GEOGRAPHIC VARIATIONS IN ALCOHOL CONSUMPTION AMONG RACIALLY/ETHNICALLY DIVERSE OLDER ADULTS

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ABSTRACT

This dissertation sought to examine the role of geographic location, geographic characteristics, and individual level race/ethnicity in alcohol consumption among older adults. Data were obtained from the 2010 Behavioral Risk Factor Surveillance System (BRFSS) and the 2010 US Census. Participants aged 60 and older who were not missing data on any of the main study variables were included (*n*=185, 190). Data was analyzed for a total of 2,229 counties. Racial/ethnic groups examined included American Indian/Alaska Natives, Asians/Pacific Islanders, Blacks, Hispanics, and Whites.

Multilevel modeling was used for main analyses in order to account for the nested structure of the data. Individuals at level 1 were nested within counties at level 2 which were nested within regions at level 3. Alcoholic drinks consumed per month was used as the dependent variable. Significant within and between county variance was found in average alcoholic drinks consumed per month. There were significant main effects of race/ethnicity, county percentage of older adults, county percentage of racial/ethnic minorities, and county median income on average alcoholic drinks consumed per month. Significant interactions were found for individual level race/ethnicity and each of the aforementioned county level variables.

These results indicate that geographic location and characteristics are significantly related to the alcohol consumption of older adults. Additionally, results suggest that the role of geographic characteristics in the alcohol consumption of older adults varies by individual level race/ethnicity.

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INTRODUCTION

Although the health of our older adult population has always been a topic of importance, the predicted future increases in the older adult population make developing an understanding of the health and health behaviors of this group all the more important. It has been estimated that the number of individuals 65 and older will increase from 40.3 million to 72.1 million between 2010 and 2030 (IOM, 2012). The result is that the nation's healthcare system is at risk for being overwhelmed by the drastic increase in older adults. Thus, calls have been made to take action to manage this increasing burden.

Research has suggested that alcohol-related problems are likely to increase in the near future among older adults (SAMHSA, 2007). Regardless of this predicted increase, estimates suggest that at least one third of adults 65 and older consume alcohol on a monthly basis (SAMHSA, 2002). Additionally, it has been found that older adults have higher sensitivity to alcohol than their younger counterparts (Substance Abuse & Mental Health Services Administration [SAMHSA], 1998). This increased sensitivity is largely due to a change in body composition which alters the way that alcohol is distributed in the body when consumed (Blow & Barry, 2000; Smith, 1995). The prevalence of alcohol consumption among older adults coupled with the age group's increased sensitivity to alcohol suggest that developing a better understanding of alcohol use among this age group is crucial.

Whereas the number of older adults and alcohol related problems among this age group are predicted to increase, so is the racial/ethnic diversity of the United States. Using data from the 2010 US Census, it has been projected that by 2043 the United States will become a "majority-minority" nation with no racial/ethnic group comprising the majority of the population

(US Census Bureau, 2012). More specifically, the proportion of Whites in the older adult population is projected to decrease from about 80 to about 71 percent, as the Black and Hispanic older populations increase making the older adult population more diverse than ever before (Cummings et al., 2011; IOM, 2012; Vincent and Velkoff, 2010). Additionally, research has consistently found that racial/ethnic differences exist in alcohol use patterns, consequences, related social/cultural factors, and treatment utilization (Bryant & Kim, 2012; Chartier, 2010). Thus, it appears that race/ethnicity may be one important factor to take into consideration when examining alcohol use.

A large body of research suggests that a significant relation exists between geographic location/geographic characteristics and health status (Beard et al., 2009; Cagney et al., 2006; Deeg & Thomese, 2005; Hybels et al., 2006; Yen et al., 2009). More specifically, the research suggests that geographic location and characteristics play a significant role in the health, health behaviors, and functioning of the elderly (Kim et al., 2013; Yen et al., 2009).

As described above, understanding the health and health behaviors of the older adult population is becoming increasingly important. Alcohol use can be viewed as one important factor that contributes to both the mental and physical health of this age group. Geographic location and characteristics as well as race/ethnicity appear to be factors that may influence older adults' alcohol consumption. Therefore, this study sought to examine the relation between geographic location/characteristics and alcohol consumption among older adults while accounting for racial/ethnic variation.

THEORETICAL FRAMEWORK

A discussion of relevant theories is necessary in order to develop a greater understanding of the geographic location/characteristic-health relation, as well as to inform hypotheses and results that are outlined in later sections. A variety of theoretical perspectives have been used to conceptualize the relation between geographic location/characteristics and health and/or health behaviors. One of the first conceptualizations of this relation was that of Faris and Dunham (1939) who suggested that deprived neighborhoods with high residential turnover contributed to the development of schizophrenia and substance abuse. Faris and Dunham's theory (1939) has been used to lay the ground work for many of the more contemporary theories which have attempted to clarify the mechanism through which geographic location may impact health. These more recent theories include the social stress model and the ecological perspective.

The social stress model is similar to Faris and Dunham's original conceptualization but is more specific. This theory suggests that neighborhoods that are disadvantaged and have a high residential turnover make it difficult for residents to develop and maintain social support thus making them more susceptible to stress, poor mental health, and substance use (Dohrenwend & Dohrenwend, 1969; Kubzansky et al., 2005). More recent research has found evidence for the negative impact of lack of social support and isolation on mental health, providing support for this perspective (Heaney & Israel, 2002; Kawachi & Kerman, 2001).

An additional relevant theory is the ecological perspective. This theory suggests that physical and social aspects of one's environment impact their health via influence on health behaviors (Kwag et al., 2011). For example, the ecological perspective suggests that vicinity to

hospitals or clinics may influence health care utilization (as a result of ease of access) and thus overall health. The theoretical framework guiding the conceptualization of this dissertation could best be described as a combination of social stress and ecological perspective theories.

When examining the influence of geographic characteristics it is crucial to differentiate between compositional (i.e. the differences people make to neighborhoods) and contextual effects (i.e. the differences neighborhoods make to people). This distinction can be difficult. A compositional effect occurs when a neighborhood effect is the result of the composition of the individuals in the area. For example, poor neighborhoods are generally composed of poorer individuals who are not able to afford health care services (regardless of where they were to live). Therefore, it may appear as if poor health of individuals residing in these disadvantaged neighborhoods results from the disadvantaged neighborhood itself when in reality it may be due to the poor composition of individuals living in the neighborhood (Kwag et al., 2011; Subramanian et al., 2006; Yen, Michael, & Perdue, 2009). A contextual effect occurs when there is something about a neighborhood that affects the health of residents independent of individual level variables. For example, in relation to the same disadvantage neighborhoods previously mentioned, it may be environmental factors such as shortage of health care and poor sanitation that contribute the health of residence in addition to their low SES status which does not allow them to afford health care (Kwag et al., 2011; Ross & Mirowsky, 2001). To determine if neighborhood effects are in fact contextual and if the neighborhood characteristics impact health and health/behaviors past the effect of individual level characteristics, multilevel designs (statistical designs in which there are multiple levels of data with lower levels of data nested within higher levels of data) are necessary (Kubzansky et al., 2005). Hence, this dissertation relies on a multilevel design in order to distinguish contextual effects.

LITERATURE REVIEW

A thorough literature review was conducted to identify studies relevant to this dissertation. Findings from this literature review are reported in the subsequent paragraphs. First, relevant studies that examine alcohol use are discussed. This section also contains a discussion of findings related to racial/ethnic variations in alcohol use. Next, relevant studies that examine the influence of geographic location and geographic characteristics on health and health behaviors are discussed. This section contains a discussion of findings pertaining to specific geographic characteristics. Relevant theories are tied to findings throughout.

Alcohol Consumption

The relation between alcohol consumption and health among older adults is not simple. The National Institute on Alcoholism and Alcohol Abuse (NIAAA) recommends that adults aged 65 and older consume no more than one drink a day, a maximum of two drinks on any occasion, and that women should have even lower limits (NIAAA, 2005). However, terminology used in the literature does not always reflect these guidelines. Problem drinking is a term frequently found in the literature pertaining to alcohol use among older adults. Problem drinking is often specified as a type of alcohol consumption that is harmful and should be avoided by older adults, however, it is not usually used in a way that reflects the NIAAA guidelines. Problem drinking among older adults is generally defined as drinking at a level that leads to adverse medical, psychological, or social consequences, or increases the risk of experiencing any of those problems (Oslin, 2004; Sorroco & Ferrell, 2006). This definition is relatively circular and as a result may be difficult for both clinicians and older adult drinkers to interpret. Thus, more

research is needed in order to clarify what level of alcohol consumption is likely to be related to negative health outcomes among this age group. Hopefully, more clarity on what amount of alcohol consumption is hazardous would eventually lead to more consistency in functional definitions and terminology in the literature.

Many studies have found a U-shaped relation between alcohol consumption and risk for dementia, stroke, and cognitive decline (Christensen et al., 2006). While exactly what amount of alcohol is beneficial is unclear, it is clear that excessive consumption is detrimental to many aspects of health. Among older adults, consumption over the NIAAA guidelines or problem drinking (terminology and functional definitions vary by study) is associated with various health problems as well as poor mental health and elevated levels of psychological distress (Bryant & Kim, 2013; Graham, 1999; Okoro, 2004). More specifically, alcohol abuse in older adults has been found to be related to cardiovascular disease, breast cancer in women, cirrhosis, decreased bone density, decreased immune system functioning , depression, anxiety, dementia, malnutrition, gastrointestinal bleeding, memory problems, sleep problems, as well as increased risk for injury, illness, and socioeconomic decline (Blow, 1998; Blow & Barry, 2000; Christensen et al., 2006; Tarter, 1995). Additionally, older adults that use alcohol at levels above recommended guidelines tend to report higher levels of loneliness, less social support, fewer social resources, lower social integration, lower satisfaction with social relationships, and more social isolation (Bott et al., 2005; Encrenaz, Kovess-Masfesty, Sapinho, Chee, & Messiah, 2007; Graham & Schmidt, 1999). Furthermore, older adults are likely to be prescribed one or more medications increasing the risk for adverse drug interactions which may cause negative health outcomes or overdoses, even when alcohol is used in the same consumption pattern that was previously not harmful (IOM, 2012). Longitudinal research has linked increases in alcohol

consumption to increased suicide mortality (Kerr, Subbarman, & Ye, 2011). It has been suggested that at worst, interactions among mental health and/or substance use conditions and a combination of age-related factors among older adults can result in a "spiral" of decline in physical, cognitive, and psychological health (Blazer, 2000; Bruce et al., 1994).

While the exact nature of the mental health-alcohol consumption relation is yet to be perfectly understood, it is clear that there is a relationship between excessive alcohol consumption and risk for negative physical and mental health outcomes as described above (Bryant & Kim, 2013; Graham & Schmidt, 1999; Moore et al., 2006; Sacco, Bucholz & Spitznagel, 2009; Waern, 2003). However, research also suggests that alcohol consumption within guidelines may have positive effects on both the physical and mental health of older adults (Graham & Schmidt, 1999; Mishara & Kastenbaum, 1980; O'Connell, 2006; Tait & Hulse, 2006). For example, research indicates that moderate alcohol use is associated with a reduced risk for mental health related hospital admissions (O'Connell, 2006; Tait & Hulse, 2006). Thus, it appears that the alcohol consumption habits of older adults are highly significant as they may be related to improvements in or decreases in health outcomes depending on the nature of the consumption.

The causal direction of the alcohol consumption-mental health relation is still ambiguous in the literature. Some have theorized that mental health problems precede alcohol abuse (Harris & Edlund, 2005; Mueser, Drake, & Wallach, 1998). The self medication hypothesis is one theory from this perspective which purports that individuals with mental health problems or psychiatric disorders drink alcohol to relieve symptoms of the disorders (Harris & Edlund, 2005; Mueser, Drake, & Wallach, 1998). Others have suggested that heavy alcohol use may precede mental health problems or that the relation is reciprocal (Fergusson, Boden, & Horwood, 2009; Wang &

Patten, 2001; Wang & Patten, 2002). However, research has yet to ascertain which of these theories is the most accurate. Much of the research on this topic has relied on cross-sectional data and/or retrospective reports of alcohol consumption which make it difficult to establish causality (Bryant & Kim, 2013).

A recent study relied on longitudinal data to examine the direction of the relation between alcohol abuse and major depression (Fergusson et al., 2009). Fergusson and colleagues (2009) utilized structural equation modeling and found that alcohol abuse/dependence precedes major depression. Theories on the mechanism of the relation include alcohol use as a trigger of a genetic predisposition for mental health problems, alcohol's depressant effects causing a depressed affect in drinkers, and mental health problems resulting from the problems that heavy alcohol use cause in one's life (Fergusson et al., 2009). While examining mental health outcomes is outside of the scope of this proposed project, the research described does provide additional evidence for the importance of examining alcohol consumption as it may in fact lead to negative mental health outcomes.

Previous studies indicate that alcohol abuse and dependence are likely to go undiagnosed among older adults (IOM, 2012). Common reasons for this are ageism, lack of awareness, clinical behavior, and comorbidity (Blow, 1998). It has been found that chronic or other preexisting medical conditions may mask symptoms of alcohol abuse among the elderly (Blow, 1998). Furthermore, researchers have found that many health care professionals assume it is not worth treating older adults for substance abuse disorders because they are "not likely to have many years left" (Blow, 1998). Despite this assumption, research indicates that older adults abusing alcohol report lower levels of happiness and life satisfaction than their non-alcohol abusing counterparts (Blow, 1998). Therefore, it appears that treatment may indeed be

worthwhile in order to increase quality of life for remaining years. Other barriers to identification of alcohol problems in older adults are a lack of available transportation to health care, shrinking social networks, time limitations of health care professionals, lack of expertise, and financial constraints (Blow, 1998). While it has been found that older adults that consume alcohol at "hazardous amounts" (as defined by an Alcohol Use Disorders Identification Test cut-off score 8 or more) are twice as likely to be hospitalized, they are significantly less likely to visit their general practitioners (Khan et al., 2002). This may be yet another barrier to identification of alcohol abuse.

Not only may it be difficult for a physician to diagnose an older adult with an alcohol problem, but it may be just as difficult for an older adult with a drinking problem to recognize their behavior as unhealthy. This may be the case because of lower alcohol tolerance in older adults, which may cause alcohol to negatively affect older adults at a smaller amount than it had previously (Barry et al., 2002).

