# ALCOHOL USE AND BLOOD FLOW IN COLLEGE MEN: THE RELATIONSHIP WITH PERSONALITY

A Thesis
by
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**Abstract**

ALCOHOL USE AND BLOOD FLOW IN COLLEGE MEN: THE RELATIONSHIP WITH PERSONALITY

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Hypertension affects 1 in 3 adults and is becoming increasingly more prevalent among young adults. Nearly 18% of young adults have prehypertension, a preliminary condition increasing risk for hypertension and associated medical conditions (e.g., obesity, diabetes, cardiovascular disease). Hypertension and prehypertension are both more prominent among men than women, and a number of behavioral risk factors predispose prehypertension, including alcohol consumption. The literature is inconsistent regarding the association between self-reported alcohol consumption and blood pressure (BP) in men, with studies supporting J-shaped associations, as well as dose-response relationships. The results of previous studies are also conflicted regarding the acute impact of alcohol on BP, appearing to have no effect on normotensive men and variable effects on hypertensive men. Inconsistent findings may be due to individual differences mediating the relationship between alcohol intake and BP. Low conscientiousness and high extraversion and neuroticism are associated with increased alcohol consumption. In addition, high hostility (a facet of neuroticism) is associated with increased cardiovascular risk, consistent with hypertension. Because this mediational model has not been

tested previously, the present study ($N$ = 155) examined the role of personality in the alcohol-BP relationship in a sample of young adult men (18-25 years) through self-report measures ($n$ = 154). The acute relationship between BP and alcohol consumption was also assessed in a subsample by administering alcohol in a standardized laboratory setting ($n$ = 17). Results indicated acute alcohol consumption significantly increased nighttime systolic blood pressure (SBP). In addition, hostility appeared to suppress the relationship between alcohol consumption and SBP. Findings are discussed.

*Keywords:* alcohol, blood pressure, personality, college, men, prehypertension

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## Dedication

This work is dedicated to the influential educators in my life, most of who are faculty members in the psychology departments at James Madison University and Appalachian State University. Thank you for cultivating my love of learning and research. I would also like to thank the clinicians I have worked alongside and learned from, predominantly at the Psychology Clinic and Counseling and Psychological Services Center at Appalachian State University, for teaching me the importance of applying and adapting such research.

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# Alcohol Use and Blood Flow in College Men: The Relationship with Personality

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Abstract

Hypertension affects 1 in 3 adults and is becoming increasingly more prevalent among young adults. Nearly 18% of young adults have prehypertension, a preliminary condition increasing risk for hypertension and associated medical conditions (e.g., obesity, diabetes, cardiovascular disease). Hypertension and prehypertension are both more prominent among men than women, and a number of behavioral risk factors predispose prehypertension, including alcohol consumption. The literature is inconsistent regarding the association between self-reported alcohol consumption and blood pressure (BP) in men, with studies supporting J-shaped associations, as well as dose-response relationships. The results of previous studies are also conflicted regarding the acute impact of alcohol on BP, appearing to have no effect on normotensive men and variable effects on hypertensive men. Inconsistent findings may be due to individual differences mediating the relationship between alcohol intake and BP. Low conscientiousness and high extraversion and neuroticism are associated with increased alcohol consumption. In addition, high hostility (a facet of neuroticism) is associated with increased cardiovascular risk, consistent with hypertension. Because this mediational model has not been tested previously, the present study ($N$ = 155) examined the role of personality in the alcohol-BP relationship in a sample of young adult men (18-25 years) through self-report measures ($n$ = 154). The acute relationship between BP and alcohol consumption was also assessed in a subsample by administering alcohol in a standardized laboratory setting ($n$ = 17). Results indicated acute alcohol consumption significantly increased nighttime systolic blood pressure (SBP). In addition, hostility appeared to suppress the relationship between alcohol consumption and SBP. Findings are discussed.

*Keywords:* alcohol, blood pressure, personality, college, men, prehypertension

# Alcohol Use and Blood Flow in College Men: The Relationship with Personality

Blood pressure (BP) is the force propelling oxygen- and nutrient-rich blood to the body's tissue. It must be high enough so blood efficiently circulates throughout the body's organs, but not so high it creates added work for the heart (Sherwood, 2010). Hypertension is the latter of those two extremes and is becoming increasingly more prevalent in the United States. Hypertension is diagnosed when the mean of two physician BP measurements indicates elevated systolic blood pressure (SBP; pressure during cardiac contraction) $\geq$ 140 mmHg or diastolic blood pressure (DBP; pressure during cardiac relaxation) $\geq$ 90 mmHg (James et al., 2014; Chobanian et al., 2003). While diagnosis utilizes static daytime measurements of BP, elevated nighttime BP may independently increase hypertensive risk.

Hypertension is also affected by dynamic, or pulsatile, measures of BP that better account for the rhythmic movement of blood through the body's vasculature versus momentary BP readings at systole and diastole (Safar, 2003). As the heart contracts, it sends a shock wave of blood to the body. Pulse wave velocity (PWV) is a pulsatile measure of how quickly blood circulates with each heart beat and is a measure of arterial stiffness (AS), or how elastic the arteries are. The more resistance blood has in the form of stiff arteries, the slower it moves. When blood hits a branch in the arterial tree, some of that initial wave of blood is reflected back towards the heart while the rest moves forward. Increases in the amount of blood reflected back can cause an increase in SBP (Sherwood, 2010). This increase in SBP is referred to as an augmentation index (AIx) and represents a second measure of AS and dynamic BP. PWV is normed according to age, BP, and health, with 6.1 (±1.5) - 6.8 (±1.7) m/s considered normal for healthy (non-diabetic, non-smoking), young adults (< 30 years; Boutouyrie & Vermeersch, 2010). Central AIx (measured proximally to the heart) is also normed according to age and

health with values below 23.4% (95$^{th}$ percentile, 37.0%) considered normal for healthy (non-diabetic, non-hypertensive) young adults (< 39 years old; Chung et al., 2010; van Trijp et al., 2005). PWV and AIx are positively correlated and an increase in either increases hypertensive risk (Safar, 2003; Zieman, Melenovsky, & Kass, 2005).

Hypertension affects one in three adults (Fields et al., 2004; Gillespie, Kuklina, Briss, Blair, & Hong, 2011; Roger et al., 2012) and incidence among children, adolescents, and young adults has escalated in recent years. Among 8-17 year-olds, the incidence of hypertension (classified as exceeding 95$^{th}$ percentile by age and gender) rose from 2.7% in 1988 to 3.7% in 2002, a 37.4% relative increase (Din-Dzietham, Liu, Bielo, & Shamsa, 2007). Among those 18-34 years old, the incidence of hypertension is even greater at 7.4% (Gillespie et al., 2011).

**Prehypertension**

An additional 29.7% of adults have prehypertension, defined as having untreated SBP of 120-139 mmHg or DBP of 80-89 mmHg (Ogunniyi, Croft, Greenlund, Giles, & Mensah, 2010). Among 7-18 year olds, 10.0% have prehypertension (classified as 90$^{th}$-95$^{th}$ percentile by age and gender; Din-Dzietham et al., 2007) and among 18-34 year olds, 17.8% have prehypertension (Pletcher et al., 2008). Hypertension and prehypertension are both more prominent among adult men than women. Of the 17.8% of pre-hypertensive young adults, 70% are male (Pletcher et al., 2008).

The relationship between BP and cardiovascular health is linear, with cardiovascular risk doubling each 20 mmHg increase in SBP or 10 mmHg increase in DBP above 115/75 mmHg (Vasan, Larson, Leip, Kannel, & Levy, 2001). Therefore, individuals with prehypertension are at-risk for hypertension and related illness (e.g., cardiovascular disease, obesity, diabetes mellitus) despite not being hypertensive. Of 9,845 men and women in the Framingham Heart

Study, the four-year incidence of hypertension was 5.3% among those with a baseline BP < 120/80 mmHg, 17.6% among those with a baseline BP of 120/80 to 129/84 mmHg, and 37.3% among those with a baseline BP of 130/85 to 139/89 mmHg (Vasan, et al., 2001). Prehypertension is also associated with high total cholesterol levels, obesity, diabetes mellitus, and cardiovascular disease (Lloyd-Jones, Evans, & Levy, 2005). BP readings in the pre-hypertensive range may be decreased by reducing maladaptive risk factors, including poor diet, inactivity, smoking, and alcohol consumption (Ornish, 1996). While similar lifestyle changes may impact hypertensive BP, antihypertensive medication is often concurrently prescribed (Sherwood, 2010).

**Alcohol**

Of the many risk factors predisposing prehypertension and hypertension, alcohol use is the focus of this study because of its prominence among young adult men. According to the Southern Illinois University Carbondale Core Institute's Alcohol and Other Drug Database (2008), 84.3% of college students reported consuming alcohol at least once in the previous year and 71.7% in the last 30 days. Furthermore, 46.1% reported binge drinking (i.e., consuming five or more drinks in one sitting) in the past two weeks. Studies also show that, on average, men consume 8.1 g more alcohol on a daily basis, have a higher SBP, and binge drink more often than women (Gillman, Cook, Evans, Rosner, & Hennekens, 1995).

The association between alcohol intake and hypertension has been studied in two ways, both of which are implemented in the present study. A self-report approach examines the relationship between drinking patterns and health risk through the use of surveys. This approach is easy to execute and is amenable to large sample sizes. Self-report studies have uniformly shown a J-shaped association between alcohol intake and hypertensive risk in women (Gillman

et al., 1995; Sesso, Cook, Buring, Manson, & Gaziano, 2008). Women consuming three or fewer standard drinks (14 g ethanol) per day are more likely to experience a decrease in hypertension risk (8-21%); whereas, women consuming four or more drinks per day are more likely to experience an increase in hypertension risk (Sesso et al., 2008).

There is less consistency, however, regarding the association between self-reported alcohol intake and BP in men. Some researchers have identified a J-shaped association in men similar to that seen in women (Gillman et al., 1995). Others have found a dose-response relationship in which hypertension risk increases with each daily drink (Brummett et al., 2011; Sesso et al., 2008). Regardless of the association between one to two drinks per day and BP, experts agree anything above that threshold appears to have a harmful association with BP among men. These trends appear independent of age, appearing in young adults, ages 18-26 (Brummett et al., 2011; Gillman et al., 1995), and in middle to older adults, ages 40-84 (Sesso et al., 2008). Furthermore, men and women who drank daily or who drank frequently without food exhibited a significantly higher incidence of hypertension (Stranges et al., 2004). There is no significant association between alcoholic beverage type and hypertension (Zilkens et al., 2005).

The second approach to studying the relationship between alcohol consumption and BP examines immediate consequences of alcohol administration in a laboratory setting. While this method is less prevalent in the literature, it has advantages over self-report measures. For example, heavy drinkers do not often participate in surveys, past and present consumption may be underreported, and drinking patterns are difficult to quantify from survey data (Beilin & Puddey, 2006).

Laboratory studies have shown acute BP change as a result of alcohol consumption is moderated by baseline BP (Sengul et al., 2011). Insufficient literature is available on acute BP

changes as a result of alcohol intake in pre-hypertensive individuals; thus, the literature reviewed here on the impact of acute alcohol consumption and BP is restricted to normotensive and hypertensive individuals.

