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One-Per-Occasion or Less: Are Moderate Drinking Postmenopausal Women Really Healthier than their Non-Drinking and Heavier-Drinking Peers?

Laura J. Tivis, Ph.D. and Rick D. Tivis, M.P.H.

Idaho State University

Abstract

Background—While some reported benefits of moderate drinking are thought to be the direct results of physiological mechanisms associated with consumption, other effects may be attributable to mediating factors. Both explanations suggest that moderate drinkers may be healthier than non-drinking and heavier-drinking peers. The purpose of this study was to determine whether moderate drinking postmenopausal women report healthier dietary and exercise patterns, and whether they demonstrate better physiological functioning compared to peers. This study also aimed to describe patterns of relationships between alcohol and measures of general health functioning in postmenopausal women.

Methods—One-hundred-fifteen women, aged 50–65 participated. Participants completed alcohol interviews, diet and exercise questionnaires, and bone density examination. Blood pressure, height, and weight were assessed, and blood was collected to conduct basic chemistry and complete blood count tests.

Results—Postmenopausal moderate drinkers failed to demonstrate healthier dietary or exercise habits, and did not exhibit significantly better health-functioning compared to peers. They did evidence positive associations between drinking and healthy behavior, and between drinking and cardiovascular health. Relationships between alcohol and blood analytes differed between drinking groups, some of which suggested possible negative health consequences for higher-end drinkers in both drinking groups.

Conclusions—These data suggested that moderate drinking postmenopausal women are not significantly healthier than their non- or heavier drinking peers, but may drink as part of a larger effort to take care of their health. Despite this, even one-drink-per-drinking-day moderate drinkers may have tendencies toward unhealthy conditions. Limitations include small sample size, inability to assess specific cardiac risk and socio-economic status, small number of correlations, and clinical relevance of analyte values.

Keywords

Moderate drinking; alcohol; postmenopausal; health; diet; exercise

Introduction

Researchers have long identified health risks associated with abusive drinking. Every organ system is adversely affected by heavy drinking including the brain, gastrointestinal, and cardiovascular systems (Díaz, Cumsille and Bevilacqua, 2003; Ferrari et al., 2007; Husain,

2007; Puddy and Beilin, 2006; Schulte et al., 2006; Taylor and Rehm, 2005). It is also well known that women are more negatively affected by alcohol than men (Castellnuovo et al., 2006; Epstein, Fischer-Elber, Al-Otaiba, 2007). Studies have long documented that on average, groups of women who drink for the same length of time and consume about the same amount of alcohol as men, exhibit more severe consequences (Hill, 1995). For example, in studies of neuropsychological functioning among individuals with alcoholism, women are often found to perform as poorly as their male counterparts despite fewer years of drinking and/or smaller quantities consumed per drinking occasion (Flannery et al., 2007; Mann et al., 2005). Recently, as little as 10g of alcohol per day has been associated with an increased risk of breast cancer in women (Zhang et al., 2007).

For some years, the term “social drinking” was used in an effort to distinguish “alcoholic” drinking from non-pathological consumption. Studies of social drinking effects were inconclusive as definitions were broad, and tended to vary from study to study (Babor, Kranzler and Lauerma, 1987; Parsons and Nixon, 1998). However, international common standard drink units (Miller, Heather and Hall, 1991), and specific cut-points for both men and women developed (U.S. Department of Agriculture and U.S. Department of Health and Human Services, 2005) and the more precise “moderate drinking” replaced “social-drinking” as the non-pathological drinking referent.

In general, findings suggested that when consumed in moderation, alcohol beverages are not necessarily harmful and may in fact impart health benefits (Hendriks and van Tol, 2005). Historical accounts of alcohol’s medicinal properties are plentiful (Stolberg, 2006). More recently, empirical investigations lend support for health benefits among moderate drinkers, compared to nondrinkers and/or heavy drinkers (Bryson, et al., 2006; Cawthon et al., 2006; Elkind et al., 2006).

Some studies have examined gender differences with regard to moderate drinking with many identifying sex-dependent effects of moderate drinking. For example, Beulens et al. (2007) reported a decreased risk of diabetes among moderate to heavy drinking women, but not men. Interestingly, Waki et al. (2004) and Wändell, de Faire and Hellénus (2007) reported an increased diabetes risk among moderate to heavy drinking men, but not women.

Gender differences have also been observed with regard to cardiovascular effects. For example, Burger, Mensink, Brönstrup, Thierfelder and Pietrzik (2004) found a linear relationship between alcohol consumption and homocysteine level, an important risk factor for cardiovascular disease. Among men consuming greater than 30 g/day of alcohol, homocysteine levels were significantly below those of non-drinkers. However, for women in the same study, a quadratic relationship was observed; most favorable homocysteine levels were found at 10–20 g/day of alcohol with significantly higher rates (undesirable) among non-drinkers and those consuming more than 30 g/day. Lussier-Cacan and colleagues reported that among women with a specific apolipoprotein E genotype ($\epsilon 4/3$), body mass index (BMI) positively predicted lipid levels, but only among drinkers (an alcohol by BMI interaction). The effect was not found among non-drinking women, and not among drinking or non-drinking men (Lussier-Cacan, bolduc, Xhignesse, Niyonsenga, and Sing, 2002).

Gender effects have also been found with regard to alcohol and bone density/fracture risk. For example, Felson, Zhang, Hannan, Kannel, and Kiel (1995) reported increased bone density levels in moderate drinking women compared to infrequent/very light drinkers. The effect was less pronounced among men, and only at higher drinking levels. Conversely, men who consumed 28+ drinks per week had an increased risk for hip fracture (Høidrup, Gønbæk, Gottschau, Lauritzen, Schroll, and the Copenhagen Centre for Prospective Population Studies, 1999). The effect did not remain significant for women.