Racial/ethnic variations in alcohol consumption. Research has shown variations in alcohol consumption patterns between racial/ethnic groups among both adults of all ages (Chartier & Caetano, 2010; SAMHSA, 2007) and older adults specifically (Bryant & Kim, 2012; Moore et al., 2006; Sacco, Bucholz & Spitznagel, 2009). For instance, a recent study (Agic, Mann, & Kobus-Matthews, 2011) examining alcohol use in seven different ethnic communities in Canada found ethnic differences in the types and sizes of drinks consumed as well as differences in what amount of alcohol consumption was considered "normal" versus "excessive." For example, those of Somali ethnicity reported that no alcohol consumption was acceptable in their communities. Conversely, it was found that alcohol use was perceived as a normal part of daily life among the Portuguese, Polish, Russians, and Serbians interviewed. Some of the ethnic

groups interviewed reported that alcohol serves particular roles in their communities. Those of Polish, Russian, Portuguese, Serbian, and Punjabi ethnicity reported that offering alcohol to a guest is a social norm and is viewed as a sign of respect for the guest. There were many similarities reported in alcoholic beverage of preference. Wine was reported as a drink of preference for Portuguese, Tamils, Somalians, and Russians. Unique drinks of preference reported included schlivovitz (plum brandy) among Serbians and vodka among "less educated" Russians. None of the ethnic groups interviewed reported that excessive drinking was condoned in their communities. However, it was reported that "occasional inebriation" was viewed as tolerable among the Russians, Polish, Portuguese, Serbians, and Punjabis. In the Russian and Serbian communities it was reported that the ability of men to consume large quantities of alcohol is directly related to perception of masculinity (Agic et al., 2011). Such findings demonstrate ethnic variations that exist in alcohol consumption as well as cultural factors that may contribute to these variations.

In addition to racial/ethnic variations in alcohol consumption patterns, research has found that the relation between alcohol use and psychological disorders varies between racial/ethnic groups (Smith et al., 2006). For example, previous research found that the relation between alcohol use disorders (AUDs) and anxiety disorders showed variability by race/ethnicity (Smith et al., 2006). More specifically, alcohol abuse was significantly related to Specific Phobia and Panic Disorder for Asians while it was related to Agoraphobia for Blacks. Alcohol dependence was related to specific anxiety disorders for all racial/ethnic groups except American Indian/ Alaska Natives (AIANs) (Smith et al., 2006). It has also been found that race/ethnicity is associated not only with probable differences in alcohol consumption and the prevalence of mental health conditions, but also with the kinds of treatment and services that are needed (IOM,

2012). For example, it has been found that incorporation of cultural characteristics of minority groups into treatment can predict a favorable treatment response (Villaneuva, 2003).

A recent study conducted by Fesahazion and colleagues (2012) found that Black and White adults who are exposed to similar social and environmental risks have similar alcohol use patterns. Thus, it is possible that taking environment into account may attenuate differences between racial/ethnic groups in alcohol use. However, as this study only compared two racial/ethnic groups it is difficult to say if such findings would persist across multiple groups. Regardless, this study highlights the importance of taking geographic characteristics and location into consideration to avoid examining the role of race/ethnicity as if it exists in a vacuum.

Geographic Location & Characteristics

A 2009 review conducted by Yen and colleagues examined studies focused on geographic characteristics' impact on the health of older adults and identified six frequently-examined geographic characteristics. These included socio-economic status (SES), racial/ethnic composition, demographics, perceived resources/problems, physical environment, and social environment. Only a handful of studies found in the review actually cited specific theories pertaining to the relation between geographic characteristics and the health of older adults (i.e. Cagney, Browning, & Wen, 2005; Clark & George, 2005; Fisher et al., 2004; Yen at al., 2009). The majority of studies identified in Yen's 2009 review were based on the hypothesis that geographic characteristics influence health beyond the effects of an individual's demographic characteristics (Aneshensel et al., 2007; Balfour & Kaplan, 2002; Berke et al., 2007; Li, Gisher, & Brownson, 2005; Michael et al., 2006; Yen et al., 2009). Many offered a more general reasoning for why neighborhood could be related to a health outcome (Yen et al., 2009). More specifically, some studies focused on the idea that geographic characteristics may exacerbate the

effect of individual level characteristics on health (Deeg & Thomese, 2005; Clarke & George, 2005; Wen & Christakis, 2005; Yen et al., 2009). Other studies focused on the idea that geographic characteristics impacted health and health behaviors through the mechanism of increased stress exposure (Chaix et al., 2007; Krause, 1998; Robert & Ruel, 2006; Schieman & Meersman, 2004; Yen et al., 2009).

Research has suggested that geographic characteristics may be of particular importance for older adults given the possibility of decreased mobility, changes in physical capabilities, declines in cognitive functioning, and reduction in social networks (Beard et al., 2009; Cagney et al., 2006; Hybels et al., 2006; Shaw, et al., 2007; van Tilburg, 1998; Yen et al., 2009). It should be noted that mobility can refer both to the physical ability to move and the ability to drive, both of which impact the daily life and activities of older adults (Marottoli et al., 2000; Yen et al., 2009). The combination of decreased functioning, decreased mobility, and decreased social contacts results in older adults being likely to spend more time in their neighborhoods and being more dependent on their immediate geographic location (Shaw, et al., 2007; Yen et al., 2009; van Tilburg, 1998). This leaves the elderly in a position to be more easily impacted by the characteristics of their geographic location (Yen et al., 2009).

Geographic variations in alcohol consumption. Research has examined the impact of geographic location on alcohol consumption (Borders & Booth, 2007; Dawson et al., 1995; Midanik & Clark, 1994). Rurality is one geographic variable that has been examined and been found to significantly relate to alcohol consumption. Earlier research found that abstinence from alcohol use was more common in nonmetropolitan than metropolitan areas (Midanik & Clark, 1994). However, more recent research reveals that this relation is likely more complex (Borders & Booth, 2007; Dawson et al., 1995). For example, it has been found that while abstinence from

alcohol may be more common in both rural and urban areas as compared to suburban areas, drinkers in urban and rural areas may drink more heavily than their suburban counterparts (Borders & Booth, 2007; Dawson et al., 1995). In fact, while those living in rural areas are more likely to be abstainers, drinkers in rural areas are more likely to have an alcohol use disorder and to exceed daily limits than drinkers in suburban areas (Borders & Booth, 2007)

In a 2007 study, Borders and Booth examined rural/urban and regional differences in non-institutionalized Americans age 18 years and older using the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC). This study revealed that the relation between rural/urban residency and alcohol consumption is one that varies by region (Borders & Booth, 2007). More specifically, those living in the rural Northeast, rural Midwest, rural South, and urban Northeast are significantly more likely to abstain than their suburban counterparts (Borders & Booth, 2007). Heavy drinking is most common among drinkers in the rural and urban Midwest (Borders & Booth, 2007). Among drinkers, alcohol use disorders and use in excess of daily limits is most common in the rural and urban Midwest. Regardless of rurality, it has consistently been found that the South has the highest alcohol abstinence rate (Borders & Booth, 2007; Dawson et al., 1995). Borders and Booth suggested (2007) that regional differences in alcohol consumption may be due to variations in cultural norms, variations in the health system, and the physical environment. This explanation is in line with the ecological perspective in that there may be physical and social aspects, such as population density, norms, and religiosity that impact drinking behaviors.

A study conducted by Kim and colleagues (2010) found more evidence for an effect of environment on alcohol consumption. The study examined drinkers and alcohol consumption related variables among Filipino Americans living in Honolulu and San Francisco. Filipino

American drinkers living in San Francisco differed significantly from drinkers living in Honolulu on a number of factors including age, education, religiosity, and psychological distress (Kim et al., 2010). This study also found that protective and risk factors for the development of alcohol use disorders varied by place of residence (Kim et al., 2010). Additionally, the authors found that Filipino Americans living in San Francisco were more than twice as likely to have an alcohol use disorder than those living in Honolulu. In line the with social stress model, the authors theorized that this is due to the fact that the majority of the population in Honolulu is of Asian/Pacific Islander ethnicity (Kim et al., 2010). The authors suggested that this likely exerts a protective effect against the development of alcohol use disorders in the form of a stronger sense of community (Kim et al., 2010). This study highlights the impact of environment on alcohol consumption patterns.

While the research described above is a start to understanding the geographic characteristic-alcohol consumption pattern relation, there is a dearth of literature examining this relation. Much of the literature that does exist focuses on topics that are not relevant to the focus of this study. For example, there is a large body of research examining concentration of available alcohol outlets and alcohol consumption/AUDs (Gruenewald, 2007; Theall et al., 2011), but this is beyond the scope of this paper.

Much of the available literature examining the significance of geographic characteristics for older adults focuses on more general health and health outcomes rather than the specific health behavior of alcohol consumption patterns. While this research does not directly examine the health behavior of alcohol consumption, it does provide some insight into the significance of geographic characteristics in the absence of research examining the significance of geographic characteristics on alcohol consumption specifically.

Geographic variations in (physical and mental) health. While not a direct examination of alcohol consumption, a variety of specific geographic characteristics have been examined and found significant as they relate to the health of the elderly. Topics examined include rurality/population density (Breeze et al., 2005; Walters at al., 2004), age composition (Kwag et al., 2011; Subramanian et al., 2006; Usui & Keil, 1987), racial/ethnic composition (Coffe, 2009; Eschbach et al., 2004; Kwag et al., 2011; Ostir et al., 2003; Rios, Aiken, & Zautra, 2012; Wickrama & Bryant, 2003; Yen et al., 2003), neighborhood SES/poverty level (Beard et al., 2009; Breeze et al., 2005; Deeg & Thomese, 2005; Kubzansky et al., 2005; Ostir et al., 2003; Robert & Ruel, 2006 Robert & Ruel, 2006; Yen et al., 2009), and quality of physical environment (Galea et al., 2007). In the absence of alcohol specific literature, such previous research may be useful to help inform this study of the role that geographic characteristics may play.

Rurality/population density. Rurality/population density has been found to be significantly related to mental health in numerous studies (Breeze et al., 2005; Walters at al., 2004). In general, research indicates that among older adults, living in a high population density area is a risk factor for worse mental health outcomes (Breeze et al., 2005; Walters at al., 2004). More specifically, it has been found that among adults 75 and older living in the UK, living in a rural area is associated with better morale while living in a high population density area is associated with increased risk for depression and anxiety (Breeze et al., 2005; Walters at al., 2004). This finding is consistent with other studies examining the population density mental health relation in a younger population (Walter et al., 2004). It has been suggested that the association between population density and mental health is a complex one that may be attributable to numerous factors such as provision of health care, social services, ethnicity and

culture, attitudes towards mental health problems, crime rates, higher population mobility (resulting in lower levels of social support), and housing availability (Walters et al., 2004). Thus, the relation between population density and mental health can be viewed through both lens of the social stress model and the ecological perspectives.

Age composition. Results pertaining to the effect of age composition have been inconsistent. Some studies have found that older adults living in a geographic location with a higher concentration of older adults have better mental health (Kwag et al., 2011; Kubzansky et al. 2009; Subramanian et al., 2006), while some studies have found the opposite (Usui & Keil, 1987). However, most recent studies have found that a higher concentration of older adults is in fact beneficial for mental health among this age group (Kwag et al., 2011; Subramanian et al., 2006). For example, Kubzansky and colleagues (2009) found that older adults who were living in a neighborhood with a high percentage of older adults had better mental health than their counterparts living in neighborhoods with fewer older adults. This finding is in line with the social stress model as the effect may be attributable to greater opportunity for social engagement and higher levels of social support (Kubzansky et al., 2009).

Minority percentage. As race/ethnicity and racial/ethnic composition of location are areas of particular interest in this study, previous research on this topic warrants discussion. Findings pertaining to the effect of racial/ethnic composition are mixed with some studies indicating that racial/ethnic heterogeneity has a negative influence on health, possibly through the mechanisms of economic disadvantage or decreased trust in neighborhood (Yen et al., 2009). This perspective can be viewed as coinciding with the social stress model. Other studies have found that heterogeneous environments may be beneficial to the mental health of minority groups (Coffe, 2009; Kwag et al., 2011; Rios, Aiken, & Zautra, 2012; Wickrama & Bryant,

2003). Yet other studies have found no effect for location racial/ethnic composition after accounting for individual level characteristics (Beard et al., 2009; Gerst et al., 2011). In total, it appears the research reveals that the effect of geographic location racial/ethnic composition varies by the race/ethnicity of individuals and may have the most significance for certain minority groups while minimal significance for others (Eschbach et al., 2004; Ostir et al., 2003; Yen et al., 2003).

While results do seem to vary by race/ethnicity, there is strong body of research examining the effect of minority composition on the health of Latinos. It has been found that geographic locations with a high percentage of Latinos or "ethnic enclaves" may be protective against depression for Latinos (Eschbach et al., 2003; Ostir et al., 2003; Yen et al., 2009). Research has found among Mexican American older adults that living in a high-density Mexican American neighborhood had a protective effect on mental and physical health that outwieghed the disadvantages associated with living in a low SES geographic location (which is a common characterisitic of these enclaves) (Eschbach et al., 2004; Ostir et al., 2003). This phenomenon has been referred to as the barrio effect (Eschbach et al., 2004; Ostir et al., 2003). This effect may be particularly evident for older Mexican American men (Gerst et al., 2011). This can also be explained from a social stress perspective in that individuals living within these ethnic enclaves are likely to have significantly better social support and thus reduced risk for negative mental health outcomes. However, similar benefits for living in ethnic enclaves have not been found for other minority groups including Blacks (Kubzansky et al., 2005; Yen et al., 2009).

SES/poverty. Numerous studies have been conducted on the effect of neighborhood poverty and found that neighborhood deprivation was realted to increased prevalence of mental disorder including schizophrenia and depression after individual level variables were controlled

for (Ostir et al., 2003; Kubzansky et al., 2005; Ross, 2000; Ross et al., 2000; Silver et al., 2002; Van et al., 2000; Wainwright & Surtees, 2003). It has also been found that high neighborhood SES was significantly related to better health and lower psychological distress (Rios, Aiken, & Zautra, 2012). Studies have been conducted examining this relation in an older adult specific population. SES or poverty level of geographic location has been found to be the most consistent geographic level predictor of a variety of mental and physical health outcomes among older adults (Yen et al., 2003). The majority of these studies have found that living in a low SES neighborhood was related to negative health outcomes including higher levels of depression, increased incident of depressive disorders, lower self-rated health, and lower quality of life among older adults, after individual level characteristics were controlled for (Breeze et al., 2005; Galea et al., 2007; Kubzansky et al., 2005; Kwag et al., 2011; Subramanian et al., 2006). However, it should be noted that one study found that census tract SES lost its significance once individual level characteristics were controlled for (Hybels et al., 2006).

Additionally, research indicates that among older adults, the relation between neighborhood poverty or low neighborhood SES and poor health outcomes may be complicated (Beard et al., 2009; Breeze et al., 2005; Deeg & Thomese, 2005; Kubzansky et al., 2005; Ostir et al., 2003; Robert & Ruel, 2006 Robert & Ruel, 2006; Yen et al., 2009). For example, interactions have been found between personal and neighborhood SES such that those with low SES living in a high SES neighborhood may actually be at a greater risk of negative mental health outcomes than those of low SES living in a low SES neighborhood (Deeg & Thomese, 2005).

The effect of neighborhood SES on health has been examined across the lifespan. It has been found that the relation between community SES and health is most predominant for adults ages 60 to 69 (Robert & Li, 2001). This suggests that considering neighborhood SES may be

particularly important for understanding the health of this age group. This may be the result of limited mobility (as discussed in the previous sections), combined with fewer options for exercise and other healthy behaviors due to crime, housing, pollution, and a lack of services found in low SES areas (Breeze et al., 2007). These findings indicate that both the social-stress model and the ecological perspective may be applied to this relation.