Across age, normotensive individuals who consume alcohol experience no immediate change in BP (Hering, Kucharska, Kara, Somers, & Narkiewicz, 2011; Sengul et al., 2011; van de Borne, Mark, Montano, Mion, & Somers, 1997). The relationship is less clear in hypertensive individuals. Kojima et al. (1993) found BP decreased in habitually drinking hypertensive men after consuming a single alcoholic drink with dinner. Conversely, Hering et al. (2011) found after consuming 1 g ethanol/ kg body weight following a light breakfast, BP increased in hypertensive men and women. The principal differences between these two studies are the amount of alcohol consumed and time of day. Kojima et al. (1993) administered 14 g of ethanol to participants, while Hering et al. (2011) administered 1 g/kg body weight (approximately 75 g for a 150 lb individual). In addition, Kojima et al. (1993) administered alcohol in the evening, whereas Hering et al. (2011) did so in the morning. While BP varies < 15 mmHg throughout the day (Sander, Kukla, Klingelhöfer, Winbeck, & Conrad, 2000), it is typically higher in the morning than the evening (Imai et al., 1999). Therefore, the amount of alcohol consumed and time of day may moderate acute BP changes in hypertensive individuals. Diet, exercise, and personality represent other potential factors affecting the relationship between baseline and post alcohol consumption BP (Mezquita, Stewart, & Ruipérez, 2010; Sherwood, 2010).

**Five Factor Model of Personality**

Personality is examined in the present study because it empirically relates to both alcohol consumption (Clark et al., 2012; Mezquita et al., 2010; Ruiz, Pincus, & Dickinson, 2003; Stewart, Zvolensky, & Eifert, 2001) and cardiovascular risk (Hemingway et al., 2003).

Researchers and practitioners frequently describe personality in terms of five broad dimensions: openness to experience, conscientiousness, extraversion, agreeability, and neuroticism. Each trait is further differentiated into six more specific facets. This assembly is referred to as the Five Factor Model (FFM). Psychologists generally agree scoring neither high nor low on any of these five dimensions is inherently good or bad, with the possible exception of neuroticism, which is generally considered a maladaptive trait (Costa & McCrae, 1992).

Openness to experience describes individuals who are curious, creative, original, and imaginative. Conscientiousness depicts individuals who are organized, reliable, hard-working, self-disciplined, punctual, and ambitious. Extraversion describes individuals who are sociable, active, talkative, optimistic, fun-loving, and affectionate. Agreeability portrays soft-hearted, good-natured, trusting, helpful, forgiving, gullible, and straightforward individuals. And individuals who are nervous, depressed, worrying, insecure, angry, and hostile are described as neurotic (Costa & McCrae, 1992).

These 5 personality traits and 30 facets were yielded through a factor analysis of a wide variety of individual trait words sampled from the dictionary and rated as applicable to the self or others (Costa & McCrae, 1992). Today, the 5 traits and 30 facets are assessed similarly. Individuals complete questionnaires of varying lengths on which they rate themselves or others on a variety of items. One of the most popular measures is the NEO-Personality Inventory (NEO-PI), which uses 8 items to assess each facet, culminating in 240 items (Costa & McCrae, 1992). The NEO-Five Factor Inventory (NEO-FFI) is an abridged version of the NEO-PI, containing only 60 items and assessing the 5 traits without specific facet scores. The 16 Personality Questionnaire (16PF; Cattell, Eber, & Tatsuoka, 1970) and the California

Psychological Inventory (CPI; Gough, 1987) are two other similar questionnaire measures of personality.

The International Personality Item Pool (IPIP), while similar to the measures described above, is different because of the motives behind its creation. The IPIP was developed by Goldberg (1999) as an economic solution to research budgets and the high cost of commercial instruments. Through an international development program, 1,252 personality items were yielded and made freely available online through public domain. Additionally, two highly correlated five-factor instruments were created: a 50-item measure (IPIP-50; 10 items per trait) and a 100-item measure (20 items per trait; Lim & Ployhart, 2006).

**Personality and alcohol consumption.** Personality strongly correlates with quantity and frequency of alcohol intake (Cooper, Agocha, & Sheldon, 2000; Malouff, Thorsteinsson, Rooke, & Schutte, 2007; Stewart et al., 2001) and alcohol-related problems (Cooper et al., 2000; Malouff et al., 2007; Martin & Sher, 1994; Mezquita et al., 2010; Ruiz et al., 2003; Stewart et al., 2001; Trull & Sher, 1994). Self-report studies with college students, more specifically, have shown three of the FFM personality traits consistently predict specific drinking patterns and behavior.

Conscientiousness most reliably predicts alcohol use. Both heavy drinking and related problems, including alcohol use disorders (AUD), are high among those low in conscientiousness (Clark et al., 2012; Ibáñez et al., 2010; Isaak, Perkins, & Labatut, 2011; Kashdan, Vetter, & Collins, 2005; Malouff et al., 2007; Martin & Sher, 1994; Mezquita et al., 2010; Trull & Sher, 1994). Additionally, extraversion reliably predicts increased drinking quantity and frequency (Cooper et al., 2000; Gerra et al., 2004; Malouff et al., 2007; Peterson, Morey, & Higgins 2005), but not drinking problems or AUDs (Malouff et al., 2007; Martin &

Sher, 1994; Mezquita et al., 2010; Ruiz et al., 2003; Trull & Sher, 1994). In addition, Mezquita et al. (2010) found men were significantly more extraverted ($M$ = 57.42, $SD$ = 9.26) than women ($M$ = 55.38, $SD$ = 7.99), and consumed more drinks per month ($M$ = 23.76, $SD$ = 25.34) than women ($M$ = 15.71, $SD$ = 17.14) in a correlational self-report study of 799 college students.

Neuroticism is the final trait consistently predicting alcohol use. Higher self-reported neuroticism relates to frequent and heavy drinking among young adults (Stewart et al., 2001) in addition to drinking problems and AUDs (Cooper et al., 2000; Isaak et al., 2011; Ruiz et al., 2003; Stewart et al., 2001; Trull & Sher, 1994). The other two personality traits included in the FFM, agreeability and openness to experience, have not been shown to predict specific alcohol patterns consistently (Clark et al., 2012; Ibáñez et al., 2010; Malouff et al., 2007; Ruiz et al, 2003; Stewart et al., 2001).

**Personality and cardiovascular risk.** The best known connection between personality and cardiovascular risk is the constellation of personality traits known as the Type A personality. Friedman and Rosenman (1974) noted heart patients who showed a greater sense of time urgency, multi-tasking, competitiveness, and hostility in their interactions with people had a greater risk for coronary heart disease and heart attack. This assembly of characteristics is typical of individuals considered to be "Type A." In contrast, a "Type B" individual is relaxed, patient, and easy-going. Type A personality correlates with high neuroticism and conscientiousness; and Type B personality is linked with high agreeability (Cervone & Lawrence, 2010).

However, the entire Type A constellation does not reliably predict poor cardiovascular health. Rather hostility, a facet of neuroticism, appears to reliably relate to poor cardiovascular functioning (Barefoot, Dodge, Peterson, Dahlstrom, & Williams, 1989; Boyle, Jackson, &

Suarez, 2007; Costa & McCrae, 1992). Cook and Medley (1954) dissected the hostility loading questions out of the Minnesota Multiphasic Personality Inventory (MMPI) to yield a separate 50-item scale (Cook-Medley Hostility Scale) to specifically assess hostility, cynicism, and interpersonal mistrust without the noise of the other psychopathology scales measured by the MMPI (Bunde & Suls, 2006; Miller, Smith, Turner, Guijarro, & Hallet, 1996). Using prospective and retrospective designs, these and similar self-report measures of hostility have since been found to correlate with heart attacks and mortality in at-risk individuals (Miller et al., 1996). Other emotions play a role in cardiovascular stress, including depression and anger, which increase the likelihood of heart problems and increase the progression to cardiovascular disease (Gurung, 2010).

**Present Study**

In summary, the literature supports an interrelation between alcohol consumption, individual personality differences, and BP. Among young adult men, the relationships between alcohol intake and low conscientiousness and high extraversion and neuroticism, and between high hostility (a facet of neuroticism) and BP, have largely been supported in previous studies. However, there is less consensus surrounding the relationship between alcohol intake and BP among this same demographic, with some studies identifying a J-shaped association (Gillman et al., 1995) and some identifying a dose-response association (Brummett et al., 2011; Sesso et al., 2008). A potential explanation of the mixed findings in the relationship between alcohol consumption and BP among young men may be the mediational role of individual differences in neuroticism and related hostility. The present study examined this mediational model via self-report measures of alcohol use. In addition, by administering alcohol to a subset of participants

in a laboratory, the acute relationship between alcohol consumption and BP was examined among college-aged men.

**Hypothesis 1.** Self-reported alcohol consumption was hypothesized to correlate positively with SBP and DBP (day values as per ambulatory measurement). In response to acute alcohol administration, daytime and nighttime SBP and DBP, PWV, and AIx was hypothesized to increase following alcohol consumption.

**Hypothesis 2**. Conscientiousness was hypothesized to correlate negatively with self-reported alcohol consumption. Conversely, extraversion, neuroticism, and hostility were hypothesized to correlate positively with self-reported alcohol consumption. There was no predicted relationship between personality and alcohol consumption in the alcohol administration portion of the study because alcohol administration was standardized across participants and, thus, did not vary.

**Hypothesis 3.** Neuroticism and hostility was hypothesized to correlate positively with SBP and DBP. There was no predicted relationship between personality and nighttime SBP and DBP (or PWV and AIx) because the small sample size ($n$ = 17) of the alcohol administration study did not generate the power needed to examine personality effectively. A statistical power analysis using G*Power (Faul, Erdfelder, Buchner, & Lang, 2009) indicated the need for a sample of approximately 160 participants to detect associations found in previous research ($r$ = .15, $\alpha$ = .05, $\beta$ = .60; Malouff et al., 2007). There was no predicted relationship between conscientiousness or extraversion and BP because the literature only supports a relationship between these traits and alcohol consumption, not blood flow.

**Hypothesis 4.** Alcohol consumption was predicted to indirectly affect daytime SBP and DBP through the mediational role of neuroticism and hostility. Again, there was no predicted

mediational relationship for nighttime SBP and DBP (or PWV and AIx) due to standard alcohol administration and sample size. Conscientiousness and extraversion were excluded from mediational analysis because previous research does not support a relationship between these traits and BP.

## Method

### Participants

Two hundred and eight male volunteer college student participants (18-25 years) were recruited from Appalachian State University (ASU) via an online system facilitating research participation for course credit, as well as email and flyer methods of advertisement. Women were excluded from this study because the research questions involve males and alcohol administration could adversely interact with a concurrent pregnancy.

Thirty-one participants were excluded for screening positively for hazardous alcohol use and one for endorsing a history of cardiopulmonary or metabolic disease because of the potential harm from consumption of alcohol. In addition, three participants were excluded for tobacco use, eight for endorsing abstinence from alcohol, and ten for currently taking prescription or over-the-counter medications (OTCs; must have abstained 72 hr to participate). Informed consent was obtained before beginning the study.

