THE RELATIONSHIP BETWEEN MOUNTAINTOP COAL REMOVAL AND ADOLESCENT AND YOUNG ADULT RISK BEHAVIORS IN RURAL, URBAN, AND APPALACHIAN AREAS OF KENTUCKY

A Thesis
by
Ellen Elizabeth Hunt Steele

Submitted to the Graduate School
at Appalachian State University
in partial fulfillment of the requirements for the degree of
MASTERS OF ARTS

May 2015
Department of Psychology

THE IMPACT OF MOUNTAINTOP COAL REMOVAL ON ADOLESCENT AND YOUNG ADULT RISK BEHAVIORS IN RURAL, URBAN, AND APPALACHIAN AREAS OF KENTUCKY

A Thesis
by
ELLEN ELIZABETH HUNT STEELE
May 2015

APPROVED BY:

_____
John Paul Jameson, Ph.D.
Chairperson, Thesis Committee

_____
Will Canu, Ph.D.
Member, Thesis Committee

_____
Kurt Michael, Ph.D.
Member, Thesis Committee

_____
James Denniston, Ph.D.
Chairperson, Department of Psychology

_____
Max C. Poole, Ph.D.
Dean, Cratis D. Williams School of Graduate Studies

Abstract

THE IMPACT OF MOUNTAINTOP COAL REMOVAL ON ADOLESCENT AND YOUNG ADULT RISK BEHAVIORS IN RURAL, URBAN, AND APPALACHIAN AREAS OF KENTUCKY

Ellen Elizabeth Hunt Steele
B.A., University of North Carolina at Chapel Hill
M.A., Appalachian State University

Chairperson: John Paul Jameson

In Appalachia, coal mining has historically been a major source of industry, yet it is associated with significant environmental and health consequences, including increases in rates of depression, cancer, cardiac and respiratory diseases, birth defects, low birth weight, and overall poor physical health and stress. However, there is a dearth of research on the effect of mountaintop coal removal (MTR) mining on mental health in Appalachia, particularly on adolescents and emerging adults. In the current study, using a statewide emergency department dataset, groups of emerging adults from Appalachian and non-Appalachian areas, both with and without MTR, were compared. It was hypothesized that both location in Appalachia and the presence of MTR would be positively associated with relatively higher odds of risky behaviors including self-harm, substance use, and sexually transmitted infections. Cases from a statewide emergency department database (n = 347,531) were separated into groups of adolescents and emerging adults from rural and non-rural, Appalachian and non-Appalachian areas, with and without MTR. These groups were compared through a series of binary logistic

regressions. Adolescents and emerging adults in Appalachia, rural Appalachia, and rural Appalachia with MTR had relatively higher odds of diagnosis of a polysubstance use disorder. Additionally, adolescents and emerging adults experienced increased odds of a diagnosis with of an alcohol use disorder in rural Appalachia and rural Appalachia with MTR. Overall, this suggests that MTR may play a role in influencing substance use in rural Appalachia, but more research is needed to explore the relationship.

Keywords: Appalachia, emerging adult, rural, risky behaviors, coal mining

Acknowledgments

I would like to thank my thesis chair, Dr. John Paul Jameson, for his patient guidance and support throughout the development of this thesis project. Similarly I would like to extend my gratitude to my thesis committee, Drs. Will Canu and Kurt Michael, for their thoughts, feedback, and support in assisting me in completing this thesis. Additionally, I would like to thank Michael Denslow at the National Ecological Observatory Network for his assistance locating and categorizing coal mines in Kentucky.

Dedication

I would like to dedicate this manuscript to my parents and my fiancé for their ongoing love and support through my master's career and this project.

Table of Contents

List of Tables

List of Figures

The Relationship Between Mountaintop Coal Removal and Adolescent and Young Adult Risk Behaviors in Rural, Urban, and Appalachian Areas of Kentucky

The relationship between mountaintop removal coal mining (MTR) on the rates of youth risk behaviors, specifically, sexually transmitted infections (STI), substance use, and self-harm, using cases from the statewide emergency department database (SEDD) from the state of Kentucky during 2008 through the Healthcare Cost and Utilization Project (HCUP) was examined in this thesis. Additionally, this project explored the impact of living in Appalachia within a rural or non-rural community while controlling for sex, age, race, income, and primary form of payment for treatment (e.g., health insurance, self-pay).

Rural Mental Health

Individuals living in rural areas face multiple barriers with regard to mental health and substance use treatment, including high poverty rates, shortages of providers, lower likelihood of health insurance coverage, distance from providers, stigma, and overall negative attitudes towards seeking mental health treatment (Corrigan, 2004; Hendryx, 2008; Judd et al., 2006; Perkins et al., 2010; Wagenfeld, 2003; Zullig & Hendryx, 2008). Additionally, rural residents are significantly less likely to receive psychological treatment, particularly via specialized mental health services, than their metropolitan counterparts (Hauenstein, Peterson, Rovnyak, Merwin, Heise, & Wagner, 2006). Ziller and colleagues (2010) suggest that rural areas had greater need for additional mental health services coupled with lower rates of visits to mental health providers and increased rates of use of medical interventions, particularly pharmacology, than urban areas. Other studies indirectly support these results, as rural

individuals prefer to seek mental health treatment from a medical provider, such as their general practitioner, rather than seek specialty mental health treatment (Judd et al., 2006; Perkins et al., 2010). Moreover, Wagenfeld (2003) notes that rural residents' health insurance policies, in comparison to urban counterparts, are less likely to include prescription drug coverage and provide fewer overall benefits. In additional, even if an individual's insurance includes mental healthcare, they may still be underserved due to a shortage of mental healthcare providers (Hendryx, 2008; Ziller, Anderson, & Coburn, 2010).

Similar to rural adults, rural children may have fewer chances for both psychological assessment and treatment as compared to children in non-rural areas, leaving rural children at a significant disadvantage (Hauenstein et al., 2006; Heflinger & Christens, 2006). Despite research that suggests rural children have a similar risk to their non-rural counterparts for psychosocial problems and internalizing and externalizing symptoms, only 30% of rural children and adolescents needing mental health treatment receive specialty treatment (Merikangas et al., 2010; Starr, Campbell, & Herrick, 2002). Many children only receive mental health treatment through the Emergency Department (ED) in hospitals, similar to rural low income adults (Dolan, Fein, & The Committee on Pediatric Emergency Medicine, 2011; Hauenstein, et al., 2006). When children and adolescents visit the ED for mental health concerns, it is most frequently for suicidal behaviors, conduct disorder, oppositional defiant disorder, general risky behaviors, anxiety, or depression (Dolan et al., 2011). Furthermore, low treatment utilization by rural children and adolescents is associated with increased risk of hospitalization, which may indicate more severe symptomology and increased

likelihood for suicidality (Heflinger & Christens, 2006). Rural adolescents are 30% to 50% more likely than their non-rural peers to attempt or complete suicide (Heflinger & Christens, 2006; Hirsch, 2006). Additionally, rates of completed suicide among rural youth were approximately twice that of their urban counterparts among both males and females (Fontanella et al., 2015). This is particularly concerning considering the overlap between the shortage of treatment providers and parents' negative attitudes associated with seeking treatment. Specially, many parents seeking treatment for their children in the rural southeastern United States expressed concerns that mental health professionals "would not care for their child" (p. 297) and the child would have negative outcomes due to receiving treatment (Starr et al., 2002).

Visits to EDs for children's mental health are significantly higher in rural children (42%) as compared to urban children (35.4%), yet rural children are only equally as likely to receive outpatient mental health treatment (Lambert, Ziller, & Lenardson, 2008). Additionally, the authors suggest that high ED use may be due to the scarcity of mental health care providers, particularly for children and adolescents (Lambert et al., 2008). These findings indicate that more rural children visit the ED for emergency mental health care, but fewer rural children pursue ongoing mental health treatment than their urban counterparts.

Appalachia

The Appalachian region of the United States, referred to hereafter simply as Appalachia, is characterized by low population density, higher rates of unemployment and poverty, high levels of religiousness, and poorer physical and mental health among its residents as compared to non-Appalachian communities (Meyer, Toborg, Denham, &

Mande, 2008; Zullig & Hendrix, 2008). Additionally, mental health concerns are further complicated by higher lifetime rates of substance use disorders in Appalachia for adults, with the most common types including alcoholism, opioid addiction (e.g., heroin, OxyContin, methadone), and abuse of psychotherapeutic medications (Zhang et al., 2008). Treatment for heroin or other opioid use has been significantly increasing from 2000 to 2004 in Appalachia (7.5%) compared to in non-Appalachian areas (3.2%). Moreover, Zhang and colleagues (2008) reported a proportionally higher rate of increase in Appalachian coal mining areas, from 5.7% to 14.6%, than areas in Appalachia without mining, from 5.7% to 9.3% during the same four-year period.

In addition, studies suggest significant concerns about barriers to seeking substance use treatment and have found that monetary cost or lack of insurance is the greatest barrier to receiving mental health care, followed by individuals' denial of need for mental health treatment, social stigma toward psychological disorders, and a shortage of service providers (Hendryx, 2008; Zhang et al., 2008). Research on access to mental health providers in Appalachia is inconsistent; Hendryx (2008) reported a long-term shortage of providers in Appalachian West Virginia, yet Zhang and colleagues (2008) found that people in Appalachia are slightly more likely to receive outpatient counseling than individuals outside of Appalachia overall. Generally, the literature suggests that Appalachia has overall poorer mental health and individuals may have mixed access to mental health treatment beyond that of the already reduced mental health existent in rural communities.

Though research on children and adolescents in rural areas is not uncommon, research on Appalachian children and adolescents is relatively sparse. Existing research

suggests that children and adolescents in Appalachia have poorer mental health and significant risk of developing a substance use problem, similar to adults, yet they are less likely to have seen a mental health care provider as compared to their non-Appalachian counterparts (Polaha, Dalton, & Allen, 2011; Zhang et al., 2008). Another study found that parents in rural Appalachia are more likely to take children to their general practitioner or pediatrician than to a specialty mental health provider (Polaha et al., 2011). Other research notes that living in poverty significantly increases the likelihood of being diagnosed as well as elevated impairment associated with psychological disorders (Costello, Angold, Burns, Erkanli, et al., 1996; Costello, Angold, Burns, Stangl, et al., 1996). Overall, these results suggest increased risk of diagnosis with a psychological disorder and significant impairment associated with the disorder in Appalachian children while emphasizing the influential role of poverty in Appalachia, particularly on mental health.