RESEARCH NEEDS

As described above, a large body of research has examined the significance of geographic characteristics as they relate to the health of older adults. However, few studies have directly examined the relation of these characteristics to alcohol consumption patterns. More specifically, there were no studies found in the literature search examining the variability of alcohol use patterns among older adults by geographic location. Furthermore, no studies examining the effect of geographic characteristics on the alcohol consumption of older adults were found. Given that no such research was found, it is also true that racial/ethnic differences in the geographic characteristics-alcohol consumption relation were also not discovered.

SPECIFIC AIMS & HYPOTHESES

The overall aim of this dissertation was to examine the effects of race/ethnicity, geographic location, and geographic characteristics on alcohol consumption among older adults. Specific variables that previous research indicated may be of significance for alcohol consumption among older adults were selected. Five specific aims and hypotheses were specified pertaining to their effect on alcohol consumption among older adults. These aims and hypotheses were as follows:

Specific Aim & Hypothesis 1 – Geographic Location & Race/Ethnicity

Specific aim one was to determine if regional differences exist in alcohol consumption among older adults.

It was expected that the greatest overall alcohol consumption would be found in the Midwest while the least would be found in the South. These hypotheses were made based on previous research (Borders & Booth, 2007; Dawson et al., 1995) and on ecological theory. There are likely both physical and social aspects of the region that encourage alcohol consumption in the Midwest, however, research has yet to determine what such aspects in the Midwest may be (Borders & Booth, 2007). Conversely, there are likely aspects such as conservative religiosity that discourage alcohol consumption in the South (Borders & Booth, 2007). Additionally, it was expected that significant racial/ethnic differences would be found as previous research shows that alcohol consumption varies by race/ethnicity (Bryant & Kim, 2012; Chartier & Caetano, 2010; Moore et al., 2006; Sacco, Bucholz & Spitznagel, 2009; SAMHSA, 2007).

Specific Aim & Hypothesis 2 - Population Density

Specific aim two was to examine the effect of population density on alcohol consumption among older adults.

It was expected that less alcohol consumption would be found in areas with lower population density (a proxy for rurality). Hypotheses regarding the effects of population density (i.e., rurality) were made based on the ecological perspective. The ecological perspective suggests that there are aspects of rural areas such as religious beliefs and social norms that may decrease drinking behaviors (Borders & Booth, 2007).

Specific Aim & Hypothesis 3 – Racial/Ethnic Composition

Specific aim three was to examine the effect of county racial/ethnic composition as measured by minority percent of the county population on alcohol consumption.

It was expected that overall, individuals living in locations with a higher minority percent population would consume more alcohol. However, individual racial/ethnic differences were expected in this finding. This hypothesis was derived from the social stress model, which may suggest that alcohol consumption would be greater in areas with more diversity (i.e. higher minority percent) as individuals may be less likely to develop a strong support network when surrounded by dissimilar individuals or may experience neighborhood distrust and thus use alcohol as a means to cope (Coffe, 2009; Kwag et al., 2011; Rios, Aiken, & Zautra, 2012; Wickrama & Bryant, 2003). However, given previous research it was expected that significant interactions could be found for individual race/ethnicity by minority percent population. For example, given the barrio effect (i.e. the protective effect of living in ethnic enclaves for Hispanics) it was believed possible that Hispanics living in areas with high minority percent populations would consume less alcohol than counterparts living in locations with a smaller minority percent (Eschbach et al., 2004; Ostir et al., 2003). While conversely, Whites were

predicted to show the greatest effect for living in an area with a higher minority percent as this could potentially be more isolating for members of this racial/ethnic group as compared to members of minority racial/ethnic groups. As previous research has not demonstrated protective effects similar to the barrio effect found among Hispanics for other minority groups it was expected that other minority groups would demonstrate a pattern similar to Whites in regards to minority percent population (Kubzansky et al., 2005; Yen et al., 2009).

The question of the relation between minority percent and alcohol consumption could also be viewed from an ecological perspective which could suggest alternative expectations for findings. Given that alcohol is often used in social settings (Wiscott, Kopera-Frye, & Begovic, 2002), the ecological perspective may suggest that individuals living in locations with more similar individuals (i.e. lower minority percent with regards to White individuals) would consume more alcohol as they may have more opportunities for social interactions. While it was difficult to predict which theoretical perspective would prevail given the dearth of research, the social stress model was used to guide hypotheses for this aim. The social stress model was used as it was thought that social stress may be more prevalent and universal to older adults in communities with high minority percentages through circumstances that may be unavoidable such as decreased community trust and lack of community stability. Increased alcohol consumption as a result of decreased minority percent and potentially more frequent social interaction (i.e. ecological perspective) may reflect more of a personal choice with greater individual variability than increased social stress in a community. Additionally, as research has shown that older adults tend to have fewer social contacts they may be less likely to participate in social drinking (Shaw, et al., 2007; van Tilburg, 1998).

Specific Aim & Hypothesis 4 – Poverty

Specific aim four was to examine the effect of poverty on alcohol consumption among older adults.

It was expected that individuals residing in counties with lower median household incomes and/or a higher percentage of the population living in poverty would consume more alcohol than their counterparts as a result of related social stress via neighborhood instability, etc. These hypotheses regarding the effects of median household income and percent of the population living in poverty were guided by the social stress model. This theoretical perspective suggests that individuals may consume alcohol to cope with the stresses associated with living in an economically disadvantaged neighborhood.

Specific Aim & Hypothesis 5 – Age Composition

Specific aim five was to examine the effect of county age composition on alcohol consumption among older adults.

It was expected that older adults living in counties with a lower percentage of older adults would consume more alcohol than older adults living in counties with a high percentage of older adults. Hypotheses regarding the effect of age composition could be viewed through more than one theoretical perspective. One could argue that a lower percentage of older adults would increase alcohol consumption via decreased social support and increased social stress (i.e. social stress model) or that a higher percentage of older adults would increase alcohol consumption through increased social opportunities for alcohol consumption (i.e. ecological perspective). While it was difficult to predict which theoretical perspective would prevail given the dearth of research, again the social stress model was used for similar reasons as described in relation to minority percent.

METHOD

Datasets

Data from the 2010 Behavioral Risk Factor Surveillance System (BRFSS) were used. The BRFSS collects data on health risk behaviors, clinical preventive practices, and health care access and use primarily related to chronic diseases and injury (CDC, 2010). BRFSS data are collected monthly by telephone through the use of random-digit dialing, by state health departments with technical and methodological assistance provided by the CDC. Data is collected in all 50 states as well as Puerto Rico, Guam, the US Virgin Islands, and the District of Colombia (CDC, 2010). The 2010 BRFSS data was used as this year coincides with the most recent version of the US Census data. This is significant as data from the 2010 Census was merged with the 2010 BRFSS data for certain analyses. The use of data from the same year allows for more confidence in interpretation of findings. With regards to the Census data, the USA counties data files were used.

The BRFSS dataset was chosen based on the following inclusion criteria: 1) inclusion of a large sample of racially/ethnically diverse older adults; 2) inclusion of alcohol consumption related variables; and 3) inclusion of geographic identifiers capable of being linked to data from the US Census. Other datasets considered were California Health Interview Survey (CHIS), National Epidemiological Survey on Alcohol and Related Conditions (NESARC), National Health Interview Survey (NHIS), and National Latino and Asian American Study (NLAAS). However, these data sets either did not meet the above listed inclusion criteria, or are no longer available to individual researchers.

Sample

This study included adults age 60 and older from diverse racial/ethnic backgrounds. Adults who were not missing data on the study variables of interest (race/ethnicity, drinks consumed per month, and geographic location) were included for analyses. The self-reported racial/ethnic categories included White (*n*=161,711; 87.3%), Black (*n*=12,312; 6.6%), Asian (*n*=2,040; 1.1%), Pacific Islander (*n*=223; 0.1%), American Indian/Alaska Native (AIAN) (*n*=1,868; 1.0%), Hispanic (*n*=7,036; 3.8%). Due to their small sample sizes, the Asian and Pacific Islander racial/ethnic groups were merged into a larger single Asian/Pacific Islander group (API). Given the assumed exceptional level of heterogeneity of the Multiracial (*n*=2,929) and Other (*n*= 906) groups, they were excluded from analyses leaving a total sample size of *n*=185,190.

Measures

Outcome variable – Monthly alcohol consumption. The main outcome variable, alcohol consumption, was assessed by examining number of alcoholic drinks consumed per month. This is available as a calculated variable in the BRFSS data. This variable was calculated based on self-reported number of days alcohol was consumed in the past month and number of drinks consumed per drinking day in the past month. Research has shown that self-report methods are both valid and reliable for measuring alcohol consumption (Del Boca & Darkes, 2002). For the remainder of this document the term "drinks" refers to alcoholic drinks for the sake of sentence length and readability.

Independent variables – Individual-level.

Demographic characteristics. Age was measured continuously. Sex was measured dichotomously. Race/ethnicity was measured via self-report as previously described. Marital status was measured via self-report and was dichotomized into married and not married.

Educational attainment was assessed utilizing the following 4 categories: did not graduate high school, graduated high school, attended college or technical school, and graduated from college or technical school. Employment status was assessed utilizing several categories but was dichotomized into unemployed and employed. Annual household income was assessed categorically with the following response options, less than $10,000; $10,000 to less than $15,000; $15,000 to less than $20,000; $20,000 to less than $25,000; $25,000 to less than $35,000; $35,000 to less than $50,000; $50,000 to less than $75,000; and $75,000 or more. However, to aid in interpretation annual household income was recoded into the following groups: less than $10,000, $10,000-$19,999, $20,000-$34,999, $35,000-$49,999, $50,000-$74,999, and 75,000 plus. Self-rated health was assessed based on the response to the following: Would you say that in general your health is excellent (1), very good (2), good (3), fair (4), or poor (5).

Independent Variables – Geographic-level.

Geographic location and identifiers. County-level Federal Information Processing Standard (FIPS) codes included in the BRFSS data were used to match data with the US Census data. State of residence and county of residence were also be used. Geographic region was calculated based on the region of the United States in which participants resided. Categories included West, Midwest, Northeast, and South. State's membership into specific regions was assigned based on the US Census defined regions. The US Census defined regions are as follows. The Northeast is comprised of Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont. The Midwest is comprised of Indiana, Illinois, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin. The South is comprised of Alabama, Arkansas, Delaware, District

of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia. The West is comprised of Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, New Mexico, Oregon, Utah, Nevada, Washington, and Wyoming.

Geographic characteristics. Geographic characteristics were examined at the county level as it was the lowest level of geography available in both data sets. Geographic characteristic variables were obtained from the 2010 US Census. Percent racial/ethnic minority population was calculated based on the percentage of Blacks, Hispanics, Asians, multiracial individuals, and AIANs residing in the county. This variable indicated the percent of the county that does not self-identify as non-Hispanic White alone. Percent of older adults was calculated based on the percentage of the population 60 and older residing in the county. Median household income at the county level was used. This variable was one of the indicators of county level economic status used. Population density was measured as number of residents per square mile and was used as such. It should be noted that population density was relied on as a rurality proxy with lower population density indicating greater rurality. Percent of the county living in poverty was also used. This was calculated based on the percent of the county below the 2010 poverty threshold which was set at $22,314 for a family of four (US Census Bureau, 2010). This variable was the second indicator of county economic status used.

Data Analysis

Analyses conducted on the publically available BRFSS data and the US Census data are preapproved by the University of Alabama's Institutional Review Board (IRB).

To begin data analysis, descriptive statistics were conducted for demographic variables and county level variables by geographic region. Past month alcohol consumption was also

computed by geographic region. In order to examine significant differences in these variables between geographic regions, one-way analyses of variance (ANOVAs) or chi-square tests were conducted as appropriate. To examine relations between independent variables, as well as to check for the presence of high multicollinearity, bivariate correlations were conducted using Pearson's correlation coefficients. Both individual and county level variables were included for descriptive analyses.

In order to assess how geographic location (i.e. region) and race/ethnicity were associated with drinks consumed per month among older adults, an analysis of covariance (ANCOVA) was conducted. This allowed for an examination of the main effects of race/ethnicity and region as well as the conditional effects on alcohol consumption via the race/ethnicity by region interaction. Additionally, the use of ANCOVA allowed for in depth post hoc analyses including various pairwise comparisons without the limitation of a reference group. Simple effects tests relying on a Bonferroni adjustment were used to interpret interactions.

Given the nested structure of the data, individuals at level 1, nested within counties at level 2, nested within regions at level 3, multi-level modeling (MLM) was used. MLM was used as it allows for an examination of individual level characteristics and county level characteristics while taking into account the non-independence of individuals living in the same county (Kreft & Leeuw, 1998). Prior to MLM analyses, all level 1 variables (individual level) that were not dummy coded were centered about the group mean. All level 2 variables (county level) were centered about the grand mean. Centering in this manner was done in order to aid in interpretation (Enders & Tofighi, 2007; Raudenbush & Bryk, 2002).

All necessary statistical assumptions were examined and appeared to be met. In regards to the assumption of lack of multicollinearity, first correlations were examined. With the

exception of the correlation between county percent of population in poverty and county level median household income, high multicollinearity was not found between study variables. Excluding the aforementioned exception, correlations between study variables were all below 0.4, indicating that multicollinearity was not a problem for the majority of study variables. The correlation between county percent of population in poverty and county level median household income was high enough to warrant examination, r=-.80. Given the potential for multicollinearity related issues as indicated by this high correlation, VIFs were examined for all study variables. All VIFs were found to be less than 5, which is a commonly used cutoff, indicating that multicollinearity was not too high (Kutner, Nachtsheim, & Neter, 2004; O'Brien, 2007). The assumption of non-zero variance was examined and found to be met all as variables had variance greater than 0. To examine the assumption of normally distributed errors, standardized residuals were plotted against normal scores with a best fit line. As the best fit line was similar to a straight diagonal this assumption appeared to be met (Bell et al., 2014). To examine the distribution of the overall residuals a histogram was used (Bell et al., 2014) and again this assumption appeared to be met. The assumption of homoscedasticity was checked by examining the plot of the residuals and predicted drinks consumed per month (Bell et al., 2014). The assumption appeared to be met as the variance of the residuals was similar for all predicted outcomes. It should be noted that plots were not made separately for each level 2 unit given the high number of level 2 units, such an examination was not practical and visual comparisons would not be possible across such a high number of counties. Given that all assumptions appeared to be met within reason, multilevel model analyses were continued.

