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Effects of alcohol consumption on blood pressure in hypertensive women

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Abstract

Background—Problem drinking carries significant health burdens, including an increased risk of hypertension. The effect of chronic alcohol intake on blood pressure (BP) in women is understudied and poorly understood.

Objectives—We sought to examine the relationships between drinking habits and BP in hypertensive women.

Methods—We analyzed drinking habits in 113 women followed in the Brigham and Women's Hospital Hypertension Clinic for at least one year.

Results—Among these women with well-controlled hypertension, baseline diastolic BP was significantly lower in moderate drinkers compared with women who rarely or never drank. Changes in both systolic and diastolic BP over 12 months showed a significant negative association with changes in percent drinking days. In contrast, there was a trend toward higher baseline systolic BP among those women who consumed more drinks per drinking day.

Conclusions—Among these women with controlled hypertension, our data failed to demonstrate an association between drinking beyond recommended limits and higher disease burden. These findings parallel the widely reported difference between drinking frequency, associated with a host of positive health outcomes, and drinking intensity, associated with negative outcomes. Novel to this report is an observed reduction in blood pressure over the one-year follow-up period accompanying an increased drinking frequency in treated hypertensive women.

Cautions include the suggestion that greater number of drinks per drinking day was associated with higher baseline pressure. These data imply that drinking within sensible limits has no negative impact on chronic hypertension. In fact, for women with well-controlled hypertension, such a habit may impart benefit.

INTRODUCTION

The relationship between alcohol consumption and cardiovascular health in women is complex. Moderate compared to no alcohol consumption has been shown to decrease the risk of cardiovascular disease, including stroke and myocardial infarction, by up to 30%, yet excessive consumption of alcohol is often cited as one of the most common reversible causes of hypertension (O’Keefe et al., 2007). This dichotomy is supported by conflicting results from experimental and epidemiologic studies. Because of the known risks of high drinking levels for hypertension, stroke, hepatitis, abuse and violence, most authorities and guidelines do not recommend alcohol consumption to reduce risk. Rather, alcohol appears in guidelines as a focus for reduction of excessive intake as a lifestyle modification for the lowering of heart disease [Cushman JCH 2001].

While public health guidelines for alcohol consumption differ, many recommend limiting alcohol intake to ≤ 1 drink/day for women (≤ 2 drinks/day for men; one drink is considered a 12-ounce beer, 4 ounces of wine, 1.5 ounces of 80-proof spirits or 1 ounce of 100-proof spirits) (Lichtenstein et al., 2006; Pearson, 1996; Mosca et al., 1999; USDA & USDHHS, 2010). The American Heart Association and the American Diabetes Association warn that exceeding these limits can increase the risk for hypertension and diabetes (Mosca et al., 1999; Bantle et al., 2008). The lifetime risk of harm from drinking alcohol increases with the amount of alcohol consumed, yet a paucity of scientific evidence supports the limitation of one drink daily for women. Australian guidelines, for example, state that drinking no more than *two* standard drinks on any day reduces the lifetime risk of harm from alcohol-related disease (National Health and Medical Research Council, 2009). The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure, the last widely accepted American guideline, states that less than 30g of ethanol a day (about 2 drinks) is not associated with a blood pressure increase regardless of gender (Chobanian et al., 2003). There was no new guidance from the panel who prepared the eight JNC report [James et al, 2014].

In this report we studied the association between several measures of alcohol intake and blood pressure control, in a cohort of 113 women followed in a Hypertension Clinic in Boston, Massachusetts.

METHODS

Women in this study were part of a larger randomized control trial of a brief intervention against alcohol excess in over 500 women with a medical diagnosis of diabetes, hypertension, infertility, or osteoporosis (Chang et al., 2011). The group reported here included all with the diagnosis of hypertension (n=113), defined either by preexisting high blood pressure on more than one visit (SBP $\geq$ 140 or DBP $\geq$ 90 mm Hg), or taking at least one blood pressure medicine during the study. Most were seen in the Hypertension Specialty Clinic at the Brigham and Women’s Hospital. Blood pressure was measured by an automatic recording device by a trained medical assistant (Dinamap, Critikon Inc, Tampa, FL, USA). The study was reviewed and approved by the Partners HealthCare Institutional Review Board. A federal Certificate of Confidentiality was obtained (Number AA-30–2005). All

participants followed institutional guidelines for consent, which was obtained in writing before participation in the study.