Lack of treatment, coupled with the stresses of adolescence, can develop into suicidality in Appalachian children and adolescents, similar to adolescents in rural areas more generally. A study of Appalachian adolescents found that the greatest risk for suicidality was associated with comorbid depression and anxiety, particularly generalized anxiety disorder, as well as comorbid depression and disruptive behavior disorders (Foley, Goldston, Costello, & Angold, 2006). Interestingly, both males and females in Appalachia endorsed suicidal ideation equally, yet females reported more suicide planning and actual attempts than males. In addition, risk of suicide increased in both genders after age 13, but suicide attempts were significantly higher in females as compared to their male counterparts. Poverty was also a significant risk factor (Foley et

al., 2006), consistent with previous findings of increased risk (Costello, Angold, Burns, Erkanli, et al., 1996; Costello, Angold, Burns, Stangl, et al., 1996). Overall these findings emphasize the influential role of poverty and the importance of mental health treatment of children and adolescents in Appalachia.

Risk Behaviors

Youth engagement in a small degree of risky behaviors, including norm-breaking, substance use, risky automobile driving, unprotected sex, and minor criminal acts, are considered to be a normal part of development (Arnett, 1999; Arnett, 2000). Although an accepted characteristic of adolescent development, these behaviors can incur negative consequences such as STIs (e.g. chlamydia, gonorrhea, syphilis, Human Immunodeficiency Virus (HIV), Acquired Immunodeficiency Syndrome (AIDS), genital warts), unintended pregnancy, substance dependence, unemployment, automobile accidents, failure to earn a high school diploma or GED, arrest and incarceration, and even death (Arnett, 1999; Hair, Park, Ling, & Moore, 2009; Pharo, Sim, Graham, Gross, & Hayne, 2011). Although the risk behaviors are common across the Western world, consequences are influenced by their communities and other outside factors (Arnett, 1999; Pharo et al., 2011). For instance, though rural adolescents have similar rates of alcohol use as their non-rural counterparts, rural adolescents typically spend more time in cars and are therefore at higher risk for intoxicated driving and automobile accidents (Heflinger & Christens, 2006). Despite substance use similarities in rural and non-rural youth, there exist differences in the type and severity of the consequences. For example, other research has found that adolescents and emerging adults tend to engage in more risky or sensation seeking behaviors during and after alcohol consumption that more

frequently require ED treatment for alcohol consumption or accidents related to alcohol consumption (Hulse, Robertson & Tait, 2001; Kelly, Donovan, Corenlius, Bukstein, Delbridge & Kinnane, 2005; Sanjuan, Rice, Witkiewitz, Mandler, Crandall, & Boogenshutz, 2014).

Youth substance use tends to vary based on physical location and tends to begin at a younger age for males than females (Substance Abuse Mental Health Services Administration, SAMHSA, 2006). Youth in rural communities are as or more likely to binge drink alcohol than their non-rural counterparts (SAMHSA, 2006). Additionally, Heise (2010) noted that rural individuals with low-risk drinking habits (5 or more drinks a day for 1 to 11 days a year) were less likely to use physical or mental health services, but rural individuals with high-risk alcohol use behaviors (5 or more drinks a day 12 or more days a year) were more likely to use ED, office based visits, and all other health services as compared to their urban counterparts. In rural Appalachian Kentucky, males typically began drinking at a younger age (13.2 years) than females (15.1 years; Shannon, Havers, Oser, Crosby, & Leukenfeld, 2011). Paralleling national trends, these same males were both more likely to use cocaine, marijuana, and hallucinogens and to begin such illicit drug use at a younger age than females (Shannon et al., 2011). Furthermore, results of a recent study of Appalachian children, reports that children in rural Appalachia have poorer mental health with higher risk for substance and alcohol use as well as heavy alcohol consumption (Zhang et al., 2008). Additionally, approximately a third of Appalachian adolescents and young adults who met criteria for an alcohol use disorder continued to meet criteria in their mid-20s and had higher risk for illicit substance use (Copeland, Angold, Shanahan, Dreyfuss, Dlamini,

& Costello, 2012). These findings noting high rates of early alcohol and other substance use (Copeland et al., 2012) coupled with the SAMSHA (2006) results noting rural Kentucky residents 12 years or older have among the highest prevalence rates of illicit substance use, excluding marijuana, in the United States are concerning for the health of rural Appalachian youth and their risk of substance use. Moreover, substance use is associated with unsafe sexual practices, particularly having multiple sexual partners (Hair et al., 2009; Yan, Chiu, Soesen, & Wang, 2007).

Adolescents and young adults have the highest rates of STIs and the fastest rising rates of HIV/AIDS (Arnett, 1999; Centers for Disease Control and Prevention (CDC), 2009 Yan et al., 2007). The CDC (2009) notes that adolescent females (ages 15 to 19) have the highest rates of chlamydia, gonorrhea, and syphilis as compared to adolescent and emerging adult males and emerging adult females. Additionally, national rates of chlamydia, gonorrhea, and syphilis tend to range between less than 1% and greater than 3% for adolescents and emerging adults (CDC, 2009). Rural adolescents appear to be particularly prone to risky sexual behaviors and are overall less likely to use contraceptives, both oral contraceptives and condoms (Petridou, 1997; Yan et al., 2007). Multiple studies suggest that rural females are less likely to use condoms for several reasons, including these females may be sexually active with older male partners, may feel coerced to engage in unsafe practices by their partner, or may believe they have a lower risk of contracting of an STI (Hair et al., 2009; Petridou, 1997; Yan et al., 2007). Although research has primarily focused on female STI rates, rural males are at higher risk for contracting a STI as they are more likely to have multiple sexual partners than their female counterparts (Yan et al., 2007).

The Effects of Coal Mining

Since the late 1800s, the United States has used coal for heating, travel, manufacturing, and general industrialization (Burns, 2007). Much of that coal has come from Appalachia. In fact, in 2008 the United States produced 1.17 billion tons of coal with 390.2 million tons mined in Appalachia (Freme, 2008). Unsurprisingly, coal mining remains one of the primary industries and sources of income in 8 of the 13 states that comprise the region (Freme, 2008).

Despite its economic value, coal mining can have significant, negative environmental consequences, including deforestation, decreases in water quality (e.g., decreased oxygenation, increased heavy metal content), and the extinction of some rare species of plants and animals (Palmer et al., 2010). Several studies have focused on the physical health (e.g., chronic diseases) of people living near coal mining sites. Researchers have found high levels of heavy metals including lead, cadmium, mercury, and arsenic in water near mines; long-term exposure has been shown to increase mortality from chronic heart disease, chronic kidney disease, and respiratory disease (Palmer et al., 2010). In addition, other studies have found that an increase in respiratory diseases is associated with living near coal mines in Appalachia, even after controlling for smoking rates, obesity, and other physical risk factors (Hendryx 2008; Hitt & Hendryx, 2010). Moreover, prior research suggests that exposure to pollutants from mining can elevate risk for other health issues, such as heart disease, kidney disease, low birth weight, birth defects, and lung and other cancers (Ahern, Mullett, Mackay, & Hamilton, 2011; Hendryx, 2009; Hendryx, 2013; Hendryx, Wolfe, Luo, & Webb, 2011; Hitt & Hendryx, 2010; Palmer et al., 2010). Unsurprisingly, such serious

chronic illnesses are associated with higher mortality for those living near coal mines in Kentucky and West Virginia, especially for women (Hendryx, 2009; Hendryx, 2013; Hendryx & Zullig, 2009). Overall, prior research suggests that coal mining may play an influential role beyond other demographic and regional factors in community members' physical health.

Research has found connections between the quality of an individual's physical and mental health. For example Boyle, Jackson, and Suarez (2007) found that high scores on hostility, depression, and anger scales from the Minnesota Multiphasic Personality Inventory Second Edition (MMPI-2; Butcher, Dahlstrom, Graham, Tellegen & Kaemmer, 1989) are correlated with an increase in C3 levels, a protein precursor to the development of coronary heart disease. Furthermore, their findings suggest that if these negative emotional states were maintained over time, such as at follow-up after a decade, the C3 level continued to increase. Additionally, there is a similar connection between depression and cardiac disease, and there is evidence to support the behaviors that improve physical health (e.g., exercise and healthy eating) can alleviate some symptoms of depression (Blumenfield, Suojanen, & Weiss, 2012; Fox, 1999). Happell and colleagues (2012) noted that individuals in rural populations who have serious mental illness are more likely to have physical health problems as well. Overall, given the substantial body of evidence linking physical health, mental health, and the association between mining activities and physical health problems, the existence of a link between mining and mental illness seems plausible.

One of the most controversial forms of mining is mountaintop removal coal mining (MTR). MTR involves removing trees and plant life, storing the topsoil either in

storage compartments or more frequently dumping the soil in a near-by valley, and removing the top layer(s) of sediment through multiple controlled explosions to expose buried coal seams (Palmer et al., 2010). There is a significant dearth of research measuring the physical and mental health consequences. In one of just a few studies that inform this topic, Hendryx and colleagues (2011) surveyed residents of two areas in Appalachian West Virginia, one with MTR and the other without MTR. In the community with MTR, the odds of getting cancer are significantly higher (5% greater risk) than in the non-MTR Appalachian community. Additionally, Hendryx (2013) reported from the same survey that there were increased rates of serious illness (e.g., cardiovascular disease, chronic asthma) and higher rates of death from these illnesses as compared to areas without MTR in Appalachia.

To date, there are two studies that focus on the association between poor mental health and MTR. Cordial, Riding-Malon, and Lips (2012) focus on *solastalgia*, or loss of sense of place or belonging, similar to homesickness, due to unwelcome environmental changes (Albrecht et al., 2007). In a series of community meetings in Appalachian areas with and without MTR, citizens reported they face issues like lack of access to clean water, unusual patterns of flooding, and changes in the ecosystem that affect both wildlife and recreational activities. Furthermore, they reported that the destruction of the land can be distressing for families who have lived in an area for many generations and had hopes of remaining there for many years to come. Cordial and colleagues (2012) described that people living in Appalachian areas have increased rates of distress related to solastalgia, lower socioeconomic status, and increased risk for developing posttraumatic stress disorder. This initial study began to capture the

community opinions and experiences related to MTR, yet it failed to develop a causal connection between MTR and mental health concerns.

In recent study by Hendryx and Innes-Wimsatt (2013), central Appalachian residents in areas with and without MTR completed phone surveys about their mental health. Nearly 17% of residents in Appalachian areas with MTR met criteria for a current mild, moderate, or severe depressive episode as compared to non-MTR Appalachian (11%) residents even after controlling for demographic differences. Furthermore, depression rates in Appalachian areas with MTR were significantly higher than the national lifetime prevalence rates (10%). These results are particularly concerning given the frequency of the overlap between risky behaviors and depression, particularly among females (Waller, Hallfors, Halpern, Iritani, Ford & Guo, 2006). In general, these two studies have made significant strides towards further understanding the role of MTR in Appalachia, but may be limited by unrepresentative sampling and missing individuals who are experiencing mental health related distress or impairment.