Guidelines for model building as suggested in Bell, Ene, Smiley, & Schoeneberger (2013) were followed. Detailed information on the model building procedure and fit statistics

obtained are displayed in Tables 1 and 2. To begin model building a null random intercepts model, also known as an unconditional means model, was fit. This model includes no individual or county level characteristics. This model serves as a baseline against which to test subsequent more complicated models. Additionally, interpretation of this model reveals if there is systematic variation worth exploring. Initially, an unconditional means model including random effects for both county and region was fit. This model allowed for examination of within county variance, between county variance, and between region variance. However, results of this model revealed that there was not significant regional level variance after county level variance had been accounted for (p=.18). This indicated that there was not systematic regional variation that warranted exploration. Therefore, region was removed from the model as a random effect and an unconditional means model including a random effect only for county was used as the baseline model (model 1). Given the lack of significance of region in the unconditional means model, which yields the most liberal estimates for the effects of location related variables in the given analysis, region was not included in subsequent models for the sake of model parsimony.

For model 2, individual level (level 1) fixed effects were added. For this model and all following models, the Satterthwaite method for approximation of degrees of freedom for fixed effects was used as it is intended for use with unbalanced designs with more complex covariance structures as are commonplace in hierarchical multilevel models (Bell et al., 2014). Interpretation of this model reveals the relation between individual level predictors and monthly alcohol consumption. Next, random slopes for individual level (level 1) variables were added for model 3. The addition of random slopes for level 1 variables indicates if the relation between individual characteristics and monthly alcohol consumption varies between counties (level 2 units). For model 4, county level fixed effects (level 2) were added. The addition of these fixed effects

displays the relation between county level characteristics and county average monthly alcohol consumption. For model 5, fixed effects for cross level interactions were added to model 4. More specifically, the interaction of individual race/ethnicity x county level characteristics was added. The addition of these interaction terms indicates if the effect of county level variables varies by race/ethnicity.

Preliminary analyses were conducted in SPSS 17. All multilevel models were estimated using the SAS PROC MIXED procedure in SAS software version 9.4 of the SAS System for Windows. Maps were created using Google Fusion Tables.

Table 1. Model Construction Procedure

Model	Model 1 (Null)	Model 2	Model 3	Model 4	Model 5
Components of the Model	No predictors at level-1 or level-2 Random effect for the intercept	Model 1 + level-1 fixed effects	Model 2 + random slopes for level-1 predictors	Model 3 + level-2 fixed effects	Model 4 + interaction effects
Interpretation of the Model	Results used to calculate ICC ICC indicates how much variation exists in the outcome between counties Serves as baseline for comparisons	Results indicate the relation between level-1 variables and monthly drinks consumed	Results indicate the same information as Model 2 Additionally, random slopes results reveal if the relations between level-1 variables and monthly drinks consumed varies between counties	Results indicate the same information as Model 3 Additionally, level-2 fixed effect results indicate the relation between level-2 variables and monthly drinks consumed	Results indicate the same information as Model 4 Additionally, interaction effects results indicates if the slope for level-1 variables varies by level-2 variables

Notes: Level-1 variables refer to individual level variables, level-2 variables refer to county level variables (geographic characteristics); Table based on Bell et al., 2013

Table 2. Statistics from Model Construction Procedure

Model	**-2LL**	**Δ-2LL**	***Intercept***	***p***	***Residual***	***p***	***Int r^2***	***Res r^2***
1) Unconditional Means or Null including random effect for county only	1,339, 343	-	6.71	<.001	171.22	<.001	-	-
2) Model 1 + fixed effects for Individual level variables	1,103,475	235,868	4.15	<.001	166.40	<.001	.38	.03
3) Model 2 + random slopes for individual level variables	1,102,219	1,256	1.81	<.001	164.70	<.001	.73	.04
4) Model 3 + county level fixed effects	1,101,821	398	.73	<.01	164.70	<.001	.89	.04
5) Model 4 + individual level race/ethnicity x county level effects interaction	1,101,925	-104	.84	<.01	164.70	<.001	.87	.04

NOTES: Intercept refers to the intercept estimate from the covariance parameter estimates; Residual refers to the residual estimate from the covariance parameter estimates; Δ-2LL indicates reduction in the -2LL fit statistic and was compared to the preceding model; Int r^2 refers to the pseudo r^2 for the intercept; Res r^2 refers to the pseudo r^2 for the residual; both r^2 statistics were compared to the null model and indicate amount of explainable variance accounted for

RESULTS

Characteristics of the Sample

As displayed in Table 3, demographic, health, and alcohol consumption variables were computed for the sample as a whole, as well as by region. Overall there were significant regional differences in all demographic characteristics of the sample, as well as self-rated health and drinks consumed per month. In regards to race/ethnicity, non-Hispanic Whites comprised the majority of the sample (87.3%), followed by Blacks (6.6%), Hispanics (3.8%), APIs (1.2%), and AIANs (1.0%). Non-Hispanic Whites comprised the highest percentage of the sample in the Northeast (91.4%) and the lowest percentage of the sample in the South (83.1%). In regards of racial/ethnic minority groups, the West had the highest percentage of AIANs (1.5%) while the Northeast had the lowest (0.4%). The West also had the highest percentage of APIs (3.7%) while the Midwest had the lowest (0.3%). The South had the highest percentage of Blacks (11.6%) while the West had the least (1.1%). Lastly, the West had the highest percentage of Hispanics (6.5%) while the Midwest had the lowest (1.4%). The mean age of the sample was 71.4 (SD=8.3). The sample was the oldest in the Midwest (72.0 years) and the youngest in the South and the West (71.2 years). The majority of the overall sample was female (64.6%). Females accounted for the largest percentage of the sample in the South (66%) and the smallest percentage of the sample in the West (62.4%). Approximately half of the sample was married (50.4%). Married individuals comprised the largest segment of the sample in the West (53.3%) and the smallest segment in the Northeast (47.0%). In regards to educational attainment, the majority of the sample had completed high school or a higher level of education (88.7%).

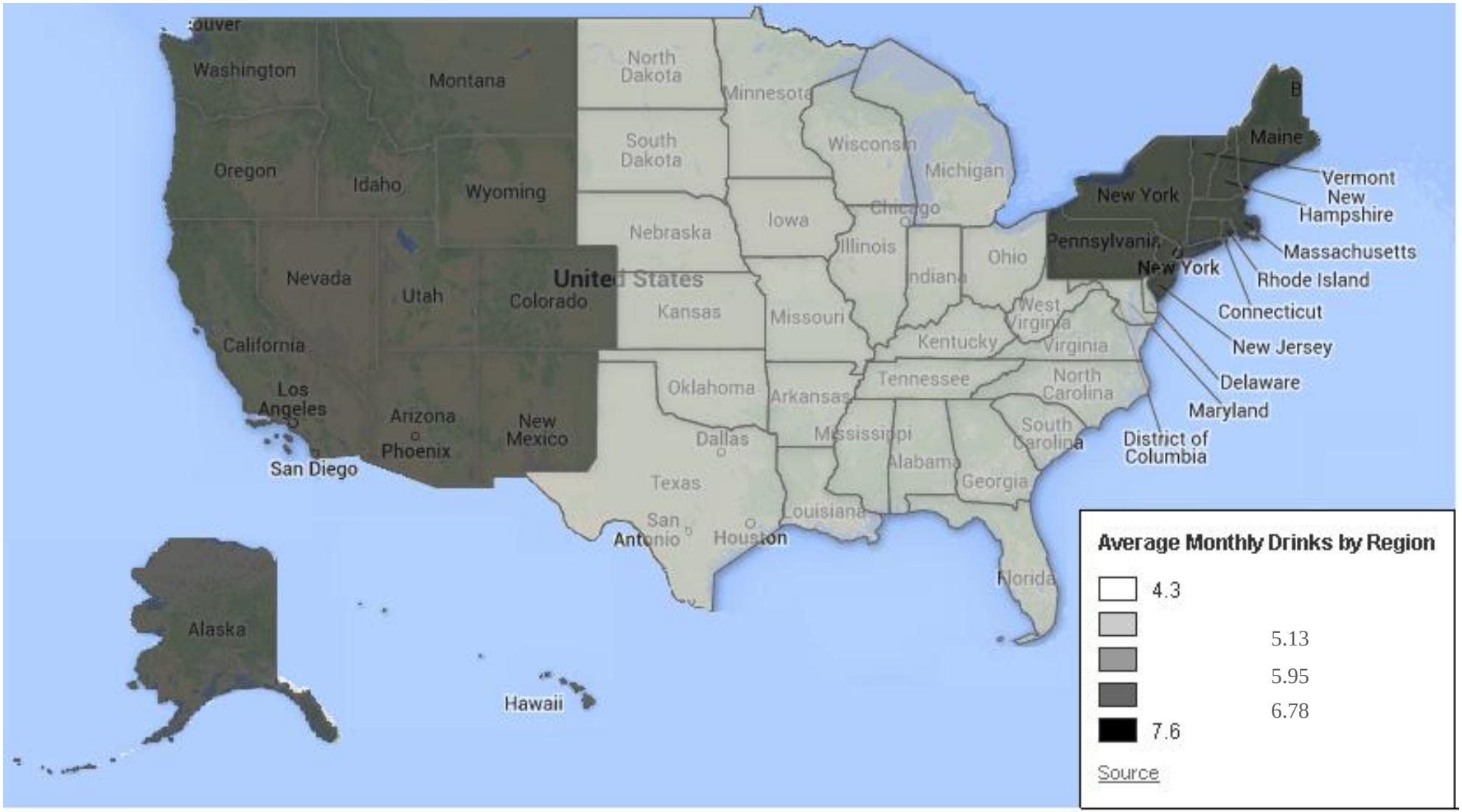
Completion of high school or greater was most common in the West (92.3%) and least common in the South (85.0%). The most common annual income in the sample was $20,000-$34,999 (23.5%), while the least common annual income was less than $10,000 (4.3%). Annual incomes of less than $10,000 a year was most common in the South (6.5%). The mean self-rated health was 2.8 (SD=1.2) which is indicative of good to very good health. Self-rated health was the highest in the West (M=2.7, SD=1.2) and lowest in the South (M=2.9, SD=1.2). Average drinks consumed per month was 6.1 (SD=13.2) for the entire sample. The greatest mean drinks consumed per month was found in the Northeast (M=7.6, SD=14.2) and the least in the South (M=5.1, SD=12.5). Average drinks consumed per month by region are displayed in map form in Figure 1.

Table 3. Characteristics of the Sample and Study Variables – Individual Level Variables (n=185,190)

	Total Sample	**Northeast, *n*(%)**	**Midwest, *n*(%)**	**South, *n*(%)**	**West, *n*(%)**	**X^2 or (*F*)**
Total	-	32,828 (17.7)	40,692 (22.0)	67,936 (36.7)	43,734 (23.6)	
Race/Ethnicity						9,815.39**
AIAN	1,868 (1.0)	128 (0.4)	448 (1.1)	641 (0.9)	651 (1.5)	
API	2,263 (1.2)	209 (0.6)	136 (0.3)	287 (0.4)	1,631 (3.7)	
Black	12,312 (6.6)	1,486 (4.5)	2,438 (6.0)	7,912 (11.6)	476 (1.1)	
Hispanic	7,036 (3.8)	997 (3.0)	560 (1.4)	2,637 (3.9)	2,842 (6.5)	
White	161,711 (87.3)	30,008 (91.4)	37,110 (91.2)	56,459 (83.1)	38,134 (87.2)	
Age (Mean +/- SD)	71.4 (8.3)	71.5 ± 8.5	72.0 ± 8.6	71.2 ± 8.0	71.3 ± 8.3	(81.10)**
Female	119,678 (64.6)	21,213 (64.6)	26,357 (64.8)	44,830 (66.0)	27,278 (62.4)	152.70**
Married	93,425 (50.4)	15,434 (47.0)	20,559 (50.5)	34,134 (50.2)	23,298 (53.3)	295.83**
Educational Attainment						3,827.85**
< High School	20,942 (11.3)	3,296 (10.0)	4,072 (10.0)	10,194 (15.0)	3,380 (7.7)	
Graduated High School	62,007 (33.5)	11,230 (34.2)	16,136 (39.7)	22,511 (33.1)	12,130 (27.7)	
Some College	46,816 (25.3)	7,190 (21.9)	10,292 (25.3)	16,566 (24.4)	12,768 (29.2)	
Graduated College	55,062 (29.8)	11,030 (33.6)	10,127 (24.9)	18,510 (27.2)	15,395 (36.2)	
Employed	41,196 (22.3)	8,264 (25.2)	9,699 (23.8)	13,221 (19.5)	10,012 (22.9)	537.08**
Annual Income						1,489.24**
Less than $10,000	8,003 (4.3)	1,244 (4.6)	1,421 (4.2)	3,554 (6.5)	1,784 (4.8)	
$10,000-$19,999	29,071 (15.7)	5,061 (18.7)	6,556 (19.5)	11,522 (21.0)	5,932 (15.8)	
$20,000-$34,999	43,449 (23.5)	7,411 (27.4)	10,631 (31.6)	15,342 (28.0)	10,065 (26.8)	
$35,000-$49,999	25,669 (13.9)	4,265 (15.7)	6,039 (17.9)	8,626 (15.7)	6,739 (18.0)	
$50,000-$74,999	20,748 (11.2)	3,699 (13.7)	4,353 (12.9)	6,847 (12.5)	5,849 (15.6)	
$75,000+	26,107 (14.1)	5,407 (20.0)	4,657 (13.8)	8,891 (16.2)	7,152 (19.1)	
Self-Rated Health (Mean +/- SD)	2.8 (1.2)	2.8 ± (1.2)	2.8 ± (1.1)	2.9 ± (1.2)	2.7 ± (1.2)	(397.45)**
Drinks Per Month (Mean +/- SD)	6.1 (13.2)	7.6 (14.2)	5.2 (12.1)	5.1 (12.5)	7.4 (14.4)	(444.92)**

NOTES: *AIAN=American Indian/Alaska Native; API=Asian/Pacific Islander,* $^{**}p<.001$

Figure 1. Map of Average Monthly Drinks by Region



Notes: Alaska and Hawaii are shown out of their actual proportions/geographic locations for ease of map interpretation

Table 4 displays county level geographic characteristics for the sample as a whole as well as by region. Significant regional differences were found for all geographic characteristics examined. The average county percentage of the population 60 and older was 20.0 (SD=5.0). The largest average county percent of the population 60 and older was found in the South (M=20.8, SD=6.2) and the smallest average percent was found in the West (M=18.8, SD=5.0). The overall average county percent of the population that was a racial/ethnic minority was 29.2 (SD=20.1). The largest mean county percent of racial/ethnic minorities was found in the West (M=35.0, SD=21.5) and smallest in the Midwest (M=20.2, SD=14.8). The average percent of the county in poverty was 14.7 (SD=5.4). Mean county level poverty was the highest in the South (M=17.3, SD=5.8) and lowest in the Northeast (M=11.6, SD=4.1). The average county median income was 49,151.8 (SD=12,468.9). The highest average county level median income was found in the Northeast (M=56,533.2, SD=13,491.6) and the lowest average county level median income was found in the South (44,148.6, SD=11,720.4). The average county level population density was 1,084.9 residents per square mile (SD=4,134.9). Average county population density was greatest in the Northeast (M=2,827.2, SD=8,767.9) and lowest in the West (M=522.9, SD=1,235.2).