The final sample consisted of 155 male participants 18 to 25 years old ($M$ = 20.97, $SD$ = 9.11). Participants predominantly identified as college freshmen (36.6%; 26.1% sophomores; 17.0% juniors; 20.3% seniors) and as Caucasian (83.8%; 5.8% African American; 2.5% Hispanic American; 7.8% other). The consent process and protocol were approved by the Institutional Review Board at ASU on February 18, 2013 (see Appendix A).

## Measures

**Demographic information.** Participants were asked to indicate their gender, age, ethnicity, class rank, and extracurricular involvement (see Appendix B).

**Substance use questionnaire.** Three items assessed family history of substance use, and 10 questions measured personal use of alcohol (see Appendix C). This included two items assessing the quantity and frequency of alcohol use. One item asked the number of days participants used alcohol across the past 30 (i.e., frequency [F]). Participants either responded in an open-ended fashion or endorsed one of two available scale anchors (*Never used; Have used, but not in last 30 days*). The other item inquired the average number of alcoholic drinks consumed per typical drinking occasion (i.e., quantity [Q]), to which participants responded in an open-ended fashion. A composite variable describing drinks per month was calculated by multiplying quantity by frequency (QF; Mezquita et al., 2010; Sesso et al., 2008). A comparative study of alcohol consumption self-report measures indicated QF was comparable to similar methodology (e.g., recent recall). On average, self-report surveys estimate approximately 50-75% of actual consumption, with QF on the lower end estimating 49.8% (Stockwell et al., 2004).

**Alcohol Use Disorder Identification Test (AUDIT) and health questionnaire.** The AUDIT is a reliable measure used to screen for AUDs (i.e., abuse, dependence) consisting of 10 questions regarding drinking behavior (e.g., *Have you or someone else ever been injured by your drinking?*; see Appendix D). The first eight questions have five answer choices sequentially worth 0-4 points; the last two questions each have three answer choices worth 0, 2, and 4 points. Summed scores of 8 or more suggest hazardous drinking, while scores of 15 or more in men and 13 or more in women suggest dependence. The health questionnaire used in this study assessed

the presence of concurrent general medical conditions (e.g., hypertension, cardiovascular disease) in addition to whether or not the individual was taking any prescription or OTC medications, currently smoked cigarettes, or had any allergies. The health questionnaire was used primarily to assess for exclusion criteria.

A recent study of primary care patients compared the validity of the AUDIT when administered as a single scale with the validity of AUDIT when administered alongside a health questionnaire (H-AUDIT), as was done in the present study (Daeppen, Yersin, Landry, Pécoud, & Decrey, 2006). The test-retest reliability of the H-AUDIT was .88 over a 6-week interval; and internal consistency was comparable to the AUDIT when administered singly (.85). An alternative study reported a sensitivity of .84 and specificity of .71 when utilizing a cut-off score of 11 on the AUDIT in a college sample (Fleming, Barry, & Macdonald, 1991). Internal consistency of the AUDIT for the present study was .56.

**IPIP-50.** The 50-item IPIP is an instrument utilizing 10 behavioral items (e.g., *Am the life of the party*) to assess each of the five traits outlined by the FFM (i.e., openness to experience, conscientiousness, extraversion, agreeability, and neuroticism). The IPIP was chosen over other measures of personality as it is a public domain measure with high degrees of convergent validity with other established FFM measures, including the NEO (.94), 16PF (.86), and CPI (.84; Goldberg, 1999; Lim & Ployhart, 2006). Furthermore, the 50-item measure was selected over the 100-item measure to consider subject burden, and because of the high correlation between the shorter and longer measure. Goldberg (1999) found the part-whole correlations between the 50-item and 100-item scales to be .96 (openness to experience), .95 (conscientiousness), .96 (neuroticism), .94 (agreeableness), and .95 (extraversion).

This shorter version of the IPIP presents individuals with 50 behavioral items to which they endorsed the degree each behavior accurately described them on a 5-point Likert scale (1 = *Very Inaccurate* and 5 = *Very Accurate*). Each item is scored such that greater amounts of the measured trait correspond with more points (except for neuroticism, in which fewer points correspond with more neuroticism and more points with less neuroticism). Item points are summed for each trait and divided by the total number of items loading on that trait (i.e., 10) to yield a value on a 1 to 5 scale where 1 represents less of the trait and 5 represents more of the trait. In the present study, items loading on neuroticism were reverse-scored to aid interpretation of findings. Internal consistencies for the present study were .82 (openness to experience), .76 (conscientiousness), .86 (neuroticism), .81 (agreeableness), and .88 (extraversion).

**Anger/hostility IPIP scale (IPIP-Ho).** The IPIP database created by Goldberg (1999) contains hundreds of items beyond those included in the 50- and 100-item measures. These items are available for the creation of unique measures, but are also organized into different scales that load on the domains of the NEO-PI, 16PF, CPI, and many other measures of personality. Using the same logic employed by Cook and Medley (1954) to parse out hostility items from the MMPI, the anger/hostility scale of the IPIP was consulted and the 10 available items (e.g., *Get angry easily*) were selected for use in the current study. Goldberg (1999) indicated this subscale to be reliable (.88) and internal consistency for the present study was .90.

These 10 items were inserted amongst the 50 more general IPIP items to yield one large 60-item measure assessing six scales (openness to experience, conscientiousness, extraversion, agreeability, neuroticism, and anger/hostility) with 10 items each (see Appendix E). Each hostility behavior is measured in the same way as the more general trait items: with a 5-point Likert scale (1 = *Very Inaccurate* and 5 = *Very Accurate*). Again, each behavioral item is scored

such that greater anger and hostility correspond with more points. Item points are summed and divided by the total number of anger/hostility items administered (i.e., 10) to yield a value on a 1 to 5 scale where 1 represents less anger/hostility and 5 represents more anger/hostility.

**SphygmoCor CP.** The SphygmoCor CP is an instrument that quickly and non-invasively obtains measures of arterial elasticity, including central and peripheral AS. The data collection procedure requires a tonometer be gently pressed against the carotid, radial, femoral, and dorsalis pedis arteries (in the neck, wrist, thigh, and foot respectively), yielding pulse-wave transit times as the heart contracts and ejects a wave of blood (i.e., pulse) throughout the body. Central and peripheral velocities are calculated by dividing the distance traveled by the wave (m) by the time for the wave to travel that distance (s). From these measure, the SphygmoCor CP can derive central or aortic PWV and AIx. Aortic PWV and AIx are preferred measures of arterial stiffness over peripheral assessments because they are better predictors of cardiovascular risk (Avolio, 2008); and thus, were used in this study. The SphygmoCor CP has been shown to be a reliable technique for measuring indicators of blood flow, including AIx (.89).

**Oscar 2 Ambulatory Blood Pressure Monitor (Oscar 2).** The Oscar 2 is a non-invasive measure and consists of a brachial BP cuff attached to a pocket-sized monitor that takes oscillatory SBP and DBP measurements every 20 min and may be worn while awake during the day or asleep at night. Data is stored within the monitor until uploaded to a computer. The difference between the Oscar 2 measurement of SBP and DBP and a professional observer measurement of SBP and DBP was $\leq$ 5 mmHg 62% and 70% of the time, respectively, clearing the device for clinical use by the British Hypertension Society (Goodwin, Bilous, Winship, Finn, & Jones, 2007).

**Omron Automatic Blood Pressure Monitor (Omron).** The Omron is an oscillometric BP monitor that measures BP via the brachial artery (in upper arm), producing a digital reading of SBP and DBP. The British Hypertension Society and the Association for the Advancement of Medical Instrumentation determined on average the Omron differed from traditional sphygmomanometers by 0.60 (±6.) mmHg and -3.15 (±6.6) mmHg when measuring SBP and DBP respectively. These values cleared the Omron for professional and home use in an adult population (Coleman, Freeman, Steel, & Shennan, 2005).

**Alco-Sensor III (ASIII).** The ASIII is a hand-held pocket breath alcohol tester. Participants breathe into disposable mouthpieces while their breath alcohol content (BrAC) is shown on a large three-digit display. BrAC as measured with the ASIII has been shown to correlate well with blood alcohol levels in cooperative (.87) patients (Gibb, Yee, Johnston, Martin, & Nowak, 1984).

## Procedure

Two related studies were conducted to assess the relationship between alcohol use and personality among college men by a) examining the relationship between BP measures (i.e., daytime SBP and DBP), self-report measures of alcohol use, and personality; and by b) administering alcohol in the lab to examine change in BP measures (i.e., AIx, PWV, and daytime and nighttime SBP and DBP) before and after alcohol consumption.

**Study 1: Self-report.** One hundred and thirty-eight participants were recruited via an online system facilitating research participation for course credit. They were asked to eat 1 hr prior to participating in the study; abstain from alcohol for 24 hr before participating in the study; abstain from prescription and OTC medications for 72 hr before beginning the study; and abstain from exercising the day of their participation. Food bars and juice were on hand in the event a

participant did not eat beforehand and participants were asked to reschedule if they did not abstain from alcohol, medication, or exercise for the required amount of time.

After reviewing procedures and risks and benefits of the study with participants, informed consent was obtained (see Appendix F) and the screening protocols were administered in small group sessions (i.e., AUDIT, health questionnaire). If participants did not meet inclusion criteria based on screening protocols, they were not allowed to participate. If the AUDIT suggested an AUD, the participant was informed of available resources (i.e., ASU Counseling Center, ASU Wellness Center). If participants met inclusion criteria based on screening protocols, they provided their demographic information and a valid form of identification (i.e., driver's license or other government-issued photo identification listing the participant's birth date) to verify their age. Height (cm), weight (kg), and daytime BP (using Omron) were then measured individually by the principle investigator or a trained research assistant in an adjacent room to maintain the participant's privacy. Afterwards, participants completed the IPIP-50, IPIP-Ho, and a substance use questionnaire before being debriefed.

Individuals were reimbursed with course credit based on the extent of their participation (i.e., screener, full protocol). The data from these 138 participants was combined with the self-report data and pre-alcohol height, weight, and daytime BP from the 17 participants in the alcohol administration study to yield 155 cases of self-report and simple physiological data.

**Study 2: Alcohol administration.** Seventeen male participants (21-25 years) were recruited via email and flyers. Participants verbally gave limited consent and completed a brief telephone screening (i.e., AUDIT, health questionnaire). Individuals excluded because of an AUD were informed of available resources (i.e., ASU Counseling Center, ASU Wellness Center). Participants invited to participate in the study were asked to abstain from alcohol for 24

hr before Session 1 and throughout the duration of the study (with the exception of the alcohol provided in the lab); abstain from prescription or OTC medication for 72 hr before beginning the study and throughout the study; and abstain from exercising on days in which they participated in the study. Participants were also told what to expect from study participation: 3 laboratory visits totaling approximately 6 hr, 2 nights wearing a brachial BP cuff (i.e. Oscar 2) while sleeping, supervised laboratory alcohol consumption (i.e., one large vodka tonic consumed within 15 min) for which they would need a safe ride home (i.e., Session 2), and $20 as payment for their participation (amount prorated for partial participation). Participants then reported to the laboratory for three individual testing sessions.