Current Study

In rural Appalachia, there is a lack of access to mental health treatment, increased out-of-pocket cost for quality mental health care, and greater likelihood for receiving medically based mental health treatment (Hendryx, 2008; Judd et al., 2006; Perkins et al., 2010; Polaha et al., 2011; Wagenfeld, 2003; Ziller et al., 2010). With the general shortage of research on rural adolescent and emerging adult mental health, particularly in Appalachia, there is a significant gap in the literature. In an effort to further understand the impact of MTR, rurality, and living in Appalachia on adolescent and emerging adults' risky behaviors specifically, substance use, STIs and self-harming

behavior, this project examined the incidence of these diagnoses in EDs in Appalachian and non-Appalachian areas of Kentucky. The project focused on adolescents and emerging adults due to (a) the research showing that many disorders develop in adolescence, (b) the higher rates of substance use and suicidality, (c) the low reported rates of condom use, and (d) the overall increased usage of mental health services through hospitals, particularly EDs in rural communities. Based on the extant research on the rates of anxiety, substance use, and suicide in adolescents in rural Appalachia, the physical health consequences of mining and MTR, the relationship between physical and mental health, and the findings from research on the mental health consequences of environmental disasters in rural areas, it was hypothesized that there were a higher odds of adolescent and emerging adult ED cases diagnosed with self-harm, substance abuse, and STIs within rural areas, Appalachia, and communities with MTR independently. Additionally, it was predicted that there would be higher odds of diagnosis of risky behaviors among adolescents and emerging young adult ED cases in rural Appalachia and rural Appalachia with MTR. Furthermore, it was expected that there would be increased odds of adolescent and emerging adult cases with ED diagnoses of self-harm, substance abuse, or STI cases in rural Appalachia in areas with MTR than in other rural Appalachian locales without MTR.

Method

Data

The study utilized data from the 2008 Kentucky State Emergency Department Database (SEDD). The SEDD captures information on each case at EDs that were not subsequently admitted to an inpatient unit (HCUP SEDD, 2008). Cases admitted to the

hospital are recorded in a separate database, the State Inpatient Database (SID). For example, this data set would include a patient involved in a car accident that required stitches and was sent home, but would not include this patient if the individual was admitted to an inpatient unit for further observation. The data set contains over 1.9 million unique visits to EDs by people living in the state of Kentucky during the 2008 calendar year. Participants included visits by adolescents and emerging adults between 15 and 25 years old within the SEDD (N = 347,531). Payment method was divided into four categories: private insurance, self-pay, other, and public that included Medicare and Medicaid. The dataset included information on rural-urban status, age, sex, race, income quartile by zip code from 2008, patient location, and primary form of payment. See Table 1 for demographic characteristics.

Cases involving self-harm, substance use, and STIs were identified using the International Statistical Classification of Diseases and Related Health Problems ninth revision (ICD-9) codes in the dataset. The injury resulting from the self-harm was indicated in the SEDD database as the primary or a secondary diagnosis (n = 454). ICD-9 codes E950 through E959 were used to indicate self-harm.

Other cases identified for geographical difference analyses were those with a diagnosis of substance use in the SEDD. The specific codes targeted herein were alcohol use (ICD-9 codes 303.00 and 305.00; n = 3282), and other substance use, which includes use of opioids, sedative/hypnotic/anxiolytic drugs, cocaine, cannabis, amphetamine/psychostimulants, hallucinogens, antidepressant abuse (ICD-9 codes 292.2; 304.00 - 304.63, excluding 304.13; 305.2 - 305.83; 965.00 - 965.20; n = 2686).

Polysubstance use codes were separated into a separate category (ICD-9 codes 304.13; 304.7 - 304.83; 305.9 -305.93; *n* = 2092).

STI cases were identified for geographical difference analyses through ICD-9 codes. The specific infections and their corresponding codes targeted include Genital Herpes, Pubic Lice, Gonorrhea, Syphilis, HIV, AIDS, Scabies, Hepatitis B, Hepatitis C, Hepatitis Not Otherwise Specified (NOS), and STI NOS (ICD-9 codes 042 - 044, 054.1; 090 - 099.9, 132.2, 133.0, 070.2, 070.3, 070.70, 070.71, 070.7; *n* = 1604).

Definitions of Rural and Appalachian Cases

Geographical prevalence differences were examined for adolescent and emerging adult cases involving in some form of self-harming, substance use, or STI diagnosis that was indicated during a visit to an ED. Rurality was determined based on Rural-Urban Commuting Area Codes (RUCA; Rural Health Research Center, 2003) for each case's identified home ZIP code. Using suggested guidelines (Rural Health Research Center, 2003), cases were categorized as Rural (*n* = 106,205; 30.6%) or Non-rural (*n* = 241,320; 69.4%). Cases were classified as Appalachian if the patient resides within the catchment area specified by the ARC (ARC, 2008; *n* = 54,496, 15.7%). The Appalachian catchment area contains approximately 45% of counties in Kentucky (ARC, 2011).

Mining areas

Mine locations were defined and categorized via analysis of mining permits from the Division of Mine Permits within the Kentucky Energy and Environment Cabinet. These mine permits were limited to those reported to contain MTR from the Office of Mine Safety. ZIP codes with active MTR permits during 2008 were classified as mining

areas (*n* = 3738) while ZIP codes without active permits during 2008 were classified as non-mining areas (*n* = 350,491). The United States Census Bureau reports that in 2010 areas with MTR population ranged from 252 to 17,252 people, median income ranged from $22,400 to $49,600, and percentage of people attaining a high school diploma or higher ranged from 64% to 91% (U.S. Census Bureau). Furthermore, cases in mining areas were further labeled as MTR-related if the patient resided in a ZIP code that contains an active MTR site

Analytic Plan

Initial analyses of comparison between cases residing in MTR versus non-MTR areas on risky behaviors (i.e., STI, self-harm, polysubstance use, alcohol use, and substance use without alcohol use diagnoses) were tested with separate chi-squares, and risky behaviors showing different rates of incidence in EDs between MTR and non-MTR were further explored through binary linear regression models. A series of binary logistic regression models were run to test the hypotheses that adolescents and emerging adults within Appalachia experienced higher odds of diagnosis with STI, self-harm, alcohol use, substance use without alcohol use, or polysubstance use than emerging adults living outside of Appalachia in EDs while controlling for race, gender, age, primary payment method, and income quartile (HCUP SEDD, 2008). Additionally, another series of binary logistic regressions were run to test the hypothesis that adolescents and emerging adults living in rural Appalachia in areas with MTR have greater odds for diagnosis with risky behaviors than emerging adults living in rural Appalachia without MTR, controlling for the aforementioned demographic variables.

Results

Results of the initial analyses of demographics suggest that emerging adult ED cases in communities with MTR vary significantly on numerous demographic variables from communities without MTR (see Table 1 for full demographic results). Initial analyses failed to find significant differences between MTR and non-MTR areas on gender. Unsurprisingly, cases in Appalachia were more likely to have MTR than cases outside of Appalachia, and cases in rural areas were more likely to contain MTR as compared to non-rural cases. Cases from areas with MTR were more likely to be Caucasian than non-Caucasian.

Separate chi-square analyses were conducted to compare cases residing in MTR versus non-MTR areas on risky behaviors. For full results see Table 2. Contrary to the hypothesis, results indicate that cases from MTR areas were less likely to include a diagnosis of an STI than cases from non-MTR areas. Despite significant findings for differences in STI cases, a binary logistic regression was not run due to the exceedingly small sample size of STI cases with MTR (n = 8). Results of the chi-square test suggest that a case from an area with MTR would be more likely to include diagnosis with a polysubstance or alcohol use disorder as compared to a non-MTR. Further analyses examined rates of caseness for both alcohol use and polysubstance use disorder across Appalachia, rurality, and MTR (see Figures 1 and 2). Consistently across alcohol and polysubstance use, the highest rates were found in communities in Appalachia with MTR followed by rural communities with MTR.

To control for the potential effects of demographic variables that differed between cases from MTR and non-MTR areas, a series of binary logistic regression

models were run controlling significant demographic variables including for age, race, rurality, whether the case was in Appalachia, income, and type of payment. To test the hypotheses that there are increased odds for adolescent and emerging adult cases to include diagnosed with substance use in rural Appalachia with MTR versus rural Appalachia without MTR. An additional model tested the addition of the interaction between Appalachia, rurality, and MTR. Contrary to the hypothesis, results indicated that adolescent and emerging adults in Appalachia had lower odds of including a diagnosed with an alcohol use disorder, $p < .001$, $OR = 0.53$, 95% CI = 0.46 - 0.61, as compared to non-Appalachian cases. As compared to non-rural areas, rural areas had decreased odds of inclusion of a diagnosis of an alcohol use disorder, $p < .001$, $OR = -0.64$, 95% CI = 0.46 - 0.61. Results of the interaction suggest that rural Appalachian cases were more likely to include an alcohol use diagnosis as compared to the non-rural, non-Appalachian cases $p < .001$, $OR = 2.08$, 95% CI = 1.66 - 2.6. Within the model, MTR was not a significant predictor (see Table 4). The addition of the interaction between rurality, Appalachia, and MTR to the model suggested that cases from rural Appalachia with MTR had higher odds of including a diagnosed with an alcohol use disorder as opposed to cases from non-rural, non-Appalachian without MTR, $p < .001$, $OR = 3.03$, 95% CI = 1.64 - 5.58 (see Figure 3).

A binary logistic regression was conducted to test the hypothesis that an adolescent or emerging adult case has higher odds of including a diagnosis with a polysubstance use diagnosis in rural Appalachia with MTR as compared to non-rural, non-Appalachia without MTR. Results supported the hypothesis with higher odds of inclusion of a diagnosis with a polysubstance use disorder in cases from Appalachia as

compared to non-Appalachia, $p < .001$, $OR = 1.29$, 95% CI = 1.12 – 1.49 (see Table 3). Contrary to the initial hypothesis, cases from rural areas had decreased odds of a diagnosis of polysubstance use disorder, $p < .05$, $OR = 0.76$, 95% CI = 0.36 - 0.91. Despite this, results of the interaction of rurality and Appalachia suggest that rural Appalachian cases had increased odds of inclusion of a diagnosis as compared to the non-rural, non-Appalachian cases, $p < .001$, $OR = 1.7$, 95% CI = 1.33 – 2.16. Additionally, cases with MTR has did not have significantly different odds of inclusion of a diagnosis with a polysubstance use disorder as compared to areas without MTR, and the interaction between rurality, Appalachia, and MTR suggested that cases from rural Appalachia with MTR did not have significantly different odds of including a diagnosed with an alcohol use disorder as opposed to cases from non-rural, non-Appalachia without MTR (see Figure 4). Overall, this interaction does not support the hypothesis.

