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Investigating Differences in Risk Behaviors Among Rural, Suburban, and Urban Adolescents

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by

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ABSTRACT

Introduction: According to the World Health Organization, one-third of the disease morbidity and two-thirds of premature deaths among adults are associated with behaviors that can be traced back to adolescence. These include behaviors resulting in unintentional injury, violent behaviors, alcohol, drug, and tobacco use. The purpose of this research was to explore how differing levels of urbanicity affect youth's engagement in risk behaviors.

Methods: Analysis was done using a nationally representative sample of 9^{th}-12^{th} graders in the 2003 Youth Risk Behavior Survey (YRBS), the most recent year for which urbanicity is available. The main exposure was urbanicity (classified as urban, suburban, or rural based on location of school the student attended at the time of the survey). Logistic regression was used to measure the main exposure for all risk behaviors. Race/ethnicity, sex, age and geographic region of the country were assessed as potential confounders and/or effect modifiers.

Results: Youth in rural and suburban settings engaged in risk behaviors differently than youth in urban settings. For instance, rural males had twice the odds of urban males for carrying a weapon and suburban males had twice the odds of urban males for not wearing a seatbelt. The association between urbanicity and risk behaviors was often modified by sex and geographic region. Effect modification by sex was important for the least prevalent risk behaviors: weapon carrying and seatbelt use. Males were generally more likely to report both carrying a weapon and not wearing a seatbelt than females were.

Effect modification by geographic region was important for seatbelt use, suicide contemplation and drug use. Where regional interaction was detected, suburban adolescents' risk behaviors were less impacted by geographic region than rural or urban adolescents. The exception was marijuana use, where suburban youth did experience differences in reporting based on region. Highly prevalent behaviors (like alcohol and tobacco use) were experienced more universally regardless of sex, geography or level of urbanicity.

Conclusions: Given the differences in youth risk behaviors across geography, efforts to reduce risk behaviors may be more effective when tailored to urbanicity, sex and geographic region of the country.

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β	Beta

List of Abbreviations

CI.....Confidence Interval

OR ..... Odds Ratio

PR..... Prevalence Ratio

YRBS .....Youth Risk Behavioral System

CHAPTER 1

INTRODUCTION

1.1 Statement of the problem

Adolescence is the developmental period during which many youth begin to engage in risk-taking behaviors. These high-risk behaviors include those which contribute to unintentional injuries, violence, alcohol and other drug use, and tobacco use (CDC 2013e). Such behaviors often persist into adulthood and can lead to increased morbidity and mortality (Atav and Spencer, 2002). However, the initiation of such risk behaviors is preventable (Eaton DK and R, 2010).

According to the World Health Organization (WHO), approximately two-thirds of premature deaths among adults are associated with behaviors that were initiated in adolescence. Furthermore, one-third of the disease morbidity in adults is associated with behaviors that started before adulthood, including tobacco use, risky sexual behaviors, inadequate physical activity, and violence (WHO, 2011). Tobacco and alcohol abuse, along with diet and physical inactivity, are among the top ten leading causes of "actual death" in the United States (Mokdad, Marks, Stroup, and Gerberding, 2004).

Examination of data from the most recent Youth Risk Behavioral Surveillance system (YRBS) reveals the frequency of activities in the United States (US) for four important behavior categories: behaviors contributing to unintentional injuries, violence, alcohol and other drug use, and tobacco use.

In the 2012 survey, more than two-thirds of students reported consuming alcohol, with 21% of these students reporting binge drinking in the 30 days prior to the survey. In addition, 44% of US youth reported ever smoking. Furthermore, in the month prior to taking the survey, 24% of students had ridden in a vehicle being driven by someone who had been drinking alcohol. In addition, 17% of students had carried a weapon at least once in that same 30-day period. Among those who reported having sexual intercourse in the previous three months, 22% also reported the use of alcohol or drugs prior to their last sexual encounter (CDC, 2013e). Despite the potential for the lasting impact of behaviors adopted in adolescence, rates of risk-taking behaviors remain high among adolescents and young adults.

Healthy People 2020 recognizes the importance of reducing youth risk behaviors. The mission of Healthy People 2020 includes identifying nationwide health improvement priorities and providing measureable objectives and goals. It has several measures focused on youth risk behaviors. There are multiple objectives centered on reductions in youth drinking and substance abuse, as well as increasing the proportion of youth reporting "never using substances." Other objectives touch upon unintentional injury, by reducing the proportion of adolescents who report riding in a vehicle with someone who has been drinking alcohol (US Department of Health and Human Services, 2013).

To reduce uptake in youth risk behaviors it is important to understand the problem as a whole. Measures should include research focusing on factors that influence risk behavior, including the impact that social and physical environments have on engagement in risk behavior. For instance, rural areas have cultural, environmental and community characteristics that are unique. Many rural areas are shaped by agricultural, mining or

forestry industries, and residents of rural areas in the US have a lower average income than their urban counterparts (Hartley, 2004). A 2001 study found that while less than a quarter of the population lives in rural areas, 31% of those receiving assistance from the Federal Supplemental Nutrition Assistance Program (SNAP) lived in rural areas (National Rural Health Association, 2010). In addition to environmental influences, isolation can have major impacts on rural American's health (National Rural Health Association, 2010). Rural counties also often have fewer health care providers relative to population size, and residents of such counties tend to travel farther to access health care resources (Eberhardt MS, Ingram DD, Makuc DM, et al. 2001). The rural U.S. has more than twice the number of health professional shortage areas than urban areas (National Rural Health Association, 2010). Rural health is shaped by factors such as poverty, the economy, food insecurity, isolation and access to care.

While more urban areas may facilitate risk behaviors by increasing access to tobacco and alcohol, they may also provide an environment for prevention efforts to be implemented more rapidly than in rural areas (Gutierrez, 2010). Urban areas are more likely to receive federal funding for substance abuse programs, which makes it easier for those in urban areas to seek and undergo treatment (Hutchison and Blakely, 2003). On the other hand, urban social environments are more likely to have disparities in socioeconomic status, and to experience higher rates of crime (National Center for Victims of Crime, 2012). Therefore, urban environments have both elements that may be protective as well as elements that may increase the likelihood of risky behaviors.

Less is known about how the suburban environment shapes health. The Wall Street Journal reports that, based on county health rankings from the University of Wisconsin's

Population Health Institute, suburban counties are healthier than urban or rural ones. They report fewer low birth weight babies, fewer homicides and less sexually transmitted infections when compared to rural or urban communities (Beck, 2011). Often, suburban residents are grouped with urban residents for analysis. This may be because many believe that the behaviors and health outcomes that are common in urban areas spread to suburban areas over time. For instance, Galea, Freudenberg and Vlahov report that heroin addiction and HIV infection spread from the urban areas to the suburbs in the 1970s and 1980s before spreading to the rest of the country, and that many health behaviors (such as exercise trends) also spread from urban areas in a similar manner (Galea, Freudenberg, and Vlahov, 2005).

Despite these known challenges and overarching differences by urbanicity, little research has been conducted on how these differences affect youth's engagement in risk behaviors. When urbanicity has been considered, the assumption in research has traditionally been that urban areas have attributes that create the ideal society for risk behaviors (Looker and Naylor, 2009), while the rural environment is perceived as lacking the necessary stressors to foster risk-taking behaviors (Atav and Spencer, 2002). The assumption that rural youth engage in fewer risk behaviors than urban youth may be misleading (Stewart Fahs et al., 1999), and has led to a lack of research on the influence of rural environments. Studies of youth risk-taking are often limited to examining urban at-risk youth, leaving gaps in our understanding of suburban and rural youth (Levine and Coupey, 2003); (Atav and Spencer, 2002). This study explores how differing levels of urbanicity affect youth risk behaviors using a nationally representative sample of

adolescents in the 2003 Youth Risk Behavior Survey (YRBS), the most recent year for which urbanicity is available.

1.2 Aims and Hypotheses:

Based on the literature, several hypotheses were developed in regard to how adolescents from different levels of urbanicity engage in risk behavior categories (unintentional injury, violent behaviors, alcohol and other drug use and tobacco use). Unintentional injury was measured in aim one by report of seatbelt use. Violent behaviors were measured in aim two by suicide contemplation and report of carrying a weapon. Alcohol and other drug use were measured in aim three by report of past 30 day alcohol use and report of past 30 day marijuana use. Lastly, tobacco use was measured by report of ever using tobacco in aim four. The aims and hypotheses were as follows:

Aim 1: To assess the differences in report of seatbelt use among adolescents by level of urbanicity.

Hypothesis 1: Rural adolescents would be less likely to wear seatbelts than urban adolescents, and suburban adolescents would be more likely to wear their seatbelts than urban adolescents.

Aim 2: To assess the differences in report of violent behaviors among adolescents by level of urbanicity.

Hypothesis 2: Rural adolescents would be more likely to have seriously considered attempting suicide than their urban counterparts, while suburban adolescents would be less likely to have considered suicide than their urban counterparts.

Hypothesis 3: There would be no difference between rural and urban adolescents reporting carrying a gun in the previous 30 days; suburban adolescents would be less likely to report carrying a gun than their urban counterparts.

Aim 3: To Assess the differences in report of alcohol and drug consumption among adolescents by level of urbanicity.

Hypothesis 4: Rural youth would report consumption of alcohol more frequently than urban adolescents, and suburban adolescents would report consumption of alcohol less than urban adolescents.

Hypothesis 5: Both rural and suburban adolescents would be less likely to report marijuana use than urban youth.

Aim 4: To assess the differences in report of tobacco use among adolescents by level of urbanicity.

Hypothesis 6: Rural and suburban adolescents would be more likely report tobacco use than their urban counterparts.

CHAPTER 2

LITERATURE REVIEW

2.1 Literature Review

A literature search on risk behaviors among adolescents was conducted during the fall of 2013 using Pubmed, Google Scholar, and several EBSCO databases including, ERIC, PsychInfo, Medline, and CINAHL.

The search was conducted in several steps. First, articles considering differences in risk behaviors by urbanicity were sought. Key search terms such as “risk”, “risk taking”, “rural population”, “rural health”, “urbanization”, “youth”, “adolescent”, “adolescence”, “health behavior”, “urban population” and “suburban population” were used. The search focused on differences in urbanicity for specific behaviors and health outcomes, based on the risk categories this paper focuses on (unintentional injuries, violence, alcohol and drug use, and tobacco use). Due to limited research focusing on differences by urbanicity, this also included three individual searches, one limited to urban populations, one limited to literature on suburban populations and one limited to rural populations. In addition, a search was performed for existing information on national trends in youth risk behaviors without regard to urbanicity. Some articles were identified as references in other useful works. In this way, a full picture of existing knowledge about the research question was achieved.

2.2 Unintentional Injuries

National trends and health effects of unintentional injury

The leading cause of death among adolescents 14-18 years of age is unintentional injury, including injury related to motor vehicle crashes, falls, and sports (Olsen et al., 2011). From 1999 to 2006, 136,665 unintentional injury deaths occurred in the US pediatric and adolescent population (Nance et al., 2010). When compared to other countries, only Russia, Ukraine, Estonia and Greece ranked higher than the US in youth mortality for unintentional injuries (Singh et al., 2012).

The economic burden of such high rates of unintentional injury is great. In 2005, it was estimated that the total cost of lifetime medical treatment and lost productivity due to deaths resulting from unintentional injury and violence was 10.3 billion US dollars. Furthermore, the total cost for morbidity related to unintentional injury and violence was estimated at 19.6 billion USD (Olsen et al., 2011). A Canadian study of injury in young adults similarly estimated the economic cost and determined that the burden was second only to the cost of cardiovascular disease (Picket et al., 2012).

To address this burden, Healthy People 2010 initially set objectives for unintentional injury relating to young adults. These objectives included: reducing deaths caused by motor vehicle crashes, increasing seatbelt use, and reducing the proportion of adolescents who reported riding with someone who had been drinking alcohol (US Department of Health and Human Services, 2013). Prevalence measurements were monitored to evaluate efforts to improve the health of the nation. These goals were carried forward in Healthy People 2020 and continue to remain a national priority (US Department of Health and Human Services, 2013; Jiang et al., 2011). Although youth

behaviors improved from 2000-2010, few 2010 objectives reached the target goals (Jiang et al., 2011). For instance, several objectives addressed adolescents and motor vehicles, including those aimed at reducing motor vehicle crash mortalities, alcohol-related motor vehicle mortalities, riding with a driver who had been drinking alcohol, and seatbelt use (US Department of Health and Human Service, 2013; Jiang et Al., 2011; Olsen et Al., 2011). From baseline (1991) to 2009, improvement was made in all of the above categories except motor vehicle crash mortalities, which was unchanged (Jiang et al., 2011). The 1999 prevalence of riding with someone who had been drinking alcohol was reported to be 33%; a decade later the prevalence had decreased by approximately 5% and the objective surpassed its target reduction of 30%. (Olsen et al., 2011). As of the 2011 YRBS, 24% of students had ridden in a vehicle being driven by someone who had been drinking alcohol in the previous 30 days (CDC, 2013e). This was a reduction from baseline measures in the nineties when more than a third of students reported this behavior (Jiang et al., 2011). Finally, while the prevalence of seatbelt use did increase to 90%, the target for 92% of students reporting seatbelt use was not achieved by 2010 (Olsen et al., 2011; Jiang et al., 2011).

Factors impacting the behavior

Many factors impact unintentional injuries. In a nationally representative US sample, Jiang et al also found male adolescents and young adults to be more likely to engage in most unintentional injury behaviors when compared to their female counterparts (Jiang et al., 2011). Similarly, sex and age were found to impact risky driving behaviors in Canadian youth. Compared to females, males were more likely to report driving while intoxicated or driving in a car with someone who was intoxicated.

Compared to those 15 and older, younger teens (age 13) were less likely to report driving with someone under the influence or driving while intoxicated (Picket et al., 2012). A Norwegian study on driving attitudes in young adults also focused on age and sex. Compared to females, males were more likely to report risky driving behaviors. Compared to younger respondents, older respondents reported more speeding violations (Eiksund, 2009).

Differences by urbanicity

There is a lack of research on differences by urbanicity in the US. Studies from other high-income countries allow some inference to be made on the differences by urbanicity in US, yet countries differ geographically, socially and politically (among other ways), and this limits the generalizability of findings from one country to another.

Unintentional injury involving motor vehicle crashes differs across levels of urbanicity. A cross-sectional study of students from 436 schools in Canada (n=26,078) found that 20% of respondents had ridden in a motor vehicle in the previous 30 days with an intoxicated driver and 10% had driven a motor vehicle while intoxicated. When comparing these respondents by urban-rural geographic status, rural youth were more likely than urban youth to respond 'yes' to being involved in both scenarios (Pickett et al., 2012). Similarly, a Norwegian study of urban and rural young adults' attitudes and driving behaviors found that the odds of rural residents reporting non-use of seatbelts were 5 times that of urban residents (Eiksund, 2009).

Another Canadian study that examined hospitalization and death rates among those involved in motor vehicle accidents between 2001 and 2006 found that compared to urban populations there was a two- to three-fold increase in death for rural populations

involved in motor vehicle collisions (Bell et al., 2012). This aligns with the findings by the National Rural Health Association that rural populations in the US are more likely to experience fatalities in motor vehicle crashes than urban populations (National Rural Health Association, 2010). It has been suggested that this is due to longer wait time for emergency response. Furthermore, compared to their urban counterparts rural residents are twice as likely to die from unintentional injury (National Rural Health Association, 2010). A study conducted in the US by Nance et al also supports this. An examination of unintentional injury by urbanicity found that from 1999-2006, unintentional injury deaths remained higher among rural adolescents than among urban adolescents (Nance et Al., 2010).