**Session 1.** After obtaining written consent (see Appendix G), indicating a safe means of transportation home following Session 2 (i.e., alcohol administration), and verifying the participants' age (via government-issued photo identification), participants were issued an Oscar 2 to monitor their nighttime BP while sleeping for one night. Participants were scheduled to return to the laboratory between 5 p.m. and 7 p.m. the following day for Session 2 and asked to bring a book or computer to occupy their time while their BrAC returned to a safe level (.02-.04) during Session 2.

**Session 2.** Participants returned to the laboratory the day after monitoring their nighttime BP with the Oscar 2. In addition to the above abstinence rules, participants were also asked to eat one hour prior to coming to the laboratory. Food bars and juice were on hand in the event a participant did not eat beforehand and participants were asked to reschedule if they did not abstain from alcohol, or medications for the required time period.

After measuring baseline PWV, AIx, daytime BP (using Oscar 2), height, and weight, and completing the IPIP-50, IPIP-Ho, and substance use questionnaire, BrAC was taken with the

ASIII to ascertain a 0.0 baseline reading. Participants were then administered a single large drink consisting of 2 mL/kg body weight of 100 proof vodka mixed in a solution of 1 part vodka to 4 parts tonic water and lime (Poltavski, Marino, Guido, Kulland, & Petros, 2011). Participants were instructed to consume this drink within 15 minutes (Pederson, Treloar, Burton, & McCarthy, 2011). This combination has reliably resulted in an average blood alcohol concentration of .07 to .08 (Poltavski et al., 2011). PWV and AIx were measured again 30 min after alcohol consumption. BrAC was taken in 30 min intervals after alcohol administration until BrAC was between .02 and .04 in two consecutive readings. Participants were picked up by a self-identified sober peer from the lab to get home safely. Participants were asked to monitor their nighttime BP using the Oscar 2 for an additional night.

**Session 3.** Participants returned to the laboratory the following morning between 7 a.m. and 9 a.m. to return the Oscar 2. At this time, PWV, AIx, and daytime BP were measured a final time.

## Results

Of the 155 participants completing the study, four had some missing data. Analyses were run with and without these participants, with no significant differences observed. Therefore, substitutions were applied for participants with missing data. Two participants did not indicate how many drinks they consumed per drinking occasion, for which linear interpolation was used to supplement missing values (Bye, 2007). Two additional participants omitted one item on the IPIP. Neutral responses were substituted for these missing data as per scoring protocols from a comparable personality assessment (NEO-PI-R; Costa & McCrae, 1992). In addition, one participant who completed the alcohol administration study did not provide self-report data (e.g., alcohol consumption, personality); therefore, some results are limited to 154 participants.

Normality tests indicated scale measures did not deviate significantly from normal, with the exception of age, $D(153) = 0.21$, $p < .001$, conscientiousness, $D(155) = 0.08$, $p = .012$, and self-report alcohol use measures (Q, $D(153) = 0.14$, $p < .001$; F, $D(155) = 0.10$, $p < .001$; QF, $D(155) = 0.15$, $p < .001$). Conscientiousness was negatively skewed (-.69), while alcohol use measures were positively skewed (Q, .90; F, .62; QF, 1.51). All deviant measures were leptokurtic (conscientiousness, .833; Q, .38; F, .44; QF, 2.16). Descriptive statistics for all scale measures can be found in Table 1. Independent t-tests indicated participants completing only the self-report study ($M = 7.01$, $SD = 3.09$) had significantly higher AUDIT scores than participants also completing the alcohol administration study ($M = 5.56$, $SD = 2.10$), $t(153) = 1.83$, $p = .044$. However, participants did not differ across the two studies on other measures ($p$'s > .05).

Bivariate correlations were used to test Hypothesis 1 (as it applies to self-report measures) that Q and F would correlate positively with SBP and DBP. Spearman's $r$ was employed to account for non-normal alcohol use measures; however, no significant results were observed (see Table 2). A one-way repeated-measures (baseline, 12 hr post-alcohol) analysis of variance (ANOVA) was used to examine Hypothesis 1 that daytime and nighttime SBP and DBP would increase following acute and controlled alcohol consumption. An additional one-way repeated-measures (baseline, 30 min post-alcohol, 12 hr post-alcohol) ANOVA was used to assess change in PWV and AIx, for which data was comparted across three time points. Mauchly's test indicated the assumption of sphericity was not violated for PWV, $\chi^2(2) = 2.17$, $p = .338$, or AIx, $\chi^2(2) = 0.18$, $p = .914$. No significant results were observed for changes across time in relation to acute alcohol administration on daytime SBP or DBP, nighttime DBP, PWV, or AIx. However, results indicated nighttime SBP was significantly higher 12 hr following alcohol consumption ($M = 134.19$ mmHg, $SD = 28.65$ mmHg from $M = 120.85$ mmHg, $SD =$

14.76 mmHg) as measured by the Oscar2, $F(1, 16) = 5.53$, $p = .032$. ANOVA results are described in Table 3.

Bivariate correlations were used to test Hypothesis 2 that conscientiousness would correlate negatively with Q and F and extraversion, neuroticism and hostility would correlate positively with Q and F. Spearman's *r* was utilized to account for the biased conscientiousness scale and alcohol use measures. No significant results were observed (see Table 2). Bivariate correlations were also used to test Hypothesis 3, that neuroticism and hostility would correlate positively with SBP and DBP; similarly, no significant results were observed (see Table 2).

Hypothesis 4, that alcohol consumption indirectly relates to SBP and DBP through neuroticism and hostility, was examined via the above bivariate correlations and additional mediational analyses. Indirect effects were computed from each of 1,000 bootstrapped samples to account for biased alcohol use measures (Efron & Tibshirani, 1993; Preacher & Hayes, 2004). While no significant indirect effect of alcohol consumption on blood flow through personality was observed, the negative non-significant relationship between hostility and SBP, $b = -2.37$, $p = .100$, appears to have suppressed the total effect of QF on SBP such that it approached significance when hostility was included as a mediator, $b = .066$, $p = .052$ (see Figure 1). Results are listed in Table 4.

## Discussion

The purpose of the present study was to examine the relationship between alcohol consumption, blood flow, and personality variables among male college students. Previous literature supports mixed relationships between alcohol use and BP among men, both when self-report data (Brummett et al., 2011; Gillman et al., 1995; Sesso et al., 2008) and acute alcohol administration (Hering et al., 2011; Kojima et al., 1993; Sengul et al., 2011; van de Brone et al.,

1997) have been used as methodologies. Thus, the current study tested the potential for individual differences in personality to mediate the relationship between alcohol use (Clark et al., 2012; Cooper et al., 2000; Ibáñez et al., 2010; Malouff et al., 2007; Mezquita et al., 2010; Stewart et al., 2001) and BP (Barefoot et al., 1989; Boyle et al., 2007; Cook & Medley, 1954; Friedman & Rosenman, 1974; Miller et al., 1996). Nighttime SBP was found to increase significantly relative to baseline following acute alcohol consumption. In addition, while QF did not significantly relate to SBP when examined via bivariate correlations or mediational analysis, the inclusion of hostility as a third variable increased the magnitude of this relationship to near-significance. This indicated possible suppression of QF on SBP through hostility, rather than mediation as hypothesized. No other significant bivariate correlations among alcohol consumption, BP, or personality were observed, nor did blood flow change in any other significant way following acute alcohol consumption.

Previous studies utilizing self-report surveys conflict as to whether the relationship between alcohol consumption and hypertensive risk in men is J-shaped (Gillman et al., 1995) or linear (Brummett et al., 2011; Sesso et al., 2008). However, despite this disagreement, the literature generally supports a positive correlation between alcohol consumption beyond 1-2 daily drinks and blood pressure in men, regardless of age (Brummett et al., 2011; Gillman et al., 1995; Sesso et al., 2008). The present study, however, did not observe significant relationships between self-reported alcohol consumption and BP. In addition, visual inspection of the data also indicated there was no relationship between alcohol consumption and blood pressure.

The non-significant relationship between self-reported alcohol consumption and BP may be explained by the restricted range of drinking behaviors reported by participants. Participants had to demonstrate regular consumption of alcohol, but not so much they screened positively for

hazardous use. While these exclusion criteria contributed to greater homogeneity across participants and increased participant safety (e.g., particularly in the alcohol administration study), they may also have artificially attenuated any relationship between self-reported alcohol consumption and BP. Exclusion criteria, however, were similar to previous studies (e.g., abstinence, comorbid medical conditions, hypertension; Brummett, et al., 2011; Gillman et al, 1995; Sesso et al., 2008). Range restriction of BP may also have contributed to non-significant findings. While participants were not selected based on BP, on average they were pre-hypertensive, a group not investigated in previous studies (Brummett, et al., 2011; Gillman et al, 1995; Sesso et al., 2008).

The literature is similarly mixed when alcohol consumption and BP are examined via alcohol administration in the laboratory. In general, acute alcohol consumption does not appear to impact BP in normotensive individuals (Hering et al., 2011; Sengul et al., 2011; van de Borne et al., 1997). In hypertensive individuals, however, BP response seems to be moderated by the amount of alcohol consumed, decreasing after a single drink (Kojima et al., 1993) and increasing after approximately five drinks (Hering et al., 2011). Prehypertension has not been adequately examined in previous research. However, results of the present study indicate alcohol consumption may impact the cardiovascular health of pre-hypertensive men by altering nighttime SBP.

BP normally follows a circadian rhythm, decreasing 10-15% below average daytime resting values at night (i.e., dipping; Bankir et al., 2008; Okamoto et al., 2009) and serving a potentially restorative function (Rosansky, Menachery, Whittman, & Rosenberg, 1996). Clinically, decreases < 10% are classified as “nondipping” and are associated with hypertensive organ damage (Loredo, Ancoli-Israel, & Dimsdale, 2001). In addition, approximately each 5%

decrease in nocturnal BP dip is associated with a 20% greater risk of cardiovascular mortality (Ohkubo et al., 2002). While many factors may impact circadian BP dip, behavioral patterns such as alcohol and tobacco use may play a role, altering typical rhythm (James, Toledano, Datz, & Pickering, 1995). After acute and controlled alcohol administration, results of the present study showed SBP was higher at night relative to baseline in a sample of, on average, pre-hypertensive young men. Therefore, in the same way the acute impact of alcohol consumption on blood pressure appears to be nonexistent in normotensive individuals and be moderated by amount of alcohol consumed in hypertensive individuals, the effect of acute alcohol consumption on blood pressure in pre-hypertensive men may be attenuation of normal nighttime SBP dip.

The literature also supports relationships between personality and both alcohol use and blood flow, specifically conscientiousness, extraversion, and neuroticism. Conscientiousness typically correlates negatively with alcohol consumption and related problems (including AUD diagnosis; Clark et al., 2012; Ibáñez et al., 2010; Isaak et al., 2011; Kashdan et al., 2005; Malouff et al., 2007; Martin & Sher, 1994; Mezquita et al., 2010; Trull & Sher, 1994). Extraversion, on the other hand, generally correlates positively with alcohol consumption (Cooper et al., 2000; Gerra et al., 2004; Malouff et al., 2007; Peterson et al., 2005). Neuroticism also correlates positively with frequent heavy drinking (Stewart et al., 2001) and related problems/AUDs (Cooper et al., 2000; Isaak et al., 2011; Stewart et al., 2001; Trull & Sher, 1994).