Exploratory Analyses

To focus on the influence of MTR within Appalachia due to the extensive history of MTR and dearth of research on the mental health effects, a subset of the data containing cases from rural Appalachia was examined. Within rural Appalachia the sample was primarily Caucasian (91.9%) majority female (58%) with an average age of 20.25 years ($SD = 3.09$). An independent samples t-test was run to determine differences in case age between areas with MTR and areas without MTR. Results of the independent samples t-test suggest that there is a small, but significant difference in the ages of cases from MTR ($M = 20.59$, $SD = 3.03$) and non-MTR ($M = 20.24$, $SD = 3.09$) areas $t(1,184) = 2.47$, $p < .001$, $d = 0.11$. A chi-square was performed to test demographic differences in rural Appalachia between MTR and non-MTR communities

specifically sex, race, income quartile, and type of payment. For full results see Table 5. Overall there were more Caucasian cases in areas with MTR as compared to non-Caucasian cases and all cases in areas with MTR were in the first income quartile as compared to 88% in the first quartile in areas without MTR. Both in areas with MTR and without MTR, public insurance was the most common form of primary payment method. The results from the chi-square test on STI and self-harm diagnoses were uninterpretable as there were five or fewer cases from areas with MTR (n = 1 and n = 5, respectively). Initial chi-square results suggest that there were increased rates of diagnosis of polysubstance use and alcohol use in areas with MTR as compared to areas without MTR. For the full results of the chi-square tests on risky behaviors, see Table 6.

Separate binary regressions were conducted to test for differences in odds of incidence of an alcohol use disorder or polysubstance use disorder respectively while controlling for age, race, income quartile, and primary form of payment. Results of the regression suggest that cases from areas with MTR have higher odds of including a diagnosis of an alcohol use disorder as compared areas without MTR, $p < .001$, OR = 2.99, 95% CI = 2.04 – 4.36. For additional results see Table 7. A separate binary logistic regression indicated that cases from areas with MTR are significantly more likely to include a diagnosis of polysubstance use disorder in relation to non-MTR areas within rural Appalachia, $p < .05$, OR = 1.75, 95% CI = 1.18 – 2.59. These findings partially support the hypothesis of increased odds of emerging adult cases diagnosed with risky behaviors in rural Appalachia with MTR as compared to rural Appalachia without MTR.

Discussion

Overall results of the analyses suggested mixed support for the hypotheses. In general, MTR appears to play an influential role on adolescent and emerging adult alcohol and polysubstance use in rural Appalachia. In contrast, there was not a significant difference in the odds of diagnosis with a substance use disorder, excluding alcohol, in cases residing in rural and non-rural, Appalachian and non-Appalachian, and in areas with and without MTR. Additionally, there were exceedingly small sample sizes for STIs and self-harm, precluding examination of differences in diagnostic rates. Future research should endeavor to further explore causality, longitudinal effects, and make efforts to consider differences in these low base rate experiences.

Alcohol Use Diagnoses

Alcohol use analyses suggested mixed results as related to the hypotheses after controlling for income, age, race, and primary payment method. Contrary to the hypotheses, rural and Appalachian areas separately had decreased odds of diagnoses with an alcohol use disorder, as compared to non-rural and non-Appalachian areas respectively. It is important to note that the data do not indicate that there is less alcohol use in either of these areas, but that individual cases from those areas are less likely to include diagnosis with an alcohol use disorder. Despite the decreased odds of these factors separately, cases within rural Appalachia has double the odds of non-rural, non-Appalachian cases of diagnosis with an alcohol use disorder, providing modest support for the hypotheses. Increased odds in rural Appalachia suggests that rural Appalachia is distinctly different from non-rural Appalachia and rural areas at large even after controlling for financial concerns (i.e., income quartile and primary

payment method), age, and race. Overall, the increased odds are consistent with other findings noting both younger alcohol use and higher rates of binge drinking and heavy use in rural Appalachia (Shannon et al., 2011; Zhang et al., 2008). Within the model, MTR alone was not a significant individual predictor, yet was it significant when combined with rural Appalachia, supporting the hypotheses. Overall rural Appalachian areas with MTR had nearly three times higher odds of the case including a diagnoses of Alcohol use as compared to non-rural, non-Appalachian, and non-MTR areas respectively.

Additionally, there were nearly twice the odds of including of an alcohol use diagnosis for self-pay and private insurance as compared to public forms of insurance, with particularly high odds associated with self-pay, as compared to a public form of insurance. This finding may further suggest that individuals seeking treatment in the ED may be higher income, as supported by higher odds of associated with income in the 4th quartile, and therefore may have the ability to pay for the necessary treatment. Furthermore, insurance status and ability to pay may be one of the barriers to seeking treatment as suggested by Zhang and colleagues (2008).

In analysis of the subset of data from rural Appalachia, areas with MTR experienced nearly three times higher odds of alcohol use diagnoses as compared to areas without MTR. Generally, this suggest that though MTR exists both within and outside of rural Appalachia, that MTR is predictive beyond the initial increased risk for diagnosis in rural Appalachia. Increased odds in communities with MTR support the argument that solastalgia and the influence of long-term environmental stresses may promote risky alcohol use. This was particularly meaningful as all cases from MTR

communities within rural Appalachia were categorized in the 1st income quartile and were associated with double the odds among individuals whom paid for their treatment out of pocket. Clearly those who sought ED treatment in this sample sought treatment despite financial and other barriers. Individuals may seek treatment after experiencing an alcohol related accident due to engaging in risky behaviors, common post-alcohol consumption (Hulse et al., 2001; Kelly et al., 2005; Sanjuan et al., 2014). Additionally the individuals may be receiving ED treatment as there may be a shortage of other medical providers (e.g. Hendryx, 2008).

The implications of the combination of rurality, Appalachia, and MTR are particularly concerning, yet are consistent with previous research on natural disasters and rural Appalachia. In general, increased odds of diagnosis associated with living in a rural Appalachian community with MTR remains analogous with the literature on natural disasters. For example, after Hurricane Katrina, 27% of survivors engaged in heavy drinking (4 or more drinks in 1 sitting) as compared to the Louisiana adult prevalence rate of 4.6% as well as survivors having experienced increased odds for binge drinking during the following year (Cerdá, Tracy, & Galea, 2011; Flory, Hankin, Kloos, Cheely, & Turecki, 2009). Specifically, post-disaster adolescents and emerging adults reported an increase in their alcohol use and excessive drinking, with a proportionally higher increase for females as compared to males, while none of the participants reported a decrease in their alcohol use (Reijneveld, Crone, Verhulst, & Verloove-Vanhorick, 2003; Pollice, Bianchini, Roncone, & Casacchia, 2011). Additional social and environmental disaster related stressors may contribute to the already high rates of poverty and familial stress that has been found to play an important role in

child and adolescent mental health (Costello, Angold, Burns, Erkanli, et al., 1996; Costello, Angold, Burns, Stangl, et al., 1996; Foley et al., 2006).

More concerning, other research supports that these findings may actually be an underestimate of rural incidence rates of risky alcohol use (e.g. Heise, 2010). Beyond concerns about payment for treatment, individuals may fail to seek treatment for minor consequences (e.g. hangover) associated with alcohol use and are less likely to necessitate medical treatment (Heise, 2010), unless the individual is injured during risky or sensation seeking (Hulse, Robertson, & Tait, 2001; Kelly et al., 2005; Sanjuan et al., 2014). This may suggest that this sample primarily contained more severe alcohol use as measured though ED, yet may not adequately capture both high and low risky alcohol use, except in cases where there is additional accident or injury related to the alcohol consumption. Further, Linakis and colleagues (2009) noted differences exist between EDs and their staff in their screening for behaviors associated with alcohol use. For example some staff may not question if the injury was influenced by the patient or others' alcohol use. It would be beneficial for ED as well as other medical settings to consistently use short screening or assessment tools such as the Alcohol Use Disorders Identification Test (Chung, Colby, Barnett, Rohsenow, Spirito & Monti, 2000; Reinert & Allen, 2002). Clearly there remain several inconsistencies in exploring and measuring rural and Appalachian adolescent and emerging adult alcohol use.

Polysubstance Use Diagnoses

Overall, results of the analyses were consistent with the hypotheses regarding polysubstance use diagnoses. Adolescent and emerging adult cases in Appalachia were found to have increased odds of diagnosis. Despite decreased odds of inclusion of a

diagnosis in rural areas, rural Appalachian cases were found to have increased diagnostic rates as compared to non-rural, non-Appalachian cases. Similar to alcohol use results, this is not particularly surprising given the extensive history of substance use within rural Appalachia, especially with the trend of increasing use of non-therapeutic psychopharmacological medications, opioids, and alcohol use among adolescents and adults in Appalachia (Shannon et al., 2011; Zhang et al., 2008). Additionally, cases from the rural Appalachian subset with MTR did not have increased odds of diagnosis with a polysubstance use disorder, failing to support the initial hypothesis. Furthermore, consistent with results from the alcohol use analyses, self-pay cases had double the odds to include a polysubstance use diagnosis than cases utilizing other payment methods. Again, the results suggest that economic factors may be influential when individuals are weighing whether to pursue treatment.

Analyses within rural Appalachia suggested cases from areas with MTR had increased odds of diagnosis with a polysubstance use disorder as compared to rural Appalachia without MTR, consistent with previous findings (e.g. Zhang et al., 2008). Generally, this finding supports the increasing trend of treatment for opioids and heroin use in Appalachia, with higher increasing rates in communities with coal mining during. It is particularly concerning that many of the misused opioids were initially prescribed through EDs and by primary care providers in the community (McCabe, West, & Boyd, 2013). Overall, increased odds within rural Appalachia indicates that living rural Appalachia is associated with increased odds of diagnosis, and exposure to MTR is an additional risky experience beyond normal life in rural Appalachia. In light of this evidence, it may be subsumed from the current study that adolescents and emerging

adults exposed to MTR may be engaging in maladaptive coping due to the significant disruption from the disaster on their lives. This appears consistent with the theory that polysubstance use is a form of maladaptive coping due to solastalgia or other stressors (i.e. environmental destruction, multigenerational poverty). Other research on natural disasters supports increased in polysubstance use, specifically the combination of alcohol and marijuana, as well as increased odds of MDMA and hypnotic or sedative use after exposure to a disaster as compared other adolescents who had not experienced a disaster (Pollice et al., 2011; Reijneveld, et al., 2003; Rohrbach, Grana, Vernberg, Sussman & Sun, 2009). A concerning aspect worth consideration is that adolescents and emerging adults seeking treatment for their substance use may not be receiving referrals to outside mental health providers, as suggested by Bell and colleagues (2011), or are unable to seek the treatment due to significant barriers. Moreover, these individuals may be neglecting preventative health care and instead eschewing treatment due to cost, lack of insurance, and shortage of providers leading them to only seek treatment when their symptoms become an emergency.