2.3 Violent behaviors

National trends and health effects of violent behaviors

Healthy People 2020 also created objectives to improve health through targeting violence in adolescence. These objectives included reducing homicide, reducing firearm violence, reducing physical fighting among adolescents and reducing the number of adolescents who report carrying a weapon on school property (US Department of Health and Human Services, 2013). The goals targeting youth violence had similar results to those focused on unintentional injury, with improvements made from baseline measures in 2000 to measures in 2010, but many goals remained unmet. The target reduction in the prevalence of adolescent physical fighting was met (Olsen et al., 2011; Jiang et al., 2011), yet the rate of homicide in adolescents remained unchanged from 1999 to 2007 (Jiang et al., 2011). Moreover, while a reduction was seen in the prevalence of youth carrying a weapon on school property, the goal of 4.9% prevalence was not met (Olsen et al., 2011;

Jiang et al., 2011). As of 2009, 5.6% of students still reported carrying a weapon on school property in the past 30 days (US Department of Health and Human Services, 2013). And, in 2011, 17% of students reported carrying a weapon in any location at least once in the past 30 days (CDC, 2013e). Overall, youth have the highest age-specific rates of assault-related injuries in the US (Hall et al., 2012). Reductions in prevalence of suicide attempts requiring medical attention occurred (down to 1.9% in 2009, compared to 2.6% in 1999), but this objective also did not meet the target goal of 1% (Olsen et al., 2011). This shows that while trends appear to be moving in the right direction, they are not moving as quickly as experts hoped, and there is still more work to be done.

Factors impacting this behavior

An ecologic study on all mortality among US youth found disparities in all-cause and cause-specific mortality rates according to race/ethnicity, socioeconomic status, and geographic region of the country. Adolescents who were in the most affluent socioeconomic group were least likely to experience homicide or unintentional injury-related mortality. Furthermore, the study found that homicide rates for adolescents were higher in the southeast (where SES was lower), than in other parts of the country (Singh et al., 2012). Nance et al's review of vital record statistics showed firearm mortalities were more common among adolescents aged 16 years or older when compared to younger adolescents (Nance et al., 2010).

Differences by urbanicity

Violent behavior among youth and adolescents appear to differ by urbanicity. A comparative study of health risk behaviors in New York school districts found that rural adolescents were more likely to report carrying a gun at school than urban or suburban

adolescents. Additionally, the odds of a rural youth reporting carrying a gun within their community were twice that of an urban youth (Atav et al., 2002).

Firearm death rates among adults vary based on urbanicity (Carr et al., 2012; Nance et al., 2010; Branas, 2004), and additional studies suggest this may also be true in youth. Youth in rural areas may be at a greater risk for suicide or self-harm, while urban youth may be at a greater risk for homicide or other interpersonal violence (Swahn and Bossarte, 2009; Nance et al., 2010). To explore whether adolescent firearm deaths varied by urbanicity, a study in 2010 examined eight years of US vital statistics for firearm deaths in 0-19 year olds. Overall rates of firearm deaths among youth were not statistically different when looking at the most urban and most rural counties (RR=0.91). However, even after adjusting for other factors, those from rural counties had two times the rate of unintentional firearm death or suicide compared to urban youth, while youth from urban counties experienced a rate of homicide-related firearm death that was 3.6 times the rate of youth from rural counties. Suicide rates among 0-19 year olds were lowest in urban counties and increased frequency among rural counties. Homicides on the other hand, had a tendency to be lowest in rural counties and highest in urban ones (Nance et al., 2010).

2.4 Alcohol and drug use

National trends and health effects of alcohol and drug use

Nationally, alcohol consumption among 12- to 17-year-olds is on the decline. The prevalence of alcohol use in adolescents has followed an overall downward trend since the 1980s (Johnston et al., 2013). From 2002 to 2011, this trend continued: the proportion of 12- to 20-year-olds reporting current, binge and heavy alcohol use declined. A report

released by the Substance Abuse and Mental Health Administration stated that, on an average day in 2006, nearly 8,000 12- to 17-year-olds tried alcohol for the first time (Substance Abuse and Mental Health Services Administration, 2007). Current alcohol use declined from 29% in 2002 to 25% in 2011. Binge drinking declined from 19% to 16%, and heavy drinking fell two percentage points to 4% over the same time period (Substance Abuse and Mental Health Services Administration, 2013). Despite this trend, is still estimated that in 2012 in the US, 9.3 million 12- to 20-year-olds were current drinkers, with more than 60% of them being binge drinkers (Substance Abuse and Mental Health Services Administration, 2013). According to the 2011 Monitoring the Future survey, almost a third of 8^{th} graders and over two thirds of 12^{th} graders admitted to ever trying alcohol. Of those reporting alcohol consumption, 16% of 10^{th} graders, nearly a quarter of high school seniors and over a third of college students report binge drinking (drinking 5 or more drinks in a row at least once in the previous two weeks) (Johnston et al., 2013). First time use is still occurring at an alarming rate.

Substance abuse in youth is also in a downward trend. The number of students reporting ever using marijuana on the YRBS increased from 1991-1999, but then decreased between 1999 and 2011. In 2011, 40% of students surveyed reported ever using marijuana, compared with close to half reporting ever using in 1999, and approximately a third reporting use in 1991. Nationally, reports of ever using cocaine followed this same trend, but heroin and other injectable drug use have remained largely unchanged since the 1990s (CDC, 2012d). Despite the overall decreasing trend, drug use remains problematic among youth. In 2011, nearly 1 in 15 high school students was believed to be a daily or near daily marijuana user (Johnston et al., 2012). It is estimated

by Monitoring the Future that as of 2011, in grades eight, ten and twelve, 27% of students used any illicit drug in the previous year and 11.2% used marijuana in the previous year (Johnston et al., 2012). According to the Substance Abuse and Mental Health Administration, in 2006, daily 4,348 12 to 17 year olds used an illicit drug for the first time, another 3,577 tried marijuana and 236 used methamphetamines for the first time (Substance Abuse and Mental Health Services Administration, 2007). As of 2010, the prevalence of illicit drug use in the US for youth 12 and older was 10% (Substance Abuse and Mental Health Services Administration, 2010).

Substance abuse can lead to many unfavorable outcomes, such as poor cardiovascular conditions, HIV or other STIs, domestic violence, motor vehicle crashes, homicide, suicide and complications in pregnancy (US Department of Health and Human Services, 2013). Alcohol consumption is similarly associated with negative outcomes, including traffic or other accidents, violent behavior, and suicide. Furthermore, increased frequency of consumption increases the risk of developing an alcohol-related disorder (Stolle, Sack, and Thomaisus, 2009). Additionally, compared to youth who do not drink alcohol, youth who drink alcohol are more likely to have poor grades, are less likely to participate in youth activities, more likely to face unwanted, unplanned or unprotected sexual activity, and are at a greater risk for assault than those who do not drink (CDC, 2012b). Further ill effects of alcohol include the disruption of normal development and growth, particularly brain development, which can lead to memory problems and life-long impacts (CDC, 2012b). In 2004, alcohol and drug use were estimated to contribute to 13% of the total global burden of disease, with alcohol consumption contributing to 86% of all substance-related deaths in 15- to 29-year-olds (Coomber et al 2011).

Binge drinking is the most common form of alcohol consumption in high school students and is associated with an increase in the likelihood of sexual activity, unintentional injury, smoking, other drug use and being a victim of dating violence (Miller et al., 2007; Greggo, Jones, and Kann, 2005). Binge drinking is also costly. One study estimated that in 2006 underage drinking cost approximately $24.6 billion dollars and the total cost of binge drinking was approximated to be $170.7 billion. This cost is attributed to loss of productivity, health care costs, crime and other expenses (Bouchery et al., 2011).

Factors impacting this behavior

As seen with unintentional injury, age, sex, race and ethnicity are associated with alcohol and substance use behavior. Increased age is associated with increased use of both alcohol and drugs (Lambert, Gale, and Hartley, 2008). Alcohol use and binge drinking is more common among non-Hispanic White adolescents than among African American or Hispanic adolescents (Swahn and Bossarte, 2009; Booth and Curran, 2006), and males are more likely to report drinking than females (Booth and Curran, 2006).

In addition, area-level socioeconomic status is associated with initiation of in these risk behaviors. Living in a community with a low median income or economic stress is associated with substance use (Coomber et al., 2011; Lambert, Gale, and Hartley, 2008). Both economically declining rural areas and inner cities have higher rates of substance use than the rest of the country (Lambert, Gale, and Hartley, 2008). The region of the country also appears to be associated with the prevalence of alcohol and substance use. Northeastern states report higher rates of drinking overall, while southeastern states report higher rates of abstaining from alcohol (Borders and Booth, 2007). National survey

data from 2004 again showed this trend: alcohol use among 12- to 20 year-olds was found to be highest in the Northeast and Midwest and lowest in the West and South (Lambert, Gale, and Hartley, 2008).

Differences by urbanicity

According to a recent review article, studies since the year 2000 have changed the perception that rural communities offer protection against substance abuse, and have found significant rates of substance abuse in rural areas (Lambert, Gale and Hartley, 2008). According to Coomber et al, in the 1980s, youth in rural areas were consuming alcohol less frequently than urban youth. This trend has changed over time. In the 1990s, there was no longer a difference in substance use among 11th grade students between urban, suburban and rural locations. However, recent data suggest that rural youth may now report alcohol use that is more frequent than that of their urban counterparts (Coomber et al., 2011).

An analysis of a national survey on alcohol found that rural adults had higher odds of abstaining from alcohol than suburban residents. However, those who did drink in rural areas were at slightly higher odds for having a current alcohol disorder or exceeding daily limits (Borders and Booth 2007). In Australia, an inverse monotonic trend between alcohol and urbanicity exists, with consumption among adolescents increasing as urbanicity decreases (Coomber et al., 2011). This trend is observed in several studies focusing on adolescents and youth as well. For instance, a study of New York students found that the odds of reporting frequently drinking alcohol among students in rural areas was approximately twice that of suburban and urban adolescents. The same relationship

was found for rural youth using other drugs compared to suburban and urban adolescents (Atav and Spencer, 2002).

Another study comparing Washington State with Victoria, Australia, (two demographically similar regions with differing youth substance abuse policies) found that in both areas, rural adolescents were significantly more likely to report using alcohol, tobacco and marijuana. When looking at data from both countries combined, rural youth had higher odds of lifetime alcohol use and marijuana use in the previous 30 days than their urban counterparts. No significant difference was found for illicit drug use (Coomber et al., 2011).

Differences exist even among rural youth. A study comparing drug use among adolescents from rural communities found that current alcohol, tobacco, inhalant and other illicit drug use was more prevalent among youth living on farms than youth living in towns (Rhew et al., 2011).

While some studies support the idea that there are differences in the rates of substance use between urban and rural adolescents, not all studies reached this conclusion. One study of 2003 YRBS data did not report a significant difference in lifetime or current alcohol use or heavy drinking between the two groups (Greggo, Jones, and Kann, 2005). Another study analyzing 2001 YRBS data also reported that, after adjusting for race/ethnicity, there were no significant differences between urban, suburban, and rural youth with regards to substance use (Levine and Coupey, 2003). Another analysis of a national in-person alcohol and drug use survey (The National Epidemiologic Survey on Alcohol and Related Conditions) came to yet another conclusion, finding that youth in suburban areas were at the greatest risk for alcohol use

but those who did drink in urban and rural areas were more likely to be binge drinkers (Borders and Booth, 2007). In general, the literature on the effect urbanicity has on engagement in substance use remains split. Overall, it seems that urban areas may report more substance use than rural areas (Lambert, Gale and Hartley, 2008). However, trends for certain substances do vary by urbanicity.

2.5 Tobacco use

National trends and health effects of tobacco use

Smoking typically begins in adolescence (Atav and Spencer, 2002). According to the CDC, 88% of adult daily smokers reported that they started using tobacco prior to turning 18 (CDC, 2013d). In 2011, 45% of youth responding to the YRBS reported ever trying tobacco, with almost half of those current cigarette users (CDC, 2013e). Still, adolescent cigarette use is at its lowest prevalence since peaks in the mid-1990s. Between the 1996 peak and 2011, smoking declined by 56% among 8th graders (from approximately 20% to approximately 9%). In the same time period, prevalence of smoking has declined by 47% among 10th graders (from approximately 30% to approximately 16%). From 1997 to 2011, a 32% decline was seen in smoking among 12th graders (Johnston et al., 2013). While adolescent tobacco use has been declining, many adolescents continue to experiment with tobacco; 4000 people under 18 try cigarettes for the first time each day (CDC, 2013d). Also, the rate of decline in tobacco use has slowed between 2003 and 2009 (CDC, 2010a; Johnston et al.2013; CDC 2013d).

Tobacco-related illness and death are entirely preventable. In fact, in the US, tobacco use is considered the number one preventable cause of death (U.S. Department of Health and Human Services, 2011). In a 50th anniversary update of the original Surgeon

General's report on smoking and tobacco use, tobacco use was associated with 15 different cancers as well as several cardiovascular diseases, respiratory diseases, reproductive complications, diabetes, cataracts, loss of bone density and an overall decline of health status (US Department of Health and Human Services, 2014). In the US, 443,000 deaths are due to a tobacco-related illness each year, and for each of these deaths it is estimated that 20 more people have a serious tobacco-related illness (U.S. Department of Health and Human Services, 2013). Deaths attributable to tobacco use make up 5.1 million years of potential life lost (YPLL) in the US each year (CDC, 2013a). This high prevalence of tobacco-related morbidity and mortality leads to almost 200 billion dollars in cost annually as a result of medical expenses and productivity losses (U.S. Department of Health and Human Services, 2013; CDC, 2013a.

Factors impacting this behavior

Tobacco use varies by sex. In 2011 current use of tobacco in people 12 years old or older was higher in males than females (Substance Abuse and Mental Health Services, 2013). There are also differences based on race and ethnicity. Whites are more likely to be current smokers than blacks during adolescence and young adulthood, while the prevalence of current tobacco use among Hispanic adolescents is in between that of their white and black counterparts (Substance Abuse and Mental Health Services, 2013). Black females are the only subgroup of adolescents that did not report a slowing in the rate of decline of current cigarette use between 1999 and 2003 (CDC, 2010a).

Education also plays a role in tobacco behavior. There is an inverse association between education and cigarette use, with the prevalence of current smoking being the lowest among adults who graduated college and the highest among adults who did not

complete high school (Substance Abuse and Mental Health Services, 2013). Other risk behaviors, such as substance use, are related to tobacco risk behavior: among 12- to 17-year-olds, those who report use of drugs or alcohol are more likely to be current smokers (Substance Abuse and Mental Health Services, 2013). Finally, like alcohol, tobacco use differs by geographic region. Current cigarette smoking was reported to be highest in the Midwest and South, slightly lower in the Northeast and lowest in the West (Substance Abuse and Mental Health Services, 2013).

Differences by urbanicity:

In their analysis of 1999 YRBS survey data, Levine and Coupey found no significant difference in tobacco use between adolescents from urban, suburban and rural areas (Levine and Coupey, 2003). However, a study of high school students in upstate New York found that rural youth were two times more likely than urban youth to report frequent smoking (Atav and Spencer, 2002). An analysis of YRBS data from 1997-2003 also indicated that both experimenting with and becoming a daily user of tobacco products were more common among rural than urban adolescents (Lutfiyya et al., 2008).