Although some studies have shown positive relationships between cognition and moderate drinking in men, women have been the primary group to demonstrate a cognitive benefit associated with moderate drinking. Improvements in several cognitive areas, including verbal fluency, attention, learning and memory have been identified (Dufouil, Ducimetiere and Alperovitch, 1997; Elias, Elias, D'Agostino, Silbershatz and Wolf, 1999). More recent studies have revealed that moderate consumption may protect against cognitive decline, especially among women (Britton, Singh-Manoux and Marmot, 2004; McGuire, Ajani, and Ford, 2007).

Not all studies have identified significant alcohol by gender differences. Many have found comparable effects of moderate drinking for men and women relative to cognition, diabetes risk, bone density, and cardiovascular functioning (Djoussé, Biggs, Mukamal and Siscovick, 2007; Lang, Wallace, Huppert, and Melzer, 2007; Mukamal, Robbins Cauley, Kern, Siscovick, 2007; Sierksma, van der Gaag, Kluft, Hendriks, 2002). A number of studies have focused exclusively on older women and have reported, within this sub-population, improved quality of life, benefits to cognitive functioning, cardiovascular health, bone density and/or reduced fracture risk, and reduced diabetes risk (Baer et al., 2002; Barnes et al., 2007; Byles, Young, Furuya and Parkinson, 2006; Davies, Baer, Judd, Brown, Cambell and Taylor, 2002; Espeland et al., 2006; Ganry et al., 2000; Ilich, Brownbill, Tamborini, and Crncevic-Orlic, 2002; Ögge, Brohall, Behre, Schmidt and Fagerberg, 2006; Rapuri, Gallagher, Balhorn, Ryschon, 2000; Sierksma et al., 2004ab; Williams, Cherkas, Spector, and MacGregor, 2005). For example, in a study of nicotine effects, Baron et al. (2001) identified an inverse relationship between drinking and risk for hip fracture. Likewise, in a randomized trial, Baer et al. (2002) found reduced levels of LDL cholesterol and triglycerides among women who consumed one drink per day for an eight-week period. Finally, Beulens, Stolk, van der Schouw, Grobbee, Hendriks and Bots (2005) reported a significantly reduced risk of type two diabetes among older female moderate drinkers.

Despite the growing body of research demonstrating moderate drinking benefits, study confounds have also been identified; for example, differences in overall health status between people who choose to drink moderately and those who drink excessively or, importantly, not at all, may complicate study interpretation. More specifically, learned behavioral contributions such as differences in dietary habits and in exercise patterns may complicate study interpretation (Mukamal, Ding and Djoussé, 2006). This is because individuals who drink moderately (as opposed to non-drinkers and heavy drinkers) may be more inclined to eat healthier foods and/or to more actively participate in physical activity. Thus, good health among moderate drinkers may simply be a function of proper diet and exercise rather than specific benefits derived from drinking a glass of wine or equivalent per day.

Another important concern for study interpretation is moderate drinking definitions. While many studies utilize the term “moderate drinking,” not all studies utilize USDA definitions of one or fewer drinks per day for women and two or fewer per day for men (U.S. Department of Human Services and U.S. Department of Agriculture, 2005). Thus, in many studies that report alcohol effects, participants actually drink at levels that exceed recommended limits (Beulens et al., 2005; Espeland et al., 2006; Williams et al., 2005). This complicates study interpretation since higher levels of drinking are associated with health impairments while lower levels are often associated with benefits. One drink limits for women and two drink limits for men have been identified as the maximum level of safe and beneficial drinking (U.S. Department of Human Services and U.S. Department of Agriculture, 2005).

Although health care practitioners are advised not to recommend that patients begin drinking in an effort to prevent health problems, public awareness (via media and internet access) of potential benefits directly associated with drinking in moderation have contributed to personal decisions to implement one-drink-per-day regimes. One sub-group, members of which actively seek ways to avoid heart disease, osteoporosis and other health concerns, is postmenopausal women. For many, the desire to avoid developing health problems exceeds any unknown risk associated with moderate drinking. The primary purpose of this study was to examine behavioral information (i.e., diet and exercise) and physical health indices (i.e., health outcome variables) as correlates of alcohol consumption in a sample of postmenopausal women. Specifically, we posed questions and hypotheses to determine: 1) whether postmenopausal moderate drinkers are healthier than their non-drinking and/or heavier drinking counterparts, and 2) whether the patterns of relationships between drinking and health-related variables in postmenopausal moderate drinkers differed from those observed in heavier drinkers. Using a definition of “moderate” drinking that is consistent with USDHS and USDA guidelines, the following empirical questions and hypotheses were formulated:

Empirical Question #1

Do moderate drinking (i.e., up to one drink per drinking day) postmenopausal women have healthier dietary and exercise habits than non-drinkers and/or those who drink above recommended guidelines?

Hypothesis #1

among moderate drinkers alcohol consumption is related to healthy behavior. Specifically, moderate drinking will be positively associated with healthy eating and exercise habits. These relationships will not hold true for women who drink above recommended levels.

Empirical Question #2

Are moderate drinkers healthier as a group with respect to cholesterol, triglyceride levels, and blood pressure values; all common indices of vascular health?

Hypothesis #2

among moderate drinkers, alcohol consumption is related to physical health parameters. Specifically, moderate drinking is positively associated with high-density lipoprotein (HDL) cholesterol and bone density, and negatively associated with systolic and/or diastolic blood pressure and triglycerides. It is further hypothesized that among women who drink above recommended levels, these relationships will not be observed.

Empirical Question #3

compared with non-drinkers and heavier drinkers will a significantly smaller proportion of postmenopausal moderate drinkers fall outside normal-ranges with respect to blood analytes commonly used to assess health system function/dysfunction?

Empirical Question #4

will the relationships between blood analyte values and alcohol use be significantly different for moderate postmenopausal drinkers compared to their heavier drinking peers?

Method

This study was approved by the Human Subjects Committee at Idaho State University.

Participants

One-hundred-fifteen (115) healthy, postmenopausal women age 50 to 65 and recruited from the general southern Idaho community (i.e., Boise and its surrounding communities in Southwestern Idaho, and Pocatello in Southeastern Idaho), participated as part of a larger longitudinal project aimed at testing theoretical models of mediating relationships between alcohol use, health and cognition. Participants were recruited via newspaper advertisements, posters, brochures, and word-of-mouth.

