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The Effects of Adverse Childhood Experiences on Subsequent Injury in Young Adulthood: Findings from the National Longitudinal Study of Adolescent and Adult Health

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THE EFFECTS OF ADVERSE CHILDHOOD EXPERIENCES ON SUBSEQUENT INJURY IN YOUNG ADULTHOOD: FINDINGS FROM THE NATIONAL LONGITUDINAL STUDY OF ADOLESCENT AND ADULT HEALTH

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Abstract

The objective of this study is to examine the association between adverse childhood experiences (ACEs) in the context of family and community and the likelihood of subsequent unintentional and intentional, nonfatal injury in young adulthood (ages 24-32 years). Using a cross sectional study design, data from Waves I and IV of the National Longitudinal Study of Adolescent and Adult Health, a nationally representative sample (n = 14,800) was used to examine the relationship between 16 types of ACEs and a cumulative ACE score and the odds of seven injury outcomes in young adulthood. Over a third (37.6%) of young adults sustained at least one of the seven injury outcomes. Most (93.4%) participants endorsed at least one ACE type with a mean ACE score of 2.99 (SE, 0.26). Overall, child maltreatment, particularly physical abuse and emotional neglect, tended to have a strong influence on the odds of both unintentional and intentional injury ($p < .05$). Interpersonal loss, such as a family member or friend's suicide attempt or experiencing the death of a parent tended to have a strong influence on the odds of intentional injuries ($p < .05$). With the exception of suicide attempt, we found a significant graded relationship between the number of ACE exposures and injury. For every additional ACE endorsed, the odds of injury were: Serious Injury (odds ratio (OR): 1.16), Motor Vehicle Accident (OR: 1.09), Physical IPV (OR: 1.13), Sexual IPV (OR: 1.22), Shot/Stabbed (OR: 1.16), Beaten Up (OR: 1.25). This study suggests that exposure to ACEs in childhood and adolescence are risk factors that increase the odds of subsequent injury in young adulthood.

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CHAPTER 1

INTRODUCTION

The objective of this study is to examine the association between adverse childhood experiences (ACEs) in the context of family and community and the likelihood of subsequent unintentional and intentional, nonfatal injury in young adulthood (ages 24-32 years). The prevalence of injury among young adults represents a significant and urgent public health concern in the U.S. Injury and violence prevention remains a focus for the CDC's research agenda (National Center for Injury Prevention and Control, 2009). Healthy People 2020 (2014) includes over forty objectives related to injury and violence prevention, including new developmental objectives in the areas of intimate partner violence and sexual violence. This study is aligned with the research agenda and objectives of the CDC and Healthy People 2020 for injury intervention and control.

Statement of the Problem

Young adulthood, as a developmental stage in the life course, has relevance to public health research. Although there have been great strides in public health injury prevention in the past few decades, unintentional injury, suicide and homicide still comprise the top three leading causes of death for young adults (CDC, 2012). Injuries account for almost 80% of all deaths in the first three decades of life (Haegerich, et al., 2014). Among adults, approximately 180,000 people prematurely die each year from unintentional and intentional injuries (CDC, 2014).

The burden of nonfatal injuries in the U.S. is a significant public health concern. Individuals who sustain non-fatal injuries may experience short or long term disability, sexual and reproductive health problems, poor mental health, high medical costs and lost productivity (Haegerich et al., 2014). It is estimated that the number of people who survive an injury with some form of permanent disability is ten to fifty times higher than those who die from their injuries (Gosselin, et al., 2009). The World Health Organization (2004) estimates that by the year 2020, injury will account for 20% of all disability-adjusted life years lost.