Likewise, tobacco use in people 12 years old and older was found by the National Survey on Drug Use and Health to vary based on geographic area. Current cigarette use in people 12 years old or older was highest in non-metropolitan areas (26%), and declined with increasing urbanicity. In the largest metropolitan areas, current smoking was only 20% (Substance Abuse and Mental Health Services, 2013).

Several studies from other countries show a variety of associations between urbanicity and tobacco use. In Mexico, across varying levels of SES, living in an urban area was found to be protective against current smoking when compared to rural areas

among adolescents (Gutierrez, 2011). Along with rates of tobacco use, the preference in tobacco products may also differ. A survey of urban youth in Ontario, Canada and rural youth in Alberta, Canada, found that while more rural youth reported trying smoking, there was no difference between current smokers in rural or urban areas (Plotnikoff, Bercovitz, and Loucaides, 2004). In Germany, rural residents (10 years and older) were found to be less likely to smoke than people in urban areas. Among current and former smokers, those living in urban areas were more likely to be categorized as 'heavy' smokers (smoke more than 20 cigarettes daily) than those living in rural areas (Völzke et al., 2006).

Chaung et al's findings (2009) were less straightforward. The study concluded that different types of neighborhoods (based on SES, racial make-up and urbanicity) responded differently to various risk factors for smoking. For instance, adolescents in predominantly white, suburban, middle class neighborhoods experienced higher levels of cigarette use if their parents smoked, while adolescents from predominantly white, rural, middle class neighborhoods were more likely to be influenced by their peers' smoking behaviors (Chuang et al., 2009).

CHAPTER 3

METHODOLOGY

3.1 Study Design

This study is a secondary analysis of 2003 YRBS survey data. According to the public use data documentation manual provided by the CDC, the sample used for the national 2003 YRBS is a three-stage cluster sample that consists of public and private schools with at least one of grades 9-12 that are located in the 50 states or the District of Columbia. The first stage of sampling consisted of 1,262 primary sampling units of counties, subareas of larger counties or groups of smaller counties. These primary sampling units were then organized into 16 strata based on urbanicity and percentage of black and Hispanic students; 57 PSUs were selected. During the second stage of sampling, 195 schools were selected (with probability proportional to school enrollment). Schools with higher numbers of black and Hispanic students were over sampled. The final sampling stage involved random selection at each chosen school of one to two classes from each grade. Students in these classes were eligible to participate. Weights were given to each student as an adjustment for non-response and oversampling. This weighting was done such that the weighted count was equal to the total sample size, and the weighted proportion of each grade level was equal to national population proportions (Grunbaum et al., 2004; CDC, 2013g).

3.2 Sample size

In 2003, 15,240 YRBS questionnaires were completed in 158 of the 195 selected schools. Of the completed surveys, 26 failed quality control evaluation, which left 15,214 useable surveys for analysis. The survey had a school response rate of 81%. After considering the student response rate, the overall response rate for the survey was 67% (Grunbaum et al., 2004; CDC, 2013g). From this dataset, subsamples were drawn based on response rates to the questions being used to measure the outcome variables listed below.

3.3 Study population

The YRBS survey was administered to youth in public and private schools in grades 9-12 during 2003.

3.4 Variables

Aim 1 Outcome of Interest: Unintentional Injury

Unintentional injury was analyzed on the basis of respondents' answers to the question, "How often do you wear a seat belt when riding in a car driven by someone else?" Answer options included never, rarely, sometimes, most of the time, and always. Responses were dichotomized for analysis; when the response was 'never' it was coded as no, otherwise the response was classified as yes for seatbelt use .

For the outcome of interest in aim 1, it was hypothesized that rural adolescents would be less likely to wear seatbelts than urban adolescents, and suburban adolescents would be more likely to wear their seatbelts than urban adolescents.

Aim 2 Outcome of Interest: Violent behavior

Violent behavior was measured using the following questions: "During the past 12 months, did you ever seriously consider attempting suicide?" (Yes or No) and "In the past 30 days, on how many days did you carry a gun?" Responses to the second question were dichotomized for analysis. When the respondent answered zero days, the response was coded as no to weapon carrying and otherwise it was classified as yes.

For the outcome of interest in aim 2, the hypothesis was that compared to their urban counterparts rural adolescents would be more likely to have seriously considered attempting suicide, while suburban adolescents would be less likely to have considered suicide than their urban counterparts. In regards to carrying a firearm, the hypothesis was that there would be no difference between rural and urban adolescents reporting carrying a gun in the previous 30 days; suburban adolescents would be less likely to report carrying a gun than their urban counterparts.

Aim 3 Outcome of Interest: Alcohol and Drug Use

Alcohol and drug use were assessed on the basis of the following questions: "During the past 30 days, on how many days did you have at least one drink of alcohol?" and "During the past 30 days, how many times have you used marijuana?" Responses to both of these questions were dichotomized in analysis; responses other than 'zero times' were coded as yes and a response of 'zero times' was coded as no.

The hypotheses for aim 3 were that compared to urban adolescents rural youth would report consumption of alcohol more frequently, and suburban adolescents would report consumption of alcohol less than urban adolescents. Both rural and suburban adolescents would be less likely to report marijuana use than urban youth.

Aim 4 main Outcome: Tobacco Use

The question, "Have you ever tried cigarette smoking, even one or two puffs?" (Yes, No) assessed the outcome of tobacco use.

The hypothesis for aim 4 was that both rural and suburban adolescents would be more likely to engage in tobacco use than their urban counterparts.

Main Exposure: Urbanicity

The main exposure of interest for all aims is urbanicity. YRBS classifies urbanicity as urban, suburban, or rural based on the location of the school the student attended during survey administration. A student attending a school within a metropolitan statistical area and within the central city was coded as urban, while a student within the metropolitan statistical area but outside the central city was coded as suburban. A student outside of the metropolitan statistical area was coded as rural.

3.5 Confounders and effect modifiers

The following variables were adjusted for in analysis and/or assessed as potential effect modifiers or confounders:

1. Age

Age was analyzed as a categorical variable based on respondents answers to question 1, "How old are you?" This question had the following possible answers: 12 years old or younger, 13 years old, 14 years old, 15 years old, 16 years old, 17 years old, and 18 years or older. Due to the small proportion of respondents classified as 12 years or younger and 13 years old (weighted proportions of percentages of 0.2 and 0.1, respectively), age categories were combined as 14 years old or younger, 15 years old, 16 years old, 17 years old, and 18 years or older. Age was adjusted for as a confounder.

2. Sex

Sex was defined as a dichotomous variable based on study participants' answer to the question, "What is your sex?" The categories for this variable were male or female. Sex was adjusted for in analyses as a confounder and assessed as an effect modifier.

3. Race/ethnicity:

Race/ethnicity was included for adjustment in analysis as a confounder. It was measured via self-report. Respondents initially could select their race as one of eight categories (American Indian or Alaska Native, Asian, Black or African American, Hispanic or Latino, Native Hawaiian or Other Pacific Islander, White, and Multiple–Hispanic, Multiple–Non-Hispanic). Sampling size was insufficient to accurately analyze many of these categories on their own. For the analysis in this study, race/ethnicity was combined into four categories: non-Hispanic White, non-Hispanic Black or African American, Hispanic or Latino, and Other.

4. Geographic region of the country.

Geographic region of the country was adjusted for in the full models as a confounder and assessed as a potential effect modifier. Geographic region of the country was classified as Northeast if students' schools were located in Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, or Vermont; Midwest if their schools were in Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, or Wisconsin; South if a student's school was in Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, or West Virginia; and West if schools were in

Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, or Wyoming. Due to small cell counts when also considering urbanicity, particularly within the rural West, this variable had to be further collapsed for analysis. In the analysis for all outcomes, geographic region was categorized South, Northeast, and a combined category for West and Midwest.

3.6 Analysis

Descriptive statistics for the data were obtained using survey procedures in SAS. Tables of outcomes and covariates were created to show their frequency and distribution overall, as well as by urbanicity. Chi-Square tests were performed to assess whether there were statistically significant differences between the urbanicity levels. The p-values from these test statistics were calculated and assessed at $\alpha = 0.05$ level of significance. The descriptive tables also display the missing data for each variable.

A regression analysis was then conducted for each outcome. The general model for each aim was: $G(Y) = \beta_0 + \beta_1(\text{rural}) + \beta_2(\text{suburban}) + \beta_3(\text{covariates})$, where G is a link function. Since all outcomes were dichotomous, the logit link function was used for all models within the analysis. After model estimation, the Wald test for each β was assessed. The complex sampling design (including weight, PSU and strata) was accounted for in analysis.

A series of four models were run for each aim. First, a model was estimated which included an interaction between sex and urbanicity. This model included the outcome variable and all demographic variables (age, sex, geographic location and race/ethnicity) as well as the interaction term between sex and urbanicity. When the sex interaction term was significant, results were assessed based on models stratified by sex. This was done

using the domain function in SAS to preserve the structure of the complex survey data. After assessing the sex interaction, an initial model was run (model one), which was a bivariate analysis including only the outcome and the main predictor of interest, urbanicity. Subsequently, Model two was estimated which included the outcome and urbanicity, and adjusted for all demographic variables (age, sex, geographic location and race/ethnicity). The final models included all variables present in the full model as well as the interaction between geographic location and urbanicity. Interactions were considered significant if their overall p-values were less than $\alpha = 0.10$ level of significance.

Predicted probabilities were calculated for outcomes that had a significant interaction between urbanicity and geographic location. This was done using Stata. The general formula for calculating predicated probabilities was $\exp(\beta_0 + \beta_1(\text{rural}) + \beta_2(\text{Suburban}) + \ldots\beta_x(\text{covariates}))/(1+ \exp(\beta_0 + \beta_1(\text{rural}) + \beta_2(\text{Suburban}) + \ldots\beta_x(\text{covariates}))$. Predicated probabilities were run with the referent levels for age (16 years old) and race/ethnicity (white). When the interaction term between sex and urbanicity was not significant and sex-stratified analyses were not necessary, the referent level for sex (males) was also included. These probabilities were then graphed to show how the percentage of adolescents reporting a specific behavior was predicted to change across urbanicity and geographic region.

CHAPTER 4

RESULTS

4.1 Descriptive statistics

Descriptive statistics for the 2003 YRBS data on important socio-demographic factors and youth risk behaviors are shown in Tables 4.1 and 4.2, respectively. As shown in Table 4.1, urban youth made up 27.8% of the overall sample. Half of the sample was classified as suburban (50.6%) and the remaining 21.7% of survey participants were classified as rural.

The distribution of age according to urbanicity remained fairly consistent with the distribution in the sample as a whole. The age groups ≤14 years old and ≥ 18 years old each made up around 12% of the total sample, while the remaining ages (15, 16, and 17 years old) each represented approximately a quarter of the respondents. Age distribution varied by urbanicity, such that there were fewer individuals from the youngest age group in the rural subgroup (9.2%) compared to the other levels of urbanicity. Those in the age group 18 years or older made up slightly more of the rural sample than the urban or suburban samples. The middle age groups had less variation between levels of urbanicity. The results of a chi-square test determined that there were statistically significant differences between the varying levels of urbanicity in regards to age distribution (p-value=0.0031).

The percentage of males in the sample and within each level of urbanicity was approximately 50%. The results of a chi-square test determined no differences

between the categories of urbanicity in the distribution of sex (p-value=0.5164).The majority of respondents were non-Hispanic White (61.4%), followed by Hispanic (14.1%), Black (13.9%) and other race/ethnic groups (10.6%). Urban adolescents were more diverse racially than suburban or rural adolescents; suburban and rural adolescents were predominantly non-Hispanic White. These differences were found to be statistically significant: a chi-square test found that there were differences between the three levels of urbanicity in regard to race distribution (p-value <0.0001). Within the urban classification, non-Hispanic Whites still made up the majority of respondents at 35.1%, while just over a quarter of respondents identified as black, and nearly a quarter identified as Hispanic. The remaining 14.2% identified as another race/ethnicity. The distribution of race within suburban adolescents closely resembled the distribution of the sample as a whole. They were 66.8% non-Hispanic White, 10.0% Black, 12.8% Hispanic and another 10.4% were some other race/ethnicity. The sample of rural youth was predominantly non-Hispanic White (82.2%); Black adolescents made up 7.1% of the rural sample while Hispanic youth made up only 4.1%, and the remaining 6.7% of the rural sample identified as another race/ethnicity.

Among urban youth, 10.4% lived in the Northeast, 41.8% lived in the South and the remaining 47.8% lived in the West/Midwest. Among suburban students, 26.0% were from the Northeast, 39.6% were from the South and the remaining 34.4% were from the West/Midwest. Within the rural group, 25.9% were from the Northeast, 37.6% were from the South and 36.5% were from the West/Midwest. Overall, this sample was fairly representative of all geographic regions and levels of urbanicity. A chi-square test failed

to detect significant differences between the three levels of urbanicity in the distribution of geographic region (p-value=0.6093).

There was considerable variability in the percentage of youth who reported engaging in the various risk behaviors (Table 4.2). Tobacco and alcohol use were highly prevalent in this sample (56.3% and 41.7%, respectively). The next most commonly reported behavior was marijuana use (21.6%), followed by contemplating suicide (16.8%). Fewer adolescents reported not wearing a seatbelt (8.0%) than reported the above-mentioned behaviors. Lastly, the number of respondents who reported carrying a weapon was much lower than those reporting any of the other risk behaviors (5.7%).

The overall prevalence of not wearing a seatbelt in a car being driven by someone else within this sample was 8.0%. Suburban youth were less likely on average to report this behavior, at 5.4%. However, almost twice as many (approximately 11.0%) of urban and rural youth reported this behavior. A chi-square test shows that these differences across urban, suburban and rural groups were significant (p-value<0.0001). The prevalence of contemplating suicide overall was 16.8%, which was similar across the various levels of urbanicity. A chi square test failed to detect a difference across the three urbanicity categories for this behavior (p-value=0.3517).

The percentage of respondents who reported carrying a weapon was much lower than those reporting the other risk behaviors. In this sample, 5.7% of adolescents reported carrying a weapon in the past 30 days. The number of urban youth reporting this behavior was slightly lower (4.3%) and rural adolescents reported this behavior at a higher frequency (7.4%). This difference between urbanicity groups was significant (p-value=0.0003).

In the overall sample, 21.6% of youth reported past 30-day marijuana use. The percentage of adolescents reporting marijuana use was steady across the three groups, ranging from 19.7% in the rural group to 22.5% in the suburban group. However, the percentage of youth reporting no marijuana use varied greatly. Urban youth reported not using marijuana 70.9% of the time, while suburban youth reported this response 76.0% of the time and rural youth reported it 78.8% of the time. Accordingly, the extent to which data for marijuana use were missing varied by urbanicity. Urban youth had a higher level of missing data (7.3%) than either of the other groups (1.5%). These differences in reporting marijuana use across urbanicity groups were found, using a chi square test to be statistically significant (p-value=0.0001)

A higher percentage (41.7%) of adolescents reported past 30-day alcohol use than reported marijuana use. No major differences were seen in the report of past 30 day alcohol use across the levels of urbanicity. The chi square test failed to detect that any slight variations seen were statistically significant (p-value=0.0951). Among urban youth, the frequency reporting alcohol use was slightly lower than the average, at 37.7%. A higher percentage of suburban youth reported this behavior (44.7%) compared to 39.7% of rural youth. Approximately half of all adolescents within each urbanicity group reported not using alcohol in the past month (urban 53%, suburban 51.5%, rural 47.9%). The level of missingness on this question varied between urbanicity groups (3.8%-12.4%). However, this is likely not a concern due to the fact that the difference was not found to be statistically significant.