Criteria for inclusion were age 50 to 65 years of age and absence of a menstrual period for at least one full year. Potential participants were excluded for known neurological illness or trauma such as Alzheimer's disease, Parkinson's disease, seizure disorder, stroke, or serious brain injury resulting in a prolonged period of unconsciousness (i.e., greater than one hour). Additionally, volunteers were excluded for other illnesses that could compromise cognitive functioning, specifically, heart, liver, kidney or lung disease (except controlled asthma), uncontrolled diabetes, lupus, or cancer (with the exception of surgically treated cancer with greater than five years survival).

Due to the relatively high incidence of thyroid disease, hypertension, hyperlipidemia and obesity in the postmenopausal population, we did not specifically exclude for these conditions. The proportion of obese women differed; there were significantly more non-drinkers with a BMI > 30 compared to moderate and heavier drinkers [non-drinkers 48%, moderate drinkers 17%, and heavier drinkers 25%, $\chi^2(2, N = 115) = 6.88, p < 0.04$]. There were no significant differences in the alcohol group distributions of the other three disorders (thyroid disease, 18%, hypertension 19%, and hyperlipidemia 18%; all χ^2 's ≤ 0.52 , all p 's ≥ 0.77).

Interested volunteers were first screened by telephone to determine study eligibility. Prior to asking the screening questions, a team member explained the study, described the procedures for protecting confidentiality, and obtained verbal consent to proceed with the screening questions. Information was then obtained about alcohol consumption patterns (quantity and frequency), age, education level, occupation, postmenopausal status, duration of menopause, estrogen replacement and progestin use, other medications, and general medical conditions.

Sixteen percent (n=18) of the sample had undergone surgical menopause (removal of both ovaries). Twenty-one percent (n=24) was taking hormone replacement therapy (HRT; estrogen or a combination of estrogen and progestin). Those using HRT were required to have done so continuously for at least the past six months. Those not using HRT could have done so in the past, but were required to have not done so for at least the past six months. Other medications were allowable if they had been used for longer than one month so as to stabilize their effects, and did not compromise cognitive functioning (e.g., narcotics, some allergy medications, muscle relaxers). Common medications were cholesterol-lowering preparations, thyroid hormone, and anti-hypertensives.

Drinking group was initially assigned based on telephone report of alcohol quantity and frequency across the previous three months. Verification and further refinement of drinking information occurred at the in-person visit via a 90-day alcohol use inventory described below (Miller, 1996). For this study, non-drinkers consumed fewer than three drinks per year (n=21), moderate drinkers consumed up to one drink per drinking day (but at least one drink per month; n=46). Heavier drinkers consumed greater than one drink (but fewer than five) per drinking day (n=48). Non-drinkers were not recovering from an alcohol use disorder, nor were they specifically abstaining for health reasons; rather, this group consisted of individuals who had never typically consumed more than a few drinks per year.

For the purposes of this paper, we set a “one-drink-per-day-or-less” criterion for moderate drinkers because this definition matches national recommendations for women (U.S. Department of Agriculture and U.S. Department of Health and Human Services, 2005). However, because standard drink calculations provide a conservative estimate of alcohol consumed, an upper limit of 1.35 standard drinks was used to distinguish moderate from heavier drinkers. Individuals who at the time of the telephone screening, reported consuming on average more than four drinks per drinking day, were excluded from the study. Compensation, at the rate of \$100 for a full-day’s participation, along with bone density results and a copy of their laboratory values, was provided.

Materials and Procedure

As part of the larger project, all participants were interviewed for alcohol consumption practices using a 90 day time-line-follow-back method (Miller, 1996), completed a dietary inventory (Block 98.2; Cummings, Block, McHenry and Baron, 1987), an exercise assessment questionnaire (Community Healthy Activities Model Program for Seniors; CHAMPS, Stewart et al., 2001), and received a bone density examination (Sunlight Medical Ltd, 2004). In addition, all participants provided systolic and diastolic blood pressure readings, height and weight measurements, and approximately 11.5 ml of blood to conduct basic chemistry and complete blood count (CBC) tests.

90-Day Alcohol Use Inventory

Using a time-line-follow-back method, holidays and other celebrations, times of illness, vacation, unusual work schedules and other reasons for changes or variations in typical drinking patterns were identified and labeled on calendars representing the past 90 days. Quantities and types of alcohol beverages consumed on each drinking day were recorded. Numbers of estimated drinks were later translated into standard drinks using the formula described by Miller (1996; BACCuS software). Alcohol use information, as well as incidence of current smoking, can be found in Table 1.

Block 98.2

The Block 98.2 dietary assessment questionnaire (Cummings et al., 1987) is a well-researched, gold standard, instrument that assesses quantity (using serving-size choices) and frequency of fruits, vegetables, dairy products, grains, meats and fish, breads, beans and legumes, mixed dishes (e.g., casseroles), snacks, desserts, and vitamin supplements. The instrument’s report provides a variety of nutritional analyses, but this study focused on the Healthy Eating Index (HEI) as the major dependent variable (Basiotis et al., 2002). The HEI was developed by the U.S. government to better understand the dietary status of Americans. It reflects compliance with major food group recommendations (grains, vegetables, fruit, dairy and meat-products), dietary variety, and total fat, sodium and cholesterol intake. Information about calcium intake (via dietary and calcium supplements) was also utilized in this study in order to remove its effects from analyses involving bone density and to consider within the dietary hypotheses.

Community Healthy Activities Model Program for Seniors (CHAMPS)

The CHAMPS is a 41-item paper/pencil questionnaire that assesses the relative frequency and duration per week (over the past month) in a wide variety of activities including those requiring little physical exertion (e.g., attending a meeting), moderate exertion (e.g., light gardening), and heavy exertion (e.g., jogging or running). Algorithms provide estimates of caloric expenditures per week for all activities and those requiring moderate-intensity (Stewart et al., 2001). The CHAMPS is sensitive to both low- and vigorous activity levels, making it an ideal assessment instrument for use in this population.