The most common causes of nonfatal injury among young adults include motor vehicle accidents, suicide attempt, intimate partner violence, sexual violence, and interpersonal violence (Haegerich, et al., 2014). Every year, unintentional and intentional injuries result in approximately 2.8 million hospitalizations and 31.7 million emergency department visits (CDC, 2014). The rate of all nonfatal injuries treated in hospital emergency departments was 10,003.39 per 100,000 population in 2006 (National Center for Injury Prevention and Control, 2009, p. 11). Young adults also had the highest rates of injury-related hospital emergency visits, with the exception of females over the age of 75 years (National Safety Council, 2011). Lifetime costs of injuries for medical care and lost productivity in the United States is more than $513 billion dollars every year (Haegerich, et al., 2014). The burden of injury not only affects young adults themselves, but families, friends, communities and society at large. Injuries to young adults are not inevitable nor are they unpredictable. More work needs to be done to look for factors across the life course that will reduce the prevalence of injury among young adults.

Background

There are many social determinants that contribute to the prevalence of injury among young adults. Young adults are prone to impulsivity (Caspi, et al., 1997) and have a higher risk of engaging in delinquency (Haegerich & Hall, 2011) and risky behaviors such as alcohol and drug use (Hingson & Zha, 2009; Reingle, et al., 2012; Schermer, et al., 2008). Nearly 75% of all lifetime cases of mental health disorders start by the age of 24 years old (Kessler, et al, 2005). A large body of research has established that socio-economic inequality is also inversely associated with injury. Individuals who are lower income and who have lower educational attainment have higher injury rates. (see Cubbin & Smith, 2002 for an extensive review of relevant literature). A growing area of injury prevention research is related to understanding how early childhood experiences might set the stage for these risk factors and subsequent injury involvement in later life. There is compelling research in genetics, neuroscience, evolutionary biology, and developmental psychology suggesting that traumatic or adverse events occurring during developmentally sensitive times in childhood and adolescence have lifelong consequences for individual and population health (Bronfenbrenner, 1986; Elder, 1998; Ellis, et al., 2012; Halfon & Hochstein, 2002).

"Adverse childhood experience" or ACE, is an umbrella term that includes any traumatic event "that harms the body, self, or spirit" (Whitfield, 1998). Types of ACEs include experiences such as child maltreatment, parental substance abuse, suicide of a parent and other types of family or community dysfunction experienced in childhood

(Felitti, et al., 1998; Finkelhor, et al., 2013; Van der Kolk, 2005). ACEs have the potential to dramatically affect individual development and behaviors across the life course.

Prior research has largely focused on the types of ACEs and their association with psychological functioning (Arata, et al., 2005; Nelson, et al., 2002; Silverman, et al., 1996). However, a seminal study by Felitti, et al. (1998), known as the ACE Study, was the first to examine the relationship of childhood abuse and household dysfunction to the leading causes of death among adults. The authors found a significant dose response (frequency response) relationship between the *number* of adverse experiences in childhood and poor health outcomes in adulthood. Specifically, they found that respondents who experienced four or more types of ACEs were more likely to experience ischemic heart disease, diabetes, stroke, cancer, chronic lung disease, and liver disease. In terms of risk behaviors, they found an association between higher ACE scores and a 4-12 fold increase in smoking, substance abuse, poor self-rated health, fifty or more sexual partners, physical inactivity and depression. Brown et al, (2009) also found that respondents with six or more ACEs died nearly 20 years earlier on average than those without ACEs. Further, ACEs were found to be quite prevalent. The ACE Study found that over 30% of participants had reported physical abuse as a child, 24% reported being exposed to family alcohol abuse, 20% reported being sexually abused and 13% had witnessed domestic violence (Felitti, et al., 1998; Van der Kolk, 2005).