When exploring the relationship between personality and cardiovascular health, only a facet of one of the five traits (neuroticism) has been found to positively correlate with heart attacks and increased cardiovascular-related mortality: hostility (Boyle et al., 2007; Cook & Medley, 1954; Friedman & Rosenman, 1974; Miller et al., 1996). The present study, however, did not observe significant relationships between personality and either alcohol use or blood

flow. The previously noted range restriction of both alcohol use and BP in the present sample likely limited ability to detect a relationship between constructs.

In addition, a developmental model of health and personality, by which alcohol consumption, blood flow, and personality interact differently across the lifespan, may explain discrepancies between previous literature focusing on adult behavior (Barefoot et al., 1989; Boyle et al., 2007; Cook & Medley, 1954; Malouff et al., 2007; Martin & Sher, 1994; Miller et al., 1996) and the present study on college males. Emerging adulthood (18-25 years) has been proposed as a developmental period describing individuals from their late teens through early 20s (Arnett, 2000). As a distinct period, individuals in this phase of their lives have unique demographic, subjective, and physiological attributes. Therefore, if personality and health behaviors (e.g., alcohol use, blood pressure) are distinctive during emerging adulthood and equally unique at alternative developmental periods, they may differentially affect each other across the lifespan. The literature supports a developmental model of alcohol use such that emerging adults generally transition from consuming many drinks less frequently (e.g., weekend binge episodes; Brown, et al., 2008; Southern Illinois University Carbondale, Core Institute, 2008) to more frequent consumption of fewer drinks in adulthood (e.g., daily drink with dinner; Schulenberg, O'Malley, Bachman, Wadsworth, & Johnston, 1996).

Personality also relates to age, such that neuroticism, extraversion, and openness to experience appear stable throughout the lifespan, while there is more variability in agreeableness and conscientiousness (Soldz & Vaillant, 1999). Conscientiousness was negatively skewed in the present sample, potentially consistent with a college student sample, while other traits examined resembled values observed in previous literature (Mezquita et al., 2010). Blood pressure has also been shown to increase with age (Chobanian et al., 2003; James et al., 2014).

As alcohol use, personality, and blood pressure all have been associated with one another in adult samples (Barefoot et al., 1989; Boyle et al., 2007; Cook & Medley, 1954; Malouff et al., 2007; Martin & Sher, 1994; Miller et al., 1996) and all fluctuate across the life span, it is possible relationships detectable in adulthood may look differently in emerging adulthood, potentially dormant or non-existent.

Despite the non-significant relationships between self-reported alcohol use, personality, and BP, mediational analyses were conducted as per original planned analyses. Hostility was hypothesized to explain part of the relationship between alcohol consumption and SBP, decreasing the relationship between the two constructs when included in the model. While no significant results were observed, the inclusion of hostility in the model strengthened the relationship between alcohol consumption and SBP such that alcohol consumption was a better predictor of SBP when hostility was accounted for. Within a mediation model, this is known as a suppression effect and is the result of the direct and indirect effects of alcohol consumption and SBP having opposite signs (MacKinnon, Krull, & Lockwood, 2000). In the present study, hostility had a negative effect on SBP, while alcohol consumption had positive effects on hostility and SBP. The negative relationship between hostility and SBP explained variability in SBP, increasing the predictive value of alcohol consumption in estimating SBP.

While this effect was non-significant, one potential explanation for the unpredicted negative association between hostility and SBP is that other hostility-related traits (e.g., cynical hostility, defensiveness) may mediate the relationship between hostility and cardiovascular health (Jamner, Shapiro, Goldstein, & Hug, 1991). Another possible explanation could lay in the measurement of hostility. In the present study, however, the IPIP-Ho correlated strongly with the neuroticism scale, which in turn has high convergent validity with more established measures

of neuroticism (NEO, 16PF, CPI; Goldberg, 1999; Lim & Ployhart, 2006), and the internal consistency of the IPIP-Ho was high, suggesting an adequate measure of the construct of hostility.

A final explanation for the non-significant relationship between self-reported alcohol consumption and blood flow may be the role sleep plays in the relationship. The only significant finding observed in the present study was attenuated SBP dip following acute alcohol consumption and some studies have suggested sleep architecture (e.g., quantity and quality of sleep) may affect nighttime BP drop (Loredo et al., 2001; Matthews et al., 2008; Ohkubo et al., 2002; Roehrs & Roth, 2001). Other individual differences among people may also account for the variable hemodynamic response to alcohol consumption observed among adults in previous studies (Mezquita et al., 2010; Sherwood, 2010) with elevated blood pressure. Diet (particularly when high in saturated fat and cholesterol), for instance, has been associated with both cardiovascular mortality (Sacks et al., 2001) and alcohol consumption (Hegsted & Ausman, 1988). Exercise has also been associated with elevated blood pressure (Reisin, 1997) and alcohol consumption (Murphy, Pagano, & Marlatt, 1986).

To address the limitations of the present study, future studies may recruit participants with variable alcohol use behaviors to avoid the range restriction inherent in the present study. Blood pressure should also be measured at a consistent time of day to avoid circadian variations in the construct (Imai et al., 1999; Sander et al., 2000). Although the majority of participants were assessed between 5 p.m. and 7 p.m., time of day was not uniformly controlled in the self-report portion of the study (contrary to the alcohol administration portion). A cross-sectional, or longitudinal, method would also enable researchers to compare personality and health

characteristics across developmental age groups, assessing potential developmental changes in the possible relationships between alcohol use, individual differences, and BP.

Alternatively, future studies should assess a broader range of behavioral factors (e.g., diet, exercise) to test different health-based models of mediation between alcohol consumption and blood flow. Sleep quality, in particular, may be an interesting health construct to explore further (through self-report and/or physiological means) as the only significant finding in the present study pertained to nighttime SBP, which may also be affected by sleep architecture (e.g., sleep quantity and quality; Loredo et al., 2001; Matthews et al., 2008; Ohkubo et al., 2002; Roehrs & Roth, 2001). It should be anticipated, however, these individual differences (e.g., sleep, diet, exercise) will likely differ between college students and adults as well, and are more modifiable than personality variables.

Based on the results of the present study, alcohol use patterns and personality traits of college-age pre-hypertensive men do not appear to reliably relate to BP. Yet, this population may be at risk in the future. The relationship between acute alcohol consumption and elevated nighttime SBP suggests a potential health risk independent of regular alcohol consumption or personality. Because the developmental model of alcohol use indicates acute heavy alcohol consumption is prevalent among college-age men (Brown et al., 2008), this may be an especially hazardous risk for this population. Furthermore, this risk may be masked because nighttime ambulatory BP monitoring is not a routine hypertension screening measure. By incorporating such screening, hypertensive risk among college-age men may be more apparent and the relationship between blood pressure in emerging adult and adult men may be more evident.

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Table 1

*Descriptive Statistics for Total Sample*

| Variable | Self-Report ($n$ = 154) $M$ ($SD$) |
|---|---|
| Age | 20.97 (9.11) |
| *Personality domains* | |
| Conscientiousness | 3.57 (0.61) |
| Extraversion | 3.32 (0.77) |
| Neuroticism | 2.56 (0.74) |
| Hostility | 2.34 (0.79) |
| *Drinking behavior* | |
| Q | 5.21 (4.94) |
| F | 6.52 (11.22) |
| QF | 30.54 (33.94) |
| *Blood flow measures* | |
| Daytime SBP | 127.83 (14.28) |
| Daytime DBP | 75.85 (8.68) |

*Note.* SBP = systolic blood pressure; DBP = diastolic blood pressure; Q = quantity of alcohol consumption; F = frequency of alcohol consumption; QF = composite alcohol consumption (Q x F). SBP and DBP data measured with Omron in mmHg. Results limited ($n$ = 154) due to missing data.

Table 2

*Correlation Matrix for Self-Report Sample*

| Var | Con | Ext | Neu | Hos | Q | F | QF | SBP | DBP |
|---|---|---|---|---|---|---|---|---|---|
| Con | 1.00 | .138 | .025 | .007 | -.023 | -.002 | -.003 | .077 | .058 |
| Ext | - | 1.00 | *-.229*** | *-.141* | .032 | -.016 | .043 | *-.079* | *-.057* |
| Neu | - | - | 1.00 | *.648*** | -.094 | -.034 | -.081 | *-.045* | *.020* |
| Hos | - | - | - | 1.00 | -.069 | .082 | -.008 | *-.116* | *-.073* |
| Q | - | - | - | - | 1.00 | .194* | .842** | .074 | .078 |
| F | - | - | - | - | - | 1.00 | .622** | .028 | -.034 |
| QF | - | - | - | - | - | - | 1.00 | -.081 | .008 |
| SBP | - | - | - | - | - | - | - | 1.00 | *.556*** |
| DBP | - | - | - | - | - | - | - | - | 1.00 |

*Note.* Var = variable; Con = conscientiousness; Ext = extraversion; Neu = neuroticism; Hos = hostility; Q = quantity of alcohol consumption; F = frequency of alcohol consumption; QF = composite alcohol consumption (Q x F); SBP = systolic blood pressure; DBP = diastolic blood pressure. SBP and DBP are daytime values measured with Omron in mmHg. Results limited ($n$ = 154) due to missing data. *Italics* denote Pearson's $r$ when both variables normally distributed; otherwise Spearman's $r$ employed.

* $p < .05$

** $p < .01$

Table 3

*Repeated-Measures ANOVA of Acute Alcohol Use on Blood Flow*

| Variable | Baseline *M* (*SD*) | 30 Min Post-Alcohol *M* (*SD*) | 12 Hrs Post-Alcohol *M* (*SD*) |
|---|---|---|---|
| Daytime SBP | 136.12 (16.13) | - | 141.94 (21.05) |
| Daytime DBP | 72.71 (12.86) | - | 70.71 (10.22) |
| Nighttime SBP* | 120.85 (14.76) | - | 134.19 (28.65) |
| Nighttime DBP | 58.36 (8.27) | - | 62.00 (10.52) |
| PWV | 6.21 (1.56) | 5.97 (1.59) | 5.93 (0.96) |
| AIx | -0.59 (8.52) | 3.82 (8.41) | 3.00 (9.78) |

*Note.* Results from alcohol administration study ($n$ = 17). SBP = systolic blood pressure; DBP = diastolic blood pressure; PWV = pulse wave velocity; AIx = augmentation index. All SBP and DBP measured with Oscar2 in mmHg. PWV measured in m/s. AIx measured in %. PWV is aortic. AIx is central. Alcohol administration produced breath alcohol content (BrAC) .07 to .08 (Poltavski, et al., 2011).