Bone Density Examination: Sunlight Omnisense® 8000s

Using a Sunlight Omnisense® 8000s portable bone sonometer (Sunlight Medical Ltd, 2004), bone density was assessed at the radius of the non-dominant arm by a trained research associate. Manufacturer precision ratings at the radius are 0.4%. Studies report that when bone density is measured at the radius, the sonometer is successfully able to discriminate individuals with known osteoporosis from normal controls (Hans, Ish-shalom, Njeh, Singal, Segal, Wu, Fuerst & Genant, 1998; Knapp & Blake, 1999). T-scores (representing the number of standard deviations from the mean of a normal young adult standardization group), and Z-scores (representing the number of standard deviations from the mean of an age-equivalent standardization group) were used as dependent variables (Sunlight Omnisense® 7000S/8000S Bone Sonometer User Guide, 2004).

Phlebotomy: Chemistry Profile and CBC

Phlebotomy was performed on all participants by trained technicians or nurses. Two blood collection tubes were utilized; one 7.5 ml tube with anticoagulant for a chemistry profile, and one 4.0 ml tube for a CBC. Thyroid function was also assessed. Fasting blood specimens were prepared for transport to a commercial laboratory (Interpath Labs, Inc.) where they were processed immediately. Same-day results were provided by the laboratory back to the research team.

Results

Preliminary Analyses

Demographic and other descriptive characteristics by alcohol group can be found in Table 2. The groups did not differ with respect to age, years of education, or years since menopause (all F 's ≤ 1.96 ; all p 's ≥ 0.15), nor did they differ with respect to use/non-use of hormone replacement therapy [χ^2 (2, $N=115$) = 1.01; $p < 0.60$]. Twelve percent (12%) of the sample was non-Caucasian with significantly more non-Caucasians in the non-drinking group [Likelihood ratio χ^2 (2, $N=115$) = 8.74; $p < 0.02$]. Sixty-four percent (64%) reported having very good or excellent health, 36% reported good or fair health. No participant reported being in poor health [Likelihood ratio χ^2 (6, $N=115$) = 5.56; $p < 0.47$]. Non-drinkers had a significantly greater body mass index (BMI) compared to moderate and heavier drinkers [F (2, 112) = 4.8, $p < 0.02$]. As noted in the "participants" subsection, a significantly larger proportion of non-drinkers were obese (BMI ≥ 30) compared to moderate and heavier drinkers. The two drinking groups did not differ significantly. BMI consistently correlated with diastolic blood pressure across the groups, and was thus controlled for in those analyses. None of the other demographic/descriptive variables consistently correlated with any of the dependent variables across all three groups and were thus not controlled in the remaining analyses (Adams and Brown, 1985).

Primary Analyses

To answer the empirical questions and to test hypotheses, non-drinkers (i.e., those who consumed fewer than three drinks per year), moderate drinkers (i.e., those who consumed up to one drink per drinking day) and heavier drinkers (i.e., those who consumed more than one drink per drinking day) were compared via within- and between-groups analyses. Moderate and heavier drinkers were also compared via within-group analyses. This analytical strategy was chosen in order to avoid masking beneficial and/or detrimental effects associated with moderate or at-risk drinking. In other words, while analyzing the data as one large group would seemingly provide a more powerful technique (a larger overall n), such a strategy could disguise the relationships specifically posed by the stated questions and hypotheses.

Do moderate drinking postmenopausal women have healthier dietary and exercise habits than non-drinkers and/or those who drink above recommended guidelines?

To answer the first empirical questions, one-way analysis of variance (ANOVA) was conducted using study group as the independent variable, and the HEI, calories burned in all activities, and calories burned in moderate-intensity exercise as the dependent variables. ANOVA indicated that there was no significant difference between non-drinkers, moderate drinkers and heavier drinkers on the HEI or caloric expenditures in all activities or in moderate-intensity exercises (all F 's ≤ 0.61 , all p 's ≥ 0.54). Means and standard deviations can be found in Table 3.

Among moderate drinkers (individuals who consume alcohol on a regular basis and up to one drink per day) alcohol consumption is related to healthy behavior. Specifically, moderate drinking will be positively associated with healthy eating and exercise habits. These relationships will not hold true for women who drink above recommended levels

To examine the first hypothesis, Pearson correlation coefficients between drinking variables (i.e., total and average number of standard drinks across the 90 day period) and the HEI, between drinking variables and calcium intake (dietary and supplemental), and between drinking and calories burned in all activities and those of moderate intensity, were computed separately for the two drinking groups. As shown in Table 4, among moderate drinkers, total number of standard drinks was significantly and positively correlated with the dietary (HEI) and exercise (Caloric Expenditure) variables (all r 's ≥ 0.36 , all p 's ≤ 0.01). The correlations were not significant among heavier drinkers (all r 's $\leq |0.13|$, all p 's ≥ 0.39). Dietary calcium intake correlated with standard drinks for moderate drinkers ($r = .45$, $p < 0.002$). In contrast, calcium supplement intake was negatively correlated with standard drinks for heavier drinkers ($r = -.34$, $p < 0.02$).

Are moderate drinkers healthier as a group with respect to cholesterol levels, triglycerides, and blood pressure values; all common indices of vascular health?