The research is scarce on how ACEs might contribute to injury among young adults, particularly as it relates to both unintentional and intentional injury. In the CDC ACE Study, respondents with four or more types of ACEs were 1.6 times more likely (CI 1.3-2.0) to have ever had a skeletal fracture and over 12 times more likely (CI 8.5-17.5) to have ever attempted suicide (Felitti, et al., 1998). Some studies have examined ACEs with respect to single cause of injury, such as suicide attempts (Beautrais; 2003; Dube, et al., 2001) or intimate partner violence (Cui, et al., 2013; Halpern, et al., 2009). Another problem is that most injury studies only use child maltreatment to represent ACEs, e.g., physical or sexual abuse. It is not well understood if other types of adverse childhood experiences are also associated with an increased likelihood of injury.

A better understanding of the association between a broad range of ACEs and the different causes of injury is an important area of research. Examining how social determinants, such as ACEs, contribute to the risk of unintentional and intentional injuries over the life course will offer new opportunities for injury intervention and prevention. It is clear that more work needs to be done in finding ways to reduce the burden of injury in the U.S., particularly for young adults who are highly vulnerable and pay such high costs in terms of years lost to premature mortality, morbidity and disability.

Purpose of the Study

The purpose of this study is to examine the association between adverse childhood experiences (ACEs) and subsequent non-fatal injury involvement in a nationally

representative sample of young adults, age 24-32 years. This is a quantitative, cross-sectional study of secondary data (n=15,701; weighted sample size to represent U.S. population N=14,800) designed to (a) evaluate the relationship of each type of ACE and its association with the causes of injury (i.e., unintentional injuries from accidents and motor vehicle collisions and intentional injuries from self-harm, intimate partner violence, and interpersonal violence); and (b) evaluate the dose-response relationship between ACE score and the odds of injury as a young adult. This study addresses the following two research questions and hypotheses.

Research Questions

1. **What is the association between the types of ACEs and the occurrence of injury in young adulthood?**

   Hypothesis 1.1 – ACE type will be positively associated with significantly higher odds of Unintentional Injury - Serious Injury within the past twelve months in young adulthood.

   Hypothesis 1.2 – ACE type will be positively associated with significantly higher odds of Motor Vehicles Accidents within the past twelve months in young adulthood.

   Hypothesis 1.3 – ACE type will be positively associated with significantly higher odds of Suicide Attempt within the past twelve months in young adulthood.

   Hypothesis 1.4 – ACE type will be positively associated with higher odds of Physical Intimate Partner Violence within the past twelve months in young adulthood.

   Hypothesis 1.5 – ACE type will be positively associated with higher odds of Sexual Intimate Partner Violence within the past twelve months in young adulthood.

Hypothesis 1.6 – ACE type will be positively associated with higher odds of being Shot/Stabbed within the past twelve months in young adulthood.

Hypothesis 1.7 – ACE type will be positively associated with higher odds of being Beaten Up within the past twelve months in young adulthood.

2. **Is there a frequency response relationship between the number of ACEs (ACE score) and injury in young adulthood?**

Hypothesis 2.1 – Participants who experience more ACEs will have significantly higher odds of Unintentional Injury – Serious Injury within the past 12 months compared to participants with no ACEs.

Hypothesis 2.2 – Participants who experience more ACEs will have significantly higher odds of Motor Vehicle Accidents within the past 12 months compared to participants with no ACEs.

Hypothesis 2.3 – Participants who experience more ACEs will have significantly higher odds of Suicide Attempt within the past 12 months compared to participants with no ACEs.

Hypothesis 2.4 – Participants who experience more ACEs will have significantly higher odds of Physical Intimate Partner Violence within the past 12 months compared to participants with no ACEs.

Hypothesis 2.5 – Participants who experience more ACEs will have significantly higher odds of Sexual Intimate Partner Violence within the past 12 months compared to participants with no ACEs.

Hypothesis 2.6 – Participants who experience more ACEs will have significantly higher odds of being Shot/Stabbed within the past 12 months compared to participants with no ACEs.

Hypothesis 2.7 - Participants who experience more ACEs will have significantly higher odds of being Beaten Up within the past 12 months compared to participants with no ACEs.