All potential participants completed the initial screening measure, the Women's Health Habits Survey, which contained written questions about usual quantity and frequency of alcohol intake, and the T-ACE, a four-item alcohol screen based on the CAGE, with good to excellent results in identifying risky drinking by women (Gupman et al., 2002; McQuade et al., 2000; Stevenson & Masters, 2005). No woman was receiving treatment for alcohol or drug use disorders and none was pregnant or nursing. Participants were randomized to either an active control or a treatment condition. All subjects underwent an initial assessment interview and a 12-month interview. The treatment condition included an additional Brief Intervention (BI) based on NIH guidelines (National Institute on Alcohol Abuse and Alcoholism & Office of Research on Minority Health, 2000; National Institute on Alcohol Abuse and Alcoholism, 2005), a 30 minute session which included standard components of assessment and feedback; goal setting and contracting; behavioral modification; and written materials all specifically pertaining to the women's drinking patterns and health consequences. Women in the BI group had additional follow-up interviews at months three and six. We have previously shown that overall there were no differences in drinking outcome by treatment group (Chang et al., 2011); therefore women in both groups were analyzed together for this study.

Data analysis

Drinking habits during the 6-month period prior to study enrollment were identified to establish baseline, pre-study patterns of consumption. Follow-up drinking data were gathered at the 12-month interview for the preceding 6 months, and are the basis of the multivariate analyses of changes in blood pressures. For each of our outcome measures, the change in outcome was obtained by subtracting the 12-month from the baseline measure. The drinking measures were (a) drinks per drinking day (D/DD), (b) percent drinking days (% DD), (c) number of binge episodes in the six month period, with binges defined as four or more drinks per occasion; and (d) number of weeks exceeding National Institute on Alcohol Abuse and Alcoholism (NIAAA) sensible drinking limits. Low-risk drinkers (n=46) consumed no more than 3 drinks on any single day (i.e. no binges) and no more than 7 drinks per week, according to NIAAA guidelines (NIAAA, 2014). We also categorized women into three levels of drinking based upon a composite of measures, in order to identify women at extremes of intake. "Abstainers" (n=22) reported no binge drinking, no weeks in excess of sensible limits, and fewer than one drink per month. "Risky" drinkers (n=57) consumed three or more D/DD, which by definition included all subjects with binges and/or unsafe weeks. "Moderate" drinkers included the remaining 34 women. Baseline BP was measured within at least six months of start of study, but not after enrollment. Simple descriptive statistics were calculated and are reported as percentages, means, and standard deviations, as appropriate. The relationships between baseline drinking measures and our two baseline outcomes, systolic and diastolic blood pressure, were estimated using linear regression adjusted for subject age and the number of hypertension medications at baseline. The effect of changes in drinking behaviors on changes in blood pressure were estimated

using linear regression adjusted for baseline blood pressure, age and changes in the number of blood pressure medications. All analyses used the SAS statistical package (version 9.1).

RESULTS

Of the 511 women enrolled in the overall study, 113 were eligible for this analysis (mean age 52.1 ± 12.1). One third of all women were married; sixty percent were white and forty percent black. Mean BMI was in the obese category and education level was very high (Table 1).

These hypertensive women had well-controlled blood pressure ($130/80 \pm 16/11$ mm Hg) at study onset. At baseline there was a significant negative correlation between age and diastolic BP; ($r=-0.39$; $p<0.001$); smoking was associated with higher diastolic BP (mean DBP=87 (12) for smokers versus 79(11) for non-smokers; $p=.007$). Baseline drinking measures in the women revealed that they drank on average one out of every four days, and an average of just over two drinks per drinking day (Table 2). Binge drinking appeared to be the most problematic pattern of drinking (mean 8 binges in six months).

Baseline diastolic blood pressure (DBP) in women with Moderate intake was significantly lower by 5.6 mm Hg ($p=.03$) compared with Abstainers. There was no significant difference between systolic BP (SBP) in women with Moderate intake, nor in either BP parameter in Risky drinkers. While no individual drinking measure was significantly correlated with baseline BP, the number of drinks per drinking day neared significance, with each additional drink associated with a 1.7 mm Hg higher baseline SBP ($p=0.08$).