The second empirical question was addressed using Chi Square analyses to first determine whether the groups differed with respect to use of cholesterol- and blood pressure-lowering medications. The proportions of individuals within the alcohol-use groups who used these medications did not differ significantly (χ^2 's ≤ 0.87 , p 's ≥ 0.65). Next, a one-way analysis of variance (ANOVA) using study group as the independent variable, and total cholesterol, HDL and LDL cholesterol, total cholesterol/HDL ratio, triglycerides, systolic and diastolic blood pressure values as the dependent variables, was computed. ANOVA indicated that the groups differed on HDL cholesterol and on the total cholesterol/HDL ratio [$F(2,109) = 5.45$, $p < 0.006$ and $F(2,109) = 4.29$, $p < 0.02$, respectively]. Duncan's Multiple Range test indicated that the HDL for heavier drinkers was significantly higher (i.e., healthier) than that of non-drinkers, but that HDL of moderate drinkers did not differ from either of the other two groups ($\alpha = .05$). Likewise, the total cholesterol/HDL ratio was significantly lower (i.e., healthier) for the heavier drinkers; the ratio for the moderate and non-drinkers did not differ significantly ($\alpha = 0.05$). The groups did not differ with respect to total cholesterol, LDL cholesterol, triglycerides, or blood pressure values (all F 's ≤ 1.69 , all p 's ≥ 0.19). Means and standard deviations can be seen in Table 3.

Among moderate drinkers, alcohol consumption is related to physical health parameters. Specifically, moderate drinking is positively associated with high-density lipoprotein (HDL) cholesterol and bone density, and negatively associated with systolic and/or diastolic

blood pressure and triglycerides. It is further hypothesized that among women who drink above recommended levels, these relationships will not be observed

To examine the second hypothesis, Pearson correlation coefficients between drinking variables and total cholesterol, HDL and LDL cholesterol, the total cholesterol/HDL ratio, triglycerides, blood pressure (systolic and diastolic), and bone density, were computed separately for the two drinking groups. Among moderate drinkers (shown in Table 4), triglycerides were significantly negatively correlated with average number of standard drinks ($r = -0.32, p < 0.03$).

Among heavier drinkers, total cholesterol, triglycerides, and systolic blood pressure were positively associated with both total and average number of standard drinks (r 's $\geq 0.32, p$'s ≤ 0.03). Average number of standard drinks was additionally correlated (positively) with diastolic blood pressure ($r = 0.36, p < 0.02$).

Eight individuals (six moderate drinkers and two heavier drinkers) currently taking medication for osteoporosis (e.g., Boniva®) were eliminated from the bone density analyses. Bone density was not associated with alcohol consumption for either of the drinking groups (r 's $\leq 0.24, p$'s ≥ 0.13). Follow-up bone density analyses for all three participant groups (non-drinkers, moderate drinkers and heavier drinkers) revealed that T-scores and Z-scores for this group of postmenopausal women did not differ significantly from the young adult or age-equivalent standardization samples (non-drinkers: T-score $M = -0.14, SD = 1.37$; Z-score $M = 0.76, SD = 1.32$; moderate drinkers: T-score $M = -0.73, SD = 1.09$; Z-score $M = 0.36, SD = 1.05$; heavier drinkers: T-score $M = -0.20, SD = 1.04$; Z-score $M = 0.87, SD = 0.96$). Furthermore, ANOVA indicated that the three groups did not differ statistically from one another with respect to T-score ($F(2,104) = 3.00, p < 0.05$), Z-score ($F(2,104) = 2.59, p < 0.08$), dietary calcium ($F(2,112) = 1.56, p < 0.22$) or supplemental calcium intake ($F(2,112) = 0.95, p < 0.40$).

Compared with non-drinkers and heavy drinkers, will a significantly smaller proportion of postmenopausal moderate drinkers fall outside “normal” with respect to blood analytes commonly used to assess health system function/dysfunction?

For the third empirical questions, chi-square analyses were performed between: 1) moderate drinkers and non-drinkers, and 2) between moderate drinkers and heavier drinkers to determine whether a significantly higher proportion of non-drinker and/or heavier drinker blood analyte values were outside laboratory referent ranges of functioning. There were no significant differences in the proportions of non-drinkers and moderate drinkers with laboratory values outside the referent ranges (all χ^2 's ≤ 3.01 , all p 's ≥ 0.08). Findings were similar for moderate versus heavier drinkers (all χ^2 's ≤ 3.62 , all p 's ≥ 0.06). Referent ranges were provided by the laboratory and reflect current standards designated by national guidance and counseling organizations (e.g., American Medical Association, American Diabetes Association, the National Cholesterol Education Program) and by manufacturers of specific pieces of medical equipment (R. Hartman, personal communication, 2007).

Will the relationships between blood analyte values and alcohol use be significantly different for moderate drinkers compared to heavier drinkers?

Thirty-seven blood analytes in addition to those involving lipids (second hypothesis) were assessed and entered into a correlational matrix with the alcohol use variables. As can be seen in Table 5, patterns of correlations differed between moderate and heavier drinkers for 10 of the 37 blood analytes assessed (about 25%). We identified 14 significant correlations (10 among heavier drinkers and 4 among moderate drinkers) involving glucose, uric acid, AST (SGOT), ALT (SGPT), total bilirubin, albumin, red blood cells (RBCs), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), and platelet count.

However, an independent analysis revealed that some blood analytes are inter-correlated (*all* $r's \geq .31$, *all* $p's \leq 0.003$). Specifically, glucose is correlated with uric acid and ALT (SGPT), and ALT (SGPT) is correlated with AST (SGOT). Likewise, RBCs are correlated with MCV, MCH and platelet count, and MCV and MCH are also highly correlated. Five percent of the total number of computed associations ($5\% \times 148 = 7$) plus 15% of the observed associations ($15\% \times 14 = 2$) were determined to represent a conservative estimate of the correlations expected to reach significance due to chance and analyte inter-dependence (total expected = 9). Thus the number of observed relationships was slightly higher than the number expected by chance and analyte inter-dependence.

Differing patterns of correlations were not observed for the following analytes: lactate dehydrogenase, alkaline phosphatase, gamma glutamyl transferase (GGT), protein, globulin, albumin/globulin ratio, calcium, inorganic phosphorus, urea nitrogen, serum creatinine, urea nitrogen/creatinine ratio, sodium, potassium, chloride, carbon dioxide, thyrotropin (TSH, third generation), free thyroxine (free T4), leukocytes (WBCs), hemoglobin, hematocrit, erythrocyte distribution of width (RDW), mean corpuscular hemoglobin concentration (MCHC), lymphocytes, neutrophils, monocytes, eosinophils, and basophils.

