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# Is Alcohol Use Related To High Cholesterol in Premenopausal Women Aged 40-51 Years Old?

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## Abstract

**Purpose:** Alcohol use and cholesterol are related in men and postmenopausal women but relations between alcohol use and cholesterol are unclear for premenopausal women. The purpose of this study was to determine whether alcohol use was related to cholesterol in women aged 40-51 years old.

**Methods:** This cross-sectional analysis used 2015 data from the Behavioral Risk Factor Surveillance System (BRFSS) for females aged 40-51 years old from Louisiana, Michigan, Nevada, and Tennessee. Multiple logistic regression analysis was used to assess the relationship between high cholesterol and alcohol use while controlling for high blood pressure, diabetes, weight status, daily fruit and vegetable intake, physical activity, tobacco use, age, and ethnicity/race.

**Results:** Across states, approximately one-third of women reported being diagnosed with high cholesterol (25-36%) and about half reported any alcohol use (36-55%). The results of adjusted analysis indicated that high cholesterol was not significantly related to alcohol use in three of four states. However, high cholesterol was significantly related to blood pressure in all four states with moderate to large effect sizes, and to weight status and tobacco use in three of four states with moderate to large effect sizes.

**Conclusion:** The results of this study indicate that high cholesterol is not related to alcohol use in females aged 40-51 years old, but is moderately to highly related to high blood pressure, weight status, and tobacco use. For premenopausal women in a primary care setting, about one-third may have high cholesterol, and because high cholesterol, high blood pressure, overweight or obese, and smoking are moderately to highly related, it is recommended to screen for all four if symptoms of any are present and educate and treat as comorbid conditions.

**Keywords:** Alcohol; Cholesterol; Weight status; Tobacco use; High blood pressure; Premenopausal women

## Introduction

Increased serum cholesterol levels is a major risk factor for coronary heart disease (CHD) [1], and over seventy-one million American adults have high cholesterol (27%) [2,3]. In American women, cholesterol levels have been shown to increase with age, and nearly 1 in 2 American women has high or borderline high cholesterol [4]. The decreasing prevalence of high cholesterol over the last 2 decades has been followed by an increase from 5% to 23% in the use of cholesterol lowering medication, suggesting high cholesterol is still a significant problem in the U.S. today [3].

Many studies have linked the development of high cholesterol with health behaviors, such as tobacco use, diet, weight status, and physical activity [5-7]. Smoking has also been shown to increase total cholesterol and low density lipoprotein (LDL), which is the component of cholesterol that contributes to CHD [1,5,7]. In addition, diets high in saturated fatty acids and total fat have been shown to increase cholesterol levels [7]. Also, chronic health conditions such as high blood pressure and diabetes are associated with high cholesterol [8,9]. However, weight reduction and increased physical activity for those who are obese or overweight has been shown to lower cholesterol, blood pressure, and insulin resistance [1,7]. High cholesterol also differs by demographic factors such as age, gender, and ethnicity [10,11].

Alcohol consumption has also been shown to increase the risk of developing CHD [12]; however, there are conflicting findings for the effect of alcohol consumption on cholesterol levels. Many studies suggest the relationship between alcohol consumption and cholesterol follows a dose-response, J-shaped curve: the risk for high cholesterol is higher with abstinence, lower with moderate consumption, and the highest with heavy consumption [1,5,11-13]. Such a relationship suggests that moderate consumption is cardio-protective while high consumption is harmful. In contrast, other studies suggest there is no relationship between alcohol consumption and cholesterol level [5,7].

Most studies that assess the relationship between alcohol consumption and high cholesterol have focused on men and

postmenopausal women [1,11,12], making it unclear how alcohol consumption impacts cholesterol levels in premenopausal women [11]. Since alcohol and cholesterol are both risk factors for CHD and CHD risk begins increasing in women at age 40, it would be beneficial to examine the relationship between alcohol consumption and cholesterol in premenopausal women [14]. Thus, the purpose of this study was to determine whether alcohol use is related to cholesterol in representative samples of premenopausal women aged 40-51 years old after controlling for other known risk factors for high cholesterol.

## Methods

### Design

This cross-sectional analysis used 2015 data from the Behavior Risk Factor Surveillance System (BRFSS) conducted by the CDC. BRFSS is a nationwide health-related telephone survey system that uses random digit dialing to collect state data regarding chronic health conditions, health-related risk behaviors and use of preventive services. This system was established in 1984 and completes more than 400,000 adult interviews per year from all 50 states, the District of Columbia, and three U.S. territories [15]. Our study was given exempt status by the Institutional Review Board at The University of North Texas Health Science Center.