At the end of the 12-month follow-up, mean SBP and DBP among all women were essentially unchanged (Table 2). The majority of women (76%) had no changes in number of anti-hypertensive medications, while 16% reduced their medication burden and 8% increased it. Despite no significant change in any drinking measure after 12 months, there was a non-significant fall in the number of binges (7.9 to 6.3) as well as in the number of weeks exceeding safe limits (4.6 to 3.9; Table 2).

Analysis of baseline drinking measures with both baseline follow-up blood pressure revealed a significant negative association between percent drinking days at baseline and DBP, with DBP lower by 0.55 mm Hg for every 10% increase in the percent of drinking days ($p=0.04$).

The change in BP at the end of 12 months was negatively correlated with change in one drinking measure over this same time frame: percent drinking days. There was a significant fall in both SBP and DBP in analyses adjusted for age, baseline BP, and the change in hypertension medications, with a fall in blood pressure of 1.4/1.1 mm Hg accompanying a 10% increase in the percent of drinking days. ($p=0.045$ SBP, 0.01 DBP). To illustrate further the impact of changes in the percent of drinking days, subjects who increased drinking days by $>10\%$ (on average, from 20% to 46%) experienced an average reduction in blood pressure of 8.8/5.2 mm Hg. In contrast, subjects who decreased drinking days by $>10\%$ (on average, from 51% to 18%) experienced an average increase in blood pressure of 2.4/2.9 mm Hg. The contrasting changes in blood pressure between these two groups did not reach

statistical significance ($p=0.09$ for SBP; $p=0.08$ for DBP), but was suggestive of a benefit of moderate increases in the percent of drinking days.

In addition to drinking measures, we assessed effect of BMI on BP. There was a slight positive correlation between BMI and baseline BP, but it was not statistically significant, as anticipated in a treated population. However, BMI was negatively correlated

($r=-0.19$, $p=.04$) with percent drinking days: the more days a woman drank, the lower her BMI. Conversely, BMI was positively correlated with the number of drinks per drinking day ($r=0.26$, $p=.01$): the more drinks per drinking day, the higher the BMI. There were no significant correlations between BMI and binges or weeks over safe limits. Placement of BMI into analytic models that showed significant relationships between blood pressure and percent drinking days did not alter significance of the existing relationships.

DISCUSSION

In our cohort of over 100 women with hypertension, we report that baseline diastolic BP was significantly lower in women with moderate intake compared with abstainers. We also found a negative relationship between changes in the drinking measure of percent drinking days and changes in both SDP and DBP over one year. Our data failed to demonstrate an association between drinking beyond recommended limits and higher blood pressure. However, there was a trend toward higher baseline SBP among those women who consumed more drinks per drinking day. Our findings generally echo a widely reported difference between drinking frequency, which is positively associated with a variety of healthful outcomes, and drinking intensity, which is associated with poor outcomes. The novel finding is an observed reduction in blood pressure over time accompanying an increased drinking frequency in treated hypertensive women.

Several cross-sectional epidemiological studies have examined the relationship between alcohol consumption and high blood pressure, and suggest that excess drinking is associated with worse blood pressure control (Dyer et al., 1977; Klatsky et al., 1977; O'Keefe 2007). In fact, some experts consider alcohol abuse the most common cause of secondary hypertension (Clark, 1985). Among a cohort of 84,000 men and women, those who drank three or more drinks per day had significantly higher blood pressure than those who drank less (Klatsky et al., 1977). Consumption of 30 grams/day ethanol, equivalent to three standard drinks per day, was associated with a higher prevalence of hypertension among 1000 Brazilians (OR 2.9; Moreira et al). Framingham data confirmed that BP among drinkers was higher at higher consumption levels, but showed that BP is lower among moderate drinkers than non-drinkers (Gordon & Kannel, 1983).

Many studies examining the cardiovascular risk of alcohol consumption focus on broader outcomes than just blood pressure, typically cardiovascular disease or mortality. These relationships are often described by a J or a U-shaped curve, wherein people who consume alcohol are at less of a risk for cardiovascular disease compared with abstainers and heavy drinkers (O'Keefe et al., 2007; Fuchs et al., 1995). Fuchs, for example, reported a reduction in overall mortality in women who consume 1.5g-30g of alcohol per day (0.75-14 drinks/

week) (Fuchs et al., 1995). O'Keefe reported a reduction in mortality in women who consume one drink/day, but an increase in mortality in women who consume more than two drinks per day (O'Keefe et al., 2007). A more recent meta-analysis of over one million people of both genders suggests that while there are risks associated with excessive drinking, moderate consumption of alcohol (1–2 drinks/day for women and 2–4 drinks/day for men) is inversely associated with mortality (Di et al., 2006). One of the largest prospective women's health studies reports that women who consume 1–14 drinks/week have a decreased risk of mortality compared with non-drinkers and heavy drinkers, while consuming more than 2 drinks/day increases the risk for breast cancer and cirrhosis (Fuchs et al., 1995).

