Association between alcohol consumption and systolic ventricular function: A population-based study

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Background Although moderate alcohol consumption is associated with decreased clinical heart failure, there are no population-based studies evaluating the relationship between alcohol consumption and left ventricular (LV) systolic function. We sought to evaluate the relationship between alcohol consumption and LV systolic function in the community.

Methods In a population-based random sample of 2,042 adults, age ≥45 years, we assessed alcohol consumption by a self-administered questionnaire. Responders were categorized by alcohol consumption level: abstainer, former drinker, light drinker (<1 drink a day), moderate drinker (1-2 drinks a day), and heavy drinker (>2 drinks a day). Systolic function was assessed by echocardiography.

Results We identified 38 cases of systolic dysfunction in 182 abstainers, 309 former drinkers, 1,028 light drinkers, 251 moderate drinkers, and 146 heavy drinkers. A U-shaped relationship was observed between alcohol consumption and moderate systolic dysfunction (LV ejection fraction [LVEF] ≤40%), with the lowest prevalence in light drinkers (0.9%) compared to the highest prevalence in heavy drinkers (5.5%) (odds ratio 0.14, 95% CI 0.04-0.43). This association persisted across different strata of risk factors of systolic dysfunction as well as in multivariate analysis. No significant association between alcohol consumption and systolic function was seen in subjects with LVEF >50% or ≤50%.

Conclusions There is a U-shaped relationship between alcohol consumption volume and LVEF, with the lowest risk of moderate LV dysfunction (LVEF ≤40%) observed in light drinkers (<1 drink a day). These findings are parallel to the relationship between alcohol consumption and cardiovascular disease prevalence. (Am Heart J 2014;167:861-8.)

A U-shaped relationship exists between the level of alcohol consumption and prevalence of clinical heart failure.[1] Regular heavy alcohol consumption is associated with impairment of left ventricular (LV) function[2,3] and occasionally results in overt cardiomyopathy.[4] Alternatively, regular but moderate alcohol consumption is associated with prevention of heart failure.[5,6] Although this relationship between alcohol consumption and clinical heart failure has been extensively studied, the reverse parabolic association between alcohol consumption and ventricular systolic function has not been evaluated in a population-based study. Because both moderate drinking and heavy drinking are prevalent in the community, we hypothesized that moderate alcohol consumption would be associated not only with reduced prevalence of clinical cardiovascular disease but also with reduced prevalence of systolic dysfunction. We also postulated that heavy alcohol consumption would be associated with increased prevalence of LV systolic dysfunction. This hypothesis was tested in a randomly sampled, population-based cohort of 2,042 people ≥45 years old in Olmsted County, Minnesota.

Methods

The Olmsted County Heart Function Study was approved by the Mayo Foundation and Olmsted Medical Center Institutional Review boards, and written informed consent was obtained from the subjects. The present study was carried out with funding from US Public Health Services, National Institutes of Health, grant HL-RO1-555902. The authors are solely responsible for the design and conduct of this study, all study analyses, the drafting and editing of the paper, and its final contents.

Study setting

Of the 124,277 residents of Olmsted County, as of the 2000 census, 90% were white. Other characteristics of this

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population and its unique resources for population-based epidemiological research have been previously described.[7,8]

Population sampling and data collection

A random sample of residents ≥45 years old as of January 1, 1997, was identified. A 7% sampling fraction was applied within each gender- and age- (5 years) specific stratum. Of the 4,203 subjects invited, 2,042 (48.6%) participated. Enrollment took place from January 1, 1997, to September 30, 2000. Subjects completed a self-administered questionnaire and underwent physical examination, electrocardiography, and echocardiography.