* $p < .05$

Table 4

*Mediational Analyses of Alcohol Use on Blood Flow through Personality*

| Med | Out | QF→Med (*b*) | Med→Out(*b*) | Dir Eff (*b*) | Ind Eff (*CI*) | $\kappa^2$ |
|---|---|---|---|---|---|---|
| Neuroticism | SBP | .001 | -.975 | .061 | -.0001 (-.013, .003) | .002 |
| Hostility | SBP | .002 | -2.37 | .066 | -.006 (-.025, .003) | .014 |
| Neuroticism | DBP | .001 | .211 | .012 | .0002 (-.002, .005) | .001 |
| Hostility | DBP | .002 | -.861 | .015 | -.002 (-.013, .002) | .008 |

*Note.* Med = mediating variable (neuroticism, hostility); Out = outcome variable (SBP, DBP); QF = composite alcohol consumption (predicting variable); SBP = systolic blood pressure; DBP = diastolic blood pressure. SBP and DBP are daytime values measured with Omron. 1000 bootstrap samples to correct bias. 95% confidence interval (CI). No significant effects observed.

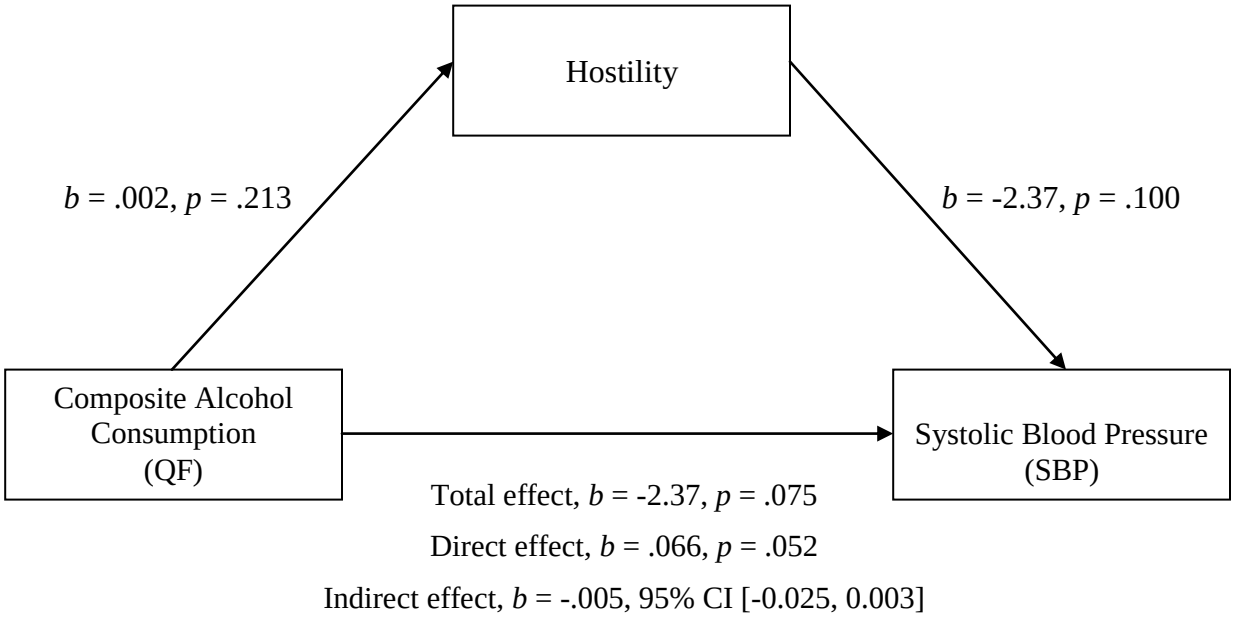


*Figure 1*. Mediation model of QF on SBP through hostility. Direct effect, $p = .052$.

Appendix A

Notice of Institutional Review Board Initial Approval by Full Board Review

**To:** Jacqueline Belhumeur

CAMPUS MAIL

**From:** Dr. Stan Aeschleman, Institutional Review Board Chairperson
**RE:** Notice of IRB Approval by Full Board Review
**Study #:** 13-0116

**Study Title:** Sleep, Individual Differences, Blood Flow, and Alcohol Use in College Males
**Submission Type:** Initial
**Approval Date:** 2/18/2013
**Expiration Date of Approval:** 11/19/2013

This submission has been approved by the above IRB for the period indicated above.

**Investigator's Responsibilities:**

Federal regulations require that all research be reviewed at least annually. It is the Principal Investigator's responsibility to submit for renewal and obtain approval before the expiration date. You may not continue any research activity beyond the expiration date without IRB approval. Failure to receive approval for continuation before the expiration date will result in automatic termination of the approval for this study on the expiration date.

You are required to obtain IRB approval for any changes to any aspect of this study before they can be implemented except to eliminate apparent immediate hazards. Should any adverse event or unanticipated problem involving risks to subjects occur it must be reported immediately to the IRB. Best wishes with your research!

CC:
Daniel Payseur
Lisa Grizzard, Psychology
Scott Collier, Health, Leisure And Exercise Science

Notice of Institutional Review Board Modification Approval by Full Board Review

**To:** Jacqueline Belhumeur

EMAIL

**From:** Dr. Stan Aeschleman, Institutional Review Board Chairperson
**Date:** 3/21/2014
**RE:** Notice of IRB Approval by Full Board Review
**Study #:** 13-0116
Study Title: Sleep, Individual Differences, Blood Flow, and Alcohol Use in College Males
**Submission Type:** Modification
**Approval Date:** 3/21/2014
**Expiration Date of Approval:** 10/21/2014

The Institutional Review Board (IRB) reviewed this study at a convened meeting and approved the modification for this study for the period indicated above. IRB approval is limited to the activities described in the IRB approved materials, and extends to the performance of the described activities in the sites identified in the IRB application. In accordance with this approval, IRB findings and approval conditions for the conduct of this research are listed below.

**Regulatory and other findings:**

The IRB determined that this study involves more than minimal risk to participants.

**Approval Conditions:**

Appalachian State University Policies: All individuals engaged in research with human participants are responsible for compliance with the University policies and procedures, and IRB determinations.

Principal Investigator Responsibilities: The PI should review the IRB's list of PI responsibilities. The Principal Investigator (PI), or Faculty Advisor if the PI is a student, is ultimately responsible for ensuring the protection of research participants; conducting sound ethical research that complies with federal regulations, University policy and procedures; and maintaining study records.

Modifications and Addendums: IRB approval must be sought and obtained for any proposed modification or addendum (e.g., a change in procedure, personnel, study location, study instruments) to the IRB approved protocol, and informed consent form before changes may be implemented, unless changes are necessary to eliminate apparent immediate hazards to participants. Changes to eliminate apparent immediate hazards must be reported promptly to the IRB.

Approval Expiration and Continuing Review: The PI is responsible for requesting continuing review in a timely manner and receiving continuing approval for the duration of the research

with human participants. Lapses in approval should be avoided to protect the welfare of enrolled participants. If approval expires, all research activities with human participants must cease.

Prompt Reporting of Events: Unanticipated Problems involving risks to participants or others; serious or continuing noncompliance with IRB requirements and determinations; and suspension or termination of IRB approval by external entity, must be promptly reported to the IRB.

Closing a study: When research procedures with human subjects are completed, please complete the Request for Closure of IRB review form and send it to irb@appstate.edu.

**Websites:**

1. PI responsibilities:
http://researchprotections.appstate.edu/sites/researchprotections.appstate.edu/files/PI%20Responsibilities.pdf

2. IRB forms: http://researchprotections.appstate.edu/human-subjects/irb-forms

CC:
Lisa Curtin, Psychology
Scott Collier, Health, Leisure And Exercise Science

## Appendix B

## Demographic Information

Gender: ___Male ___Female
Age: ____
Class rank: ___Freshman ___Sophomore ___Junior ___Senior
Race/Ethnicity: ____ (Fill in appropriate number)

1=White (not of Hispanic origin)
2=Black
3=Native American
4=Alaskan Native
5=Asian or Pacific Islander
6=Hispanic-Mexican
7=Hispanic-Dominican
8=Hispanic-Puerto Rican
9=Hispanic-Cuban
10=Other: _____

Are you involved in Greek life? _____

Appendix C

Substance Use Questionnaire

**Family History**

Have any of your immediate relatives (brothers, sisters, parents) had what you would call a significant drinking or drug use problem, one that did or should have led to treatment?
____Yes ____No

Have any of your relatives on your mother's side of the family (e.g., grandparents, aunts, uncles) had what you would call a significant drinking or drug use problem, one that did or should have led to treatment?
____Yes ____No

Have any of your relatives on your father's side of the family (e.g., grandparents, aunts, uncles) had what you would call a significant drinking or drug use problem, one that did or should have led to treatment?
____Yes ____No

**Personal Use/History**

1. Within the last 30 days, on how many days did you use alcohol (includes beer, wine, and liquor)? _____

☐ Never Used
☐ Have used, but not in last 30 days

2. On average, how many alcoholic drinks did you consume on one of these drinking days (1 serving= 1 ounce of hard liquor= 4 ounces of wine= 12 ounces of beer)?
_____

3. The last time you "partied"/socialized, how many alcoholic drinks did you have? State your best estimate. _____

**4. Using the calendar below please record the amount of alcohol that you have consumed over the past two weeks. Please record the amount as accurately as possible in the spaces provided below.**

| Sunday | Monday | Tuesday | Wednesday | Thursday | Friday | Saturday |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |

5. How many times across the past 30 days have you become "intoxicated"? _____

6. How many times in your lifetime (best estimate) have you become “intoxicated”? _____

7. How many alcoholic drinks do YOU think the typical ASU student has on a typical “drinking day”? _____

8. How many alcoholic drinks do YOU think a member of your closest group of friends has on a typical “drinking day”? _____

9. Within the last 30 days, how often do you think the typical student at your school used alcohol (beer, wine, liquor)? _____

10. How many alcoholic drinks do you think the typical student at your school had the last time he/she “partied”/socialized? _____

## Appendix D

### Alcohol Use Disorder Identification Test (AUDIT) and Health Questionnaire

These ten questions are about your use of alcohol **during the past 12 months.**

In questions 2 and 3, a unit of alcohol means one serving of alcohol.