Lastly, the reporting of tobacco use did not differ significantly between urbanicity groups. A chi-square test found no statistically significant differences between the levels

of urbanicity in the reporting of tobacco use (p-value=0.099). Slightly more rural youth (nearly 60%) reported ever trying tobacco than suburban and urban youth (around 55%). Suburban youth more often reported 'no' to tobacco use (42.4% compared to 39.5% for urban and 35.4% for rural) and less often had missing data for the question of tobacco use than their rural or urban peers.

As shown in Table 4.2, missingness was not a major problem with any of the outcomes assessed in the analysis. The analysis of seatbelt use showed that very few data were missing (less than 1% of the sample did not respond to the question). Likewise, less than half of a percent of the sample failed to respond to the question used to assess suicide contemplation. Slightly more responses were missing in the analysis of self-report of past thirty-day weapon carrying than in the analysis of suicide contemplation or not wearing a seatbelt. However, the non-response rate was still low (a weighted percentage of 4.2%) and this small percentage of missing responses likely does create selection bias (Bennett 2001; Langkamp, Lehman & Lemeshow 2010). The amount of missing data was also low for marijuana use; 3.2% of data was missing. Alcohol use had the largest percentage of missing data, yet it was still under 10% missing; 7.2% of the total sample population did not respond to the question measuring alcohol use. Lastly, tobacco use had a level of missingness of 3.6%.

Several cutoff points for the percentage of missing data have been suggested as "acceptable" in large data analysis For instance, some researchers have suggested that a level of missingness of 10% or less is of little consequence (Bennettt 2001; Langkamp, Lehman, & Lemeshow 2010). In fact, a study conducted by Langkamp et al investigated several means of dealing with missing data when conducting a secondary analysis of a

large survey dataset such as YRBS and found that compared to other imputation methods, dropping missing data when 10% or less of data may result in a slight bias of results but this slight bias would be unlikely to change the direction of the association or the resulting conclusion. Therefore, due to the relatively low rate of missing data, analysis of this data was done excluding missing data (Langkamp, Lehman, & Lemeshow 2010)

Table 4.1. Selected Descriptive Characteristics of the Study Sample, YRBS 2003

Variable	**Total** n (%)	**Urban** n=5793 (27.8%)	**Suburban** n=7027 (50.6%)	**Rural** n=2394 (21.7%)	**Chi-Square Test** (p-value)
Age					0.0031
≤14 yrs	1478 (12.5)	562 (13.0)	701 (13.6)	203 (9.2)	
15 yrs	3410 (25.5)	1324 (26.9)	1529 (25.2)	540 (24.3)	
16 yrs	3892 (26.2)	1451 (26.3)	1813 (26.4)	610 (25.7)	
17 yrs	3974 (23.3)	1457 (21.7)	1869 (23.0)	632 (26.2)	
≥18 yrs	2410 (12.5)	933 (12.1)	1069 (11.8)	396 (14.6)	
Sex					0.5164
Male	7780 (51.4)	2945 (51.9)	3502 (51.7)	1106 (50.1)	
Female	7358 (48.6)	2767 (48.1)	3469 (48.3)	1271 (49.9)	
Race/Ethnicity					<0.0001
White	6583 (61.4)	1475 (35.1)	3557 (66.8)	1551 (82.1)	
Black	3588 (13.9)	1819 (26.1)	1288 (10.0)	481 (7.1)	
Hispanic	3545 (14.1)	1778 (24.6)	1546 (12.8)	221 (4.1)	
Other	1373 (10.6)	655 (14.2)	590 (10.36)	128 (6.7)	
Geographic region					0.6093
Northeast	2,210 (21.7)	593 (10.4)	1132 (26.0)	485 (25.9)	
Midwest/west	4893 (39.8)	1888 (41.8)	2384 (39.6)	621 (37.6)	
South	7986 (38.6)	3246 (47.8)	3465 (34.4)	1275 (36.5)	

*An unweighted frequency & a weighted percent are used in the above table

Table 4.2 Distribution of Selected Risk Behaviors Within the Study Sample, YRBS 2003

Variable	**Total** n (%)	**Urban** n=5793 (27.8%)	**Suburban** n=7027 (50.6%)	**Rural** n=2394 (21.7%)	**Chi-Square Test** (p-value)
Seatbelt use					<0.0001
Yes	13931(91.4)	5295 (89.0)	6525 (93.6)	2111 (89.4)	
No	1062 (8.0)	425 (10.9)	367 (5.4)	270 (10.6)	
Missing	96 (0.6)	7 (0.1)	89 (1.0 0)	0 (0.0)	
Suicide					0.3517
Yes	2433 (16.8)	888 (15.7)	1180 (17.6)	365 (16.4)	
No	12606 (82.8)	4817 (83.9)	5780 (82.1)	2009 (83.3)	
Missing	50 (0.4)	22 (0.54)	21 (0.3)	7 (0.3)	
Handgun Carrying					0.0003
Yes	850 (5.7)	292 (4.3)	379 (5.8)	179 (7.4)	
No	13816 (89.8)	5202 (84.3)	6434 (91.8)	2180 (91.9)	
Missing	423 (4.5)	233 (11.4)	168 (2.4)	22 (0.7)	
Marijuana use					<.0001
Yes	3412 (21.6)	1326 (21.5)	1633 (22.5)	453 (19.7)	
No	11268 (75.2)	4158 (70.9)	5224 (76.0)	1886 (78.8)	
Missing	409 (3.2)	243 (7.6)	124 (1.5)	42 (1.5)	
Alcohol use					0.0951
Yes	6512 (41.7)	2334 (37.7)	3214 (44.7)	964 (39.7)	
No	7525 (51.1)	2964 (53.0)	3438 (51.5)	1123 (47.9)	
Missing	1052 (7.2)	429 (9.3)	329 (3.8)	294 (12.4)	
Tobacco use					0.0990
Yes	8877 (56.3)	3240 (54.4)	4129 (56.0)	1508 (59.9)	
No	5751 (40.1)	2268 (39.5)	2711 (42.4)	772 (35.4)	
Missing	461 (3.6)	219 (6.1)	141 (1.6)	101 (4.7)	

*An unweighted frequency & a weighted percent are used in the above table

4.2 Aim 1 results – Unintentional injury

Since the interaction between sex and urbanicity was significant at $\alpha = 0.10$ level of significance (p=0.0053), results were stratified by sex. The results for male adolescents are presented in Table 4.3. In the bivariate model (Model 1), urbanicity was not associated with seatbelt use and these results were unchanged after adjusting for age, race/ethnicity, and geographic region (Model 2). However, there was an important interaction between urbanicity and geographic region (p=0.0160, Model 3). To demonstrate how geographic region of the country impacts the effect of urbanicity on this risk behavior, Figure 4.1 shows the predicted probabilities for reporting not wearing a seatbelt using non-Hispanic White, 16-year-old males as the reference group.

Not wearing a seatbelt varied greatly by geographic region for rural adolescents, but less so for those living in urban or suburban areas. Northeastern, rural males were more likely to report not wearing a seatbelt than Southern and West/Midwestern rural males (approximately 30% for rural Northeastern males compared to around 7% of rural males in either of the other regions). Not wearing a seatbelt among urban males was highest in the South at 14.4%, and lowest in the Northeast at 6.5%. Like rural males, the number of suburban males reporting this behavior was highest in the Northeast. However, the range of reporting not wearing a seatbelt was much smaller among suburban males that the range found in rural males. In this regard, suburban males were similar to urban males. The number of suburban males that reported not wearing a seatbelt ranged from 6.1% in the Midwest/West to 12.6% in the Northeast.

Table 4.3 also shows the results for females reporting not wearing a seatbelt. In Model 1, the bivariate association showed that suburban females are had lower odds of

reporting not wearing a seatbelt than urban females (Odds ratio (OR)=0.30, 95% Confidence Interval (CI) 0.12, 0.76), but there were no significant differences between rural and urban females. In the second model, after adjusting for age, sex, race/ethnicity and geographic region, suburban females still had lower odds of reporting not wearing a seatbelt than urban females. Age was also an important predictor of not wearing a seatbelt in the second model. Youth aged 14 years old or younger had 1.67 times the odds of reporting not wearing a seatbelt as 16-year-olds (CI 1.07, 2.58), while youth aged 18 years or older had a much lower odds of reporting not wearing a seatbelt when compared to 16-year-olds (OR=0.57, CI 0.36, 0.92). The third and final model included the interaction term between urbanicity and geographic region of the country, which was significant at a p-value of 0.0191. To demonstrate the interaction between urbanicity and geographic region, Figure 4.2 shows the predicted probabilities for report of not wearing a seatbelt among female adolescents. These probabilities demonstrate the predicted percent of urban, suburban, and rural females in each geographic location for reporting not wearing a seatbelt. For these predictions, covariates were set to their referent levels (non-Hispanic White, 16-year-old females were referent).

As was seen with male adolescents, rural females reporting not wearing a seatbelt varied the most by geographic region, while urban and suburban females' behaviors were much less affected by the region of the country they lived in. Female adolescents overall were much less likely to report not wearing a seatbelt than males, with the exception of females living in the rural northeast, where 32.6% reported not wearing a seatbelt in a car being driven by someone else. This is much higher than any other group of females. For instance, 2.8% of females in the rural South reported not

wearing a seatbelt and only 1.0% of Midwest/West rural females reported the behavior. Unlike rural females, urban females reported not wearing a seatbelt at similar levels across geographic regions. Urban females were slightly less likely to report not wearing a seatbelt in the Northeast (5.3%) compared to the South (8.5%) or West/Midwest (8.4%). Hardly any variability was seen in report of not wearing a seatbelt among suburban females across the country; report of not wearing a seatbelt ranged from 2.5% to 3.0% in the three geographic regions.

Table 4.3 Odds of Reporting not Wearing a Seatbelt in Cars Being Driven by Someone Else Among Adolescents by Urbanicity, YRBS 2003

Covariates	Males			Females		
	Model 1 OR (95% CI)	Model 2** OR (95% CI)	Model 3+ OR (95% CI)	Model 1 OR (95% CI)	Model 2** OR (95% CI)	Model 3+ OR (95% CI)
Urbanicity						
Urban	1.00	1.00	1.00	1.00	1.00	1.00
Rural	0.90 (0.23, 3.63)	0.94 (0.27, 3.32)	6.23 (0.88 44.67)	1.04 (0.16 6.70)	0.91, (0.19 4.38)	8.99 (0.99 81.30)
Suburban	0.57 (0.24, 1.38)	0.55 (0.21, 1.44)	**2.07 (1.12 3.84)**	**0.30 (0.12, 0.76)**	**0.24 (0.08, 0.73)**	0.55 (0.1631 1.8714)
Race/Ethnicity						
White		1.00	1.00		1.00	1.00
Black		1.31(0.65 2.63)	1.47 (0.77, 2.81)		0.82 (0.28, 2.37)	1.09 (0.39, 3.03)
Hispanic		1.63 (0.90 2.95)	1.65 (0.95, 2.88)		1.55 (0.51, 4.74)	1.67 (0.56, 4.97)
Other		1.71 (0.84, 3.46)	**1.90 (1.01, 3.52)**		1.10 (0.63 1.91)	1.37 (0.86, 2.18)
Age						
≤ 14 yrs		.99 (0.74, 1.32)	0.97 (0.73, 1.27)		**1.67 (1.07, 2.58)**	1.53 (0.97, 2.41)
15 yrs		1.10	1.08		0.95	0.92

		(0.81, 1.51)	(0.79, 1.48)		(0.72, 1.26)	(0.70, 1.20)
16 yrs		1.00	1.00		1.00	1.00
17 yrs		1.09 (0.82, 1.45)	1.08 (0.81, 1.45)		0.86 (0.61, 1.21)	0.80 (0.56, 1.14)
≥18 yrs		0.88 (0.58, 1.33)	0.88 (0.58, 1.34)		**0.57 (0.36, 0.92)**	**0.57 (0.34, 0.95)**
Geographic Region						
Northeast		1.00	1.00		1.00	1.00
Midwest/West		0.48 (0.19, 1.23)	2.43 (0.72 8.17)		0.31 (0.07 1.39)	1.67 (0.36 7.85)
South		.43 (0.16 1.13)	1.69 (0.59 4.89)		0.33 (0.07, 1.56)	1.69 (0.41 6.93)
Urbanicity*geographic region						
p-value for joint interaction			0.0160			0.0191
CI = confidence interval; OR = odds ratio.**ORs adjusted for all variables in the column +Model 3 is adjusted for all variables in Model 2 and includes the significant interaction term of Region*urbanicity						

