types.⁹

We did not find an association between heavy episodic drinking and mortality, which may be in part due to low power given that few women reported heavy episodic drinking. In our analysis of the relationship between binge drinking and mortality in the first half of the Onset study, we found that binge drinking was associated with 2-fold higher mortality; however, 94% of the binge drinkers were men.¹⁰

Some abstainers at the time of MI may be former drinkers who quit because of illness, and combining these groups into 1 category may overestimate the risk of abstinence, the so-called “sick quitter effect.” Roerecke et al.’s recent meta-analysis showed that former drinkers and life-time abstainers have dissimilar risks of ischemic heart disease mortality and morbidity.¹¹ Specifically, in women, the relative risk estimate for mortality for former drinkers compared to lifetime abstainers was 1.54, although there was a great deal of heterogeneity among studies.¹¹ In our study, we were unable to differentiate between these 2 groups as participants were not asked about prior drinking habits. However, even if we assume that half of the 761 current abstainers were former drinkers, this would not explain a risk as low as we observed for current drinkers vs. current abstainers.

As with any observational study, the associations we observed could be partially accounted for by differences between alcohol drinkers and abstainers. Alcohol consumers tend to be more physically active and have higher socioeconomic status than abstainers, as they did in our study.¹² Furthermore, the abstainers were on average less healthy at the time of their MI. Although we did include a number of SES variables, physical activity, and health-related covariates, residual confounding by these factors (as well as by unmeasured factors) may exist.

We asked patients to report their usual alcohol consumption prior to their AMI; however, we do not know if their drinking habits changed after the MI. If the pre- and post- MI drinking patterns are not correlated, then the true effect of post-AMI alcohol consumption on survival could be different than that reported here. However, among 711 men who had an AMI in the Health Professionals Follow-Up Study, the correlation between alcohol consumption before and after AMI was high ($r = 0.79$), while the median absolute change in consumption was minimal (Eric B. Rimm, ScD, written communication, 2000). Similarly, in a study of Dutch men, alcohol consumption following AMI was only slightly lower than consumption prior to AMI.¹³

In general patients underreport alcohol intake, so the actual number of servings that study participants consumed could be different from the values here.¹⁴ Such underreporting is unlikely to affect the rank order of alcohol consumption among study participants and thus should not affect the internal validity of our results. However, this type of underreporting could explain the potential benefit we observed among women who reported only occasional alcohol consumption.

In conclusion, our results suggest that women who survive an MI need not abstain from alcohol consumption and indeed might have lower risk of mortality if they do so, but equally that any derived benefit would appear to occur well below currently recommended limits in alcohol consumption.

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Figure 1.

Panel A shows the hazard ratios for number of days/week on which alcohol is consumed and 10-year all cause mortality. Panel B shows hazard ratios for the number of drinks consumed on each drinking day, showing no difference between drinking >1 drink or <1 drinks per drinking day. Panel C shows the hazard ratios for each individual beverage type, adjusting for consumption of the other beverage types. No significant difference between the beverage types is seen. All models are adjusted for age, body mass index, previous MI, previous congestive heart failure, previous angina, diabetes mellitus, hypertension, noncardiac comorbidity, previous medication use (aspirin, β -blockers, calcium channel blockers, digoxin, and angiotensin-converting enzyme inhibitors individually), current/previous smoking, frequency of physical activity, household income, education, marital status, race, peak creatine kinase level, receipt of thrombolytic therapy, and congestive heart failure and ventricular tachycardia during hospitalization.