What the threshold is for alcohol intake to become harmful, or in fact if a threshold exists, remains controversial; some studies have shown a linear association between number of drinks per day and BP, while others have shown no effect up to 1 or 2 drinks per day (Marchi et al., 2014).

Intervention trials have been rather consistent: findings from several long-term experimental and epidemiological studies confirm that a reduction of alcohol consumption among heavy drinkers (≥ 3 drinks/day) significantly reduces blood pressure (Beilin & Puddey, 2006). Forty-two male heavy drinkers had 24-hour ABPM performed before and after one month of proven alcohol abstinence, and systolic and diastolic BP fell by 7.2/6.6 mm Hg (Aguilera et al., 1999). In their meta-analysis, Xin et al found that alcohol reduction as a sole intervention was associated with a significant reduction in BP (fall in SBP/DBP of $-3.31/2.04$ mm Hg) (Xin et al., 2001).

Several interpretations of our findings are possible, including the possibility that drinking at a moderate steady rate compared to not drinking any alcohol is beneficial in lowering BP. It is possible that among women with established and well-treated hypertension, there is no ill effect of increasing alcohol consumption. An alternate explanation is provided by research demonstrating that the morbidity effect of abstainers compared to moderate drinkers can be largely (but not entirely) accounted for by confounders. These include former problem drinking, concurrent health problems, and socio-demographic factors (Holahan et al., 2010).

Limitations of our study include a small sample size, and enrollment of a homogeneous well-educated population with a high level of adherence to medications. Several potentially important clinical features were not ascertained, including timing of onset of hypertension and of drinking; potential confounding variables like changes in lifestyle and menopause; and lack of specification as to which type of alcohol was consumed. Moderate drinking may be associated with other healthful behaviors that could benefit BP control. Despite the failure of these data to demonstrate an association between drinking beyond recommended limits and higher blood pressure, caution must be raised by the suggestion that greater number of drinks per drinking day is associated with higher baseline pressure. In addition, blood pressure at each time point was measured in the office. Although the technique was standardized and automated, ambulatory blood pressure monitoring would have provided a more robust set of pressures.

These data imply that drinking within sensible limits has no negative impact on chronic hypertension. In fact, for women with well-controlled hypertension, such a habit may impart benefit. This investigation highlights the need to augment research examining the relationship between alcohol consumption and blood pressure in women and moderate drinkers.

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Table 1:**Demographics**

	Mean (SD)
Age (yrs)	52.1 (SD 12.1)
BMI	30.7 (SD 8.5)
Marital Status	(%)
Married	32
Widowed, Divorced, Separated	33
Never Married	35
Education	(%)
< BA	56
4 years College	18
Graduate School	26
Race	(%)
White	60
Black	40
Hispanic	4
Any Children	67%
Current Smoker	14%
Exercise (self-report)	61%
Adherence to Medications	92%

Table 2:**Blood Pressures and Drinking Measures**

	Baseline Mean	12 Month Mean	Mean Change [95% CI] P-Value
Blood Pressure (BP)			
Systolic BP (mm Hg) ^a	130 (16)	131 (17)	+0.8 [−2.9, +4.5] P=.66
Diastolic BP (mm Hg) ^a	80 (11)	80 (10)	−0.2 [−2.5, +2.2] P=.90
Drinking Measure			
Binges	7.9 (26.4)	6.3 (22.2)	−1.6 [−5.6, +2.3] P=.41
Weeks over Safe Limits	4.6 (8.6)	3.9 (8.0)	−0.7 [−1.9, +0.5] P=.23
Drinks/Drinking Day	2.3 (1.7)	2.1 (2.5)	−0.2 [−0.5, +0.2] P=.32
Percent of Days Drinking	25.1 (32)	23.4 (30)	−2% [−6%, +2%] P=.41

Results expressed as mean (SD)

^aFollow-up and change BP and drinking measures were obtained in 93 out of 113 subjects