### Participants

The samples included females aged 40-51 years old in Louisiana (N=416), Michigan (N=905), Nevada (N=279), and Tennessee (N=572). These states were chosen because they had a higher prevalence of high cholesterol and alcohol use compared to the rest of the states when assessing 2015 BRFSS data [15].

### Variables

The outcome, high cholesterol, was measured in BRFSS as "Have you EVER been told by a doctor, nurse or other health professional that your blood cholesterol is high?" Responses are categorized as "ever" or "never" being diagnosed with high cholesterol. The factor of interest, alcohol use, was measured as "During the past 30 days, on the days when you drank, about how many drinks did you drink on the average?" with an equivalency scale for the type of alcohol consumed (beer, wine, shot of liquor). We categorized the numerical responses into four categories based on national guidelines for alcohol use for females [16], no use (0 drinks per day), light use (average less than 1 drink per day), moderate use (average 1-3 drinks per day), or excessive use (average 4 or more drinks per day).

Control variables included high blood pressure, diabetes, weight status, daily fruit and vegetable intake, physical activity, tobacco use, and ethnicity/race. High blood pressure was measured in BRFSS as "ever" or "never" being diagnosed with high blood pressure. Diabetes was measured as "ever" or

"never" being diagnosed with diabetes. The BRFSS weight status variable categorized persons as "underweight," "normal," "overweight," and "obese." However, we recoded this variable into two categories: "overweight or obese" versus "not overweight or obese." For daily fruit and vegetable intake, participants in BRFSS reported number of days of consumption of all forms of fruits, dark green vegetables, orange-colored vegetables, and other vegetables in the past 30 days, and we dichotomized it as "yes" (consuming both fruits and vegetables on a daily basis) versus "no" (not consuming both fruit and vegetables daily). Physical activity was categorized in BRFSS as "inactive", "insufficiently active", "active", and "highly active" based on responses to weekly participation in various activities.

Tobacco use was measured in BRFSS as "never," "former," and "current" smoker status. Ethnicity had multiple categories but because of the small numbers of non-white participants in our samples, we used the dichotomized variable of "White, non-Hispanic" versus "other."

### Statistical analysis

Frequency distributions were reported by state to describe the sample and determine any issues with the distributions of variables. Multiple logistic regression analysis by state was conducted to assess the relationship between high cholesterol and alcohol use after controlling for high blood pressure, diabetes, weight status, daily fruit and vegetable intake, physical activity, tobacco use, age, and ethnicity/race. We chose to analyze the data separately by state (instead of combining data all together) to assess patterns in relations among variables across similar samples. All analyses were conducted in R (version 3.3.3 2017). Any observations with missing data for any variable in the model were removed from the final analysis.

## Results

### Descriptive statistics

**Table 1** lists descriptive statistics for categorical variables for pre-menopausal females aged 40-51 years old in Louisiana, Michigan, Nevada, and Tennessee. Overall, this population consisted of mostly White, non-Hispanic, and overweight or obese women with ages 40 to 51 of moderate health. Across states, about one-third of participants reported being diagnosed with high cholesterol (25-36%) and about half reported any alcohol use: light alcohol use (14-21%), moderate alcohol use (12-27%), and heavy alcohol use (7-13%). For other health factors, about one-third reported high blood pressure (25-39%); few reported having never being diagnosed with diabetes (7-14%); and the majority reported being overweight or obese (66-72%).

For lifestyle choices, about half reported daily fruit and vegetable intake (42-62%); two-thirds reported being active (63-74%); and the majority were non-smokers (58-64%). The majority of the samples reported their ethnicity/race as White,

non-Hispanic (59-78%). No proportions within variable categories differed by 20% or more across states.