Table 5 displays the geographic composition of the sample. All 50 states and the District of Columbia are represented in the sample. Every state and Washington D.C. have county level data, with the exception of Alaska as county of residence was not obtained for Alaskan respondents. Therefore, the Alaskan portion of the sample was included for region level analyses but excluded for county level analyses. A total of 2,229 counties are represented in the sample. Given the large variability in the number of counties per state, the range of counties represented per state is large (3-149).

Table 6 displays the average monthly drinks consumed by state. This information is also displayed in map form in Figure 2. While states were not used as a level of analysis in this dissertation, it was believed that a visual representation of average drinks consumed by state would be more interpretable for readers than a map displaying average monthly drinks by county. The lowest state mean monthly drinks was found in Tennessee (1.98 drinks per month) while the highest state mean monthly drinks was found in New Hampshire (9.08 drinks per month). It should be noted that even higher average monthly alcohol consumption was found in Washington DC (11.12 drinks per month), which is not classified as a state.

Table 4. Characteristics of the Sample and Study Variables – County Level Geographic Variables (n=185,190)

	Total Sample	**Northeast, *M(SD)***	**Midwest, *M(SD)***	**South, *M(SD)***	**West, *M(SD)***	***F***
Percent of Population 60+	20.0 (5.0)	20.7 (3.2)	19.23 (3.4)	20.8 (6.2)	18.8 (5.0)	1,865.27**
Percent of Population Racial Minority[1]	29.2 (20.1)	21.7 (17.8)	20.2 (14.8)	34.1 (19.7)	35.0 (21.5)	7,190.77**
Percent of Population in Poverty	14.7 (5.4)	11.6 (4.1)	14.0 (4.5)	17.3 (5.8)	13.9 (4.4)	11,202.47**
Median Household Income	49,151.8 (12,468.9)	56,533.2 (13,491.6)	47,747.9 (8.915.0)	44,148.6 (11,720.4)	52,422.1 (11,365.8)	10,053.67**
Population Density (residents/mile^2)	1,084.9 (4,134.9)	2,827.2 (8,767.9)	840.3 (1,312.0)	681.7 (1,629.0)	522.9 (1,235.2)	2,594.12**

*NOTES: ** p<.001; M refers to the mean percentage; [1]Racial/ethnic minority was abbreviated to racial minority for table formatting purposes*

Table 5. Geographic Composition of the Sample (n=185,190)

	***n* (number of counties)**	**% (percent of counties)**
Geographic Regions/States	185,190 (2,229)	100.0 (100.0)
Northeast	32,828 (210)	17.8 (9.4)
Connecticut	2,745 (8)	8.4 (3.8)
Maine	3,442 (16)	10.5 (7.6)
Massachusetts	5,725 (13)	17.4 (6.2)
New Hampshire	2,559 (10)	7.8 (4.8)
New Jersey	4,271 (21)	13.0 (10.0)
New York	3,671 (61)	11.2 (29.1)
Pennsylvania	4,884 (64)	14.9 (30.5)
Rhode Island	2,739 (5)	8.3 (2.4)
Vermont	2,792 (12)	8.5 (5.7)
Midwest	40,692 (665)	22.0 (29.8)
Illinois	2,168 (80)	5.3 (12.0)
Indiana	4,359 (82)	10.7 (12.3)
Iowa	2,676 (59)	6.6 (8.9)
Kansas	3,715 (35)	9.1 (5.3)
Michigan	3,994 (71)	9.8 (10.7)
Minnesota	3,171 (61)	7.8 (9.2)
Missouri	2,388 (78)	5.9 (11.8)
Nebraska	7,617 (21)	18.7 (3.2)
North Dakota	1,907 (9)	4.7 (1.4)
Ohio	3,989 (88)	9.8 (13.2)
South Dakota	2,904 (14)	7.1 (2.1)
Wisconsin	1,804 (67)	4.4 (10.1)
South	67,936 (1087)	36.7 (48.7)
Alabama	3,387 (61)	5.0 (5.6)
Arkansas	1,997 (55)	2.9 (5.1)
Delaware	1,836 (3)	2.7 (0.3)
District of Columbia	1,541 (1)	2.3 (0.01)
Florida	16,971 (63)	25.0 (5.8)
Georgia	2,250 (110)	3.3 (10.1)
Kentucky	3,347 (88)	4.9 (8.1)
Louisiana	2,751 (55)	4.0 (5.1)
Maryland	3,345 (24)	4.9 (2.2)
Mississippi	3,746 (63)	5.4 (5.8)
North Carolina	5,137 (91)	7.5 (8.4)
Oklahoma	3,357 (50)	4.9 (4.6)
South Carolina	4,171 (44)	6.1 (4.0)
Tennessee	2,608 (82)	3.8 (7.5
Texas	7,466 (149)	11.0 (13.7)
Virginia	2,054 (106)	3.1 (9.8)
West Virginia	1,972 (42)	2.9 (3.9)
West	43,734 (267)	23.6 (12.0)
Alaska	469 (0)	1.1 (0)
Arizona	2,860 (14)	6.5 (5.2)
California	6,696 (55)	15.3 (20.6)
Colorado	4,268 (35)	10.0 (13.1)
Hawaii	2,316 (4)	5.3 (1.5)

Idaho	3,009 (22)	6.8 (8.2)
Montana	3,095 (12)	7.1 (4.5)
Nevada	1,528 (9)	3.5 (3.4)
New Mexico	3,017 (25)	7.0 (9.4)
Oregon	2,181 (28)	5.0 (10.5)
Utah	3,367 (17)	7.7 (6.4)
Washington	8,405 (33)	19.2 (12.4)
Wyoming	2,523 (13)	5.8 (4.9)

Table 6. Mean Monthly Drinks by State (n=185,190)

State	*M*
Alabama	3.00
Alaska	8.00
Arizona	7.57
Arkansas	3.91
California	8.78
Colorado	7.70
Connecticut	8.76
Delaware	7.13
District of Columbia[1]	11.12
Florida	7.28
Georgia	4.48
Hawaii	7.99
Idaho	5.54
Illinois	6.63
Indiana	4.11
Iowa	5.01
Kansas	4.59
Kentucky	2.69
Louisiana	4.26
Maine	8.62
Maryland	6.71
Massachusetts	7.88
Michigan	5.95
Minnesota	7.18
Mississippi	2.61
Missouri	4.30
Montana	7.30
Nebraska	4.87
Nevada	8.94
New Hampshire	9.08
New Jersey	6.80
New Mexico	5.72
New York	7.12
North Carolina	4.42
North Dakota	5.19
Ohio	4.79
Oklahoma	3.28

Oregon	8.63
Pennsylvania	5.14
Rhode Island	7.74
South Carolina	5.83
South Dakota	4.95
Tennessee	1.98
Texas	4.83
Utah	3.11
Vermont	8.85
Virginia	5.61
Washington	8.48
West Virginia	2.00
Wisconsin	7.08
Wyoming	6.15

Notes: [1]The District of Columbia was analyzed for this table even though it is not technically classified as a state

Figure 2. Map of Average Monthly Drinks by State

Notes: Alaska, Hawaii, and the District of Columbia are shown out of their actual proportions/geographic locations for ease of map interpretation

Correlations between Study Variables

Bivariate correlations between study variables are displayed in Table 7. This table shows that all individual level variables were significantly correlated with past month alcohol consumption. In regards to county level variables, all variables with the exception of county level racial/ethnic minority percent were significantly correlated with past month alcohol consumption.

Correlations between race/ethnicity and past month alcohol consumption for the overall sample as well as by region are displayed in Table 8. Race/ethnicity was dummy coded with the White sample as the reference group for Table 8. As compared to the reference group, every racial/ethnic group was significantly and negatively correlated with past month alcohol consumption.

Table 7. Bivariate correlations between study variables (*n=185,190*)

	1	2	3	4	5	6	7	8	9	10	11	12
Individual Level Characteristics												
1. Drinks per month	-											
2. Female	-.18**	-										
3. Age	-.07**	.06**	-									
4. Married	.10**	-.24**	-.24**	-								
5. Educational attainment	.10**	-.11**	-.15**	.13**	-							
6. Employed	.07**	-.08**	-.36**	.10**	.17**	-						
7. Annual income	-.05**	.10**	.10**	.02**	-.04**	.07**	-					
8. Self-rated health	-.16**	.00	.11**	-.11**	-.28**	-.19**	.00	-				
County Level Characteristics												
9. Percent of population 60+	.04**	-.01**	.03**	.02**	-.03**	-.05**	.01*	.03**	-			
10. Percent of population racial minority	-.00	.01**	.00	-.05**	.03**	.00	-.02**	.12**	-.38**	-		
11. Percent of population in poverty	-.10**	.03**	-.01	-.04**	-.14**	-.06**	.00	-.11**	.01**	.37**	-	
12. Median household income	.11**	-.03**	-.00	.02**	.18**	.07**	-.01	-.00	-.28**	.01**	-.80**	-
13. Population density (residents/mile^2)	.02**	.00	.01*	-.05**	.05**	.02**	-.01**	-.00	-.12**	.27**	.05**	.14**

*NOTES: *p<.01, **p<.001*

Table 8. Bivariate correlations between race/ethnicity and drinks consumed per month by region (*n=185,190*)

	Total Sample	**Northeast**	**Midwest**	**South**	**West**
AIAN[1]	-.02**	-.01**	-.02**	-.02**	-.03**
API[1]	-.02**	-.03**	-.01*	-.01**	-.05**
Black[1]	-.08**	-.07**	-.05**	-.09**	-.02**
Hispanic[1]	-.04**	-.06**	-.02**	-.04**	-.07**

*NOTES: AIAN=American Indian/Alaska Native, API=Asian/Pacific Islander; [1]reference group=Whites; **p<.001*

Preliminary Examination of the Effects of Region and Race/ethnicity

In order to develop a better understanding of the role of geography and race/ethnicity, additional preliminary analyses were conducted prior to multilevel modeling analyses. More specifically, a two-way analysis of covariance (ANCOVA) was conducted to examine both the main effects and the interaction of region and race/ethnicity. ANCOVA results are displayed in Tables 9 and 10. A significant main effect of race/ethnicity was found [$F(4,185170)=206.06$, $p<.001$]. Means presented in the following section are estimated marginal means, or means adjusted for covariates. Post hoc testing relying on a Bonferroni adjustment revealed that Whites (M=6.76, 95%CI=6.70-6.83) had significantly higher average monthly alcohol consumption than other racial/ethnic groups: AIAN (M=3.37, 95%CI=3.26-4.11), API (M=3.16, 95%CI=2.34-3.98), Black (M=3.05, 95%CI=2.68-3.42), and Hispanic (M=3.14, 95%CI=2.76-3.52). A significant main effect was also found for region [$F(3,185170)=16.32$, $p<.001$]. Post hoc testing relying on a Bonferroni adjustment revealed the following significant pairwise comparisons: average monthly alcohol consumption was significantly higher in the Northeast (M=4.21, 95%CI=3.59-4.82) than the South (M=3.18, 95%CI=2.80-3.56). Additionally, average monthly alcohol consumption was significantly higher in the West (M=4.90, 95%CI=4.55-5.25) than the Midwest (M=3.30, 95%CI=2.75-3.86) and the South (M=3.18, 95%CI=2.80-3.56). Lastly, there was a significant race/ethnicity by region interaction [$F(12,185170)=16.32$, $p<.001$], indicating that racial/ethnic alcohol consumption patterns varied by region of residence among the sample.

Figure 3 illustrates the estimated marginal means for monthly alcohol consumption by region and race/ethnicity. Simple effects testing relying on the Bonferroni adjustment revealed significant regional differences for both the Black and White samples: Black [$F (3,185190 = 8.00$, $p<.001)$] , White [$F (3,185190 = 401.71$, $p<.001)$]. Among the Black sample, those living

in the Northeast (M=3.04, 95%CI=2.37-3.70) were predicted to have higher monthly alcohol consumption than those living in the South (M=1.99, 95%CI=1.70-2.28). Additionally, among the Black sample those living in the West (M=4.48, 95%CI=3.30-5.66) were predicted to have significantly higher monthly alcohol consumption than those living in the South (M=1.99, 95%CI=1.70-2.28) and the Midwest (M=2.68, 95%CI=2.16-3.20). A similar pattern was found among the White sample. More specifically, among the White sample those living in the Northeast (M=7.99, 95%CI=7.84-8.14) were found to have significantly higher alcohol consumption than those living in the Midwest (M=5.47, 95%CI=5.34-5.60) and than those living in the South (M=5.73, 95%CI=5.62-5.84). Furthermore, among the White sample those living in the West (M=7.85, 95%CI=7.72-7.98) were found to have significantly higher alcohol consumption than those living in the Midwest (M=5.47, 95%CI=5.34-5.60) and than those living in the South (M=5.73, 95%CI=5.62-5.84). Lastly, among the White sample those living in the South (M=5.73, 95%CI=5.62-5.84) were found to have significantly higher monthly alcohol consumption than those living in the Midwest (M=5.47, 95%CI=5.34-5.60).

Simple effects testing was also conducted to examine racial/ethnic differences in monthly alcohol consumption within geographic regions. Results indicated significant racial/ethnic differences within all four geographic regions: Northeast [F (4,185190=94.23 , p<.001)], Midwest [F (4,185190=35.85 , p<.001)], South [F (4,185190=169.15 , p<.001)], and West [F (4,185190=105.40 , p<.001)]. Within the Northeast, Whites (M=7.99, 95%CI=7.84-8.14) were predicted to have significantly higher monthly alcohol consumption than all other racial/ethnic groups: AIANs (M=4.33, 95%CI=2.05-6.60), APIs (M=2.95, 95%CI=1.17-4.73), Blacks (M=3.04, 95%CI=2.37-3.70), Hispanics (M=2.73, 95%CI=1.92-3.55). Similarly, within the Midwest, Whites (M=5.47, 95%CI=5.33-5.60) were predicted to have significantly higher

alcohol consumption than AIANs (M=2.52, 95%CI=1.29-3.73), Blacks (M=2.68, 95%CI=2.16-3.20), and Hispanics (M=3.05, 95%CI=1.96-4.14). The South showed a somewhat more diverse pattern of alcohol consumption. While again Whites (M=5.73, 95%CI=5.62-5.84) were predicted to have significantly higher monthly alcohol consumption than all other racial/ethnic groups: AIAN (M=2.40, 95%CI=1.38-3.41), API (M=2.81, 95%CI=1.29-4.32), Black (M=1.99, 95%CI=1.70-2.28), Hispanic (M=3.00, 95%CI=2.48-3.48), an additional pairwise comparison was also found to be significant. Specifically, within the South Blacks (M=1.99, 95%CI=1.70-2.28) were predicted to have significantly lower alcohol consumption than Hispanics (M=3.00, 95%CI=2.48-3.48). Within the West, Whites (M=7.85, 95%CI=7.72-7.98) were again predicted to have significantly higher alcohol consumption than all other racial/ethnic groups: AIANs (M=4.24, 95%CI=3.23-5.25), APIs (M=4.09, 95%CI=3.46-4.73), Blacks (M=4.48, 95%CI=3.30-5.66), Hispanics (M=3.81, 95%CI=3.23-4.29).