STI, Self-Harm, & non-Alcohol Substance Use Diagnoses

STIs, self-harm, and substance use without alcohol use diagnoses were too rare for analysis within areas with MTR. There appear to be some consistent themes contributing to these low sample sizes. Fear of stigma appears to be a consistent barrier to seeking or receiving treatment for STI, self-harm and substance use. Several studies have suggested that perceived stigma or fear of stigma is one of the most significant barriers for parents and their children seeking and receiving treatment in rural communities and Appalachia at large (Lichtenstein, Hook & Sharma, 2005; Polaha et al.,

2011; Williams & Polaha, 2014; Starr et al., 2002) and may lead to a preference for a general practitioner or other medical provider over a mental health provider (Dolan et al., 2011; Lichtenstein et al., 2005; Elliot & Larson, 2004; Steele, Jameson, & Kelso, 2013).

This study found similar low rates of self-harm in areas with and without MTR possibly due to low base rates, mild forms of self-harm that do not require ED treatment, or that individuals are eschewing treatment due to previously discussed barriers (e.g. financial concerns, stigma, or shortage of providers). There are similar concerns with STI treatment, yet it is likely that affected individuals seek treatment from other health providers or may not have had multiple sexual partners, overall lowering their risk for STIs.

Limitations

This project has significant limitations associated with the archival nature of the data set. Despite the large sample size within HCUP SEDD (2008) of approximately 355,000 adolescent and emerging adult cases from EDs, there exist a range of risky behaviors, many of which are not captured through ED visits. Generally, this study measures the some of the possible consequences from engaging in risky behaviors rather than the prevalence and practice of those activities. It is likely that the individuals are coming to ED for an alternative primary reason than substance use such as accident or injury which has been associated with intoxication, particularly alcohol use (e.g. Hulse et al., 2001; Sanjuan et al., 2014). In addition, the dataset does not contain "mild" consequences (e.g., a hangover) or more severe consequences such as hospitalization from a suicide attempt. The more mild consequences or treatment

could be better measured through surveys with youth (e.g. YRBSS, National Survey on Drug Use and Health), general practitioners, specialty clinics, or a variety of interviews. Conversely more serious consequences that may involve hospitalization and could be measured through the State Inpatient Database (SID) or through specialty inpatient facilities. Overall, this is a barrier to obtaining an accurate estimate of and continued engagement in risky behaviors.

Another significant limitation was the inability to determine a causal relationship due to the nature of this research. The analyses focuses on diagnoses from 2008 in communities with MTR during 2008 rather than considering longitudinal changes such as in other studies (e.g. Green et al., 1994; McFarlane, Policansky, & Irwin, 1987; McFarlane & Van Hooff, 2009). Generally this minimizes the long-term influence of MTR and potentially excludes areas in which MTR has had a significant effect on the local environment and community. A longitudinal study would provide additional support for the possibility of a causal relationship between MTR in rural Appalachia and the increased odds for risky behaviors, substance use particularly.

Additionally, the study lacks granularity in that it does not track individual trends of risky behaviors. This suggests that some of the ED visits could be due to a singular event or could be a trend of risk behavior. Tracking would provide more support to theories suggesting risky behaviors are a form of maladaptive coping. Clearly, there is a need for additional research on risky behaviors among adolescents and emerging adults in rural Appalachia with a special focus on communities with MTR.

Conclusion

Although there is a significant body of research detailing many of the physical health effects associated with MTR, This study is among the first focusing on the influence of MTR on adolescent and emerging adult risk behaviors. Despite inconsistent results, clear trends and themes have emerged. Primarily, there appears to increased odds of diagnoses with substance use, specifically alcohol and polysubstance use, in rural Appalachia with MTR. Overall, these results provide further support to the concept of solastalgia and that the increased substance use may be a maladaptive coping technique. Further themes that have emerged from the risk behaviors are concerns about stigma and treatment cost due to low rates of insurances and high rates of poverty (Zhang et al., 2008). Overall, this suggests that this data, as well as other existing data sets, is likely an underrepresentation of actual base rates of risky behaviors among adolescents and emerging adults. It is vital to have accurate estimates of base rates to further research, diagnosis, treatment, and prevention both for individuals and in the community at large.

It is worthwhile for future research to explore the function of risky behaviors, specifically as a form of maladaptive coping from exposure to MTR, as suggested from other natural disaster research (e.g. Cerdá, et al., 2011; Pollice et al., 2011; Reijneveld, et al., 2003; Wagner et al., 2009), or as an indicator of solastalgia. Additionally it is unclear if there are consistent norms about substance use within rural Appalachia. The normative information could be helpful in developing preventative and treatment programs for substance use for adolescents and emerging adults in heavily affected areas.

References

Ahern, M., Mullett, M., Mackay, K., & Hamilton, C. (2011). Residence in coal-mining areas and low-birth-weight outcomes. *Maternal and Child Health Journal, 15,* 974-979. doi: 10.1007/s10995-009-0555-1

Albrecht, G., Sartore, G. M., Connor, L., Higginbotham, N., Freeman, S., Kelly, B., … Pollard, G. (2007). Solastalgia: The distress caused by environmental change. *Austrailasian Psychiatry, 15,* S95-S98. doi: 10.1080/10398560701701288

Appalachian Regional Commission. (2001). *ARC Projects*. Retrieved from http://www.arc.gov/about/ARCProjects.asp

Appalachian Regional Commission. (2010). *ARC Projects*. Retrieved from http://www.arc.gov/about/ARCProjects.asp

Appalachian Regional Commission. (2011). *ARC Projects*. Retrieved from http://www.arc.gov/about/ARCProjects.asp

Arnett, J. J. (1999). Adolescent storm and stress, reconsidered. *American Psychologist, 54*, 317-326.

Arnett, J. J. (2000). Emerging adulthood: A conception of development from the late teens through the twenties. *American Psychologist, 55*, 469-480.

Bell, L., Stargatt, R., Bosanac, P., Castle, D., Braitberg, G., & Coventry, N. (2011). Child and adolescent mental health problems and substance use presentations to an

emergency department. *Australasian Psychiatry, 19,* 521-525. doi: 10.3109/10398562.2011.603329

Blumenfield, M. Soujanen, J. K., &Weiss, C. (2012). Public awareness about the connection between depression and physical health: Specifically Heart Disease. *The Psychiatric Quarterly, 83,* 259-269. doi: 10.1007/s11126-011-9199-6

Boyle, S. H., Jackson, W. G., & Suarez, E. C. (2007). Hostility, anger, and depression predicts increases in C3 over a 10-year period. *Brain, Behavior, and Immunity, 21,* 816-823.

Burns, S. S. (2007). *Bringing down the mountains: The impact of mountaintop removal on southern West Virginia communities.* Morgantown, WV: West Virginia University Press.

Butcher, J. N., Dahlstrom, W. G., Graham, J. R., Tellegen, A., & Kaemmer, B. (1989).*The Minnesota Multiphasic Personality Inventory-2 (MMPI-2): Manual for administration and scoring*. Minneapolis, MN: University of Minnesota Press.

Centers for Disease Control and Prevention. (2009). *Sexually Transmitted Disease Surveillance, 2008.* Atlanta, GA: U.S. Department of Health and Human Services

Cerdá, M., Tracy, M., & Galea, S. (2011). A prospective population based study of changes in alcohol use and binge drinking after a mass traumatic event. *Drug and Alcohol Dependence, 115*, 1-8. doi: 10.1016/j.drugalcdep.2010.09.011

Chung, T., Colby, S.M., Barnett, N.P., Rohsenow, D. J., Spirito, A., & Monti, P. M. (2000). Screening adolescents for problem drinking: Performance of brief screens against DSM–IV alcohol diagnoses. *Journal of Studies on* Alcohol, *61*, 579–587.

Copeland, W. E., Angold, A., Shanahan, L., Dreyfuss, J., Dlamini, I., & Costello, E. J. (2012). Predicting persistent alcohol problems: A prospective analysis from the Great Smoky Mountain Study. *Psychological Medicine, 42*, 1925-1935. doi: 10.1017/S0033291711002790

Cordial, P., Riding-Malon, R., & Lips, H. (2012). The effect of mountaintop removal coal mining on mental health, well-being, and community health in central Appalachia. *Ecopsychology, 4,* 201-208. doi: 10.1089/eco.2012.0032

Corrigan, P. (2004). How stigma interferes with mental health care. *American Psychologist, 59*, 614-635. doi: 10.1037/0003-066X.59.7.614

Costello, E., Angold, A., Burns, B. J., Erkanli, A., Stangl, D. K., & Tweed, D. L. (1996). The Great Smoky Mountains Study of youth: Functional impairment and serious emotional disturbance. *Archives of General Psychiatry, 53*, 1137-1143. doi: 10.1001/archpsyc.1996.01830120077013

Costello, E., Angold, A., Burns, B.J., Stangl, D. K., Tweed, D. L., Erkanli, A., & Worthman, C., M. (1996). The Great Smoky Mountains Study of youth: Goals, design, methods, and the prevalence of DSM-III-R disorders. *Archives of General Psychiatry, 53*, 1129-1136. doi: 10.1001/archpsyc.1996.01830120067-12

Dolan, M. A., Fein, J. A., & The Committee on Pediatric Emergency Medicine. Pediatric and adolescent mental health emergencies in the emergency medical service system. (2011). *American Academy of Pediatrics, 127,* e1356-e1366. doi: 10.1542/peds.2011-0522

Elliot, B. A., & Larson, J. T. (2004). Adolescents in mid-sized and rural communities: Foregone care, perceived barriers, and risk factors. *Journal of Adolescent Health, 35*, 303-309. doi: 10.1016/j.jadohealth.2003.09.015

Flory, K., Hankin, B. L., Kloos, B., Cheely, C., & Turecki, G. (2009). Alcohol and cigarette use and misuse among Hurricane Katrina survivors: Psychosocial risk and protective factors. *Substance use & Misuse, 44*, 1711-1724. doi: 10.3109/10826080902962128

Foley, D. L., Goldston, D. B., Costello, E., & Angold, A. (2006). Proximal psychiatric risk factors for suicidality in youth: The Great Smoky Mountains Study. *Archives of General Psychiatry, 63*, 1017-1024. doi:10.1001/archpsyc.63.9.1017

Fontanella, C. A., Hiance-Steelesmith, D. L., Phillips, G. S., Bridge, J. A., Lester, N., Sweeney, H. A., & Campo, J. V. (2015). Widening rural-urban disparities in youth suicide, United States, 1996-2010. *The Journal of the American Medical Association Pediatrics,* doi:10.1001/jamapediatrics.2014.3561

Fox, K. R. (1999). The influence of physical activity on mental well-being. *Public Health Nutrition, 3A,* 411-8.

Freme, F. (2008). *Annual coal report, 2008*. Energy Information Administration, US Department of Energy, Washington, DC.

Green, B. L., Grace, M. C., Marshall, V. G., Kramer, T. L., Gleser, G. C., & Leonard, A. C. (1994). Children of disaster in the second decade: A 17-year follow-up of buffalo creek survivors. *Journal of American Academy of Child and Adolescent Psychiatry, 33,* 71-79.