Table 1

Patient Characteristics by Drinking Type

Characteristics	Average Alcohol Consumption (servings/week)				p
	Abstainers (n=761)	<1 (n=280)	1 to <3 (n=75)	≥ 3 (n=137)	
Age, years, mean (SD)	68.1 (11.8)	64.5 (12.3)	60.0 (14.1)	61.9 (12.6)	<0.0001
White race	655 (86%)	251 (90%)	66 (88%)	123 (90%)	0.36
Married	325 (43%)	133 (48%)	38 (51%)	77 (56%)	0.019
Income, \$, mean (SD)	35,938 (17,010)	38,000 (16,560)	39,612 (15,741)	42,724 (19,015)	0.0002
Education					<0.001
Less than high school	231 (30%)	58 (21%)	14 (19%)	16 (12%)	
Completed high school	365 (48%)	138 (49%)	33 (44%)	63 (46%)	
Some college	148 (19%)	78 (28%)	25 (33%)	58 (42%)	
Body mass index, kg/m ² , mean (SD),	27.9 (6.2)	27.9 (5.7)	26.3 (4.8)	25.3 (4.5)	<0.0001
Smoking status					<0.001
Current	174 (23%)	95 (34%)	29 (39%)	67 (49%)	
Former	215 (28%)	104 (37%)	24 (32%)	46 (34%)	
Physical Activity (times/week)					0.014
<1	720 (94%)	251 (90%)	69 (91%)	124 (91%)	
1–4	29 (4%)	25 (9%)	7 (9%)	9 (7%)	
4+	12 (2%)	4 (1%)	0 (0%)	4 (3%)	
Morbidity					
Hypertension	419 (55%)	128 (46%)	33 (44%)	60 (44%)	0.0060
Diabetes Mellitus	283 (37%)	56 (20%)	9 (12%)	13 (9%)	<0.0001
Previous Myocardial Infarction	226 (30%)	54 (19%)	15 (20%)	18 (13%)	<0.0001
Angina	235 (31%)	68 (24%)	12 (16%)	24 (18%)	0.0005
Congestive Heart Failure	60 (8%)	5 (2%)	1 (1%)	1 (1%)	<0.0001
Regular use of					
Angiotensin-converting enzyme inhibitor	153 (20%)	29 (10%)	7 (9%)	14 (10%)	<0.0001
Aspirin	272 (36%)	106 (38%)	28 (37%)	44 (32%)	0.71
Beta blocker	192 (25%)	63 (23%)	15 (20%)	32 (24%)	0.65
Calcium channel blocker	246 (32%)	71 (25%)	15 (20%)	24 (18%)	0.0005

Characteristics	Average Alcohol Consumption (servings/week)					p
	Abstainers (n=761)	<1 (n=280)	1 to <3 (n=75)	≥ 3 (n=137)		
Digoxin	70 (9%)	19 (7%)	5 (7%)	4 (3%)		0.068
Index Hospitalization						
Thrombolytic use	229 (30%)	109 (39%)	25 (33%)	69 (50%)		<0.0001
Congestive Heart Failure	145 (19%)	44 (16%)	13 (17%)	24 (18%)		0.66
Ventricular Tachycardia	45 (6%)	21 (8%)	7 (9%)	15 (11%)		0.15
Peak Creatine kinase level, U/L, mean (SD)	1, 243 (1,633)	1,401 (1,565)	1,242 (1,380)	1,589 (2,317)		0.12

HRs for all-cause mortality after 10 years of follow up according to average weekly alcohol consumption

Table 2

	Average Alcohol Consumption (serving/week)				p-trend
	None (n=761)	<1 (n=280)	≥1 to <3 (n=75)	≥ 3 (n=137)	
All-cause mortality, n	331 (44%)	70 (25%)	15 (20%)	25 (18%)	---
Mortality rate per 100 person-years	5.8	2.9	2.3	2.0	---
Age adjusted HR (95%CI)	---	0.56 (0.44, 0.73)	0.51 (0.30, 0.85)	0.45 (0.30, 0.67)	<0.0001
Fully Adjusted * HR (95%CI)	---	0.66 (0.50, 0.86)	0.65 (0.38, 1.11)	0.71 (0.46, 1.09)	0.008

CI: confidence interval, HR: hazard ratio

* Model adjusted for age, body mass index, previous MI, previous congestive heart failure, previous angina, diabetes mellitus, hypertension, noncardiac comorbidity, previous medication use (aspirin, β -blockers, calcium channel blockers, digoxin, and angiotensin-converting enzyme inhibitors individually), current/previous smoking, frequency of physical activity, household income, education, marital status, race, peak creatine kinase level, receipt of thrombolytic therapy, and congestive heart failure and ventricular tachycardia during hospitalization.