**Table 1** Sample characteristics by state.

Variables	Louisiana N=416		Michigan N=905		Nevada N=279		Tennessee N=572	
	n	%	n	%	n	%	n	%
High cholesterol (Total)	356	88%	840	93%	240	86%	522	91%
Ever diagnosed	120	34%	212	25%	76	32%	188	36%
Never diagnosed	236	66%	628	75%	164	68%	334	64%
Alcohol use (Total)	392	94%	862	95%	269	96%	539	94%
No alcohol use	193	49%	365	42%	124	46%	344	64%
Light alcohol use	81	21%	184	21%	51	19%	76	14%
Moderate alcohol use	90	23%	233	27%	59	22%	84	16%
Heavy alcohol use	28	7%	80	9%	35	13%	35	6%
High blood pressure (Total)	416	100%	901	100%	279	100%	571	100%
Ever diagnosed	160	39%	224	25%	72	26%	203	36%
Never diagnosed	256	61%	677	75%	207	74%	368	64%
Diabetes (Total)	416	100%	904	100%	279	100%	571	100%
Ever diagnosed	58	14%	65	7%	35	13%	78	14%
Never diagnosed	358	86%	839	93%	244	87%	493	86%
Weight status (Total)	372	89%	804	89%	244	87%	496	87%
Overweight or obese	266	72%	507	63%	160	66%	341	69%
Not overweight or obese	106	28%	297	37%	84	34%	155	31%
Daily fruit/vegetable intake (Total)	369	89%	831	92%	243	87%	491	86%
Yes	154	42%	489	59%	151	62%	254	52%
No	215	58%	342	41%	92	38%	237	48%
Physical activity (Total)	367	88%	812	90%	249	89%	483	84%
Inactive	135	37%	210	26%	69	28%	152	31%
Insufficiently active	85	23%	207	25%	45	18%	103	21%
Active	72	20%	158	19%	58	23%	87	18%
Highly active	75	20%	237	29%	77	31%	141	29%
Tobacco use (Total)	400	96%	867	96%	272	97%	546	95%
Never smoker	255	64%	533	61%	174	64%	319	58%
Former smoker	70	18%	180	21%	56	21%	92	17%
Current smoker	75	19%	154	18%	42	15%	135	25%
Ethnicity/ race (Total)	408	98%	894	99%	273	98%	566	99%
White, non-Hispanic	245	60%	684	77%	161	59%	439	78%
Others	163	40%	210	23%	112	41%	127	22%

### Adjusted statistics

As shown in **Table 2**, the results of the multiple logistic regression analysis for women aged 40-51 years old indicated that high cholesterol was not related to alcohol use across the four states. Only one of four states showed one significant and inverse relationship between light alcohol use and cholesterol.

However, in all four states, high cholesterol was about 2 to 4 times more likely to be reported by those who reported being diagnosed with high blood pressure. In addition, in three out of four states, high cholesterol was about 2 to 4 times more likely to be reported by those who were overweight or obese, and about two times more likely to be reported by current smokers.

**Table 2** Results of logistic regression analysis by state.

High Cholesterol (ever diagnosed vs. never)	Adjusted Odds Ratio (95% Confidence Interval)			
	Louisiana	Michigan	Nevada	Tennessee
Alcohol use				
None	ref	ref	ref	ref
Light alcohol use vs. none	0.68 (0.32-1.42)	0.58 (0.35-0.97)	1.34 (0.50-3.58)	0.69 (0.34-1.41)
Moderate alcohol use vs. none	0.5 (0.24-1.08)	0.85 (0.54-1.34)	0.97 (0.37-2.52)	0.8 (0.41-1.56)
Heavy alcohol use vs. none	1.42 (0.50-4.05)	1.19 (0.64-2.20)	1.35 (0.42-4.33)	1.07 (0.39-2.91)
High blood pressure				
Ever diagnosed	2.53 (1.40-4.57)	2.06 (1.36-3.13)	3.39 (1.40-8.17)	3.92 (2.28-6.75)
Diabetes				
Ever diagnosed	2.29 (1.07-4.91)	1.91 (1.05-3.49)	2.85 (0.82-9.86)	1.31 (0.66-2.57)
Weight status				
Overweight or obese	3.86 (1.81-8.21)	1.96 (1.28-3.02)	2.41 (0.99-5.84)	1.89 (1.06-3.38)
Daily fruit/vegetable intake				
Yes	1.11 (0.62-1.97)	0.8 (0.55-1.16)	0.36 (0.17-0.77)	0.64 (0.39-1.04)
Physical activity				
Inactive	ref	ref	ref	Ref
Insufficiently active	0.91 (0.44-1.90)	1 (0.60-1.67)	1.22 (0.40-3.74)	0.67 (0.35-1.29)
Active	0.82 (0.37-1.82)	0.96 (0.55-1.70)	1.72 (0.61-4.89)	0.93 (0.44-1.96)
Highly active	0.82 (0.36-1.85)	1.25 (0.74-2.10)	0.97 (0.35-2.70)	0.7 (0.38-1.31)
Tobacco use				
Never	ref	ref	ref	ref
Former smoker	1.5	1.54	0.53	1.1