Discussion

The purpose of this study was to explore health and health-related behaviors in non-drinking, moderate, and heavier drinking older women. The rationale was to determine whether moderate drinkers are healthier, both in terms of lifestyle choices and general indices of physical health. In addition, this study examined relationships between healthy eating and exercise habits, and alcohol consumption, among women who drank one or fewer drinks per drinking day and those who consumed more than one drink per drinking day. The proposed hypotheses and empirical questions are important because: 1) studies have long suggested that people who drink in moderation may simply be healthier than both their non-drinking and their heavy drinking counterparts and 2) studies have linked moderate drinking to specific health benefits (e.g., cardiovascular functioning and bone health). The literature, however, remains somewhat guarded with respect to health benefits. For example, in a recent review Norström and Ramstedt (2005) determined that while individual studies often identify cardioprotective benefits associated with moderate drinking, such effects are not evident at the population level.

The current data indicated that this sample of postmenopausal moderate drinkers did not have healthier dietary patterns or exercise habits than their non-drinking and heavier-drinking peers. However, their drinking patterns were positively related to their diet and exercise tendencies. Said another way, our data revealed within-group differences, but no between-group differences. This supports the idea that attitudes or health consciousness may include drinking as part of a healthy lifestyle (Slater, Basil and Maibach, 1999). This does not appear to be true among the heavier drinkers; no specific associations between drinking and diet/exercise were identified among the latter group.

Regarding measures of cardiovascular functioning, moderate drinkers did not appear to have significantly lower blood pressure values, nor did their cholesterol readings appear to reflect better health than those of their non-drinking or heavier drinking peers. However, moderate drinking was negatively associated with triglyceride levels and with diastolic blood pressure [although the latter was not significant when BMI was controlled ($p < 0.06$)], probably reflecting the health consciousness discussed above. Specifically, decisions about drinking are likely made within a larger lifestyle context that includes decisions about diet and exercise, ultimately impacting blood pressure and triglyceride levels (i.e., a mediating role).

According to these data, moderate alcohol consumption does not improve bone density; the women in this study had, as a group, remarkably good bone health but alcohol does not appear to have contributed to it. This is in contrast to Feskanich et al (1999) who found that women consuming 75 grams of alcohol per week or more had significantly higher bone densities than non-drinkers. Compared to the traditional dual energy x-ray absorptiometry (DEXA), it could be argued that ultrasonometry is an inferior method of measuring bone density. However, ultrasonometry is regularly and successfully used both in research as well as clinical practice (Lequin et al., 2003; Maalouf et al., 2007; Tomić-Brzac and Pavolvić, 2004). Had our moderate drinkers differed from the heavier drinkers in terms of dietary patterns and exercise habits, bone density might also have differed, suggesting a possible mediating role for diet and exercise in the alcohol/bone density relationship.

In addition to lipids, this study also investigated other general health indices via general laboratory tests of physiological functioning to determine whether differences might be attributable to alcohol consumption. The data revealed that moderate drinkers had no less pathology and by extrapolation, were not significantly healthier than non-drinkers or heavier drinkers.

Two findings were particularly intriguing and suggest areas of future investigation. First, 28% of moderate drinkers had elevated fasting blood glucose levels. This proportion is similar to that of the non-drinkers (33%). Given this, it might be expected that the two groups would have similar obesity prevalence (DelParigi et al., 2005). However, 48% of non-drinkers were obese compared to only 17% of moderate drinkers, supporting Arif and Rohrer's (2005) findings of reduced risk of obesity among moderate drinkers. This suggests that something other than obesity may be affecting glucose values among our sample of moderate drinkers.

Second, among moderate drinkers, but not heavier drinkers, total bilirubin was positively correlated with total number of drinks. Elevated bilirubin levels are frequently associated with red blood cell destruction (hemolysis). This may simply be a spurious correlation, especially given that only the total number of drinks over the evaluation period, not the average number of drinks, is correlated. However, the association is significantly different from the corresponding correlation among heavier drinkers ($r = 0.37$ versus $r = -0.12$, r to z transformation > 1.96 , $p < 0.05$). In addition, other indices of blood health (RBCs, MCV and platelet count) were also correlated with total number of drinks among moderate, but not heavier drinkers. Taken together, these relationships suggest that moderate drinking may be associated with hemolytic anemia, or that heavier drinking is protective. Further research is needed to clarify these relationships.

This study revealed several interesting findings among heavier drinkers. First, HDL values were significantly better compared to those of non-drinkers. This is consistent with studies that have linked alcohol with increases in "good" cholesterol. However, while it was the heavier drinkers that displayed the highest mean HDL level, it is important to note that it did not differ significantly from that of moderate drinkers. In fact, positive associations were identified between total cholesterol (but not HDL or the cholesterol ratio), triglycerides, blood pressure and alcohol consumption among heavier drinkers, supporting research suggesting that postmenopausal women who drink above recommended levels are at increased risk for cardiovascular problems (Klatsky and Udaltsova, 2007). Thus, while at first glance it appears that the heavier drinkers had better cardiovascular health (as measured by HDL), this is not the case. Contrarily, "good" cholesterol values for this group were not superior to those of moderate drinkers, and in fact, other indices of poorer cardiovascular functioning were positively associated with alcohol consumption above one drink per drinking day.

Second, the use of calcium supplements was negatively associated with drinking variables among the heavier drinkers. This suggests that these women may be less likely to adopt a practice that is important for good bone health. It might be interesting to know what factors most impede the use of calcium supplements among postmenopausal heavier drinkers.