Table 9. ANCOVA of drinks consumed per month (n=185,190)

Variable	Df	SS	*F*	*P*-value
Main Effects				
Race/Ethnicity	4	142,177.85	206.06	<.001**
Region	3	8,445.50	16.32	<.001**
Interaction Effect				
Region x Race/Ethnicity	12	10,419.93	5.03	<.001**

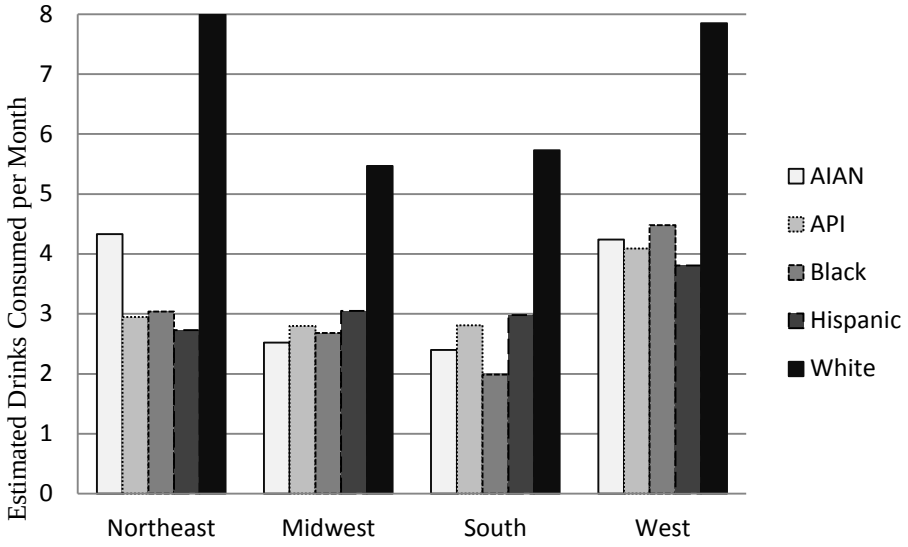
*NOTES: ** p<.001*

Table 10. Estimated Marginal Means of Drinks Consumed per Month (n=185,190)

	AIAN	API	Black	Hispanic	White	TOTAL
Northeast	4.33	2.95	3.04	2.73	7.99	4.21
Midwest	2.52	2.80	2.68	3.05	5.47	3.30
South	2.40	2.81	1.99	2.98	5.73	3.18
West	4.24	4.09	4.48	3.81	7.85	4.90
TOTAL	3.37	3.16	3.05	3.14	6.76	

NOTES: AIAN=American Indian/Alaska Native, API=Asian/Pacific Islander

Figure 3. Estimated Marginal Means of Drinks Consumed per Month by Region and Race/Ethnicity



Multilevel Model Results

Results from model fitting procedure

Statistics from the model fitting procedure are displayed in Table 2. The null model provides a baseline against which to compare the gradually more complicated models and eventually the final model. The covariance parameter estimates for the intercept from the null model indicate how much variation exists between counties. The null model indicated that there was significant between county variation in average drinks consumed per month (p<.001). The null model's covariance parameter estimate for the residual indicates how much variance is within counties. The results from the null model also indicated that there was significant within county variance in average drinks consumed per month (p<.001). The parameter estimate from the fixed effect of the intercept of the null model indicates the average county level drinks consumed per month. Results from the null model indicated that the average county level drinks consumed per month (not to be confused with average individual level) 5.25. Additionally, the null model is used to determine how much variance can be accounted for by improving on the model. Intraclass correlation coefficients (ICC) can be used to estimate what portion of the total variance occurs between and within counties. ICC's were calculated and indicated that 4% of the variance in monthly alcohol consumption occurred between counties and that 96% of variance in monthly alcohol consumption occurred within counties.

In step 2, fixed effects for the level 1 (individual level) variables were added to the null model. This model had an increased model fit as indicated by a decrease in the -2LL statistic (Δ-2LL=235,868). It should be noted that the change in -2LL presented is indicative of the amount of reduction throughout this document. Results from the covariance parameter estimates for this model indicated that the addition of fixed effects for the individual level variables accounted for

38% of the explainable variance between counties in average county level drinks consumed per month and 3% of the within county explainable variance. The Z test for both the intercept (p<.001) and residual (p<.001) was significant indicating that there was a significant amount of additional explainable variance that can be accounted for. This indicated that examination of additional variables was warranted. The results from the fixed effects for this model indicated that all individual level variables were significantly related to drinks consumed per month.

In step 3, random slopes were added for the individual level variables. This step statistically allows the relation between individual level variables and drinks consumed per month to vary by county if such variation exists. Additionally, this step indicates if the relation between individual level variables and drinks consumed per month does in fact vary significantly by county. This model had an increased model fit as indicated by a decrease in the -2LL statistic (Δ-2LL=398). Results from the covariance parameter estimates for this model indicated that the addition of random slopes for the individual level variables accounted for an additional 35% of the explainable between county variance in the outcome. Therefore, at this step 73% of the explainable between county variance was accounted for by the individual level variables when slopes were allowed to be random. Additionally, the result indicated that the addition of the random slopes accounted for an additional 1% of the explainable variance within counties, leaving 4% of the explainable variance within counties accounted for. The results from the covariance parameter estimates also indicated that the relation between the outcome variable and race (p<.001), marital status (p<.01), educational attainment (p<.001), employment status (p<.05), annual income (p<.001), and self-rated health (p<.001) varied significantly by county. Such a significant variation was not found by county for the relation between the outcome variable and age or the outcome variable and sex. The Z test for both the intercept (p<.001) and

residual (p<.001) was significant which indicated that there was a significant amount of additional explainable variance that could be accounted for. Again, this indicated that examination of additional variables was warranted. As in the previous model, the result from the fixed effects indicated that all individual level variables were significantly related to drinks consumed per month.

In step 4, fixed effects for the level 2 (county level) variables were added to model 3. This model had an increased model fit as indicated by a decrease in the -2LL statistic (Δ-2LL=-104). Results from the covariance estimates for this model indicated that the addition of the fixed effects for the county level variables accounted for an additional 16% of the explainable between county variance. Therefore, 89% of the between county variance was accounted for at this step. The explainable percent of the within county variance was not impacted by the addition of county level variables. This left the explainable within county variance account for at 4%, as in the previous model. The remaining information obtained from the covariance parameter estimates was the same as in model 3 with one exception. The addition of the county level variables resulted in the random slope of individual level employment status becoming non-significant. This indicated that once county level variables were accounted for, the relation between individual level employment status and the outcome variable no longer varied significantly by county. The Z test for both the intercept (p=.005) and residual (p<.001) was significant which indicated that there was a significant amount of additional explainable variance that could be accounted for. Yet again, this indicated that examination of additional variables was warranted. The results from the fixed effects for this model indicated that all individual level variables were still significantly related to drinks consumed per month. In regards to county level variables, the results indicated that the percentage of older adults in the county (p<.001), the

county level median household income ($p<.001$), and the percentage of racial/ethnic minorities in the county ($p<.001$) were significantly related to the outcome variable.

In step 5, interaction terms for race/ethnicity by county level variables were added to model 4. This model had a decreased model fit as indicated by an increase in the -2LL statistic (Δ-2LL=-104). However, regardless of the decreased model fit this step was necessary in order to test specific hypotheses posed by this dissertation. The results from the covariance parameter estimates indicated that the amount of explainable between county variance was reduced by 2% by the addition of the interaction terms. This resulted in 87% of the between county variance being account for by this model. The amount of within county variance accounted for remained at 4%, as in the previous model. Additionally, the results from the covariance parameter estimates indicated the same pattern of significant random slopes as in model 4. The Z test for both the intercept ($p<.01$) and residual ($p<.001$) was significant indicating that there was a significant amount of additional explainable variance that could be accounted for. Yet again, this indicated that examination of additional variables would be warranted. However, at this point all proposed variables/variables of interest for this project had been examined. The results from the fixed effects of this model indicated the same pattern of significance as model 4. Additionally, significant interactions were found for race/ethnicity x percentage of population 60 and older ($p<.001$), race/ethnicity x median household income ($p<.001$), and race/ethnicity x racial/ethnic minority percentage ($p<.01$). This final model had a reduction of 237,418 in the -2LL fit statistic as compared to the null model. Interpretation of the effects for specific variables and interaction terms are described below.

Interpretation of the final multilevel model

Results of the final model are presented in Table 11. The fixed effect for the intercept for the final model indicated that when all individual level, county level, and interactions of interested were controlled for, the county average drinks consumed per month by older adults was 6.31. The terms (*B*) for the fixed effects of individual level variables indicate the average slope representing the relation between the level 1 variable and drinks consumed per month. The fixed effects from the final model indicate that all individual level variables were significantly related to monthly alcohol consumption. More specifically, at the individual level, the fixed effects results indicated that older age (*B*=-.02, *p*<.001), being female (*B*=-4.12 [referent: male], p<.001), being married (*B*=-.54 [referent: not married], *p*<.001), and being employed (*B*=-.62 [referent: not employed], p<.001) were related to less monthly alcohol consumption. Additionally, in regards to race/ethnicity, as compared to the White reference group, being AIAN (*B*=-1.89, *p*<.001), API (*B*=-4.28, *p*<.001), Black (*B*=-2.50, *p*<.001), and Hispanic (*B*=-1.22, *p*<.001) were all significantly related to less monthly alcohol consumption. This suggests that older adult Whites are likely to have the most alcohol consumption followed by Hispanics, AIANs, Blacks, and lastly APIs. Conversely, greater education as compared to less than a high school diploma (High school diploma: *B*=.47, *p*<.001, Some college or technical school: *B*=1.30, *p*<.001, College or technical degree: *B*=2.72, *p*<.001) and better self-rated health (*B*=-.93, *p*<.001) were related to more monthly alcohol consumption. Additionally, an effect was found for annual income such that with respect to the referent of an annual income of less than $10,000, all annual income categories starting at $20,000, were related to greater monthly alcohol consumption: ($20,000-$34,999: *B*=.77, <.001; $35,000-$49,999: *B*=1.92, *p*<.001; $50,000-$74,999: *B*=3.23, *p*<.001; $75,000+: *B*=5.61, *p*<.001).

County level fixed effects represent the contextual effects. Given that the county level variables were centered among the grand mean, county level fixed effects can be interpreted as follows: the term (*B*) indicates how much a county varies in county mean drinks consumed per month when there is a 1 point difference in the county level variable be examined. For example, the results indicate that as the percentage of racial/ethnic minorities in a county increases by 1%, the average county level drinks consumed per month increases by .03 (*B*=.03). In terms of all significant county level characteristics, the county percent of older adults (*B*=.24, *p*<.001), the county median income (*B*<.001, *p*<.001), and the county percent of racial/ethnic minorities (*B*=.03, *p*<.001) were all significantly related to average monthly county alcohol consumption. More specifically, the results indicated that higher percentages of the county that was 60 and older, higher county level median income, and higher percentages of the county that was a racial/ethnic minority were all related to greater county level average alcohol consumption. It should be noted that while the term for county median income was found to be significant, the very small value of the terms suggests that the effect may be weak. County population density (*B*=<.001, *p*=.44) and county poverty percentage (*B*=-.03, *p*=.28) were not significant.

Generally, fixed effects for interaction terms indicate if the slopes for the relation between the level 1 variable of interest and outcome differ significantly by the level 2 variable of interest. As all interactions examined were race/ethnicity by county level variables, the White racial/ethnic group was used for reference. Therefore, the interaction terms indicate if the effect of the county level variable of interest on monthly alcohol consumption for the racial/ethnic minority group of interest is significantly different from the effect of the county level variable of interest on monthly alcohol consumption for the White sample. For example, the interaction term for race/ethnicity-Black x percentage of the county 60 and older indicates that as compared to the

White sample, the influence of the percentage of the county 60 and older is significantly less (B=-.20, p<.001). Additional significant interactions were race/ethnicity-Hispanic x county percentage 60 and older (B=-.16, p<.01), race/ethnicity-Black x county median household income (B<-.001, p<.001), race/ethnicity-Black x county racial/ethnic minority percentage (B=-.04, p<.01), and Hispanic x county racial/ethnic minority percentage (B=-.03, p=.01). These interactions are displayed in Figures 4-6 to aid in interpretation. As displayed in Figure 4, the relation between county percentage 60 and older and drinks consumed per month is positive for Whites, Hispanics, and Blacks. However, the effect is weaker for both Blacks and Hispanics and compared to Whites. As displayed in Figure 5, the relation between median county income and drinks consumed per month is positive for Whites while it is virtually neutral for blacks. This indicates that the effect for median county income is weaker among Blacks as compared to Whites. As displayed in Figure 6, the relation between county racial/ethnic minority percentage and drinks consumed per month is positive for Whites while it is negative for Blacks and very slightly negative for Hispanics. The effect of county minority percent is weaker for Blacks and Hispanics and compared to Whites. No significant interactions were found for race/ethnicity by county population density or race/ethnicity by county poverty percent.

Covariance parameter estimates for the random slopes terms indicate how much the slope for the individual level variable as it relates to the outcome varies by county. The following individual level variables were found to vary significantly between counties: race/ethnicity (B=1.03, p<.001), marital status (B=.24, p<.01), educational attainment (B=.43, p<.001), annual income (B=.72, p<.001), and self-rated health (B=.15, p<.001).