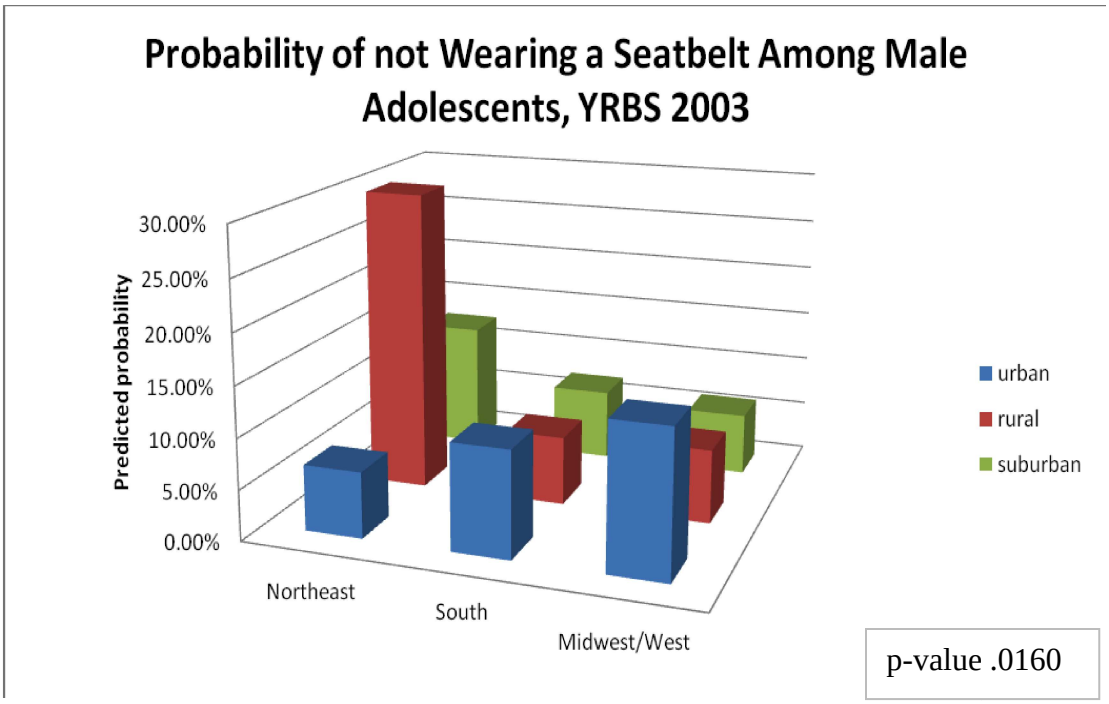

Figure 4.1 Prediictive Probabilities of Not Waering A Seatbelt Among Males

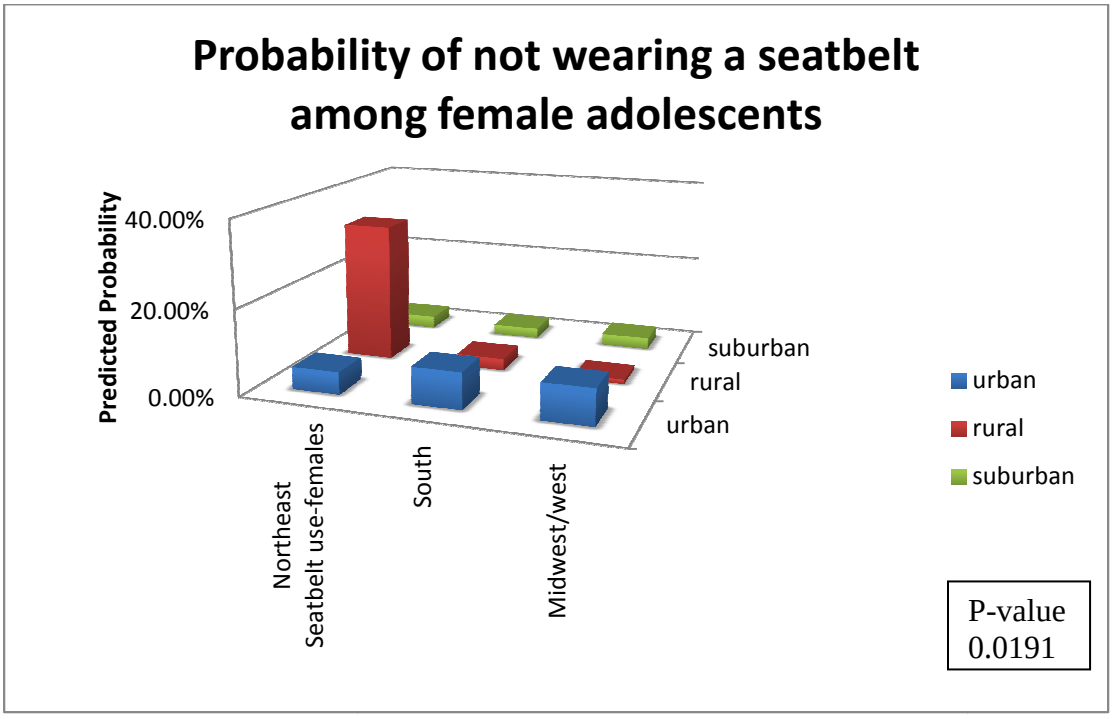

Figure 4.2 Predictive Probabilities of Not Wearing a Seatbelt Among Females

4.3. Aim 2 results

Contemplating suicide

Analysis began by testing for an interaction between urbanicity and sex on suicide contemplation. The joint test for interaction was not significant (p-value=0.4309), so Models 1-3 were not stratified by sex. In the first model, which assessed the relationship between suicide contemplation and urbanicity, suburban adolescents had slightly higher odds of reporting that they contemplated suicide than urban adolescents (OR=1.15, CI 1.01, 1.30). No significant differences were seen between rural and urban adolescents. After adjusting for age, race/ethnicity, sex, and geographic region, the odds of suburban adolescents compared to urban adolescents was still significantly different. Also of note, in this second model, females had 1.86 times the odds of reporting suicide contemplation as compared to males (CI 1.64, 2.09), and non-Hispanic Black adolescents had a lower odds of reporting suicide contemplation (OR=0.72, CI 0.59, 0.87) than non-Hispanic White adolescents. Additionally, adolescents identifying as a race/ethnicity other than non-Hispanic White, non-Hispanic Black, or Hispanic had a higher odds of reporting suicide contemplation than their non-Hispanic White counterparts (OR=1.55, CI 1.25, 1.91). There were no statistically significant differences based on age for this behavior.

The third model included the variables from Model Two as well as the interaction between geographic region and urbanicity (p-value=0.0209). Figure 4.3 shows the predicted probabilities calculated for suicide contemplation, in order to illustrate the significant interaction term between geographic region of the country and urbanicity. The rural and urban adolescents are more impacted by the geographic region of the country than adolescents living in suburban areas. The highest prevalence of suicide contemplation is in the South for both urban and rural adolescents; these youth were less

likely to report contemplating suicide if they lived in the North or the Midwest/West than if they lived in the South. For example, nearly 17% of urban adolescents in the South reported suicide contemplation compared to only 13.0% of urban adolescents reporting suicide contemplation in the Northeast, and 15.2% in the Midwest/West. Rural adolescents peaked at 17.8% reporting suicide contemplation in the South compared to 15.0% in the Northeast and 16.6% in the West/Midwest. Urban youth were slightly less likely than rural youth to report contemplating suicide in all regions. The percentage of suburban youth reporting suicide contemplation did not vary greatly from region to region. Slightly more suburban adolescents reported this behavior if they lived in the Northeast (18.8%) compared to the Midwest/West (16.8%) and South (17.5%).

Table 4.4 Odds of Contemplating Suicide Among Adolescents by Urbanicity,YRBS 2003

Covariates			
	Model 1 OR (95% CI)	Model 2** OR (95% CI)	Model 3^{+} OR (95% CI)
Urbanicity			
Urban	1.00	1.00	1.00
Rural	1.05 (0.89, 1.25)	1.06 (0.89, 1.27)	**1.20 (1.03 1.39)**
Suburban	**1.15(1.01, 1.30)**	**1.15 (1.00, 1.32)**	**1.59 (1.32 1.90)**
Sex			
Male		1.00	1.00
Female		**1.86 (1.64, 2.09)**	**1.86 (1.65, 2.10)**
Race/Ethnicity			
White		1.00	1.00
Black		**0.72 (0.59, 0.87)**	**0.74 (0.60, 0.90)**
Hispanic		1.14 (0.97, 1.35)	1.15 (0.98, 1.37)
Other		**1.55 (1.25, 1.91)**	**1.59 (1.28, 1.94)**
Age			
≤ 14 yrs		0.95 (0.79, 1.13)	0.95 (0.79, 1.14)

15 yrs		0.88 (0.75, 1.03)	0.88 (0.75, 1.03)
16 yrs		1.00	1.00
17 yrs		0.85 (0.71, 1.03)	0.85 (0.70, 1.04)
≥18 yrs		0.86 (0.82, 1.14)	0.86 (0.72, 1.03)
Geographic Region			
Northeast		1.00	1.00
Midwest/west		0.97 (0.82, 1.14)	**1.22 (1.02 1.47)**
South		1.05 (0.88, 1.67)	**1.39 (1.15 1.69)**
Urbanicity*geographic region			
p-value for joint interaction			0.0209
CI =confidence interval; OR=odds ratio **ORs adjusted for all variables in the column +Model 3 is adjusted for all variables in Model 2 and includes interaction term of Region*urbanicity. Sex interaction term not significant for suicide (p-value=0.4309)			

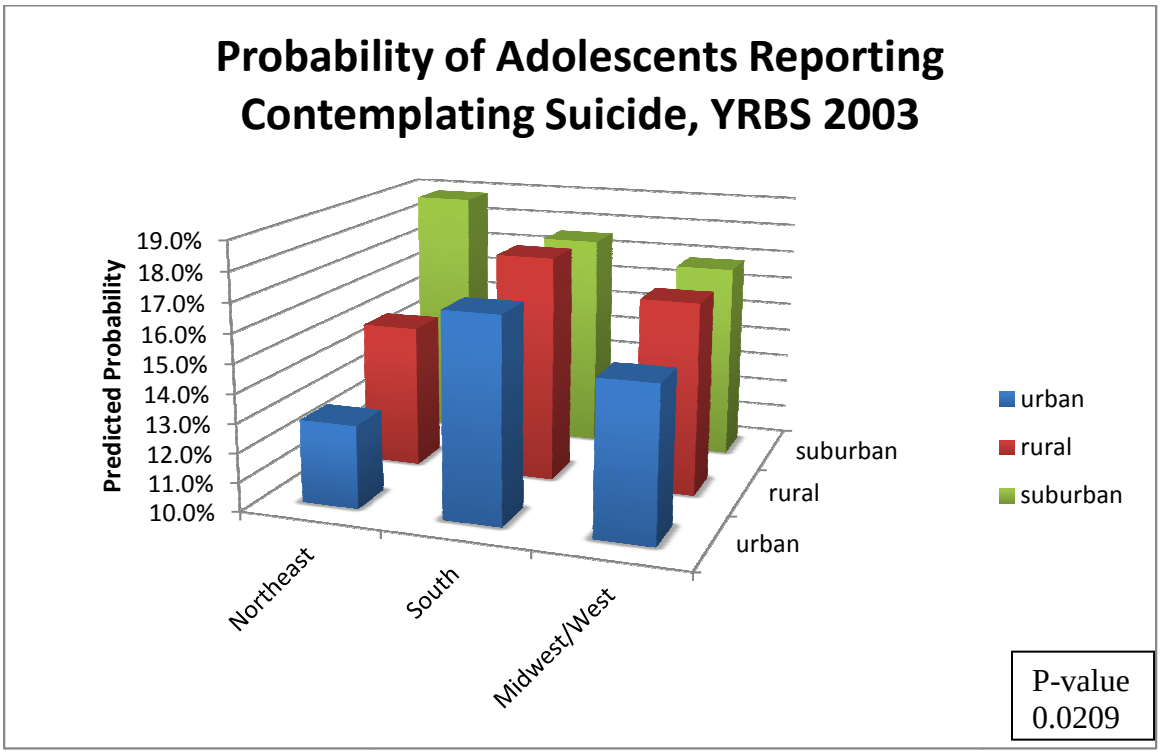

Figure 4.3 Predictive Probabilities of Suicide Contemplation

Carrying a weapon

The interaction term between sex and urbanicity was significant (p=0.1); therefore results for this analysis (models 1-3) are stratified by sex. The first model for both males and females shows the bivariate relationship between urbanicity and report of carrying a weapon (Table 4.5). In this initial model, rural males reported this behavior at an odds that is 1.85 (CI 1.27, 2.70) times the odds of their urban counterparts. The odds of reporting carrying a weapon among suburban males was not statistically significantly different than the odds of reporting this behavior among urban males. In Model 2, which is adjusted for demographic variables (race/ethnicity, age, and geographic region of the country), the strength of the association among rural males versus urban males was higher than in Model 1. After adjustment, rural males' odds of reporting carrying a weapon were 1.99 times that of urban males (CI 1.23, 3.22). Again, there are no statistically significant differences between suburban males and urban males for carrying a weapon. There were no statistically significant differences between females across urbanicity in Model 1 or Model 2. Given the hypothesis that rural and urban adolescents would be equally likely to report this behavior, and that no differences were detected between these levels of urbanicity within the female population, a test of equivalence was conducted. The test concluded that there were no statistically significant differences between the probability of an urban female reporting not wearing a seatbelt and the probability of a rural female reporting this behavior. However, because of small numbers reporting this behavior among females (1.4%), power was limited.

The significant interaction term between sex and urbanicity is most noteworthy within the rural population, where the odds of carrying a weapon is higher for rural versus urban males compared to rural versus urban females (OR=1.99 and OR=1.16,

respectively). Suburban youth appeared to have similar odds regardless of sex (OR=1.35 for males and OR=1.31 for females in Model 2). There was no evidence of effect modification by geographic region for either males or females (Model 3). The p-value for interaction was 0.5393 for males, and 0.6612 for females.

Table 4.5 Odds of Reporting Carrying a Gun Among Adolescents by Urbanicity, YRBS 2003

Covariates	Male			Female		
	Model 1 (OR, CI)	Model 2** (OR, CI)	Model 3+ (OR, CI)	Model 1 (OR, CI)	Model 2** (OR, CI)	Model 3+ (OR, CI)
Urbanicity						
Urban	1.00	1.00	1.00	1.00	1.00	1.00
Rural	**1.85 (1.27, 2.70)**	**1.99 (1.23, 3.22)**	1.47 (0.65, 3.34)	0.89 (0.43, 1.83)	1.16 (0.59, 2.19)	1.57 (0.24, 10.25)
Suburban	1.10 (0.83, 1.09)	1.35 (0.95, 1.92)	1.49 (0.75, 2.97)	0.99 (0.58 1.70)	1.31 (0.70, 2.45)	3.54 (0.70, 17.88)
Race/Ethnicity						
White		1.00	1.00		1.00	1.00
Black		1.22 (0.86, 1.72)	1.18 (0.82, 1.70)		1.25 (0.60, 2.61)	1.30 (0.58, 2.96)
Hispanic		0.90 (0.58, 1.41)	0.88 (0.55, 1.40)		1.91 (0.81, 4.52)	1.95 (0.81, 4.67)
Other		1.47 (0.86, 2.53)	1.44 (0.82, 2.52)		1.46 (0.70, 3.06)	1.52 (0.74, 3.10)
Age						
≤ 14 yrs		1.05 (0.71, 1.4)	1.04 (0.71, 1.53)		1.50 (0.50, 4.52)	1.51 (0.49, 4.63)
15 yrs		0.94 (0.72, 1.24)	0.94, (0.71, 1.23)		0.68 (0.40, 1.16)	0.68 (0.40, 1.16)
16 yrs		1.00	1.00		1.00	1.00
17 yrs		1.09 (0.81, 1.45)	1.09 (0.82, 1.46)		0.68 (0.38, 1.24)	0.68 (0.38, 1.22)

≥18 yrs		1.09 (0.79, 1.50)	1.08 (0.79, 1.50)		0.70 (0.32, 1.56)	0.69 (0.32, 1.51)
Geographic Region						
Northeast		1.00	1.00		1.00	1.00
Midwest/west		1.35 (0.84, 2.18)	1.56 (0.90, 2.68)		1.04 (0.40, 2.67)	2.62 (0.59, 11.56)
South		1.34 (0.85, 2.10)	1.17 (0.73, 1.86)		0.68 (0.23, 2.00)	1.37 (0.37, 5.10)
Urbanicity*geographic region						
p-value for joint interaction			0.5393			0.6612
CI = confidence interval; OR = odds ratio. **ORs adjusted for all variables in the column +Model 3 is adjusted for all variables in Model 2 and includes interaction term of Region*urbanicity.						

4.4 Aim 3 results

Alcohol use

The interaction between urbanicity and sex was not statistically significant (p-value=0.4727), therefore results for models 1-3 were not stratified by sex. Results are shown in Table 4.6 for urbanicity and alcohol use. In Model 1, the bivariate analysis of alcohol use and urbanicity, rural adolescents had a slightly higher odds of reporting alcohol use in the past 30 days compared to urban adolescents (OR =1.17, CI 0.93, 1.45), although the relationship was not statistically significant. Likewise, suburban adolescents had a slightly higher odds of reporting alcohol use when compared to urban adolescents (OR=1.22, CI 0.99, 1.50), but again, this was not statistically significant.

In Model 2, after adjustment for age, sex, race/ethnicity, and geographic region of the country, there were still no statistically significant differences found between

adolescents across the three levels of urbanicity. Likewise, the interaction between region of the country and urbanicity was not statistically significant (p-value=0.5480, Model 3).

These results indicate that adolescents in the US engage in alcohol consumption at similar rates across the country, regardless of urbanicity. All other racial groups reported alcohol consumption less frequently than their non-Hispanic White counterparts. Non-Hispanic Black adolescents reported drinking less than non-Hispanic White adolescents, with an odds 0.65 times that of non-Hispanic White adolescents (CI 0.55, 0.76). Those in the racial/ethnic grouping of 'other' reported an odds of drinking that was 0.84 times that of their non-Hispanic White counterparts (CI 0.71, 0.99) and Hispanic adolescents reported an odds that was 0.92 times that of non-Hispanic White adolescents (CI 0.80, 1.05).