For example, one serving of alcohol equals *(approximate values)*:
1 12 oz. beer
1 5 oz. glass of wine
1 1.5 oz. shot of liquor

**1. How often do you have a drink containing alcohol?**

- Never
- Monthly or less
- 2 to 4 times a month
- 2 or 3 times a week
- 4 or more times a week

**2. How many alcohol units do you have on a typical day when you are drinking?**

- None, 1, or 2
- 3 or 4
- 5 or 6
- 7 to 9
- 10 or more

**3. How often do you have seven or more units on one occasion?**

- Never
- Less than monthly
- Monthly
- Weekly
- Daily or almost daily

**4. How often during the last year have you found that you were unable to stop drinking once you had started?**

- Never
- Less than monthly
- Monthly
- Weekly
- Daily or almost daily

**5. How often during the last year have you failed to do what was normally expected from you because of drinking?**

- Never
- Less than monthly
- Monthly
- Weekly
- Daily or almost daily

**6. How often during the last year have you needed a first drink in the morning to get yourself going after a heavy drinking session?**

- Never
- Less than monthly
- Monthly
- Weekly
- Daily or almost daily

**7. How often during the last year have you had a feeling of guilt or remorse after drinking?**

- Never
- Less than monthly
- Monthly
- Weekly
- Daily or almost daily

**8. How often during the last year have you been unable to remember what happened the night before because you had been drinking?**

- Never
- Less than monthly
- Monthly
- Weekly
- Daily or almost daily

**9. Have you or someone else been injured as the result of your drinking?**

- Never
- Yes, but not in the last year
- Yes, during the last year

**10. Has a relative, friend, or a doctor or other health worker been concerned about your drinking or suggested you cut down?**

- Never
- Yes, but not in the last year
- Yes, during the last year

| | **Yes** | **No** |
|---|---|---|
| Are you currently being treated for any heart or circulatory condition, such as vascular disease, stroke, angina, hypertension, congestive heart failure, poor circulation, valvular heart disease, blood clots, or pulmonary disease? | ____ | ____ |
| Are you currently being treated for any other general medical condition? If yes, please list: _____ _____ | ____ | ____ |
| Are currently taking any prescription medications? If yes, please list: _____ _____ | ____ | ____ |
| Have you ever consumed $\geq$ 4 alcoholic beverages in a single sitting? | ____ | ____ |
| Do you have any metal allergies? | ____ | ____ |
| Do you smoke cigarettes at present? | ____ | ____ |
| Did you smoke cigarettes in the past and quit permanently? | ____ | ____ |

How old are you? _____

**DON'T WRITE HERE →** Wt: _____ Ht: _____ BP: _____ HR: _____

Appendix E

International Personality Item Pool (IPIP): 50-Item Measure and Hostility Scale

On the following pages, there are phrases describing people's behaviors. Please use the rating scale below to describe how accurately each statement describes ***you***. Describe yourself as you generally are now, not as you wish to be in the future. Describe yourself as you honestly see yourself, in relation to other people you know of the same sex as you are, and roughly your same age. So that you can describe yourself in an honest manner, your responses will be kept in absolute confidence. Please read each statement carefully, and then fill in the bubble that corresponds to the number on the scale.

Select "A" if it is very inaccurate.
Select "B" if it is moderately inaccurate.
Select "C" if it is neither inaccurate nor accurate.
Select "D" if it is moderately accurate.
Select "E" if it is very accurate.

| A | B | C | D | E |
|---|---|---|---|---|
| Very Inaccurate | Moderately Inaccurate | Neither | Moderately Accurate | Very Accurate |

A B C D E 1. Am the life of the party
A B C D E 2. Feel little concern for others
A B C D E 3. Am always prepared
A B C D E 4. Get stressed out easily
A B C D E 5. Have a rich vocabulary
A B C D E 6. Don't talk a lot
A B C D E 7. Am interested in people
A B C D E 8. Leave my belongings around
A B C D E 9. Am relaxed most of the time
A B C D E 10. Have difficulty understanding abstract ideas
A B C D E 11. Feel comfortable around people
A B C D E 12. Insult people
A B C D E 13. Pay attention to details
A B C D E 14. Worry about things
A B C D E 15. Have a vivid imagination
A B C D E 16. Keep in the background
A B C D E 17. Sympathize with others' feelings
A B C D E 18. Make a mess of things
A B C D E 19. Seldom feel blue
A B C D E 20. Am not interested in abstract ideas
A B C D E 21. Start conversations
A B C D E 22. Am not interested in other people's problems
A B C D E 23. Get chores done right away

A B C D E 24. Am easily disturbed
A B C D E 25. Have excellent ideas
A B C D E 26. Have little to say
A B C D E 27. Have a soft heart
A B C D E 28. Often forget to put things back in their proper place
A B C D E 29. Get upset easily
A B C D E 30. Do not have a good imagination
A B C D E 31. Talk to a lot of different people at parties
A B C D E 32. Am not really interested in others
A B C D E 33. Like order
A B C D E 34. Change my mood a lot
A B C D E 35. Am quick to understand things
A B C D E 36. Don't like to draw attention to myself
A B C D E 37. Take time out for others
A B C D E 38. Shirk my duties
A B C D E 39. Have frequent mood swings
A B C D E 40. Use difficult words
A B C D E 41. Don't mind being the center of attention
A B C D E 42. Feel others' emotions
A B C D E 43. Follow a schedule
A B C D E 44. Get irritated easily
A B C D E 45. Spend time reflecting on things
A B C D E 46. Am quiet around strangers
A B C D E 47. Make other people feel at ease
A B C D E 48. Am exacting in my work
A B C D E 49. Often feel blue
A B C D E 50. Am full of ideas

A B C D E 51. Get angry easily
A B C D E 52. Get irritated easily
A B C D E 53. Get upset easily
A B C D E 54. Am often in a bad mood
A B C D E 55. Lose my temper
A B C D E 56. Rarely get irritated
A B C D E 57. Seldom get mad
A B C D E 58. Am not easily annoyed
A B C D E 59. Keep my cool
A B C D E 60. Rarely complain

Appendix F

Consent Form to Participate in Self-Report Study

*Information to Consider About this Research*

**Alcohol Use and Individual Differences in College Males**

Principal Investigator: Jacqueline Belhumeur
Department: Psychology
Contact Information: belhumeurjr@appstate.edu
Faculty Adviser: Lisa Curtin (curtinla@appstate.edu)

**What is the purpose of this research?**

The specific purpose of this study is to explore the relationships between blood pressure, individual differences (i.e., social, emotional, and behavioral differences), sleep, and alcohol use in college males. It is the intent of the primary investigator to write a Master's thesis based upon the results of this study and to publish and present the results of this study in academic journals and at professional conferences.

**Why am I being invited to take part in this research?**

You are invited to participate because you are a healthy male between the ages of 18 and 25 years old with no history of cardiovascular or other medical conditions or regular nicotine use. Additionally, you are not currently on any prescription medications that would be complicated by alcohol use and have previously consumed four alcoholic beverages in one sitting. You also have not been diagnosed with an alcohol use disorder and are not currently receiving any form of psychological service. If you volunteer to take part in this study, you will be one of 135 males to do so.

**What will I be asked to do?**

The research procedures will be conducted at Smith-Wright Hall on the ASU campus during a single hour and a half (90 minute) period today. We will measure your height, weight, and blood pressure in a private room next to the room in which you completed the screening measures. You will also complete a series of questionnaires, including measures of personality, stress, socialization, sleep, and alcohol use.

You already signed up for this study using the online SONA system and were informed that we would ask you to:

- Stop taking all over-the-counter medications and supplements for 72 hours prior to today and for the duration of the study
- Not consume alcohol 24 hours prior to today
- Not to exercise today
- To eat 2 hours prior to participating in the study – Food bars and juice will be on hand in the event that you have not eaten
- Bring a government-issues photo identification listing your birth date

**What are possible harms or discomforts that I might experience during the research?**
To the best of our knowledge, the risk of harm and discomfort from participating in this research study is no more than you would experience in everyday life. All measurements used in this study are noninvasive and are not associated with physiologic harm. You may experience some personal discomfort as you reflect upon your blood pressure feedback or responses to questionnaires. There is also some risk associated with the report of underage drinking; however, measures will be taken to maintain confidentiality (see below). You have the right not to answer any individual questions. Finally, there is some risk that confidentiality could be breached but there are many safeguards in place to prevent this possibility (see below for list of precautions).

**What are possible benefits of this research?**
By participating in this research, you may benefit by learning about the health of your cardiovascular system. Additionally, the information gained from this research will enhance our understanding of the interrelation of blood pressure, alcohol, and individual differences.

**Will I be paid for taking part in the research?**
We will not pay you for you for the time you volunteer while being in this study. You will, however, receive 1-3 Experiential Learning Credits through the SONA Psychology Subject Pool for your participation (1 ELC for completing the screening and 3 ELCs for completing the entire study). There are other research options and non-research options for obtaining extra credit or ELC's. You may consult your professor to see other non-research options that are available.

**What will it cost me to take part in this research?**
It will not cost you any money to be a part of this research.

**How will you keep my private information confidential?**
Your information will be combined with information from other people taking part in the study. When we write up the study to share it with other researchers, we will write about the combined information. You will not be identified in any published or presented materials. All data entry and analysis will be conducted with statistical programs and will not include any identifying information. Your identifiable information will be stored in a separate building from the rest of your information, and will be deleted after three years. Your files, without identifying information, will be stored in the Vascular, Biological, and Autonomic Studies Laboratory office under lock and key.

**Whom can I contact if I have a question?**
The people conducting this study will be available to answer any questions concerning this research, now or in the future. You may contact the Principal Investigator, Jackie Belhumeur, at (804) 475-5503, or Dr. Lisa Curtin at (828) 262-2729. If you have questions about your rights as someone taking part in research, contact the Appalachian Institutional Review Board Administrator at 828-262-2130 (days), through email at irb@appstate.edu or at Appalachian

State University, Office of Research and Sponsored Programs, IRB Administrator, Boone, NC 28608.

**Do I have to participate?**

Your participation in this research is completely voluntary. If you choose not to volunteer, there is no penalty or consequence. If you decide to take part in the study you can still decide at any time that you no longer want to participate. You will not lose any benefits or rights you would normally have if you do not participate in the study.

This research project has been approved on 2/18/2013 by the Institutional Review Board (IRB) at Appalachian State University. This approval will expire on 11/19/2013 unless the IRB renews the approval of this research.

**I have decided I want to take part in this research. What should I do now?**

If you have read this form, had the opportunity to ask questions about the research and received satisfactory answers, and want to participate, then sign the consent form and keep a copy for your records.

| | | |
|---|---|---|
| Participant's Name (PRINT) | Signature | Date |

Appendix G

Consent Form to Participate in Alcohol Administration Study

*Information to Consider About this Research*

**Alcohol Use, Individual Differences, and Sleep in College Males**

Principal Investigators: Jacqueline Belhumeur; Daniel Payseur
Department: Psychology; Health, Leisure, and Exercise Science
Contact Information: belhumeurjr@appstate.edu; dp76043@appstate.edu
Faculty Advisers: Lisa Curtin (curtinla@appstate.edu) and Scott Collier (colliersr@appstat.edu)

**What is the purpose of this research?**

The specific purpose of this study is to explore the relationships between blood pressure, individual differences (i.e., social, emotional, and behavioral differences), sleep, and alcohol use in college males. It is the intent of the primary investigators to write two Master's theses based upon the results of this study and to publish and present the results of this study in academic journals and at professional conferences.

**Why am I being invited to take part in this research?**

You are invited to participate because you are a healthy male between the ages of 21 and 25 years with no history of cardiovascular or other medical conditions or regular nicotine use. Additionally, you are not currently on any prescription medications that would be complicated by alcohol use and have previously consumed four alcoholic beverages in one sitting. You also have not been diagnosed with an alcohol use disorder and are not currently receiving any form of psychological service. A screening for alcohol abuse and dependence will be conducted before admitting you into the study. If you volunteer to take part in this study, you will be one of 25 males to do so.

**What will I be asked to do?**

The research procedures will be conducted at the Vascular Biology and Autonomic Studies Laboratory at the Blue Cross Blue Shields of North Carolina Institute for Health and Human Services on University Hall Drive in room 186C.