Table 11. Final Multilevel Model Results- Drinks Consumed Per Month (n=184,721)

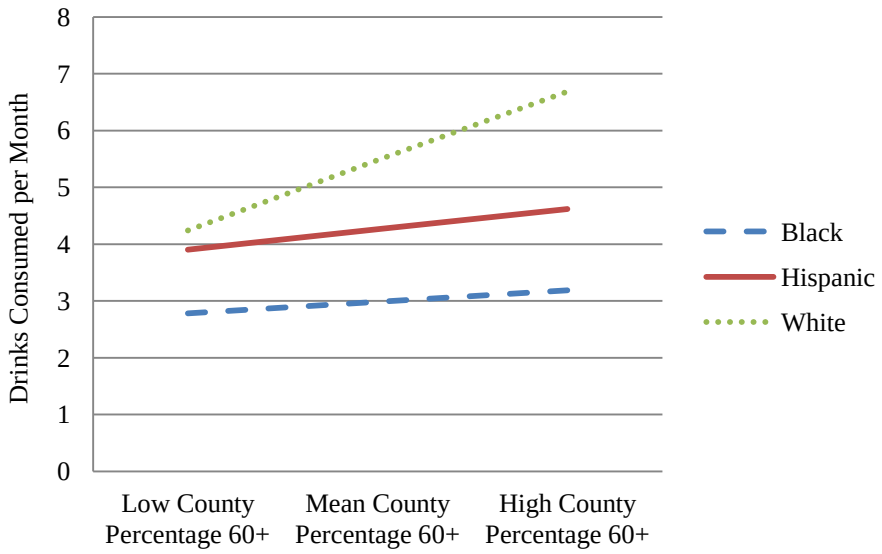
	B	***SE***	***df***	***t (z)***	***p***
Fixed Effects					
Individual Level					
Age	-.02	.01	140,000	-3.88	<.001
Sex- Female (referent: male)	-4.12	.08	825	-52.67	<.0001
Race/Ethnicity – AI/AN (referent: White)	-1.89	.45	47,000	-4.18	<.0001
Race/Ethnicity – API (referent: White)	-4.28	.57	32,000	-7.57	<.0001
Race/Ethnicity – Black (referent: White)	-2.50	.21	3,587	-11.99	<.0001
Race/Ethnicity – Hispanic (referent: White)	-1.22	.26	8,565	-4.71	<.0001
Marital Status - Married (referent: not married)	-.54	.09	1,417	-6.31	<.0001
Education – HS (referent – less than HS)	.47	.14	6,424	3.50	<.001
Education – some college or technical ed (referent – less than HS)	1.30	.14	6,901	9.10	<.0001
Education – college or technical degree (referent – less than HS)	2.72	.15	7,222	18.27	<.0001
Employment – employed (referent – not employed)	-.62	.09	1,288	-6.57	<.0001
Income - $10,000-$19,999 (referent <$10,000)	-.05	.18	12,000	-.26	.80
Income - $20,000-$34,999 (referent <$10,000)	.77	.18	13,000	4.21	<.0001
Income - $35,000-$49,999 (referent <$10,000)	1.92	.20	14,000	9.75	<.0001
Income - $50,000-$74,999 (referent <$10,000)	3.23	.21	15,000	15.63	<.0001
Income - $75,000+ (referent <$10,000)	5.62	.21	15,000	26.61	<.0001
Self-Rated Health[1]	-.93	.04	938	-26.12	<.0001
County Level					
Population Density	<.001	<.001	894	.78	.44
Percent 60+	.24	.01	1,421	17.30	<.0001
Median Income	<.001	<.001	1,785	22.57	<.0001
Poverty Percent	-.03	.02	2,544	-1.09	.28

Percent Racial/Ethnic Minority	.03	<.001	1,877	8.09	<.0001
Interaction Terms[2]					
Race/Ethnicity-AIAN x population density	<.001	<.001	67,999	-.44	.66
Race/Ethnicity-API x population density	<.001	<.001	6,445	-.65	.51
Race/Ethnicity-Black x population density	<.001	<.001	394	.55	.58
Race/Ethnicity-Hispanic x population density	<.001	<.001	691	-.91	.36
Race/Ethnicity-AIAN x Percent 60+	-.04	.10	52,000	-.41	.68
Race/Ethnicity-API x Percent 60+	.05	.11	9.428	.42	.67
Race/Ethnicity-Black x Percent 60+	-.20	.05	3,941	-4.15	<.0001
Race/Ethnicity-Hispanic x Percent 60+	-.16	.05	6,290	-3.11	<.01
Race/Ethnicity-AIAN x Median Income	<`.001	<.001	51,000	-1.25	.21
Race/Ethnicity-API x Median Income	< .001	<.001	6,239	-1.69	.09
Race/Ethnicity-Black x Median Income	< .001	<.001	2,582	-4.24	<.0001
Race/Ethnicity–Hispanic x Median Income	< .001	<.001	3,619	-1.83	.07
Race/Ethnicity-AIAN x Percent Minority	.02	.03	38,000	.66	.51
Race/Ethnicity-API x Percent Minority	< .001	.02	811	.02	.99
Race/Ethnicity-Black x Percent Minority	-.04	.02	2,313	-2.85	<.01
Race/Ethnicity-Hispanic x Percent Minority	-.03	.01	2,622	-2.47	.01
Race/Ethnicity-AIAN x Poverty Percent	-.19	.16	35,000	-1.16	.25
Race/Ethnicity-API x Poverty Percent	.05	.18	6,015	.27	.79
Race/Ethnicity-Black x Poverty Percent	-.02	.06	2,867	-.38	.71
Race/Ethnicity-Hispanic x Poverty Percent	.02	.08	3,276	.26	.80
Covariance Parameter Estimates for Random Slopes					
Age	<.001	<.001	-	(.01)	.67
Sex	.16	.10	-	(1.53)	.06
Race/Ethnicity	1.03	.26	-	(4.02)	<.0001

Marital Status	.24	.10	-	(2.41)	<.01
Education	.43	.12	-	(3.53)	<.001
Employment Status	.17	.11	-	(1.56)	.06
Income	.72	.13	-	(5.37)	<.001
Self-Rated Health	.15	.04	-	(3.33)	<.001
Covariance Parameter Estimates for Random Effects					
Intercept (between county variance)	.84	.30	-	(2.84)	<.01
Residual (within county variance)	164.70	.64	-	(256.07)	<.0001

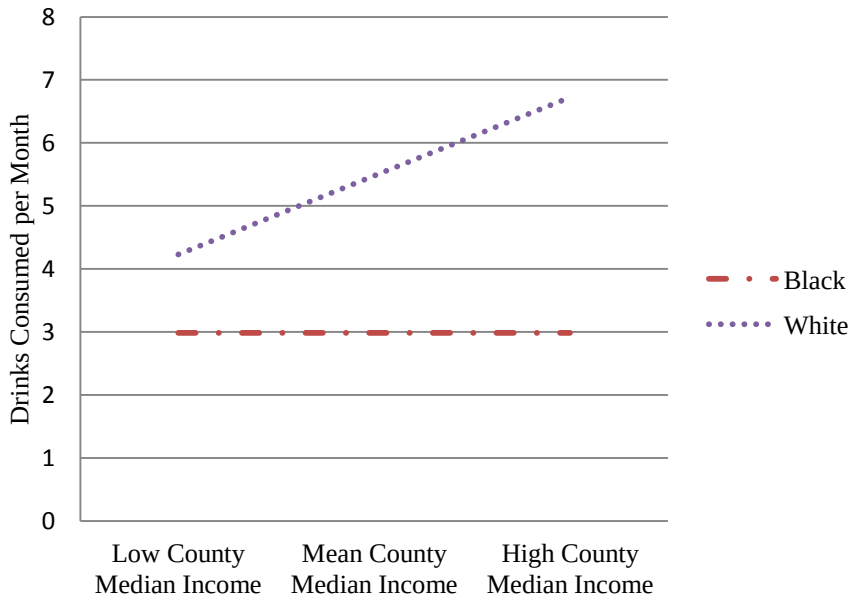
NOTES: AIAN=American Indian/Alaska Native, API=Asian/Pacific Islander; [1]the coding of the self-rated health variable (1=excellent health & 5=poor health) must be considered when interpreting estimate; [2] Whites were used as the reference group for all interaction terms, HS refers to High School

Figure 4. Race/Ethnicity by County Percentage of Adults 60 and Older Interaction



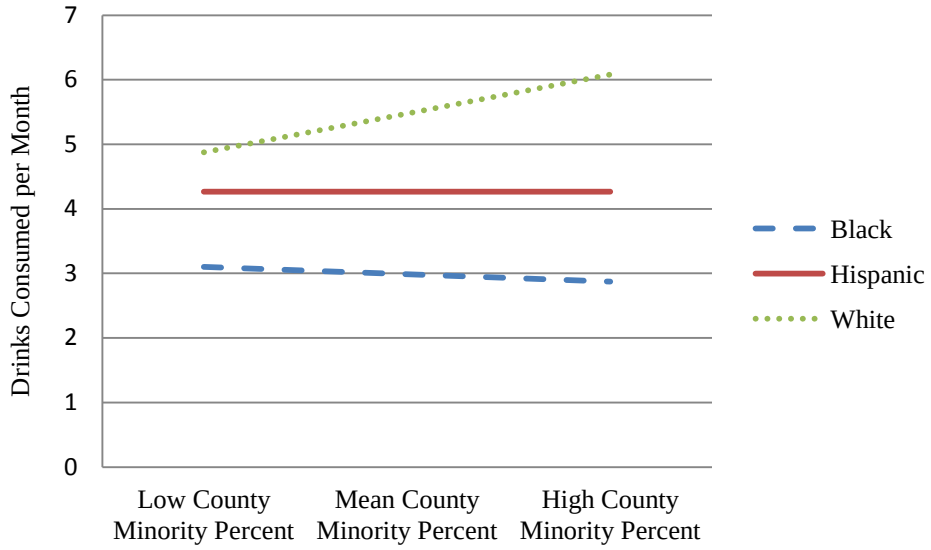
NOTES: Low and high county percentages were based on +/- 1 SD from the mean

Figure 5. Race/Ethnicity by County Median Income Interaction



NOTES: Low and high county percentages were based on +/- 1 SD from the mean

Figure 6. Race/Ethnicity by County Racial/Ethnic Minority Percentage Interaction



NOTES: Low and high county percentages were based on +/- 1 SD from the mean

Results: Specific Aim 1 – Geographic Location & Race/Ethnicity

Specific aim one of this dissertation was to determine if regional differences exist in alcohol consumption among older adults. It was hypothesized that regional differences would be found. More specifically it was hypothesized that the greatest alcohol consumption would be found in the Midwest while the least would be found in the South. Additionally, it was hypothesized that racial/ethnic differences would be found.

As displayed in Table 7, evidence was found for the existence of geographic differences in alcohol consumption among older adults [$F(3,185190)=16.32$, $p<.001$]. However, the results did not perfectly match the hypothesis. Regional differences were only found in preliminary analyses when the majority of individual level variables and county level differences were not taken into account. Interestingly, the regional pattern found in these results was not as expected. As hypothesized, the least alcohol consumption among older adults was found in the South. However, the results of the preliminary ANCOVA indicated that the greatest alcohol consumption existed in the West, followed by the Northeast, and only then the Midwest. This suggests that a different regional pattern of alcohol consumption may exist in older adults as compared to younger adults.

Once county level differences were examined in addition to regional differences the effect of region became very small and non significant. Therefore, it can be concluded that while geographic differences do exist, these differences are better accounted for by county variation than by regional variation.

As hypothesized, significant racial/ethnic differences were found in alcohol consumption among older adults [$F(3,185190)=206.06$, $p<.001$]. Additionally, it was found that the pattern of

racial/ethnic differences varied by region of residence as described previously [F(12,185170)=16.32, p<.001]. These findings are displayed in Table 7.

Results: Specific Aim 2 – Population Density

In regards to the examination of the effect of population density on alcohol consumption among older adults, it was hypothesized that there would be a significant effect for population density such that less alcohol consumption would be found in areas with lower population density. However, as displayed in Table 11, the effect of population density was found to be non significant (B<.001, p=.44).

Results: Specific Aim 3 – Racial/Ethnic Composition

Specific aim three was to examine the effect of racial/ethnic composition as measured county by minority percent on alcohol consumption among older adults. It was hypothesized that individuals living in locations with a higher county-level minority percent would have greater alcohol consumption. It was also hypothesized that racial/ethnic differences would be found for this effect. Specifically, it was hypothesized that AIANs, APIs, Blacks, and Whites would consume more alcohol when living in areas with high county minority percent while the opposite would be found for Hispanics. It was also expected that the strongest effect would be found among Whites.

The results largely supported the hypotheses for the effect of county racial/ethnic minority percent, as can be seen in Table 11. The main effect indicated that higher county minority percent was related to greater monthly alcohol consumption among older adults (B=.03, p<.001). The interaction of race/ethnicity by county minority percent did indicate that the strongest positive effect was found among the White sample as predicted. A negative effect was found among the Hispanic sample, however, the effect was only very slightly negative (B=-.03,

p<01). Unexpectedly, a negative relation between county minority percent and Blacks was found (B=-.04, *p*<.001).

Results: Specific Aim 4 – Poverty

Specific aim four was to examine the effect of poverty on alcohol consumption among older adults. It was hypothesized that lower county median household income as well as higher county poverty percent would be related to greater alcohol consumption.

As displayed in Table 11, the results regarding the effect of poverty do not support the hypotheses made. First, the effect of county poverty percent was found to be non significant (B=-.03, *p*=.28). Second, while the effect of county median income was found to be significant, the relation was positive, not negative as predicted (B<.001, *p*<.001).

Results: Specific Aim 5 – Age Composition

Specific aim five of this dissertation was to examine the effect of county age composition as indicated by county percent 60 and older on alcohol consumption among older adults. The expected results regarding this effect were considered from multiple theoretical perspectives and it was suggested that an argument could be made for finding either a positive or negative effect. However, ultimately it was hypothesized that county percent of older adults would be negatively related to alcohol consumption among older adults.

Again, the results did not support the hypothesis. While a significant effect was found for county older adult percent, the effect was found to be positive, not negative as predicted (B=.24, *p*<.001). This finding is displayed in Table 11.

DISCUSSION

Summary

The purpose of this study was to examine the role of race/ethnicity, geographic location, and geographic characteristics in the alcohol consumption of older adults in the United States. This study was conducted on a nation-wide racially/ethnically diverse sample of adults 60 and older. This study sought to fill gaps in the literature as there is little research available examining the role of geography and geographic characteristics in alcohol consumption among this age group.

One of the main goals of this dissertation was to examine the role of individual-level race/ethnicity in the alcohol consumption of older adults. Findings suggest that White older adults are likely to consume significantly more alcohol on a monthly basis than members of other racial/ethnic groups. The strongest negative effect for race/ethnicity on monthly alcohol consumption was found for APIs. These findings are consistent with previous research indicating that among both adults in general and older adults, Whites are likely to consume the most alcohol of any racial/ethnic group while Asians are likely to consume the least (Blazer & Wu, 2009; Bryant & Kim, 2012; Chartier & Caetano, 2010; SAMHSA, 2007).

The significant race/ethnicity by region interaction found in preliminary analyses was intriguing. For instance, it was found that among older adult AIANs and Whites, the greatest alcohol consumption was in the Northeast. Conversely, among older adult APIs, Blacks, and Hispanics, the greatest alcohol consumption was found in the West. This suggests that there may be individual race/ethnicity by regional characteristics interactions that account for these

differences. However, an examination of regional characteristics was not proposed to be examined in this study. Additionally, given that the main effect for region became non-significant after inclusion of county level variation, an examination of regional level characteristics was not warranted. A region specific focused project may be useful to address these differences.

Another main goal of this dissertation was to examine the effect of geographic location, in terms of both regional and county level effects. Regional differences were found when individual level variables (with the exception of race/ethnicity), county level variables, and between county variation were not taken into account. This finding from the preliminary analyses does warrant discussion as the regional pattern of alcohol consumption found was not what was expected. Given the results of previous research examining regional patterns in alcohol consumption in a sample of adults 18 and older, it was expected that the greatest alcohol consumption would be found in the Midwest while the least would be found in the South (Borders & Booth, 2007; Dawson et al., 1995). The least alcohol consumption was found in the South as expected given cultural factors such as conservative religiosity (Borders & Booth, 2007). However, the greatest alcohol consumption was found in the West, closely followed by the Northeast. This finding suggests that the regional pattern of alcohol consumption may vary among older adults as compared to adults of a younger age. One possible explanation for this finding is that individuals who consumed alcohol in large quantities throughout adulthood may be more likely to die at a younger age (IAS, 2014; Moore et al., 2006; Plunk et al., 2014; Waern, 2003). Specifically, research indicates that heavy alcohol use from early adulthood may shorten the lifespan by 10 to 15 years (IAS, 2013). This could lead to a reduction of heavy alcohol consumers and thus possibly alter the regional pattern of alcohol use between older adulthood

and earlier adulthood. While the results of these regional differences are interesting, it should be noted that these findings did lose significance after county level variation was accounted for.