Theoretical Framework

This study is grounded by the integration of two theoretical frameworks to understand the associations between ACEs and injury in young adulthood. The first is the Haddon matrix (Li & Baker, 2012), which uses the classic epidemiologic triad of host-agent-environment to understand injury occurrence, but also includes a time factor as a continuous variable. The time variable is divided into three phases of injury; pre-event, event, and post event. The Haddon matrix is useful for conceptualizing how distal exposures in time can lead to subsequent injury (Li & Baker, 2012).

The second theoretical framework used for this study is the Life Course Health Development Model (LCHD) (Halfon & Hochstein, 2002). This is an integrated life course framework that draws on a large multidisciplinary body of work to explain how health trajectories develop over an individual's lifetime. Most notably it draws on Life Course Theory (LCT), formally advanced in the 1990s by Glen Elder, Jr. (1998). LCT emphasizes the importance of time, context, process and meaning in understanding human development. The LCHD framework advances LCT to explain how

these principles also interact with genetic and biological functioning in ways that affect the health status of individuals and populations. The LCHD framework synthesizes the many variables that interact across the life course to produce a health outcome. It is well suited for understanding how ACEs exposure in childhood and adolescence are associated with subsequent injury outcomes in young adulthood.

Methods

This study utilizes data from the National Longitudinal Study of Adolescent and Adult Health, a large scale study of the health needs and outcomes of adolescents in grades 7-12 in four waves over a period of fourteen years. The Wave I in-home survey was completed in 1994-1995 (n=20,745), Wave II was completed in 1996 (n=14,738), Wave III was completed in 2001-2002 (n=15,197) and Wave IV was completed in 2007-2008 (n=15,701; weighted sample size to represent U.S. population n=14,800 – sample size represents respondents who participated in both Wave I and Wave IV of the study). This study is intended to examine the association of the type and number of ACEs and the subsequent type and likelihood of injury involvement among young adults using Waves I and IV of the Add Health data set. This is a quantitative, cross-sectional study of secondary data. The Add Health Study was selected because it was the only nationally representative study in the U.S. that followed participants from adolescence into young adulthood and included a range of survey questions on both adverse childhood experiences and injury.

The outcome variables in this study are any self-reported injury involvement in Wave IV. Outcome variables include two measures of unintentional injury (Serious Injury and Motor Vehicle Accident) and five measures of intentional injury (Suicide attempt, Physical Intimate Partner Violence, Sexual Intimate Partner Violence, Shot/Stabbed, Beaten Up). The independent variables consist of 16 types of adverse childhood experiences divided into four categories: Child Maltreatment, Household Dysfunction, Interpersonal Loss and Community Violence. Variables are derived both from Wave I of the Add Health study and retrospectively from Wave IV. Logistic Regression for complex samples, controlling for confound variables, was conducted to test the study hypotheses. The human subjects' protocol for this study was approved by the University of Nevada, Las Vegas, institutional review board (Protocol 1405–4810).

This study has several strengths: (1) a diverse sample, (2) a large stratified random sample of young adults, (3) a nationally representative sample design, (4) a broad assessment of adverse childhood experiences, and (5) the ability to measure multiple types of unintentional and intentional injury. This study advances the body of public health literature on injury prevention in three significant ways. First, it builds on previous ACE research by examining the association between adverse childhood experiences and injury in the unique developmental period of young adulthood. Second, this study will examine the cumulative effect on the association between ACEs and injury by including multiple injury categories in the analysis. Third, this study utilizes data from the only nationally representative, longitudinal study of adolescent and adult health in the United

States. The results of this study on the association between ACEs and injury will be generalizable to all young adults in the U.S.