Hair, E. C., Park, M. J., Ling, T. J., Moore, K. A. (2009). Risky behaviors in late adolescence: Co-occurrence, predictors, and consequences. *Journal of Adolescent Health, 45*, 253-261. doi: 10.1016/j/jadohealth.2009.02.009

Happell, B., Scott, D., Plantania-Phung, C., & Nankivell, J. (2012). Rural physical health care services for people with serious mental illness: A nursing perspective. *The Australian Journal of Rural Health, 20,* 248-253. doi: 10.1111/j.1440-1584.2012.01303.x

Hauenstein, E. J., Petterson, S., Rovnyak, V., Merwin, E., Heise, B., & Wagner,D. (2006). Rurality, gender, and mental health treatment. *Family & Community Health, 29*, 169-185.

HCUP State Emergency Department Databases Kentucky (SEDD). Healthcare Cost and Utilization Project (HCUP). 2008. Agency for Healthcare Research and Quality, Rockville, MD.

Heflinger, C. A., & Christens, B. (2006). Rural behavioral health services for children and adolescents: An ecological and community psychology analysis. *Journal of Community Psychology, 34,* 379-400. doi: 10.1002/jcop.20105

Heise, B. (2010). Healthcare system use by risky alcohol drinkers: A secondary data analysis. *American Academcy of Nurse Practitioners, 22,* 256-263. doi: 10.1111/j.1745-7599.2010.00500.x

Hendryx, M. (2008). Mental health professional shortage areas in rural Appalachia. *The Journal of Rural Health, 24,* 179-182. doi: 10.1111/j.1748-0361.2008.00155.x

Hendryx, M. (2009). Mortality from heart, respiratory, and kidney disease in coal mining areas of Appalachia. *International Archives of Occupational & Environmental Health, 82,* 243-249. doi: 10.1007/s00420-008-0328-y

Hendryx, M. (2013). Personal and family health in rural areas of Kentucky with and without mountaintop coal mining. *The Journal of Rural Health, 29,* 79-86. doi: 10.1111/jrh.12016

Hendryx, M., & Innes-Wimsatt, K. A. (2013). Increased risk of depression for people living in coal mining areas of central Appalachia. *Ecopsychology, 5,* 179-187. doi: 10.1089/eco.2013.0029

Hendryx, M., Wolfe, L., Luo, J., & Webb, B. (2011). Self-reported cancer rates in two rural areas of West Virginia with and without Mountaintop coal mining. *Journal of Community Health, 37,* 320-327. doi:10.1007/s10900-011-9448-5

Hendryx, M., & Zullig, K. J. (2009). Higher coronary heart disease and heart attack morbidity in Appalachian coal mining regions. *Preventative Medicine, 49,* 355-359. doi: 10.1016/j.ypmed.2009.09.011

Hirsch, J. K. (2006). A review of the literature on rural suicide: Risk and protective factors, incidence, and prevention. *Crisis, 27*, 189-199. doi: 10.1027/0227-5910.27.4.189

Hitt, N. P., & Hendryx, M. (2010). Ecological integrity of streams related to human cancer mortality rates. *EcoHealth, 7,* 91-104. doi: 10.1007/s10393-010-0297-y

Hulse, G. K., Robertson, S. I. & Tait, R. J. (2002). Adolescent emergency department presentation with alcohol- or other drug-related problems in Perth, Western Australia. *Addiction, 96,* 1059-1067. doi: 10.1046/j.1360-0443.2001.967105915.x

Jameson, J. P., & Blank, M. B. (2007). The role of clinical psychology in rural mental health services: Defining problems and developing solutions. *Clinical Psychology: Science and Practice, 14*, 283-298. doi: 10.1111/j.1468-2850.2007.00089.x

Judd, F., Jackson H., Komiti, A., Murray, G., Fraser, C., Grieve, A., & Gomez, R. (2006). Help-seeking by rural residents for mental health problems: The importance of agrarian values. *Australian and New Zealand Journal of Psychiatry, 40,* 769-776.

Kelly, T. M., Donovan, J. E., Cornelius, J. R., Buckstein, O. G., Delbridge, T. R., & Kinnane, J. M. (2005). Alcohol use disorder symptoms and risk-taking behavior as

predictors of alcohol-related medical events among young adults treated in emergency departments. *Addictive Behaviors, 30,* 174-1689. doi: 10.1016/j.addbeh.2005.07.005

Lambert, D., Ziller, E. C., & Lenardson, J. D. (2008, July). Use of mental health services by rural children. Paper presented to the Rural Health Research & Policy Center.

Lee, A., & Browne, M. O. (2008). Subjective well-being, sociodemographic factors, mental and physical health of rural residents. *Australian Journal of Rural Health, 16,* 290-296. doi: 10.1111/j.1440-1584.2008.00986.x

Lichtenstein, B., Hook III, E. W., & Sharma, A. K. (2005). Public tolerance, private pain: Stigma, sexually transmitted infections in the American deep south. *Culture, Health & Sexuality, 7*, 43-57. doi: 10.1080/13691050412331271416

Linakis, J. G., Chun, T. H., Mello, M. J., & Baird, J. (2009). Alcohol-related visits to the emergency department by injured adolescents: A national perspective. *Journal of Adolescent Health, 45,* 84-90. doi: 10.1016/j.jadohealth.2008.11.008

McCabe, S. E., West, B. T., & Boyd, C. J. (2013). Leftover prescription opioids and nonmedical use among high school seniors: A multi-cohort national study. *Journal of Adolescent Health, 52,*480-485. doi: 10.1016/j.jadohealth.2012.08.007

McFarlane, A. C., Policansky, S. K., & Irwin, C. (1987). A longitudinal study of the psychological morbidity in children due to a natural disaster. *Psychological Medicine, 17,* 727-738.

McFarlane, A. C., & Van Hooff, M. (2009). Impact of childhood exposure to a natural disaster on adults mental health: 20-year longitudinal follow-up study. *The British Journal of Psychiatry, 195,* 142-148. doi: 10.1192/bjp.bp.108.054270

Merikangas, K. R., He, J., Burstein, M., Swanson, S. A., Avenevoli, S., Cui, L., … Swendsen J. (2010). Lifetime prevalence of mental disorders in US adolescents: Results from the National Comorbidity Study – Adolescent Supplement (NCS-A). *Journal of American Academy for Child and Adolescent Psychiatry, 49*, 980-989. doi: 10,1016/j.jaac.2010.05.017

Meyer, M. G., Toborg, M. A., Denham, S. A., & Mande, M. J. (2008). Cultural perspectives concerning adolescent use of tobacco and alcohol in the Appalachian mountain region. *Journal of Rural Health,* 24, 67-75. doi: 10.1111/j.1748-0361.2008.00139.x

Palmer, M. A., Bernhardt, E. S., Schlesinger, W. H., Eshleman, K. N., Foufoula-Georgiou, E.,Hendryx, M. S., & Wilcock P. R. (2010). Mountaintop mining consequences. *Science, 327,* 148-149. doi: 10.1126/science.1180543

Perkins, D., Hamilton, M., Saurman, E., Luland, T., Alpren, C., & Lyle, D. (2010). GP clinic: Promoting access to primary health care for mental health service clients. *Australian Journal of Rural Health, 18,* 217-222. doi: 10.1111/j.1440-1584.2010.01159.x

Petridou, E., Zavitsanos, X., Dessypris, N., Frangakis, C., Mandyla, M., Doxiadis, S., & Trichopoulos, D. (1997). Adolescents in high-risk trajectory: Clustering of risky

behavior and the origins of socioeconomic health differentials. *Preventative Medicine, 26*, 215-219. doi: 0091-7435/97

Pharo, H., Sim, C., Graham, M., Gross, J., & Hayne, H. (2011) Risky business: Executive function, personality, and reckless behavior during adolescence and emerging adulthood. *Behavioral Neuroscience, 125,* 70-978.

Polaha, J., Dalton III, W. T., & Allen, S. (2011). The prevalence of emotional and behavior problems in pediatric primary care serving rural children. *Journal of Pediatric Psychology, 36,* 652-660. doi: 10.1093/jpepsy/jsq116

Pollice, R., Bianchini, V., Roncone, R., & Casacchia, M. (2011). Marked increase in substance use among young people after L'Aquila earthquake. *European Child & Adolescent Psychiatry, 20*, 429-430. doi: 10.1007/s00787-011-0192-2

Reijneveld, S. A., Crone, M. R., Schuller, A. A., Verhulst, F. C., & Verloove-Vanhorick, S. P. (2005). The effect of a severe disaster on the mental health of adolescents: Follow-up of a controlled study. *Psychological Medicine, 35*, 367-376. doi: 10.1017/S0033291704003575

Reijneveld, S. A., Crone, M. R., Verhulst, F. C., & Verloove-Vanhorick, S. P. (2003). The effect of a severe disaster on the mental health of adolescents: A controlled study. *The Lancet, 362*, 691-696. doi: 10.1016/S0140-6736(03)14231-6

Reinert, D. F., & Allen, J. P. (2002). Alcohol Use Disorders Identification Test (AUDIT): A review of recent research, *Alcoholism: Clinical and Experimental Research*, *26*, 272–279.

Rohrbach, L. A., Grana, R., Vernberg, E., Sussman, S., & Sun, P. (2009). Impact of Hurricane Rita on adolescent substance use. *Psychiatry, 72*, 222-237.

Rural Health Research Center. (2003). Using RUCA Data. *In RUCA Data.* Retrieved from http://depts.washington.edu/uwruca/ruca-uses.php

Sanjuan, P. M., Rice, S. L., Witkiewitz, K., Mandler, R.N., Crandall C., & Borgenschutz, M. P. (2014). Alcohol, tobacco, and drug use among emergency department patients. *Drug and Alcohol Dependence, 138*, 32-38. doi: 10.1016/j.drugalcdep.2014.01.025

Shannon, L. M., Havens, J. R,. Oser, C., Crosby, R., & Leukenfeld, C. (2011). Examining gender differences in substance use and age of first use among rural Appalachian drug users in Kentucky. *The American Journal of Drug and Alcohol Abuse, 37*, 98-204. doi: 10.3109/00952990.2010.540282

Simpson, M. R., & King, M. G. (1999). “God brought all these churches together”: Issues in developing religion-health partnerships in an Appalachian community. *Public Health Nursing, 16*, 41-49.

Starr, S., Campbell, L. R., & Herrick, C. A., (2002). Factors affecting use of the mental health system by rural children. *Issues in Mental Health Nursing, 23,* 291-304. doi: 0161-2840/02$10.00+.00

Steele, E. H., Jameson, J. P., & Kelso, K. C. (2013, May). *The incidence of self-harm cases in rural Appalachian emergency departments.* Poster presented at the 25th annual convention of the Association of Psychological Science, Washington, DC.