Females had slightly higher odds of reporting past 30-day consumption of alcohol than males (OR 1.13, CI 1.04, 1.22). The odds of alcohol use also increased with age. Those aged 14 years or younger had an odds of reporting alcohol use that was 0.57 times that of 16-year-olds (CI 0.45, 0.72). 15-year-olds had an odds of drinking that was 0.83 times that of 16-year-olds (CI 0.75, 0.93). The odds of drinking among 17-year-olds was 1.27 times greater than the odds among 16-year-olds (CI 1.12, 1.43) and the odds among those aged 18 or older was the greatest at 1.60 times the odds of drinking among 16-year-olds (CI 1.37,1.87). This highly prevalent behavior (41.7%) was universally experienced regardless of urbanicity or geographic region of the country.

Table 4.6 Odds of Past 30 Day Alcohol Use Among Adolescents by Urbanicity,YRBS 2003

Covariates			
	Model 1 (OR, CI)	Model 2** (OR, CI)	Model 3+ (OR, CI)
Urbanicity			

Urban	1.00	1.00	1.00
Rural	1.17 (0.93, 1.45)	1.00 (0.80, 1.26)	0.91 (0.42, 2.00)
Suburban	1.22 (0.99, 1.50)	1.13 (0.92, 1.40)	1.37 (0.92, 2.03)
Sex			
Male		1.00	1.00
Female		**1.13 (1.04, 1.22)**	**1.13 (1.04, 1.23)**
Race/Ethnicity			
White		1.00	1.00
Black		**0.65 (0.55, 0.77)**	**0.66 (0.56, 0.78)**
Hispanic		0.92 (0.80, 1.05)	0.92 (0.80, 1.06)
Other		**0.84 (0.71, 1.00)**	0.85 (0.71, 1.01)
Age			
≤ 14 yrs		**0.57 (0.45,0 .72)**	**0.57 (0.45, 0.72)**
15 yrs		**0.83 (0.75,0.93)**	**0.83 (0.74,0.94)**
16 yrs		1.00	1.00
17 yrs		**1.27 (1.12, 1.43)**	**1.27 (1.12, 1.44)**
≥18 yrs		**1.60 (1.37, 1.87)**	**1.60 (1.37, 1.88)**
Geographic Region			
Northeast		1.00	1.00
Midwest		0.80 (0.61, 1.05)	0.88 (0.60, 1.30)
South		0.99 (0.79, 1.23)	1.13 (0.79, 1.62)
Urbanicity*geographic region			
p-value for joint interaction			0.5480
CI = confidence interval; OR = odds ratio. **ORs adjusted for all variables in the column +Model 3 is adjusted for all variables in Model 2 and includes interaction term of Region*urbanicity.			

Drug use

Table 4.7 shows the regression models investigating the relationship between urbanicity and marijuana use. The interaction between sex and urbanicity was not significant at an alpha of 0.1 (p-value=0.8493), so the table shows results for all adolescents and results were not stratified by sex. Model 1 shows the bivariate analysis. In this initial analysis, suburban youth showed no differences in marijuana use when compared to urban adolescents (OR=0.98, CI 0.75, 1.28). Rural youth had slightly lower

odds of reporting marijuana use than urban youth (OR=0.83), but the confidence interval included the null value of 1 and so these findings were not statistically significant.

Model 2 included the demographic variables of age, sex, race/ethnicity, and region of the country. In this model, there was again no statistical difference found in the odds of marijuana use between adolescents in the three levels of urbanicity. The odds of reporting drug use was found, however, to increase with age. Those in the youngest age group had an odds 0.57 times (CI 0.45, 0.72) that of those in the median age group, and those in the oldest age group had the greatest odds in comparison to the median age group (OR 1.60 CI 1.37, 1.87). No significant differences were found between the racial/ethnic groups. Youth in the Midwestern/Western part of the country had a lower odds of reporting drug use than those in the Northeast (OR=0.61, CI 0.43, 0.86). Youth in the South also had lower odds of reporting drug use than youth in the Northeast, though this association was not as strong as was seen in the Midwest/West. Southern youth had an odds of reporting marijuana use that was 0.83 times the odds of Northeast youth (CI 0.57, 1.22).

The final model (Model 3) included all variables from Model 2 as well as the interaction term between urbanicity and geographic region of the country. This interaction term was significant 0.10 level (p-value =0.0192). Figure 4.4 shows how geographic region of the country impacted the association between urbanicity and marijuana use. Unlike previously analyzed behaviors, suburban youth's prevalence of drug use was markedly impacted by geographic region of the country. In fact, suburban youth experienced a greater variability by geographic region of reporting drug use than rural or urban adolescents. The largest percentage of adolescents reporting drug use was among suburban adolescents in the Northeast (31.5%). This number was lower in other

regions, with 21.9% of suburban adolescents in the South and 18.4% of suburban adolescents in the Midwest/West reporting past thirty-day drug use.

When looking at rural adolescents, the smallest percentage of reported marijuana use was in the West/Midwest (13.9%), and the largest percentage reported marijuana use was in the rural South (26.3%). Urban adolescents reported marijuana use similarly across all three regions, varying from 24.1% in the South and 22.5% in the Midwest/West to 19.6% in the Northeast. There was no consistent trend in the prevalence of reporting drug use across the geographic regions by urbanicity, though all three groups reported drug use at a similar rate in the South (ranging from 22.0% among suburban adolescents to 26.3% among rural adolescents). Reports in the Midwest/West varied from 13.9% in rural youth to 22.5% in urban youth. Lastly, both urban and rural adolescents reported prevalence of marijuana use in the Northeast at approximately 19.5%, while a much greater percentage (31.5%) of suburban youth reported drug use in the Northeast.

Table 4.7 Odds of Reporting Marijuana Use Among Adolescents by Urbanicity, YRBS 2003

Covariates			
	Model 1 OR (95% CI)	Model 2** OR (95% CI)	Model 3^{+} OR (95% CI)
Urbanicity			
Urban	1.00	1.00	1.00
Rural	0.83 (0.55, 1.24)	0.78 (0.51, 1.19)	0.99 (0.25 3.89)
Suburban	0.98 (0.75 1.28)	0.96 (0.74, 1.24)	1.93 (0.65 5.64)
Sex			
Male		1.00	1.00
Female		**0.73 (0.68, 0.79)**	**0.74 (0.68, 0.79)**
Race/Ethnicity			

White		1.00	1.00
Black		1.04 (0.84 1.28)	1.08 (0.87 1.34)
Hispanic		1.04 (0.90 1.22)	1.05 (0.89 1.24)
Other		1.06 (0.76 1.47)	1.07 (0.77 1.49)
Age			
≤ 14 yrs		**0.58 (0.48 0.69)**	**0.57 (0.48 0.68)**
15 yrs		0.90 (0.78 1.03)	0.90 (0.78 1.03)
16 yrs		1.00	1.00
17 yrs		1.20 (1.03 1.40)	**1.20 (1.04 1.40**)
≥18 yrs		1.30 (1.07 1.59)	**1.31 (1.07 1.60)**
Geographic Region			
Northeast		1.00	1.00
Midwest/west		**0.61 (0.43 0.86)**	1.20 (0.47 3.05)
South		0.83 (0.57 1.22)	1.33 (0.51 3.49)
Geographic Region*Urbanicity			
p-value for joint interaction			0.0192
CI = confidence interval; OR = odds ratio. **ORs adjusted for all variables in the column +Model 3 is adjusted for all variables in Model 2 and includes the significant interaction term of Region*urbanicity Note: sex interaction term was not significant (p-value 0.8493)			

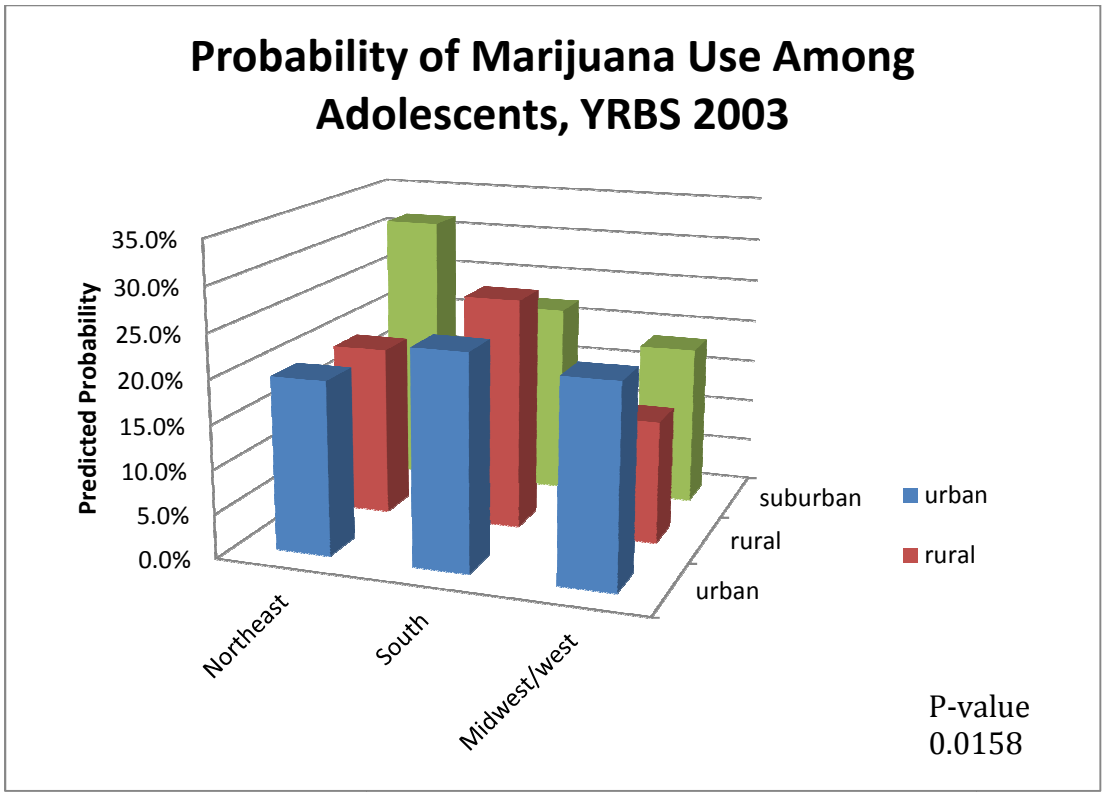

Figure 4.4 Predictive Probablities of Marijuana Use

4.5 Aim 4 results

Tobacco use

The analysis of tobacco use is presented in Table 4.8. Results are not stratified by sex, as the interaction term between sex and urbanicity was not statistically significant (p-value = 0.4375).

As shown in the bivariate analysis (Model 1), rural adolescents reported tobacco use slightly more often than their urban counterparts (OR=1.23), but the relationship was not statistically significant given that the confidence interval included the null value of one. There were no differences for tobacco use between suburban and urban adolescents (OR=0.95, CI 0.73, 1.24). After adjustment for the demographic variables (age, sex, race/ethnicity, and geographic region of the country) in Model 2, both of these estimates

remained about the same. The odds of rural adolescents reporting tobacco use compared to urban adolescents was 1.24 (CI 0.83, 1.82), while the odds of suburban adolescents reporting tobacco use compared to urban adolescents was 0.99 (CI 0.78, 1.27).

In terms of the other variables in the model, differences were found by age and race/ethnicity, but not by sex or geographic region. The odds among Hispanic adolescents of reporting this behavior was moderately higher than non-Hispanic White adolescents (OR=1.23, CI 1.00, 1.51). As seen with drug use, the odds of tobacco use increased with age. Those aged 14 years old or younger had an odds of reporting tobacco use that was 0.58 times the odds of 16-year-olds (CI 0.47, 0.70). This relationship was not as strong among 15-year-olds, who had an odds of reporting tobacco use that was 0.76 times that odds of 16-year-olds (CI 0.66, 0.88). 17-year-olds showed no difference in reporting tobacco use when compared to 16-year-olds (OR=1.07, CI 0.95, 1.21). 18-year-olds had the greatest odds of reporting tobacco use at 1.35 times the odds of 16-year-olds (CI 1.15, 1.60). The interaction between region of the country and urbanicity was not significant when analyzing tobacco use (p-value=0.3084, Model 3).

Table 4.8 Odds of tobacco use among adolescents by urbanicity, YRBS 2003

Covariates	Model 1 OR (95% CI)	Model 2** OR (95% CI)	Model 3^{+} OR (95% CI)
Urbanicity			
Urban	1.00	1.00	1.00
Rural	1.23 (0.83 1.82)	1.24 (0.86, 1.78)	1.23 (0.41, 3.68)
Suburban	0.95 (0.73 1.24)	0.99 (0.78, 1.27)	1.22 (0.78, 1.89)
Sex			
Male		1.00	1.00
Female		1.00 (0.88, 1.13)	1.00 (0.88, 1.13)
Race/Ethnicity			
White		1.00	1.00
Black		0.92 (0.72, 1.18)	0.92 (0.72, 1.18)
Hispanic		**1.23 (1.00, 1.51)**	1.22 (0.98, 1.51)

Other		0.91 (0.71, 1.17))	0.90 (0.70, 1.15)
Age			
≤ 14 yrs		**0.58 (0.47, 0.70)**	**0.57 (0.47, 0.69)**
15 yrs		**0.76 (0.66, 0.88)**	**0.76 (0.66, 0.88)**
16 yrs		1.00	1.00
17 yrs		1.07 (0.95, 1. 21)	1.06 (0.94, 1.21)
≥18 yrs		**1.35 (1.15, 1.60)**	**1.35 (1.15, 1.60)**
Geographic Region			
Northeast		1.00	1.00
South		1.32 (0.94, 1.84)	1.36 (0.80, 2.31)
Midwest/West		0.87 (0.64, 1.19)	1.12 (0.65, 1.92)
Geographic Region*Urbanicity			
p-value for joint interaction			0.3178
CI = confidence interval; OR = odds ratio. **ORs adjusted for all variables in the column +Model 3 is adjusted for all variables in Model 2 and includes the interaction term of Region*urbanicity Note: sex interaction is not significant at p=0.4375			

4.6 Discussion

This research finds that there is, in fact, important variation in the engagement in risk behaviors among adolescents across urbanicity, and that these differences are often impacted by sex and geographic location as well. When considering the main effects of urbanicity on the various risk behaviors, it is difficult to see a clear trend across all of the behavior categories. After adjusting for demographic covariates, differences in the main effects of urbanicity on adolescent risk behaviors were most often significant when comparing suburban and urban adolescents. When considering seatbelt use, suburban males had a greater odds of not wearing their seatbelt than urban males, yet suburban females had a decreased odds of reporting not wearing their seatbelt when compared to urban females. No significant differences were found between rural males or females and their urban counterparts. Again with suicide contemplation, differences are detected

between suburban and urban but not rural and urban adolescents. Suburban adolescents have a slightly greater odds of suicide contemplation than either of their counterparts. When considering weapon carrying, rural males where more likely to report carrying a weapon than urban males but no other differences were detected. No differences in main effects were seen for alcohol, tobacco or drug use.