Definitions of selected clinical conditions

Medical record review was carried out by 4 trained chart abstractor nurses. The median length of participant medical record archive was 36 years. Heart failure was diagnosed if Framingham criteria were fulfilled.[9,10] Myocardial infarction and hypertension were diagnosed with criteria from the World Health Organization and Sixth Report of the Joint National Committee, respectively.[11,12] Coronary artery disease, angina, diabetes, cerebrovascular accident, transient ischemic attack, and peripheral vascular disease were diagnosed if documented by a physician. Angina was assessed based on a self-administered questionnaire by Rose et al.[13] Previous smokers were those who had smoked ≥100 cigarettes in the past but were not currently smoking. In accordance with the National Cholesterol Education Program Adult Treatment Panel III criteria,[14] metabolic syndrome was defined by the presence of ≥3 of the following criteria: (1) *central obesity* defined as a waist circumference ≥102 cm in men and ≥88 cm in women, (2) triglyceride level >150 mg/dL (to convert to millimoles per liter, multiply by 0.0113), (3) high-density lipoprotein cholesterol level <40 mg/dL in men and <50 mg/dL in women (to convert to millimoles per liter, multiply by 0.0259), (4) blood pressure of ≥130/85 mm Hg, and (5) fasting glucose level of ≥110 mg/dL (to convert to millimoles per liter, multiply by 0.0555).

Anthropometric measurements were carried out by a trained research nurse with the subjects in the standing position. Body mass index was measured as weight (kilograms)/height (meters).[2]

Echocardiographic analysis

All subjects underwent echocardiography following a standardized protocol as previously described.[15-17] A single cardiologist, blinded to clinical status, interpreted all echocardiograms.

Measurement of LV systolic function

Ejection fraction was measured using M-mode echocardiography, 2-dimensional echocardiography by Simpson's biplane method, and visual estimate. As LV ejection fraction (LVEF) from these 3 methods was highly correlated and the visual estimate was available in >99% of participants, visual estimate was used in analysis.

Quantification of alcohol consumption

Subjects completed a self-administered questionnaire that first asked if they had ever consumed alcohol. A negative answer resulted in classification as an abstainer. Then they were asked if alcohol had been consumed in the last 12 months. A negative answer resulted in classification as a former drinker. An affirmative answer to both questions led the subject to 3 separate sections on beer, wine, and liquor. The 12 frequency categories ranged from 3 to 4 times a day to once a year. The 16 quantity categories ranged from 1 to ≥16 drinks per day. The estimated alcohol content per drink was 12.8 g for beer, 11 g for wine, and 14 g for spirits (liquor or whiskey). Responders were categorized further by alcohol consumption level: light drinker (<1 drink a day, <11 g/d), moderate drinker (1-2 drinks a day, 11-28 g/d), and heavy drinker (>2 drinks a day, >28 g/d).

Statistical analysis

Categorical data are summarized as a percentage of the group total with corresponding 95% CI based on normal approximation, and comparison between groups was based on the χ^2 test for association. Continuous variables are summarized as mean ± standard deviation, and comparisons between groups were based on analysis of variance models. Post–analysis of variance comparisons of continuous variables were based on *t* test, but no adjustments for multiple comparisons were made. Multivariate analysis was carried out with logistic regression for categorical variables and multiple linear regressions for continuous variables. Two-sided *P* values <.05 were considered significant. Analyses were performed using JMP Genomics, 5.0 (SAS Institute, Cary, NC).

Results

Characteristics of study participants

Letters of invitations were sent to 4,203 individuals. Of the 2,042 individuals (48.6%) who participated, 1,916 (941 men and 975 women) had valid data and were included in the present analysis. The majority of participants were light drinkers (n = 1,028, 53.7%), with smaller proportions of abstainers (n = 182, 9.5%), former drinkers (n = 309, 16.1%), moderate drinkers (n = 251, 13.1%), and heavy drinkers (n = 146, 7.6%). Table I shows the baseline characteristics of participants categorized by their alcohol consumption habits. Abstainers were more likely to be women, were less likely to be smokers, but were found to have a high prevalence of diabetes mellitus and hypertension. Light drinkers (<1 drinks a day) represented a healthy subset of the population with the lowest mean age, 2% current smokers, 6% diabetic, and 27% hypertensive. Heavy