Substance Abuse and Mental Health Services Administration. (2006). *Results from the 2005 National Survey on Drug Use and Health: National Findings*. 06–4194. Rockville, MD: Department for Health and Human Services.

U.S. Census Bureau, American FactFinder, Census 2010. Generated by Ellen Steele (19 April 2015).

Wagenfeld , M. O. (2003). A snapshot of rural and frontier America. In B.H. Stamm (Eds.) *Rural Behavioral Health Care: An Interdisciplinary Guide* (33-40). Washington, DC: American Psychological Association.

Wagner, K. D., Brief, D. J., Vielhauer, M. J., Sussman, S., Keane, T. M., & Malow, R. (2009). The potential for PTSD, substance use, and HIV risk behavior among adolescents exposed to Hurricane Katrina. *Substance use & Misuse, 44*, 1523-2491. doi: 10.3109/10826080902963472

Waller, M. W., Hallfors, D. D., Halpern, C. T., Iritani, B. J., Ford, C. A., & Guo, G. (2006). Gender difference in associations between depressive symptoms and patterns of

substance use and risky sexual behavior among a nationally representative sample of U.S. adolescents. *Archives of Women's Mental Health, 9,* 139-150. doi: 10.1007/s00737-006-0121-4

Williams, S. L., & Polaha, J. (2014). Rural parent's perceived stigma of seeking mental health services for their children: Development and evaluation of a new instrument. *Psychological Assessment, 26*, 763-773. doi: 10.1037/a0036571

World Health Organization. (1979). *ICD-9: International statistical classification of diseases and related health problems (9th Rev. ed.).* New York, NY: Author.

Yan, A. F., Chiu, Y., Soesen, C. A., & Wang, M. Q. (2007). STD-/HIV related sexual risk behaviors and substance use among U.S. rural adolescents. *Journal of the National Medical Association, 99*, 1386-1394.

Zhang, Z., Infante, A., Meit, M., English N., Dunn, M., & Bowers K. H. (2008, August). *An analysis of mental health and substance abuse disparities & access to treatment services in the Appalachian region.* Paper presented to Appalachian Regional Commission.

Ziller, E. C., Anderson, N. J., & Coburn, A. F. (2010). Access to rural mental health services: Service use and out-of-pocket costs. *The Journal of Rural Health, 26,* 214-224. doi: 10.1111/j.1748-0361.2010.00291.x

Zullig, K. J., & Hendryx, M. (2008). Health-related quality of life among central Appalachian residents in mountaintop mining counties. *American Journal of Public Health, 101,* 848-853. doi: 10.2105/AJPH.2010.300073

Table 1

Demographic differences between communities with and without MTR

	MTR *n* = 3,738	No MTR *n* = 350,491	χ^2	Significance	Odds Ratio (95% CI)
Age	20.34 (3.08)	20.48 (3.01)	*t* = -13.35	.731	
Caucasian	93.8%	83.8%	274.26	.000	2.93 (2.57 – 3.35)
Female	59.1%	59.7%	.44	.513	0.98 (0.92 – 1.04)
Rural	69%	29.6%	2637.66	.000	5.17 (4.82 – 5.54)
Appalachia	47.1%	<1%	359.30	.000	1.85 (1.74 – 1.97)
Income			1432.86	.000	
1st Income Quartile	48%	29.5%			
2nd Income Quartile	39.3%	26%			
3rd Income Quartile	6.2%	25.6%			
4th Income Quartile	6.3%	16.8%			
Payment Method			178.01	.000	
Public Insurance	36.7%	33.8%			
Private Insurance	23.6%	31.7%			
Self-pay	29.7%	28.4%			
Other	9.9%	5.3%			

Table 2

Comparison of Young Adult Risk Behaviors in ED cases from MTR and non-MTR counties

	MTR *n* = 3738	No MTR *n* = 350,491	χ^2	Significance	Odds Ratio (95% CI)
STIs	0.2%	0.5%	4.78	.033	0.47 (0.23- 0.94)
Self-Harm	0.2%	0.1%	1.03	.35	1.47 (0.70-3.1)
Polysubstance Use	1%	1.1%	13.19	.000	1.79 (1.30 – 2.46)
Alcohol Use	1.3%	0.9%	4.51	.035	1.37 (1.02 – 1.83)
Substance Use	0.6%	0.8%	1.94	.188	0.74 (0.48 – 1.13)
Total	122(3.2%)	11642(3.3%)			

Table 3

Binary logistic regression results for Polysubstance use cases with Interaction

	B	SE	Odds Ratio (95% CI)
Age	0.07**	0.01	1.07 (1.06 – 1.09)
Appalachia:			
Appalachian	0.27**	0.07	1.29 (1.12-1.49)
Non-Appalachian			Referent
Income:			
1st Quartile			Referent
2nd Quartile	-0.1	0.07	0.91 (0.79 – 1.05)
3rd Quartile	-0.003	0.08	1.00 (0.86 – 1.16)
4th Quartile	0.09	0.09	1.10 (0.93 – 1.31)
Race:			
Caucasian			Referent
Non-Caucasian	-0.54**	0.08	0.58 (0.50 – 0.68)
Type of Payment:			
Public Insurance			Referent
Private Insurance	-0.11	0.06	0.90 (0.80 – 1.01)
Self-Pay	0.35**	0.06	1.42 (1.27 – 1.58)
Other	0.03	0.10	1.04 (0.85 – 1.25)
Rural:			
Rural	-0.28*	0.09	0.76 (0.63 – 0.91)
Non-rural			Referent
Areas with MTR:			
MTR	0.27	0.29	1.31 (0.74 – 2.33)
Non-MTR			Referent
Appalachia x Rural	0.53**	0.12	1.70 (1.33 – 2.16)
Appalachia x Rural x MTR	0.27	0.35	1.31 (0.66 - 2.63)

*$p < .05$ ** $p < .001$

Table 4

Binary logistic regression results for Alcohol diagnoses cases with Interaction

	B	SE	Odds Ratio (95% CI)
Age	0.03**	0.01	1.03 (1.01 – 1.04)
Appalachia:			
Appalachian	-0.64**	0.07	0.53 (0.46 – 0.61)
Non-Appalachian			Referent
Income:			
1st Quartile			Referent
2nd Quartile	-0.03	0.06	0.97 (0.86 – 1.09)
3rd Quartile	-0.04	0.06	0.96 (0.85 – 1.08)
4th Quartile	0.20**	0.06	1.23 (1.09 – 1.40)
Race:			
Caucasian			Referent
Non-Caucasian	-0.67**	0.05	0.93 (0.85 – 1.03)
Type of Payment:			
Public Insurance			Referent
Private Insurance	0.71**	0.05	2.03 (1.84 – 2.24)
Self-Pay	0.75**	0.05	2.11 (1.90 – 2.34)
Other	0.65**	0.08	1.91 (1.69 – 2.24)
Rural:			
Rural	-0.63**	0.07	0.53 (0.46 – 0.61)
Non-rural			Referent
Areas with MTR:			
MTR	-0.06	0.25	0.94 (0.58 – 1.53)
Non-MTR			Referent
Appalachia x Rural	0.73**	0.11	2.07 (1.66 – 2.60)
Appalachia x Rural x MTR	1.10**	0.31	2.99 (1.63 – 5.51)

*$p < .05$ **$p < .001$

Table 5

Demographics for Rural Appalachia

	MTR	No MTR	χ^2	Significance	Odds Ratio
	n = 1760	*n* = 67, 242			(95% CI)
Age	20.59 (3.03)	20.24 (3.09)	*t* = 4.67	.000	
Caucasian	97%	92%	52.34	.000	2.50 (1.93 – 3.23)
Female	58%	58%	.00	.986	.999 (0.91 -1.10)
Income Quartiles			241.54	.000	
1st Income Quartile	100%	88%			
2nd Income Quartile	0%	10%			
3rd Income Quartile	0%	2%			
4th Income Quartile	0%	< 1%			
Insurance			272.47	.000	
Public Insurance	42%	43%			
Private Insurance	19%	24%			
Self-pay	24%	27%			
No Charge/ Other	16%	6%			

Table 6

Risky Behaviors in Rural Appalachia

	MTR *n* = 1760	No MTR *n* = 67242	χ^2	Significance	Odds Ratio (95% CI)
Polysubstance Use	1.5%	0.9%	8.92	.003	1.79 (1.22 -2.65)
Alcohol Use	1.7%	0.6%	32.93	.000	2.85 (1.96 – 4.14)
Substance Use	0.7%	0.5%	1.03	.311	1.35 (0.76 -2.40)
Totals	75 (4.2%)	1650 (2.4%)			

Table 7

Alcohol use in Rural Appalachia

	B	SE	Odds Ratio (95% CI)
Age	0.03	0.02	1.03 (1.00 – 1.07)
Income:			
1st Quartile			Referent
2nd Quartile	0.18	0.16	1.19 (0.88 – 1.62)
3rd Quartile	0.41	0.28	1.51 (0.86 – 2.63)
4th Quartile	2.10*	1.03	8.12 (1.08 – 60.91)
Race:			
Caucasian			Referent
Non-Caucasian	0.28	0.16	1.32 (0.96 – 1.81)
Type of Payment:			
Public Insurance			Referent
Private Insurance	0.20	0.14	1.23 (0.94 – 1.61)
Self-Pay	0.75**	0.12	2.13 (1.68 – 2.69)
Other	0.34	0.21	1.40 (0.93 – 2.09)
Areas with MTR:			
MTR	1.09**	0.19	2.99 (2.04 – 4.36)
Non-MTR			Referent

*Significant at *p* less than .05 **Significant at *p* less than .001

Table 8

Polysubstance use in Rural Appalachia

	B	SE	Odds Ratio (95% CI)
Age	0.13**	0.02	1.14 (1.10 – 1.17)
Income:			
1st Quartile			Referent
2nd Quartile	0.20	0.13	1.22 (0.94 – 1.57)
3rd Quartile	0.35	0.25	1.41 (0.87 – 2.30)
4th Quartile	-16.31	8429.51	.000 (0.00)
Race:			
Caucasian			Referent
Non-Caucasian	-0.28	0.17	0.76 (0.54 – 1.06)
Type of Payment:			
Public Insurance			Referent
Private Insurance	-0.37*	0.13	0.69 (0.54 – 0.89)
Self-Pay	0.50	0.10	1.64 (1.36 – 1.98)
Other	0.21	1.7	1.24 (0.90 – 1.71)
Areas with MTR:			
MTR	0.56*	0.20	1.75 (1.18 – 2.59)
Non-MTR			Referent

*$p < .05$ ** $p < .001$

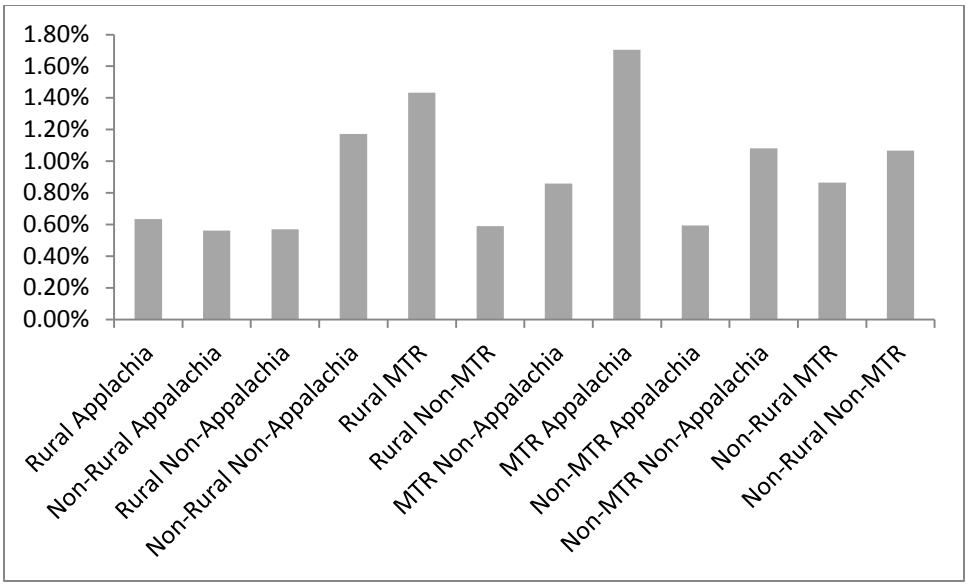

Figure 1. Proportion of cases with Alcohol use diagnosis.