Third, several blood analytes other than lipids were positively related to alcohol consumption. Not surprisingly, liver enzymes were correlated with alcohol variables for heavier drinkers. Likewise, uric acid was correlated, pointing to the known association between heavy drinking and gout (Zang et al., 2006). The strong positive relationship between drinking and glucose is particularly noteworthy for two reasons. First, the association between glucose and self-report (chronic) drinking is incompletely understood (Davies et al., 2002; Holbrook, Barrett-Connor and Wingard, 1990). Second, the comparison correlations among the moderate drinkers are strikingly different. At first glance, it appears that heavier drinking could be associated with a pre-diabetic condition. However, only 12% of our heavier drinking sample had abnormally high glucose levels (compared to 28% of moderate and 33% of non-drinkers) lending support to similar findings of decreased risk of developing diabetes in postmenopausal women drinking at comparable levels (Beulens et al., 2005; Stampfer, et al., 1988). Whether this relatively low proportion of abnormally high glucose levels is due to the behavioral choices (i.e., eating less) of the heavier drinkers, or to a direct protective action of alcohol on glucose levels, is unknown. Future investigation should include measures of insulin sensitivity to more fully understand this relationship (Ögge et al., 2006).

Finally, some reports indicate that non-drinkers tend to be unhealthy. We found some supporting evidence of this. Nearly half of the non-drinking sample had a BMI ≥ 30 whereas only 17% of moderate and 25% of heavier drinkers was obese. Other health-related indices that we examined did not differentiate this group from one or both of the drinking groups.

This study has several limitations. First, our sample was relatively small making it difficult to generalize the data to the larger population. Second, the study was not designed to independently consider cardiovascular health. Thus, specific cardiac risk factors (i.e., C reactive protein, homocysteine, or lipoprotein) were not examined. Future studies should aim to include these markers to gain a more detailed understanding of the alcohol/cardiovascular health relationship among older women (Stewart, Mainous and Gilbert, 2002).

Third, we did not assess socioeconomic status (SES) and thus cannot determine if women from all social positions were included. However, whereas the majority lived in the metropolitan area (approximately 0.5 million), many lived in surrounding farming or logging communities. Thus, while a formal measure of SES was not utilized, the result is a cross-cultural sample gathered from both rural and urban areas of the state.

Fourth, while several analytes were significantly correlated with drinking variables the actual number of significant correlations was relatively small. Further the number of significant correlations was slightly higher than the number expected by chance, and the question of whether the identified relationships are “real” or just statistical artifact remains. Given that the majority of participants were relatively healthy and had analyte values that fell within the referent ranges, the clinical relevance of the correlations may be limited.

Finally, while correlational data can be very useful to understand associations between alcohol and other variables, they do not imply cause and effect. Longitudinal data provide a more informative picture, making subtle changes visible over time. Our laboratory is in the process of re-assessing each of the participants and anticipate continued discussion associated with these preliminary findings.

In conclusion except for a lower prevalence of obesity among both drinking groups compared to non-drinkers, we found that these moderate drinking women were not significantly healthier than their peers. However, among moderate drinkers, relationships suggested that the more they drank (up to one drink per drinking day) the more likely they were to exhibit healthier dietary and exercise behaviors. This finding suggests that moderate drinkers make conscious decisions to take care of their health, but the data do not support the idea that moderate drinking leads to better health. In fact, disproportionate numbers of participants with unexplained glucose elevations, and correlations between drinking and blood health indices, suggest that these moderate drinkers may have tendencies toward unhealthy conditions. These data suggest that even limiting consumption to one-drink-or-less may be associated with adverse health consequences among postmenopausal women.

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Table 1**Alcohol Consumption and Smoking Information by Group**

Variable^a	Non-Drinkers (n=21)	Moderate Drinkers (n=46)	Heavier Drinkers (n=48)	
	Mean (SD)	Mean (SD)	Mean (SD)	F(df); p<
Days Abstinent ^a	89.6 (0.93)	54.1 (31.40)	36.4 (29.71)	26.94 (2,112); 0.0001
Drinking Days ^a	0.4 (0.93)	35.9 (31.40)	53.6 (29.71)	26.94 (2,112); 0.0001
Total SECs ^{ab}	0.48 (1.17)	42.78 (37.93)	139.85 (118.57)	26.26 (2,112); 0.0001
Average SECs ^{ab}	0.29 (0.51)	1.25 (0.33)	2.39 (1.09)	59.86 (2,112); 0.0001
	Percent (n)	Percent (n)	Percent (n)	χ^2 (df); p<
Currently Smoke	9.52 (2)	8.70 (4)	4.17 (2)	1.06 (2); 0.59

^a Alcohol variables reflect last 90 days; Duncan's test revealed that for each of the alcohol variables the three drinking groups differ significantly from one another (alpha = 0.05)

^b SECs = standard ethanol content units (i.e., "standard drinks")

Table 2

Demographic and Other Descriptive Characteristics

Variable	Non-Drinkers (n=21) Mean (SD)	Moderate Drinkers (n=46) Mean (SD)	Heavier Drinkers (n=48) Mean (SD)	p <
Age	56.0 (4.54)	57.5 (3.82)	57.5 (4.25)	0.31
Education (yrs)	14.10 (2.74)	15.25 (2.24)	15.29 (2.52)	0.15
Menopause Duration (yrs) ^a	10.7 (9.3)	8.1 (5.76)	7.8 (6.98)	0.30
Body Mass Index ^b	31.50 (7.13)	26.71 (7.43)	26.58 (5.09)	0.02
Race ^c	Percent (n)	Percent (n)	Percent (n)	0.02
<i>African American</i>	4.76 (1)	0	0	
<i>American Indian</i>	14.29 (3)	0	2.08 (1)	
<i>Hispanic</i>	14.29 (3)	4.35 (2)	4.17 (2)	
<i>Asian</i>	0	2.17 (1)	2.08 (1)	
<i>Caucasian</i>	66.67 (14)	93.48 (43)	91.67 (44)	
Self-Report Health Status	Percent (n)	Percent (n)	Percent (n)	0.47
<i>Excellent</i>	14.29 (3)	36.95 (17)	35.42 (17)	
<i>Very Good</i>	33.33 (7)	32.61 (15)	31.25 (15)	
<i>Good</i>	47.62 (10)	26.09 (12)	31.25 (15)	
<i>Fair</i>	4.76 (1)	4.35 (2)	2.08 (1)	
Use of HRT ^d	28.57 (6)	26.09 (12)	35.42 (17)	0.60

^aEleven participants (all at least 55 years of age) had undergone hysterectomy, but not bilateral oophorectomy. In these cases it was not possible to determine menopause duration.