There were important differences in the relationship between urbanicity and risk behaviors by sex and by geographic region. The effect of urbanicity on risk behaviors was modified by sex for the least prevalent risk behaviors: weapon carrying and seatbelt use, but not for suicide, drug, alcohol or tobacco use. Males were generally more likely to report both carrying a weapon and not wearing a seatbelt than females were. For seatbelt use, urban, suburban and rural males in all three regions were more likely to report not wearing a seatbelt than females in the same region and level of urbanicity with the exception of the rural Northeast. Females in the rural Northeast were predicted to report not wearing a seatbelt 32.6% of the time compared to males in the same region and level of urbanicity, who were predicted to report not wearing a seatbelt 29.9% of the time. Males were more likely to report carrying a weapon than females, regardless of geographic region or level of urbanicity. The predicted probabilities of males reporting carrying a firearm in the different geographic regions and levels of urbanicity ranged from 6.2% to 14.0% while the predicted probabilities for females throughout the geographic regions and levels of urbanicity ranged from 0.7% to 2.5%.

In terms of geographic region, suburban youths' engagement in risk behaviors was generally less affected by the geographic region than it was for rural and urban youth. Specifically, effect modification on the relationship between urbanicity and risk

behaviors by geographic region was seen when considering seatbelt use, suicide contemplation and drug use. Seatbelt use varied more between the levels of urbanicity in the Northeast than in the South or West/Midwest. Adolescents in the rural Northeast were most likely to report not wearing a seatbelt for both males and females while adolescents in the rural South (for males) and rural West/Midwest (for females) were least likely to report not wearing a seatbelt. Both rural and urban adolescents were less likely to report suicide contemplation in the Northeast than in the South or West/Midwest. Suburban adolescents did not see a great deal of difference in their predicted probability of reporting seatbelt use or suicide contemplation by geographic region. However, suburban adolescents did see differences in report of drug use by geographic region. Suburban adolescents in the Northeast were more likely to report past 30 day marijuana use than any other level of urbanicity throughout all three geographic regions. Unlike suburban adolescents, living in the Northeast was protective against reporting marijuana use among rural and urban youth; these groups were most likely to report marijuana use if they lived in the South.

When considering the most prevalent behaviors of alcohol and tobacco use, neither the sex/urbanicity nor geographic region/urbanicity interaction terms were significant. In fact, it appears that in the case of more commonly reported behaviors, risk may be more universally experienced, regardless of sex, urbanicity or geographic region.

Seatbelts:

When looking at seatbelt use by urbanicity, the original hypothesis was that rural and suburban adolescents would be less likely than urban adolescents to report wearing seatbelts. However, in models adjusted for age, race/ethnicity, and geographic region,

there were no differences by urbanicity for males, and limited differences for females. Only adolescent girls in suburban areas had a reduced odds of not wearing a seatbelt when compared to urban youth; there were no differences for seatbelt use between rural and urban females. However, there were important differences for both sexes by geographic region. As the prediction equations showed, rural youth in the Northeast reported not wearing a seatbelt much more frequently than any other group. This was true among males as well as females. The findings that Northeast rural youth were most likely to not report wearing a seatbelt were consistent with findings in the literature from Canada, the US and Norway that rural youth are more likely to engage in risky motor vehicle behaviors than urban youth (Eiksund, 2009; Pickett et al. 2012). Regarding suburban youth, for males, suburban youth were more likely than urban youth to report not wearing a seatbelt in the Northeast, but less likely in other regions of the country. For females, suburban youth were less likely than urban youth to report not wearing a seatbelt regardless of geographic region. Given the lack of literature on suburban/urban differences in seatbelt use among adolescents, comparisons to previous studies on this finding cannot be made. However, an analysis of the Behavioral Risk Surveillance System (a survey given nationally to non-institutionalized adults annually to assess self report of risk behaviors), found both regional and urbanicity differences among report of seatbelt use. Adults were most likely to report wearing a seatbelt in the Western and Southern parts of the country, and most likely to not report wearing a seatbelt in the Northeast and Midwest, while also more likely to report seatbelt use in more urban areas (Strine 2010). Given that the adults one is surrounded by often mold behavior, this

supports the findings of this research that adolescents in rural northern regions are less likely to wear a seatbelt than their counterparts.

Suicide:

The hypothesis for the first part of aim two was that rural youth would be more likely to have seriously considered attempting suicide than their urban counterparts, while suburban adolescents would be less likely to have considered suicide than their urban counterparts. The analyses showed that rural youth are not more likely to report contemplating suicide than urban youth, but that suburban youth actually had a higher odds of reporting suicide contemplation than urban adolescents (OR=1.15, CI 1.00, 1.32). Across all three geographic regions, urban adolescents were less likely to report suicide contemplation than suburban or rural adolescents. Differences between these levels of urbanicity were greatest in the Northeast. In the Northeast, suburban adolescents were also more likely than rural adolescents to report suicide contemplation, yet in the South and West/Midwest, there were virtually no differences seen between suburban and rural adolescents. In fact, in the South, across all levels of urbanicity, the probability of reporting suicide contemplation was fairly steady (ranging from 16.9% among urban to 17.8% among rural). While the literature is limited in its analysis of suburban/urban differences in suicide, the significant finding that rural youth were more likely to report contemplating suicide than urban youth in the Northeast and West/Midwest is supported by existing literature (Swhan and Bossarte, 2009; Nance et Al 2010).

Firearm carrying:

In regard to carrying a firearm (the second part of aim two), the hypothesis was that there would be no difference between rural and urban adolescents reporting carrying

a gun in the previous 30 days, and that suburban adolescents would be less likely to report carrying a gun than their urban counterparts. This hypothesis was not entirely supported by the results of the analysis. While this hypothesis was supported among females, where there was insufficient evidence to detect a significant difference between rural and urban report of weapon carrying, the hypothesis was not supported when considering males. Rural males had a higher odds than urban males of reporting carrying a weapon (OR=1.99, CI 1.23, 3.22). The evidence was also insufficient to support the hypothesis that there were any differences between suburban adolescents of either sex and their urban counterparts.

The literature is also divided on the differences in violent behaviors by urbanicity. For instance, the lack of difference between urban and rural youth on weapon carrying is supported by an analysis of US vital statistics, which found no difference in the rate of firearm deaths between urban and rural youth (Nance et Al 2010). However, Atav et al's study from New York found that rural adolescents were more likely to report carrying a weapon than urban or suburban adolescents (Atav et al 2002), which could support this finding of increased odds among rural males. The effect modification by sex shown in this analysis could explain some of these differing results in the literature.

Alcohol use:

The hypothesis for aim 3 regarding alcohol use was not supported. The hypothesis was that rural youth would report consumption of alcohol more often than urban adolescents, and suburban adolescents would report alcohol consumption less frequently than urban youth. Results showed no statistically significant differences between the three levels of urbanicity and engagement in alcohol consumption. This differs from

existing literature (Coomber et al 2011; Atav and Spencer 2002), which concluded that rural youth were more likely to engage in alcohol use than their more urban counterparts. However, these findings are supported by previous analyses of prior YRBS data which also concluded there were no significant differences detected between urban and rural youth when examining alcohol use (Levine and Coupley 2003; Greggo, Jones, and Kann, 2005). Differences found in the literature could be partially explained by the fact that those studies detecting significant differences were not conducted on nationally representative samples.

Marijuana use:

The hypothesis regarding marijuana use was that both rural and suburban adolescents would be less likely to report marijuana use than their urban counterparts. However, as seen with alcohol use, when considering the main effect, there were no differences between levels of urbanicity regarding marijuana use. When considering the interaction between urbanicity and geographic region, the group most likely to report drug use was suburban adolescents in the Northeast, and the group least likely to report drug use was rural youth in the Midwest/West. It was only in the Midwest/West that, as hypothesized, urban youth reported drug use more frequently than their counterparts. The predicted probabilities showed 22.5% of urban adolescents in this region reported use compared to 13.9% of rural youth or 18.4% of suburban youth.

While literature was limited on the topic of urbanicity's impact on drug use, these findings are at odds with the studies that have investigated this behavior (Atav and Spencer 2002; Coomber et al 2011) and found that rural youth were at an increased risk of marijuana use compared to urban youth. This could be due to differences in variables

adjusted for in analysis or due to the fact that Atav and Spencer study only looked at New York State and Coomber et al's data are from Washington state and Victoria, Australia, while this analysis was done using nationally representative data.

Tobacco use:

When analyzing tobacco use, limited evidence was found to support the hypothesis that rural adolescents would more frequently report trying cigarettes than urban adolescents. Although rural adolescents had 1.24 times the odds of reporting tobacco use than urban adolescents, the confidence interval included the null (CI 0.86, 1.78). The hypothesis that suburban adolescents would be less likely to report ever smoking was also not supported. There were no significant differences detected between urban and suburban adolescents' odds of reporting smoking.

Overall Summary:

Urbanicity affects different risk behaviors in different ways. The relationship between urbanicity and risk behavior uptake is not straightforward. This relationship is often modified by sex (in the case of seatbelt use or weapon carrying) and geographic region of the country (as seen with seatbelt use, suicide contemplation and drug use). The relationship between urbanicity and risk behaviors also seems to be influenced by how common a risk behavior is, with more common behaviors seeing little to no differences in uptake across the geographic groups.

4.7 Strengths

While the analysis did not support many of the hypotheses developed, the research still contributes important findings to the literature. The consideration of interaction terms in this analysis is strengths of this investigation. This research

considered key effect modification by sex and by geographic region. It should be noted that few studies to date have considered these interaction terms in analysis. Of particular interest is the interaction between geographic region of the country and urbanicity. Since many studies previously published focused on a specific state or region of the country, this interaction term suggests that data from these studies may not be able to be generalized to the US adolescent population as a whole.

As an analysis of a nationally representative data sample, this analysis is representative of the country as a whole. This analysis uses CDC survey questions to measure risk behaviors which have been validated over the years (Zullig et al., 2006; Brenner et al., 2002), complex sampling designs were able to be accounted for in analysis, and the overall response rate to this survey was high (CDC, 2013g; CDC, 2013f). These factors all strengthen the analysis conducted in this study.

Additionally, this research is strengthened by its ability to consider suburban-urban as well as urban-rural differences instead of merely dichotomizing the exposure. This sheds important light into the differences between suburban and urban youth's engagement in risk behaviors. Another strength of this research is its ability to consider the sex-urbanicity interaction term. This suggests that males and females experience living in various levels of urbanicity differently from one another. Considering these important interaction terms, this nationally representative research suggests that youth risk behavior is not as universally experienced as previously thought.

4.8 Limitations

This study has several limitations. First, since the last year that information regarding urbanicity was collected for YRBS was 2003, a limitation of this analysis is the

age of the data. Additionally no information was collected on several potential confounders, including socioeconomic variables; the covariates able to be included in analysis were limited to the data that was routinely collected in the anonymous YRBS survey.

In addition, the data are self-reported from a survey conducted in a classroom. This may increase the reporting bias due to socially desirable reporting. Socially desirable reporting occurs when the interviewer or circumstances influence the individual to respond dishonestly, by responding with the answer they feel will be seen more favorably. In other words, people who know they are engaging in risky behaviors may not want to admit to doing so. Administering the survey in a classroom may cause an increase in socially desirable reporting or an increase in non-response bias. Students may be reluctant to admit to illegal behaviors or behaviors that are against school policy while in school.

However, studies suggest that self-reported data are as accurate among youth as among the adult population (CDC, 2013f). Furthermore, YRBS conducts internal validity checks to attempt to identify false answers (CDC, 2013f). Likewise, previous studies have found that when surveys are given repeatedly over a period of time to the same students, answers remain fairly consistent (mean Kappa of 0.60 to 0.62) (Zullig et al., 2006; Brenner et al., 2002). Moreover, the studies are taken anonymously, which can reduce these biases.

While the variables selected to measure the behavior categories were selected to be comparable to questions analyzed in existing literature, the survey questions selected for analysis may be another potential limitation. For instance, by using a common behavior

(marijuana use) as a measure of drug use, it is possible that major differences among use of other drugs were not captured. However, given that many existing studies use marijuana use as a proxy for drug use, the results remain comparable to the literature. Future research could focus on multiple drugs to measure the differences in use by urbanicity.

4.9 Conclusion

This paper finds that, in many instances, youth in rural and suburban settings engage in risk behaviors differently than youth in more urban settings. Few studies to date have considered suburban youth separately from urban youth. The findings of this research support the idea that urbanicity should not be dichotomized into urban versus rural, and that suburban youth engage in risk behaviors in a unique way that differs from their urban or rural counterparts. Thus, efforts to prevent or reduce risk behaviors may be more effective when tailored to the full range of urbanicity. In particular, interventions related to unintentional injury and violence would likely be most effective when made specifically for urban, suburban, or rural youth. Highly prevalent behaviors, such as alcohol and tobacco use, are experienced more universally, regardless of urbanicity. Future research could explore how interventions may be effectively tailored to these specific populations.

Also of significance was the modification of the association between urbanicity and many of the outcomes by geographic region of the country, as well as the modification of the associations by sex. The manner in which a teen engages in risky behavior is impacted by a host of complex factors. It is important for future research to continue to evaluate risk behavior categories as well as the modification of engagement

in risk behavior by sex and geographic region. It is also possible that adolescents of differing race/ethnicities could experience rural, suburban and urban communities in different ways. These relationships should be assessed in future analyses.

REFERENCES

American Foundation for Suicide Prevention, "Facts and figures," 2014, Retrieved April 2014, available at http://www.afsp.org/understanding-suicide/facts-and-figures.

Atav, S., & Spencer, G. (2002). Health risk behaviors among adolescents attending rural, suburban, and urban schools: a comparative study. Family & community health, 25, 53–64.

Bae, S. ,Ye, R. Chen, S., Rivers, P. Singh, K. (2005)

Risky Behaviors and Factors Associated with Suicide Attempt in Adolescents, Archives of Suicide Research, 9:2, 193-202, DOI: 10.1080/13811110590904034

Balis, T., & Postolache, T. T. (2008). Ethnic differences in adolescent suicide in the United

States. International journal of child health and human development: IJCHD, 1(3), 281.

Beck, M. (July 11 2011). City V. Country: Who's Healthier?. The Wallstreet Journal. Health journal, retrieved from

http://online.wsj.com/news/articles/SB10001424052702304793504576434442652581806

Bell, N., Simons, R. K., Lakha, N., & Hameed, S. M. (2012). Are we failing our rural communities? Motor vehicle injury in British Columbia, Canada, 2001–2007. Injury, 43(11), 1888–1891. doi:10.1016/j.injury.2011.07.018

Bennett, D. A. (2001). How can I deal with missing data in my study?. Australian and New Zealand Journal of Public Health, 25(5), 464-469.

Borders, T. F., & Booth, B. M. (2007). Rural, suburban, and urban variations in alcohol consumption in the United States: findings from the National Epidemiologic Survey on Alcohol and Related Conditions. The Journal Of Rural Health: Official Journal Of The American Rural Health Association And The National Rural Health Care Association, 23, 314–321.

Booth, B. M., & Curran, G. M. (2006). Variations in drinking patterns in the rural South: joint effects of race, gender, and rural residence. The American journal of drug and alcohol abuse, 32(4), 561-568.

Bouchery, E. E., Harwood, H. J., Sacks, J. J., Simon, C. J., & Brewer, R. D. (2011). Economic costs of excessive alcohol consumption in the US, 2006. American journal of preventive medicine, 41(5), 516–524.

Branas, C. C., Nance, M. L., Elliott, M. R., Richmond, T. S., & Schwab, C. W. (2004). Urban-rural shifts in intentional firearm death: different causes, same results. American Journal of Public Health, 94(10), 1750–1755.