	(0.68-3.33)	(0.98-2.42)	(0.21-1.33)	(0.58-2.09)
Current smoker	2.51	1.95	0.54	2.27
	(1.23-5.13)	(1.21-3.14)	(0.17-1.73)	(1.29-3.99)
Ethnicity/race				
White, non-Hispanic	1.8	1.66	1.08	3.32
	(0.97-3.34)	(1.04-2.67)	(0.49-2.37)	(1.74-6.34)
Note: ref=referent group; Bolded results are significant (adjusted odds ratios with 95% confidence intervals that do NOT include 1.0 are significant)				

## Discussion

The purpose of this population-based study was to determine whether alcohol use was related to high cholesterol in premenopausal women aged 40-51 years old and the results may generalize to premenopausal women ages 40-51 in primary care settings. In premenopausal women, primary care providers could expect that about one-third may have high cholesterol (25-36%) and about half will report alcohol use (36-58%).

However, the results of adjusted analysis indicated that alcohol use was not related to high cholesterol across states. This is inconsistent with prior research that suggests a dose response, J-shaped curve where the risk for high cholesterol is higher with none to light alcohol use and highest with heavy alcohol use [1,11-13]. Conflicting findings may be related to a difference in the target population. Previous studies focused on men and postmenopausal women [1,11,12], whereas this study analyzed data from premenopausal women. Use of oral contraceptives or prescription medications, including any cholesterol-lowering medications, in this target population could alter the results [17]. In addition, it is possible that the participants who take prescription medications generally drink less alcohol to avoid drug-drug interactions. Although we did not have the data to do so, further research should assess the effects of contraceptive and prescription medication use on the relationship between alcohol use and cholesterol levels in premenopausal women.

Clinicians might also expect that about one-third of women 40 to 51 years of age to have high blood pressure (25-36%), about two-thirds to be overweight or obese (63-72%), and up to one-fourth to report being current smokers (15-25%). According to the results of this study, these three factors should be considered moderately to highly related to high cholesterol in premenopausal women ages 40-51. In all four states, participants who reported having ever been diagnosed with high blood pressure were about 2 to 4 times more likely to report ever having been diagnosed with high cholesterol, which was consistent with prior research that shows these conditions to be related [8,9]. In three of four states, participants who reported being overweight or obese were about 2 to 4 times more likely to report having high cholesterol, which is consistent with prior research indicating that obesity increases cholesterol [18]. Also, participants who reported being current smokers were about 2 times more likely to report high cholesterol, which is also consistent with previous research showing that smoking increases total cholesterol [1,5,7].

## Limitations

Use of the BRFSS 2015 data allowed assessment of population-based responses to the outcome and variables of interest; however, the available data lacked specificity for some variables of interest. For example, participants did not report specific LDL, HDL, and triglyceride levels, which prevented analysis of the relationship of alcohol use with more specific components of high cholesterol. Similarly, the data did not include duration of alcohol consumption in years or variations in drinking patterns, which have been shown to alter cholesterol levels [13]. In addition, participants did not report their menopausal status so we used the average age of menopause as 51 [19]. However, this may have led to women who underwent early menopause to be included in this study and women older than 51 years who were premenopausal to be excluded from the study.

## Conclusion

The results of this population-based study may generalize to premenopausal women in a primary care setting. Primary care providers could expect about one-third of premenopausal women to have high cholesterol (25-36%) and about half to report any alcohol use (36-58%). The results of this study indicated no relationship between alcohol use and high cholesterol. However, high cholesterol was moderately to highly related to high blood pressure, weight status, and tobacco use. Given the results, providers should screen for high cholesterol more frequently than the "every 5-year" screening recommendations by American Heart Association [18] if risk factors such as high blood pressure, obesity, or tobacco use are present. It is also recommended to screen for alcohol use, high blood pressure, obesity, and smoker status regardless of the presence of symptoms, since each is a modifiable risk factor for multiple chronic diseases. However, because high cholesterol, high blood pressure, overweight or obese, and smoking are moderately to highly related, it is recommended to screen for all four if symptoms of any are present and educate and treat any combination of high cholesterol, high blood pressure, obesity, and smoking as co-morbid conditions.

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