You already participated in the brief telephone interview and were informed that we would ask you to:

- Stop taking all over-the-counter medications and supplements for 72 hours prior to today and for the duration of the study
- Not consume alcohol 24 hours prior to today and to not drink alcohol during your time in the study (except for when we ask you to drink alcohol during the next lab visit)
- Bring a government-issues photo identification listing your birth date

In addition to the above:

- You will need to come here 3 times (today and two other days) over the course of 3-5 days (depending on your schedule) for a total of approximately 350 minutes or 5 hours and 50 minutes.
- You will need to continue abstaining from over-the-counter medications and supplements for the duration of the study
- You will need to abstain from exercise on days you visit the lab.
- You will not consume alcohol throughout the duration of the study (3-5 days) with the exception of the next visit to the laboratory when we will ask you to consume alcohol.

Here is a summary of what to expect during each lab visit:

First Session

The first visit will take approximately 80 minutes or 1 hour and 20 minutes. During this visit, we will conduct a series of noninvasive blood pressure tests, including pulse wave velocity, pulse wave analysis, and reactive hyperemia. This is so we can get an idea of how efficiently your blood moves throughout your body. At this time, you will also be given instructions on an ambulatory blood pressure cuff and a ZEO sleep band. This is so we can monitor the flow of your blood and the quality of your sleep over the course of a night before the alcohol consumption session at your second visit. You will be asked to provide a urine sample for assessment of hydration. You will be asked to wear both of these noninvasive devices while sleeping *the night before your second lab visit* (even if this is not the day immediately after your first lab visit). You will need to agree to have a friend drive you to the next session, or agree to take the AppalCart/taxi to and from the lab for the next session. You will receive $10 for your time.

Second Session

After 1-3 nights, you will return to the Vascular Biology and Autonomic Studies Laboratory for a second time at 5:30pm. You will also be asked to eat something two hours before arriving. Food bars and juice will be available in the event that you do not eat. This visit will take approximately 180 minutes or 3 hours and will involve the same blood pressure tests as before (i.e. pulse wave velocity, pulse wave analysis, and reactive hyperemia), additional biological measurements (i.e. height, weight, blood pressure, and body composition), and a series of individual differences measurements (i.e. personality, stress, socialization, sleep, and alcohol-related questions). At this time, you will also be asked to fill out a demographic questionnaire. Finally, you will be asked to consume enough alcohol so that your blood alcohol content reaches approximately .08. This is the equivalent of three to five drinks for most males. These drinks will consist of one part vodka and four parts tonic water and lime. Again, we ask that you not volunteer for this study if you have never consumed four alcoholic beverages in one sitting. Following the alcohol administration, you will be required to stay at the lab until your blood alcohol content returns to .02-.04, at which time we will release you to a sober driver or escort you to the AppalCart which runs from the lab to the ASU campus until 9:09 PM. We will ascertain your blood alcohol concentration by having you blow into a handheld breathalyzer. We will also measure your blood pressure, pulse wave velocity, and reactive hyperemia after alcohol administration, in addition to assessing your hydration level via urinanalysis. You will be asked to wear the ambulatory blood pressure cuff and ZEO sleep band for a final night and return to the

lab in the morning. This is so we can see how the alcohol affected your blood pressure and sleep following alcohol consumption. You will receive $20 for your time.

Third Session

Your third and final visit will take approximate 60 minutes or 1 hour. At this time you will be asked to return your ambulatory blood pressure cuff and ZEO sleep monitor. You will be asked to provide a urine sample for assessment of hydration.We will also conduct pulse wave velocity, pulse wave analysis, and reactive hyperemia tests for a final time. You will receive $10 for your time.

**What are possible harms or discomforts that I might experience during the research?**

To the best of our knowledge, the risk of harm and discomfort from participating in this research study is slightly more than you would experience in everyday life. Alcohol consumption will take place in a supervised laboratory setting and you will not be released until your blood alcohol content has returned to a safe level, as defined by the National Institute on Alcohol Abuse and Alcoholism. Additionally, you will not be allowed to operate a motor vehicle following the administration to prevent the risk of harming yourself or others; you will not be on any concurrent medications to prevent possible detrimental drug interactions; and you will be required to eat beforehand so that you are not drinking on an empty stomach. All measurements used in the lab are noninvasive and will cause no physiological harm. You may also experience some personal discomfort as you reflect upon your blood pressure feedback or responses to questionnaires. You have the right not to answer any individual questions. Finally, there is some risk that confidentiality could be breached but many safeguards are in place to prevent such harm (see below for list of precautions).

Measures

Body Composition Testing:

There are no known risks associated with this measure. It is essentially the same as stepping on a bathroom scale at home.

Reactive Hyperemia:

No substantial risks are associated with reactive hyperemia. Subjects may feel some discomfort in their arm during the portion of the test when blood is occluded to the arm. The sensation is similar to the "pins and needles" individuals feel if their arm "falls asleep." This feeling will immediately disappear once the occluding pressure cuff is released and blood flow returns to normal. This is a common technique employed to determine vascular function, and 5 minutes of occlusion is the minimum amount of time needed to yield accurate measures. No tissue damage is associated with this method.

Pulse wave velocity:
There are no known risks associated with the Doppler ultrasounds used in this technique. A small Doppler sensor will be placed on the surface of the skin against the arteries in your neck, wrist, upper thigh, and ankle. The sensor uses ultrasound to measure the direction and speed of blood flow through an artery. No physical discomfort should be experienced during this assessment. Patient privacy will be upheld through the use of a curtain during the assessment of the femoral artery, as this is located near the pubic area.

Electrocardiography (ECG):
There are no known risks associated with standard ECG. A series of sensors will be placed on your chest. Trained technicians will perform all ECG preparation and measurements. Again, care will be taken to uphold patient privacy during preparation and assessments, as the chest area will need to be somewhat exposed for electrode placement.

Urine Specific Gravity (hydration assessment):
There are no known risks associated with Urine Specific Gravity. The specific gravity of these samples will be analyzed utilizing a refractometer to assess urine specific gravity. Once the urine sample has been analyzed for hydration it will then be immediately destroyed.
Ambulatory Sleep Monitoring:
Minor risk of discomfort is possible wearing the soft-fabric ZeoTM headband while sleeping. Because metallic fibers are used in the ZeoTM headband to transmit brainwave data, there is risk of skin rash or reaction in individuals who may be allergic to metals. Subjects will be informed to remove the device in such a case and contact one of the investigators.

Ambulatory Blood Pressure Assessment:
There are no known risks associated with ambulatory blood pressure assessment. A small cuff is placed around the upper arm and it is inflated similar to an arm blood pressure cuff. Subjects will be asked to wear this as they sleep. Subjects may feel slight discomfort in their arm with this cuff but this will disappear almost immediately when the cuff is released. A trained technician will demonstrate and fit the cuff for each subject.

AlkoSensor:
The AlkoSensor is a handheld breathalyzer. You will be asked to breathe into a disposable plastic tube for a few seconds and your breath alcohol content will be displayed on a display screen.

**Are there any reasons you might take me out of the research**?
If you do not use the ambulatory blood pressure cuff or ZEO sleep band as directed, we will have to remove you from the study. Additionally, if you cannot abstain from alcohol for 24 hours prior to initial testing as well as the duration of this study (3-5 days) we will have to remove you from the study. Also, abstaining from all prescription medications for 72 hours prior to the study and abstaining from exercise on lab days is required. Inability to do so will prompt your removal from the study. Finally, if you become uncomfortable at any point throughout the study, you may leave the study without penalty. You cannot, however, leave the lab after consuming alcohol until your BAC returns to a safe level and we know you have safe transportation.

**What are possible benefits of this research?**
By participating in this research, you may benefit by learning about the health of your cardiovascular system and how you react to alcohol. Additionally, the information gained from this research will enhance our understanding of the interrelation of blood pressure, alcohol, sleep, and individual differences.

**Will I be paid for taking part in the research?**
We will pay you for you for the time you volunteer while being in this study. You will receive $10 for your first and third visits and $20 for your second visit, for a total of $40 for your participation. You will receive payment each time you arrive at the lab.

**What will it cost me to take part in this research?**
It will not cost you any money to be a part of this research. Parking at the lab is free, as is the AppalCart. Recall that you may not drive to the second session, but must take the bus, a taxi, or have a friend drive you.

**What if I get sick or hurt while participating in this research study?**
If you need emergency care while you are at the research site, it will be provided to you. If you get hurt or sick when you are not at the research site, you should call your doctor or call 911 in an emergency. If your illness or injury could be related to the research, tell the doctors, or emergency room staff about the research study, the name of the Principal Investigators, and provide a copy of this consent form if possible. Call Jacqueline Belhumeur, at (804) 475-5503 or Daniel Payseur at (704) 530-8679 as soon as you can to let them know that you are hurt or ill. Please exercise caution regarding all activities regarding the alcohol administration session.

**How will you keep my private information confidential?**
Your information will be combined with information from other people taking part in the study. When we write up the study to share it with other researchers, we will write about the combined information. You will not be identified in any published or presented materials. All data entry and analysis will be conducted with statistical programs without using identifying information. Additionally, your identifiable information will be stored in a separate building from the rest of your information and will be deleted after three years. Your files, without identifying information, will be stored in the Vascular, Biological, and Autonomic Studies Laboratory office under lock and key.

**Whom can I contact if I have a question?**
The people conducting this study will be available to answer any questions concerning this research, now or in the future. You may contact the Principal Investigators at (704) 530-8679 (Daniel Payseur) or at (804) 475-5503 (Jackie Belhumeur). If you have questions about your rights as someone taking part in research, contact the Appalachian Institutional Review Board Administrator at 828-262-2130 (days), through email at irb@appstate.edu or at Appalachian State University, Office of Research and Sponsored Programs, IRB Administrator, Boone, NC 28608.

**Do I have to participate?**
Your participation in this research is completely voluntary. If you choose not to volunteer, there is no penalty or consequence. If you decide to take part in the study you can still decide at any time that you no longer want to participate. You will not lose any benefits or rights you would normally have if you do not participate in the study.

This research project has been approved on 2/18/2013 by the Institutional Review Board (IRB) at Appalachian State University. This approval will expire on 11/19/2013 unless the IRB renews the approval of this research.

**I have decided I want to take part in this research. What should I do now?**

Please indicate how you plan to get home at the end of the alcohol administration (second) session by checking one of the choices below:

____ Friend

____ AppalCart

____ Taxi

If you have read this form, had the opportunity to ask questions about the research and received satisfactory answers, and want to participate, then sign the consent form and keep a copy for your records.

_____

Participant's Name (PRINT) Signature Date

## Vita

Jacqueline Renee Belhumeur was born in Pittsburgh, Pennsylvania, the daughter of John and Ruth Belhumeur. She graduated from Deep Run High School in Richmond, Virginia, in June 2008 and began her undergraduate study at James Madison University. She received her Bachelor of Science in Psychology with minors in Human Science and Non-Teaching Special Education in May 2012. In the following fall, Jacqueline began study toward a Master of Arts degree in Clinical Health Psychology at Appalachian State University and was awarded the degree in May 2015.