The effect of county remained significant even after individual level, county level, and individual x county level interactions were controlled for. This suggests that county level variation in alcohol consumption among older adults does exist. However, it should be noted that the ICC calculations from the unconditional means model suggested that only 4% of the variance in alcohol consumption occurred between counties, while 96% occurred within. This suggests that while county differences do exist, within county variation warrants further examination. As counties can often be large and contain diverse settings, examination of lower levels of geography such as zip code or census tract may provided further insight into this within county variation.

Examination of the influence of geographic characteristics on the alcohol consumption of older adults was another goal of this project. While it had been expected that less alcohol consumption would be found in rural areas as indicated by lower population density, the effect of population density was not significant. While previous research has demonstrated population density as a useful rurality proxy (Breeze et al., 2005), it is possible that in the present study the use of this proxy did not accurately represent the difference in urban versus rural areas. It is also possible that the use of county as the geographic unit may have disallowed for a significant finding given the possible variation of rural versus urban areas within a single county. Future studies may wish to use a more precise measure of rurality and to use more precise geographic units to further probe the role of rurality in older adult alcohol consumption.

County percent of racial/ethnic minorities was another geographic characteristic examined. The strongest positive effect was found among the White sample as predicted. This

was expected given the possibility of increased social stress via difficulties developing and maintaining strong socials support network when living in an area with many dissimilar individuals (Coffe, 2009; Kwag et al., 2011; Rios, Aiken, & Zautra, 2012; Wickrama & Bryant, 2003). A negative effect was found among the Hispanic sample, as predicted given the barrio effect (Eschbach et al., 2004; Ostir et al., 2003). However, it should be noted that the effect was weak and was only very slightly negative. One possible explanation is that social drinking within Hispanic communities may attenuate the protective barrio effect. Unexpectedly, a negative relation between county minority percent and Blacks was found. This result has not been found in previous research (Kubzansky et al., 2005; Yen et al., 2009). However, this result may be viewed from the social stress model. This would suggest that older adult Blacks living in areas with higher minority percentages may be better able to form and maintain adequate social support systems given the presence of similar indviduals. Therefore, they may be less likely to turn to alcohol as a coping mechanism, given the presence of larger numbers of minorities.

The effect of county level economic status was also examined. This was examined via county percent in poverty and county median household income. It was expected that lower county economic status as indicated by more poverty and/or lower median income would be related to greater alcohol consumption given the social stress model. However, the results did not support this hypothesis. The effect of county poverty percent was found to be non-significant. Again, this could be due the geographic units used as poverty tends to be concentrated within specific neighborhoods within a given county (Lichter, Parisi, Taquino, & Beaulieu, 2008). The effect of county median income was found to be significant but the effect was opposite of what was expected. However, an examination of research pertaining to individual level economic status and alcohol consumption of older adults helps to explain this finding. Previous research

has consistently found that individual with higher incomes are more likely to consume alcohol possibly due to the ability to afford alcohol and the increased frequency of social situations in which alcohol is used (Cerda, Johnson-Lawrence, & Galea, 2012; Heine, 1996; Bryant & Kim, 2012). Therefore, this finding may reflect similar mechanisms such as more social events at which alcohol is a regular fixture. It should be noted that this study did not differentiate between alcohol abuse and alcohol use. Given previous research it is likely that while alcohol use was found to be more common in higher income areas, if alcohol abuse was examined it may have been found to be more common in lower income areas (Cerda et al., 2010).

A significant race/ethnicity by county median income interaction was found. There was a positive relation found between median county income and drinks consumed per month among Whites. The effect was found to be virtually neutral for county median income among Blacks, which was significantly different than the effect found in the White sample. It is unclear what may account for these unexpected findings in regards to the effect of median county income among the Black sample. It is possible that the more conservative attitudes on alcohol consumption held by Blacks may contribute to this difference (Keefe & Newcomb, 1996). More research is needed to clarify the specific mechanisms of this finding.

County age composition as examined by the percent of the county 60 and older was the final geographic characteristic examined. The strongest geographic characteristic effect was found for county age composition. The effect was positive, indicating that higher county percentages of older adults were related to more monthly alcohol consumption among older adults. This finding was opposite of what was expected. However, as discussed in the aims and hypothesis section, it was difficult to predict the direction of this relation as it could be viewed from multiple theoretical perspectives. The results are in line with the ecological perspective as

opposed to the social stress model. One possible explanation for this finding is that the presence of more older adults in a given older adult's geographic area may increase opportunities for social alcohol consumption via increased social opportunities. This is consistent with previous research which has found that greater alcohol consumption among older adults is associated with greater social activity and socialization (Adams, 1996; Alexander & Duff, 1988; Castle et al., 2012). Additionally, it has been suggested that social alcohol use may be part of the integration process into the leisurely lifestyle of retirement which is often found in older age (Alexander & Duff, 1988). It is noteworthy that age composition had the strongest effect of the geographic characteristics examined. This suggests that the presence of greater numbers of older adults is more influential on monthly alcohol consumption among this age group than the economic status, racial/ethnic composition, or population density of a county. One possible explanation for this is that social alcohol use among groups of older adults may be a part of the leisurely lifestyle of retired older adults regardless of other county characteristics.

A significant interaction for race/ethnicity by county percentage of older adults was also found for Blacks and Hispanics as compared to the White reference group. The direction of the relation between county percentage of older adults and alcohol consumption was positive for these racial/ethnic groups, and the effect was simply significantly weaker as compared to the White sample. This suggests that the county percentage of older adults does not have as strong of an effect of the alcohol consumption patterns of Blacks and Hispanics and compared to Whites. Given that the main effect may possibly be interpreted through the role of social drinking, this finding is consistent with the social alcohol norms of these racial/ethnic minority groups (Caetano & Clark, 1999). More specifically, previous research has revealed that Whites have more liberal attitudes towards alcohol use than both Blacks and Hispanics (Caetano & Clark,

1999). Therefore, alcohol use may not be as commonly a part of social functions and interactions that are representative of the leisurely life style as previously discussed. This difference could potentially explain why these minorities groups may be less impacted by an increased percentage of older adults in their counties.

Theoretical Interpretation of Results

In regards to theoretical framework, hypotheses for this dissertation were made using both the social stress model and the ecological perspective. With the exception of the effect found for county minority percent, the results largely did not support the social stress model. However, results did tend to support the more broad ecological perspective. There are possible explanations for this. First, the social stress model is a more specific theory than the ecological perspective as it purports to explain the way in which variables associated with social stress (such as higher poverty) will impact health behaviors such as drinking (increasing drinking). The ecological perspective does not attempt to address the way in which health behaviors will be impacted by geographic characteristics, but simply states that they will be impacted. Given the less specific nature of the ecological perspective, it makes sense that it would be easier to find evidence in support of this. Additionally, it is possible that older adults may be less likely to use alcohol as a means to cope with social stress than other age groups. Therefore, the experience of social stress as a result of environmental characteristics may not necessarily translate into greater alcohol consumption among this age group.

Implications

Identifying geographic variations in alcohol consumption and variations in alcohol consumption by county level geographic characteristics among racially/ethnically diverse older adults is significant for numerous reasons. First, these findings will help to develop a better

understanding of how alcohol is being used within this age group. This is significant as alcohol use among older adults is a topic that often does not acquire much attention in the research or in society as a whole, although, it warrants such attention. Having a better understanding of how and where alcohol is used is an important first step for identifying potential alcohol related problems and benefits on both an individual and community wide level.

Second, findings may be used to guide alcohol related policy. Findings regarding geographic location and characteristics related to greater consumption may be useful for pinpointing areas with the greatest need for alcohol related education aimed at older adults. Identification of areas with the greatest need for such programs may help in allocation of funds for relevant programs. For example, findings may suggest the need for alcohol related education to be available at senior centers and older adult education centers, especially in locations with higher alcohol consumption and in locations with characteristics associated with higher alcohol consumption, to include regular education on alcohol use and health.

Specific findings may have more narrow implications for policy. For example, the finding that county percentage of older adults is significantly related to increased alcohol consumption among older adults may have policy implications. Recent research supports the finding that alcohol use is more common in environments with a high concentration of older adults (Castle et al., 2010). More specifically, the same study found that alcohol use is more common in assisted living facilities, which have a high concentration of older adults, than the community (Castle et al., 2012). Additionally, it was found that untreated alcohol problems may be relatively common in assisted living facilities (Castle et al., 2012). Taken together, findings from the present study and this recent study suggest that higher concentrations of older adults in a community or environment may in fact be related to the more common occurrence of alcohol

use disorders. While more research is needed before policy related decisions would be founded, preliminary interpretations suggest that the adoption of preventive education and possibly alcohol use policies that discourage alcohol abuse may be useful in these high older adult concentration facilities or environments.

Additionally, findings identify specific risk factors for increased alcohol use such as White race/ethnicity, high county percentage of older adults, high county economic status, and high county percentage of racial/ethnic minorities. This has implications for both identification of communities in which in which preemptive alcohol related education may be important as described above, as well as for individuals in need of intervention. Understanding geographic location, geographic characteristics, and individual level characteristics that are related to greater alcohol consumption among older adults may aid clinicians in efforts to identify older adults with a need for more thorough alcohol use screening and possible intervention. Research has found that one-time, brief interventions of 15 minutes or less can reduce nondependent problem alcohol consumption by more than 20% among older adults (SAMHSA, 2005; Sorocco & Ferrell, 2006). Thus, increasing awareness and visibility of potential alcohol use problems among the public and among clinicians is crucial.

Furthermore, findings add to the growing body of research which highlights the significance of geography in health and health behaviors. Better developing an understanding of the role of geography and geographic factors grants new insight and perspectives into physical and mental health and possible interventions.

Lastly, findings from this project help to extend our understanding of how alcohol is being used among older adults and should help lay the foundation for future research examining more specific elements of alcohol use in this age group. This is something that is difficult to do

at the moment given the lack of a more broad understanding of the role of geography in alcohol use among older adults in the research community. Unexpected findings, such as greater alcohol consumption in counties with higher household median incomes and less alcohol consumption among Blacks living in communities with greater racial/ethnic minority percent warrant further examination. These unexpected findings suggest the presence of intricacies which may previously have been overlooked.

Limitations

It should be noted that this study relied on secondary data and therefore, was limited by the available variables. This study attempted to lay the groundwork for a better understanding of the role of race/ethnicity, geographic characteristics, and geographic location in older adult alcohol consumption. However, there are many related topics that warrant examination (i.e. mobility or direct measures of social support) in regards to alcohol use among older adults that were either not possible given available data or not within the scope of this paper. Given that only 4% of within county variance was explained by the variables in this study, future research may seek to find variables that account for a larger amount of within county variance. This may be accomplished by taking a more narrow approach to closely examine additional topics might be important factors in older adult alcohol consumption.

It should also be noted that while this study sought to examine alcohol consumption among older adults, there was no younger adult control group as the purpose of this paper was not between age group comparisons. The sample of this dissertation was restricted to older adults in order to ensure that the findings are in fact based on the alcohol consumption patterns of older adults. This is necessary as alcohol related literature often examines younger adults but excludes the elderly (IOM, 2012). However, future research may want to examine age group comparisons

to determine if differences do in fact exist. Especially, given the unexpected regional pattern of alcohol consumption found in the sample.

Furthermore, it should be noted that the use of county level geographic data does have certain limitations. As the size and diversity of counties does vary it may be difficult to generalize county level statistics to the individual experience of participants. However, county level analysis still provided a good deal of information in the absence of available zip code level data. Initially this study intended to examine geographic characteristics at the zip code level. However, while BRFSS states that it provides zip code data, it in fact does not for the national level. Zip code data must be obtained from individual state health departments through a cumbersome application process which may or may not be successful by individual state. Additionally, BRFSS has adequate sample sizes by county for meaningful analysis but not by zip code (i.e. the sample sizes by individual zip code are too small in many locations). Thus, county level geographic characteristics were used as this data was available and had adequate sample sizes.

Lastly, it should be noted that racial/ethnic subgroup differences were not accounted for. Previous research has found that certain racial/ethnic groups, such as the Asian and Hispanic groups, have a large amount of within group heterogeneity (Borrell, 2005; Kim, Chiriboga, Jang et al., 2010). Therefore, it is quite possible that significant subgroup differences in alcohol consumption and the role of geography and geographic characteristics in this consumption may exist.

Future Directions

This dissertation raises many possibilities for future research. Given that only 4% of within county variance was explained by the variables in this study, future research may seek to

find variables that account for a larger amount of within county variance. This may be accomplished by taking a more narrow approach to closely examine additional topics that are important factors in older adult alcohol consumption.

Additionally, future research may utilize smaller geographic units for analysis (i.e. zip codes or census tracts). This may provide additional insights into the significance of geographic locations and characteristics. Future research also may wish to focus on specific geographic areas or states with unique consumption patterns, such as very high or very low consumption, to identify characteristics associated with unique consumption patterns. For instance, given the results of this dissertation, the states of Rhode Island, Tennessee, and the District of Columbia may provide interesting information on the role of geography for alcohol consumption among older adults if examined in depth.

Given the lack of a younger adult comparison group in this study, future research may want to examine age group comparisons to determine if significant differences do in fact exist in geographic consumption patterns. This is especially intriguing given the unexpected regional pattern of alcohol consumption found in the sample.

Future research may also wish to examine subgroup racial/ethnic differences. It is quite possible that an examination of within racial/ethnic group variation among older adults would provide novel and interesting findings.

Additionally, the present study did not examine outcomes which may be related to alcohol consumption patterns such as mental or physical health variables. Future research may need to directly examine relevant outcome variables to determine the influence of geographic consumption patterns such as average quality of life or average psychological distress.

Conclusions

The present study found that alcohol consumption among older adults varies by geographic location. More specifically, county level variance was found to better account for geographic variation than regional variance. However, the findings do suggest that examination of the role of geographic location using geographic units more precise than county would be useful in furthering the understanding of the importance of geography in older adult alcohol consumption. In regards to county level characteristics, it was found that higher county percentages of older adults, higher county median income, and higher percentages of racial/ethnic minorities were related to greater alcohol consumption among older adults. Significant individual level race/ethnicity by county level characteristic interactions were found for all three of these significant geographic characteristics indicating that race/ethnicity is an important factor in the role that geography has on alcohol consumption. Findings have significant policy implications and lay the groundwork for future research examining the role of geography in alcohol use among this age group. Additionally, findings specify both individual-level and county-level factors that may aid clinicians in effective screening for alcohol use among older adults.

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