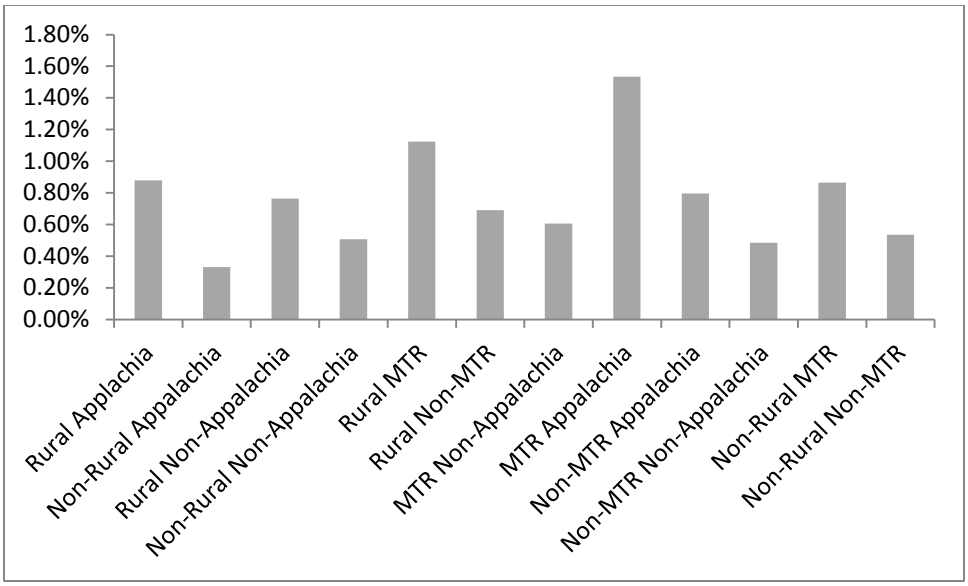

Figure 2. Proportion of cases with Polysubstance use diagnosis

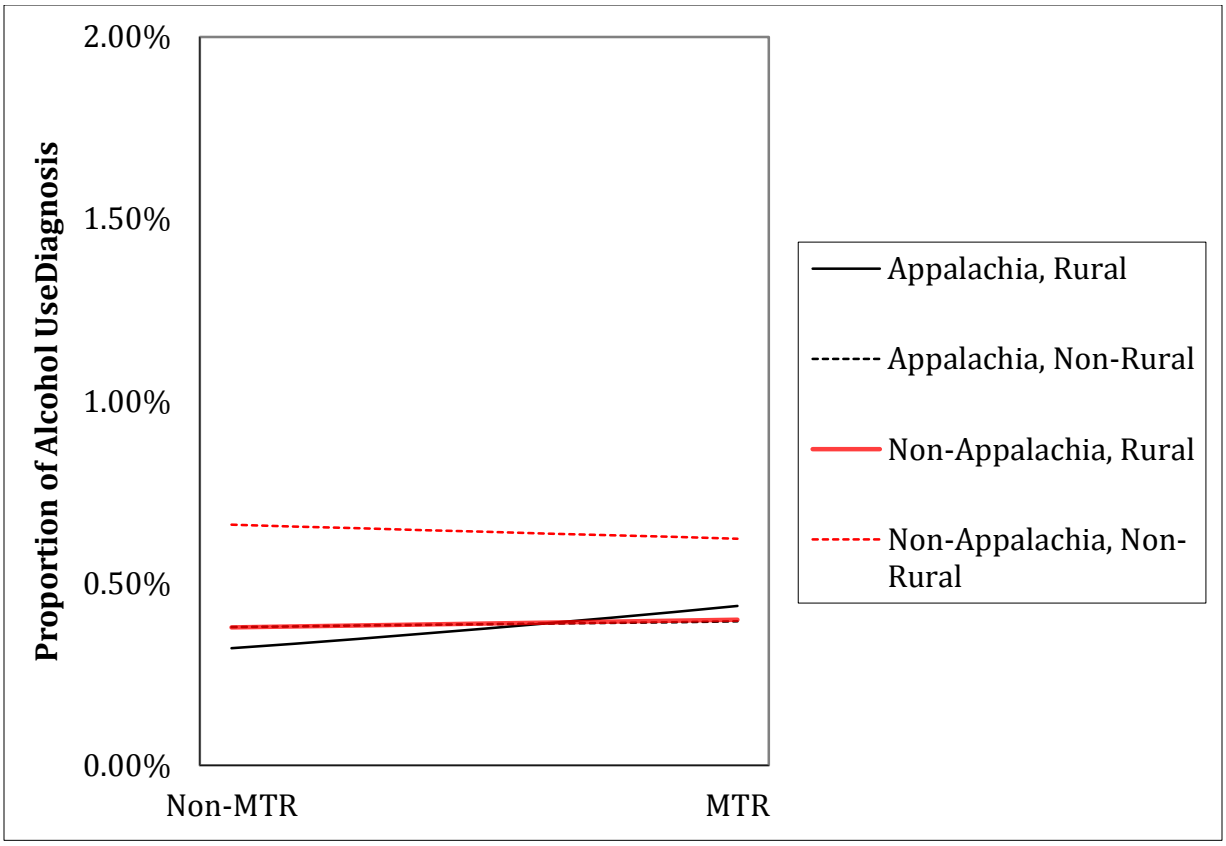

Figure 3. Three-way Interaction of Alcohol use diagnosis

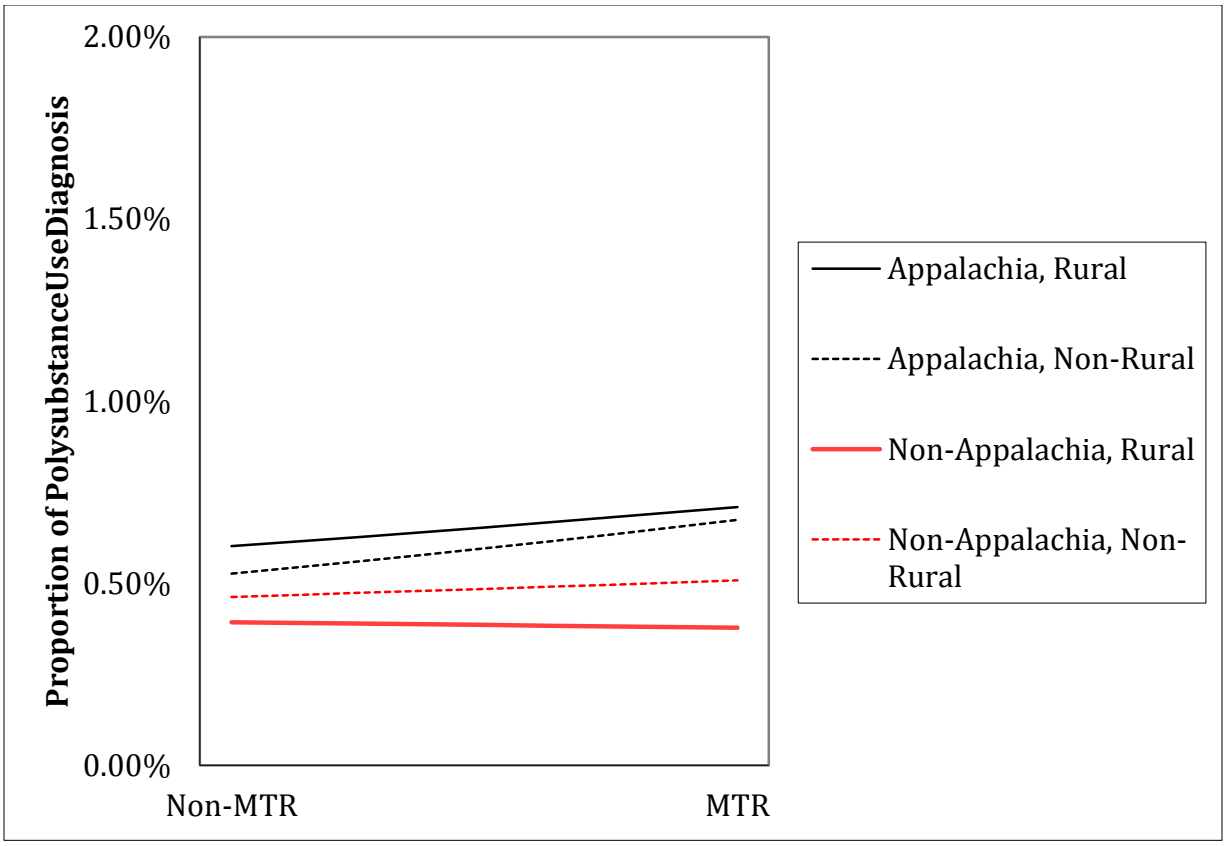

Figure 4. Three-way Interaction of Polysubstance use diagnosis

Vita

Ellen Hunt Steele was born in Durham, North Carolina, to Robin Hunt and Kenneth Steele. She graduated from Watauga High School in North Carolina in June 2004. In the fall, she entered the University of North Carolina to study Psychology, graduating with a Bachelor of Arts in Psychology in May 2008. She accepted a position as an AmeriCorps VISTA at Serve Rhode Island in August of 2009. In the fall of 2012, she began study towards a Master of Arts in Clinical Health Psychology and a research and teaching assistantship in the Psychology department. The M.A. was awarded in May 2015.