^bNon-drinkers were significantly heavier than moderate or heavier drinkers; $F(2,112) = 4.80$

^cNon-drinkers were significantly more likely to be non-Caucasian; $\chi^2(2, N=115)=8.74$

^dHRT=Prescription or OTC use of hormone replacement therapy; $\chi^2(2, N=115)= 1.01$

Table 3**Healthy Behavior and Physical Health Means**

Variable	Non-Drinkers	Moderate Drinkers	Heavier Drinkers	F(df); p <
	(n=21) Mean (SD)	(n=46) Mean (SD)	(n=48) Mean (SD)	
Healthy Eating Index ^a	61.52 (13.39)	63.72 (13.11)	63.77 (12.56)	0.25 (2,112); 0.78
Caloric Expenditure: All Activities ^b	4301 (3181)	3968 (2655)	4611 (2821)	0.61 (2,112); 0.55
Caloric Expenditure: Moderate Intensity ^b	2573 (2294)	2627 (2217)	3044 (2041)	0.57 (2,112); 0.57
Total Cholesterol	199.9 (30.9)	209.4 (35.3)	206.2 (31.6)	0.59 (2,109); 0.56
HDL Cholesterol	50.9 (13.9)	56.2 (13.6)	62.8 (15.4)	5.45 (2,109); 0.006
LDL Cholesterol	128.2 (28.0)	132.0 (30.4)	124.4 (26.9)	0.78 (2,107); 0.47
Total Cholesterol/HDL Ratio	4.2 (1.2)	4.0 (1.4)	3.4 (0.8)	4.29 (2,109); 0.02
Triglycerides	104.5 (60.7)	102.4 (69.5)	97.2 (80.8)	0.09 (2,109); 0.91
Systolic Blood Pressure	129.7 (13.3)	128.7 (16.4)	126.5 (15.5)	0.41 (2,111); 0.67
Diastolic Blood Pressure	82.8 (9.1)	81.2 (11.8)	84.2 (9.2)	1.69 (2,110); 0.19

^aFrom the Block 98.2 (Cummings et al., 1987)

^bFrom the Community Healthy Activities Model Program for Seniors (Stewart et al., 2001)

Table 4

Pearson Product Correlations: Diet, Exercise and Health Measures with Alcohol Consumption Variables

Variable	Moderate Drinkers (n=46)		Heavier Drinkers (n=48)	
	SEC	Avg SEC	SEC	Avg SEC
Healthy Eating Index	0.36 [*]	−0.01	−0.05	−0.06
Dietary Calcium (mg/day)	0.45 ^{**}	−0.03	−0.02	0.03
Supplemental Calcium (mg/day)	−0.01	−0.03	−0.34 [*]	−0.25
Caloric Expenditure: All Activities	0.38 ^{**}	−0.05	−0.13	−0.13
Caloric Expenditure: Moderate Intensity Exercise	0.43 ^{**}	−0.04	−0.10	−0.11
Total Cholesterol (mg/dl)	−0.06	−0.18	0.39 ^{**}	0.32 [*]
HDL Cholesterol (mg/dl)	0.25	0.18	0.16	0.05
LDL Cholesterol (mg/dl)	−0.08	−0.07	0.22	0.15
Total Cholesterol/HDL Ratio	−0.21	−0.27	0.14	0.20
Triglycerides (mg/dl)	−0.19	−0.32 [*]	0.35 [*]	0.43 ^{**}
Systolic Blood Pressure (mmHg)	−0.10	0.12	0.48 ^{***}	0.57 ^{***}
Diastolic Blood Pressure (mmHg)	−0.28	0.14	0.25	0.36 [*]
Bone Density (speed of sound; T-score)	0.24	0.10	0.18	0.11
Bone Density (speed of sound; Z-score)	0.20	0.13	0.13	0.10

*
p< 0.05;**
p< 0.01;***
p< 0.001

Table 5
Pearson Product Correlations and Ranges: Blood Analytes with Alcohol Consumption Variables

Variable	Moderate Drinkers (n=46)			Heavier Drinkers (n=48)		
	SEC	Avg SEC	Moderate Drinker Range	SEC	Avg SEC	Heavier Drinker Range
Glucose	-0.18	0.02	75-116 mg/dl	0.52***	0.61***	81-130 mg/dl
Uric Acid	-0.00	-0.20	3.1-7.2 mg/dl	0.30*	0.35*	2.2-7.2 mg/dl
AST(SGOT)	0.05	-0.09	16-44 U/L	0.19	0.36*	14-58 U/L
ALT(SGPT)	-0.01	-0.11	13-37 U/L	0.33*	0.49***	10-62 U/L
Total Bilirubin	0.37*	0.08	0.5-1.9 mg/dl	-0.12	-0.13	0.5-2.0 mg/dl
Albumin	0.11	0.00	3.5-4.4 g/dl	0.35*	0.29	3.5-4.5 g/dl
Red Blood Cells (RBC)	-0.34*	0.15	4.03-5.61 M/ul	-0.20	-0.13	3.89-5.20 M/ul
Mean Corpuscular Volume (MCV)	0.45***	0.13	76.5-93.6 fl	0.27	0.26	81-99 fl
Mean Corpuscular Hemoglobin (MCH)	0.24	0.13	25-31 pg	0.34*	0.30*	27-34 pg
Platelet Count	0.33*	-0.14	10-412 K/ul	-0.05	-0.04	10-423 K/ul

* p< 0.05;

** p< 0.01;

*** p< 0.001

[/] Standard Reference Ranges were provided by Interpath Laboratories, Inc.