Brener, N. D., Kann, L., McManus, T., Kinchen, S. A., Sundberg, E. C., & Ross, J. G. (2002). Reliability of the 1999 youth risk behavior survey questionnaire. *Journal of Adolescent Health*, *31*(4), 336-342.

Carr, B. G., Nance, M. L., Branas, C. C., Wolff, C. S., Kallan, M. J., Myers, S. R., & Wiebe, D. J. (2012). Unintentional firearm death across the urban-rural landscape in the United States. The Journal of Trauma and Acute Care Surgery, 73(4), 1006–1010.

CDC (July 2010a). Cigarette Use Among High School Students – United States 1991-2009. MMWR. Morbidity and Mortality Weekly Reports. Available at http://www.cdc.gov/mmwr/PDF/wk/mm5926.pdf. Retrieved October 2013.

CDC (June 2010b). Youth Risk Behavior Surveillance --- United States, 2009. Available at http://www.cdc.gov/MMWR/preview/mmwrhtml/ss5905a1.htm. Retrieved October 2013.

CDC (November 2012a) About Teen Pregnancy. Available at http://www.cdc.gov/teenpregnancy/aboutteenpreg.htm. Retrieved October 2013.

CDC (October 2012b). CDC Fact Sheets- Underage Drinking. Available at http://www.cdc.gov/alcohol/fact-sheets/underage-drinking.htm. Retrieved October 2013.

CDC (June 2012c). Trends in HIV-Related Risk Behaviors Among High School Students — United States, 1991–2011. MMWR. Morbidity and Mortality Weekly Reports. Available at http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6129a4.htm?s_cid=mm6129a4_w. Retrieved October 2013.

CDC (June 2012d) Trends in the Prevalence of Marijuana, Cocaine, and Other Illegal Drug Use National YRBS: 1991-2011. Available at http://www.cdc.gov/healthyyouth/yrbs/pdf/us_drug_trend_yrbs.pdf. Retrieved October 2013.

CDC (August 2013a). CDC Factsheet- Economic Facts About U.S. Tobacco Production and Use. Available at

http://www.cdc.gov/tobacco/data_statistics/fact_sheets/economics/econ_facts/. Retrieved October 2013.

CDC (June 2013b). CDC Factsheet- Smoking and Tobacco Use. Available at http://www.cdc.gov/tobacco/data_statistics/fact_sheets/fast_facts/. Retrieved November 2013.

CDC (March 2013c). CDC Fact Sheet STD Trends in the United States 2011 National Data for Chlamydia, Gonorrhea, and Syphilis. Available at http://www.cdc.gov/std/stats11/trends-2011.pdf. Retrieved October 2013.

CDC (June 2013d). CDC factsheet- Youth and Tobacco Use- Smoking & Tobacco. Available at: http://www.cdc.gov/tobacco/data_statistics/fact_sheets/youth_data/tobacco_use/. Retrieved October 2013.

CDC (June 2013e). Youth Risk Behavior Surveillance System: 2011 National Overview. available at http://www.cdc.gov/healthyyouth/yrbs/pdf/us_overview_yrbs.pdf. Retrieved September 2013.

CDC (August 2013f). YRBS FAQ. Available at http://www.cdc.gov/healthyyouth/yrbs/faq.htm. Retrieved April 2014.

CDC (August 2013g). 2003 National School-based Youth Risk Behavior Survey Public-use Data Documentation. Available ftp://ftp.cdc.gov/pub/data/yrbs/2003/YRBS_2003_National_User_Guide.pdf Retrieved April 2014.

Chuang, Y.-C., Ennett, S. T., Bauman, K. E., & Foshee, V. A. (2009). Relationships of Adolescents' Perceptions of Parental and Peer Behaviors with Cigarette and

Alcohol Use in Different Neighborhood Contexts. Journal of Youth & Adolescence, 38(10), 1388–1398. doi:10.1007/s10964-009-9424-x

Coomber, K., Toumbourou, J. W., Miller, P., Staiger, P. K., Hemphill, S. A., & Catalano, R. F. (2011). Rural Adolescent Alcohol, Tobacco, and Illicit Drug Use: A Comparison of Students in Victoria, Australia, and Washington State, United States. The Journal of Rural Health, 27, 409–415. doi:10.1111/j.1748-0361.2010.00360.x

Dk, E., L, K., S, K., S, S., J, R., J, H., … H, W. (2008). Youth risk behavior surveillance--United States, 2007. Morbidity and mortality weekly report. Surveillance summaries (Washington, D.C.□: 2002), 57(4), 1–131.

Dunn, M. S., Ilapogu, V., Taylor, L., Naney, C., Blackwell, R., Wilder, R., & Givens, C. (2008). Self□Reported Substance Use and Sexual Behaviors Among Adolescents in a Rural State. Journal of school health, 78(11), 587–593.

Eaton DK, K. L., & R, M. T. (2010). Youth risk behavior surveillance (pp. 1–42). United States.

Eberhardt MS, I. D. (2001). Urban and Rural Health Chartbook. Hyattsville, Maryland: National Center for Health Statistics.

Eiksund, S. (2009). A geographical perspective on driving attitudes and behaviour among young adults in urban and rural Norway. Safety Science, 47(4), 529–536.

Galea, S., Freudenberg, N., & Vlahov, D. (2005). Cities and population health. *Social Science & Medicine*, *60*(5), 1017–1033. doi:10.1016/j.socscimed.2004.06.036

Greggo, J., Jones, S. E., & Kann, L. (2005). Population density and alcohol-related risk behaviors among US high school students. Journal of Health Education, 36(3), 148–154.

Grunbaum, J. A., Kann, L., Kinchen, S., Ross, J., Hawkins, J., Lowry, R., ... & Collins, J. (2004). Youth risk behavior surveillance--United States, 2003. *Morbidity and mortality weekly report. Surveillance summaries (Washington, DC: 2002)*, *53*(2), 1-96.)

Gutierrez, J. & A. (2010). Socioeconomic status, urbanicty and risk behaviors in Mexican youth; an analysis of three cross-sectional surveys. BMC public health. doi:10.1186/1471-2458-11-900

Hall, J. E., Simon, T. R., Mercy, J. A., Loeber, R., Farrington, D. P., & Lee, R. D. (2012). Centers for Disease Control and Prevention's expert panel on protective factors for youth violence perpetration: background and overview. American journal of preventive medicine, 43(2), S1–S7.

Jiang, N., Kolbe, L. J., Seo, D.-C., Kay, N. S., & Brindis, C. D. (2011). Health of Adolescents and Young Adults: Trends in Achieving the 21 Critical National Health Objectives by 2010. The Journal of adolescent health□: official publication of the Society for Adolescent Medicine, 49(2), 124–132.

Johnston, L. D., O'Malley, P. M., Bachman, J. G., & Schulenberg, J. E. (2013). Monitoring the Future national survey results on drug use, 1975–2012: Volume I, Secondary school students. Ann Arbor: Institute for Social Research, The University of Michigan.

Johnston, L. D., O'Malley, P. M., Bachman, J. G., & Schulenberg, J. E. (2012). Monitoring the Future national results on drug use: 2012 Overview, Key Findings on Adolescent Drug Use. Ann Arbor: Institute for Social Research, The University of Michigan

Johnson, A. O., Mink, M. D., Harun, N., Moore, C. G., Martin, A. B., & Bennett, K. J. (2008). Violence and Drug Use in Rural Teens: National Prevalence Estimates From the 2003 Youth Risk Behavior Survey. Journal of School Health, 78, 554–561. doi:10.1111/j.1746-1561.2008.00343.x

Keeler, H. J., & Kaiser, M. M. (4). An Integrative Model of Adolescent Health Risk Behavior. Journal of Pediatric Nursing, 25, 126–137. doi:10.1016/j.pedn.2009.01.005

Lambert, D., Gale, J. A., & Hartley, D. (2008). Substance Abuse by Youth and Young Adults in Rural America. The Journal of Rural Health, 24, 221–228. doi:10.1111/j.1748-0361.2008.00162.x

Langkamp, D. L., Lehman, A., & Lemeshow, S. (2010). Techniques for handling missing data in secondary analyses of large surveys. *Academic pediatrics*, *10*(3), 205-210.

Levine, S. B., & Coupey, S. M. (2003). Adolescent substance use, sexual behavior, and metropolitan status: is "urban" a risk factor? Journal of Adolescent Health, 32, 350–355. doi:10.1016/S1054-139X(03)00016-8

Lutfiyya, M. N., Shah, K. K., Johnson, M., Bales, R. W., Cha, I., McGrath, C., … Lipsky, M. S. (2008). Adolescent daily cigarette smoking: is rural residency a risk factor? Rural And Remote Health, 8(1), 875–875.

Miller, J. W., Naimi, T. S., Brewer, R. D., & Jones, S. E. (2007). Binge drinking and associated health risk behaviors among high school students. Pediatrics, 119(1), 76–85.

Miniño, A. M. (2013). Death in the United States, 2011. US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics.

Mokdad, A. H., Marks, J. S., Stroup, D. F., & Gerberding, J. L. (2004). Actual causes of death in the united states, 2000. JAMA, 291, 1238–1245. doi:10.1001/jama.291.10.1238

Moreland, J. J., Raup-Krieger, J. L., Hecht, M. L., & Miller-Day, M. M. (2013). The Conceptualization and Communication of Risk Among Rural Appalachian Adolescents. Journal of Health Communication, 18, 668–685. doi:10.1080/10810730.2012.743620

Nance, M. L., Carr, B. G., Kallan, M. J., Branas, C. C., & Wiebe, D. J. (2010). Variation in Pediatric and Adolescent Firearm Mortality Rates in Rural and Urban US Counties. Pediatrics, 125(6), 1112–1118. doi:10.1542/peds.2009-3219

National Rural Health Association. (2010). What's different about rural health care. Retrieved September 18, 2013.

National Center for Victims of Violent Crime (2012). Urban and Rural Crime. Available at http://www.victimsofcrime.org/library/crime-information-and-statistics/urban-and-rural-crime. Retrieved December 2013.

Olsen, E. O., Hertz, M. F., Shults, R. A., Hamburger, M. E., & Lowry, R. (2011). Healthy People 2010 Objectives for Unintentional Injury and Violence Among

Adolescents: Trends from the National Youth Risk Behavior Survey, 1999–2009. American Journal of Preventive Medicine, 41(6), 551–558. doi:10.1016/j.amepre.2011.08.011

Pitts, S. B. J., Carr, L. J., Brinkley, J., Byrd, J. L., Crawford, T., & Moore, J. B. (2013). Associations Between Neighborhood Amenity Density and Health Indicators Among Rural and Urban Youth. American Journal of Health Promotion, 28, e40–e43. doi:10.4278/ajhp.120711-ARB-342

Pickett, W., Davison, C., Torunian, M., McFaull, S., Walsh, P., & Thompson, W. (2012). Drinking, substance use and the operation of motor vehicles by young adolescents in Canada. PloS one, 7(8), e42807.

Plotnikoff, R. C., Bercovitz, K., & Loucaides, C. A. (2004). Physical activity, smoking, and obesity among Canadian school youth. Comparison between urban and rural schools. Canadian Journal Of Public Health. Revue Canadienne De Santé Publique, 95(6), 413–418.

Riesch, S. K., Kedrowski, K., Brown, R. L., Temkin, B. M., Wang, K., Henriques, J., … Giustino-Kluba, N. (2012). Health-risk behaviors among a sample of US pre-adolescents: Types, frequency, and predictive factors. International journal of nursing studies.

Rhew, I. C., David Hawkins, J., & Oesterle, S. (2011). Drug use and risk among youth in different rural contexts. Health & Place, 17(3), 775–783. doi:10.1016/j.healthplace.2011.02.003

Rothwell, E., & Lamarque, J. (2011). The Use of Focus Groups to Compare Tobacco Attitudes and Behaviors Between Youth in Urban and Rural Settings. Health Promotion Practice, 12(4), 551–560. doi:10.1177/1524839909349179

Santelli, J. S., Robin, L., Brener, N. D., & Lowry, R. (2001). Timing of alcohol and other drug use and sexual risk behaviors among unmarried adolescents and young adults. Family Planning Perspectives, 200–205.

Singh, G. K., Azuine, R. E., Siahpush, M., & Kogan, M. D. (2012). All-cause and cause-specific mortality among US youth: socioeconomic and rural–urban disparities and international patterns. Journal of Urban Health, 1–18.

Stewart Fahs, P. S., Smith, B. E., Serdar Atav, A., Britten, M. X., Collins, M. S., Lake Morgan, L. C., & Spencer, G. A. (1999). Integrative research review of risk behaviors among adolescents in rural, suburban, and urban areas. Journal of Adolescent Health, 24(4), 230–243. doi:10.1016/S1054-139X(98)00123-2

Strine, T. W., Beck, L. F., Bolen, J., Okoro, C., Dhingra, S., & Balluz, L. (2010). Geographic and sociodemographic variation in self-reported seat belt use in the United States. *Accident Analysis & Prevention*, *42*(4), 1066-1071.

Stolle, M., Sack, P.-M., & Thomasius, R. (2009). Binge drinking in childhood and adolescence: epidemiology, consequences, and interventions. Deutsches

Ärzteblatt international, 106, 323–328. doi:10.3238/arztebl.2009.0323Substance Abuse and Mental Health Services Administration (2013), Results from the 2012 National Survey on Drug Use and Health: Summary of National Findings,NSDUH Series H-46, HHS Publication No. (SMA) 13-4795. Rockville, MD:

Substance Abuse and Mental Health Services Administration (2010). Results from the 2009 National Survey on Drug Use and Health: Volume I. Summary of National Findings. Rockville, MD: United States Department of Health and Human Services.

Substance Abuse and Mental Health Services Administration, Office of Applied Studies. (October 18, 2007). The OAS Report: A Day in the Life of American Adolescents: Substance Use Facts. Rockville, MD.

Swahn, M. H., & Bossarte, R. M. (2009). Assessing and quantifying high risk: Comparing risky behaviors by youth in an urban, disadvantaged community with nationally representative youth. Public health reports, 124(2), 224.

Swahn, M. H., Gaylor, E., Bossarte, R. M., & Dulmen, M. van. (2010). Co-occurring suicide attempts and physical fighting: A comparison between urban, suburban, and rural high school students. Vulnerable Children and Youth Studies, 5(4), 353–362.

US Department of Health and Human Services. (2014). The health consequences of smoking—50 years of progress: A report of the Surgeon General. *Atlanta, GA: US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health*, *17*.

U.S. Department of Health and Human Services. Office of Disease Prevention and Health Promotion. (2013) Healthy People 2020. Washington, DC. Available at http://www.healthypeople.gov/2020/topicsobjectives2020/overview.aspx?topicid Accessed 09/18/2013

Völzke, H., Neuhauser, H., Moebus, S., Baumert, J., Berger, K., Stang, A., … Döring, A. (2006). Urban-rural disparities in smoking behaviour in Germany. BMC Public Health, 6(1), 1–8. doi:10.1186/1471-2458-6-146

WHO. August 2011. Young people: health risks and solutions, factsheet. Available at http://www.who.int/mediacentre/factsheets/fs345/en/. Retrieved September 2013

Zullig, K. J., Pun, S., Patton, J. M., & Ubbes, V. A. (2006). Reliability of the 2005 middle school youth risk behavior survey. *Journal of adolescent health*, *39*(6), 856-860.