Significance of the Study

This study is significant in that it will provide empirical evidence using a nationally representative study design on the comorbidity of two serious public health concerns: ACEs and injury among young adults. Modern epidemiology and injury prevention research, in particular, has traditionally focused on the proximal causes of injury. In other words, using the classic epidemiologic triad of host-agent-environment, researchers examine those risk factors that immediately precede an injury, such as individual behavior (e.g., substance abuse), psychological distress (e.g., depression), or environmental or mechanical factors (e.g, poor street lighting) (Arnett, 2002; Chipman, 1995; Dicker, et al., 2011; Patil, et al., 2006; Schermer, et al., 2008; Sleet, et al., 2010). Some scholars argue that this approach examines some risk behaviors that are out of context and also fails to account for social factors (Pearce, 1996). In referencing prevention efforts to reduce motor vehicle collisions, the National Institute of Health (2013) states, "Of particular importance for prevention efforts is the recent realization that alcohol abuse, dependence, and related problems such as alcohol-impaired driving must be addressed throughout the lifespan, not just at middle age." Thus, moving "upstream" and conducting research that examines early life factors such as ACEs will contribute to solving the applied problem of injury prevention.

Empirically, this research seeks to address several gaps in the literature. First, it builds on previous ACE research by examining the association between adverse childhood experiences and injury in the unique developmental period of young adulthood. Most ACE research in public health has focused on the associations between ACEs and chronic diseases in older populations (Felitti, et al., 1998; Springer, et al., 2003).

Second, it expands on the existing literature by providing a more comprehensive picture of the relationship between ACEs and the occurrence of unintentional and intentional injury in young adults. While a number of studies have been published that examine the relationship between ACEs and a specific injury intent category, such as suicide or intimate partner violence, few studies have researched if injuries are incurred across multiple categories. Also, the majority of studies use a limited range of ACE variables, primarily physical and/or sexual abuse (Arias, 2004; Elam & Kleist, 1999; Springer, et al., 2007).

Finally, it utilizes secondary data from a large scale, 14-year longitudinal study, The National Longitudinal Study of Adolescent and Adult Health (Add Health). The results of this study will be generalizable to the U.S. population. The majority of studies have used clinical samples (Felitti et al., 1998; O'Donnell, 2009; Ramstad, et al., 2004), or specific subpopulations such as women or criminal offenders (Grella, et al., 2005; Reavis, et al., 2013; Thompson, et al., 2002). These types of studies may not be representative of young adults in the U.S.

Findings from this study provide public health researchers and practitioners with a better understanding of the social determinants of injury morbidity. It brings increased attention to the injury risks and consequences of ACEs. It provides additional opportunities throughout the life course for primary prevention intervention and clinical practice to reduce the burden of injury in young adults. This research also provides additional justification for trauma informed care in the delivery of health services to adolescents and young adults who have been exposed to adverse childhood experiences. Understanding the relationship between ACEs and injury from this study will substantiate findings from other ACE research and aid in finding interventions to mitigate the multiple effects of ACEs on risk behaviors and long term health. It will assist professionals in a diversity of fields such as public health, health care, child protective services, social services, criminal justices, substance abuse, and mental health to understand the challenges and behaviors that impact health and health status over the life course.

Summary

This chapter provided the purpose, significance and a brief background of the study. A summary of the theoretical framework grounding this study was also discussed. The public health problem that this study addresses is the high prevalence of injury, a leading cause of death for young adults, age 24-32 years old. The Haddon Matrix and the Life Course Health Development model are the theoretical frameworks that ground this research. Adverse childhood experiences will be used to predict the odds of unintentional

and intentional injury among young adults. Secondary data from the Add Health Study will be used to answer two research questions through hypothesis testing using logistic regression analysis for complex samples. Chapter two provides a comprehensive review of the literature on ACEs and injury. Chapter three provides detailed information of the methods used for this study. This chapter will expand the research questions and hypotheses to include the statistical analyses that will be used. An explanation of the research population and research design, and operational definitions of the variables used for this study will also be provided. Chapter four presents the results of the study and chapter five discusses the results and conclusions from this research, offers directions for future research, the implications for public health policy and practice and discusses the limitations of the study.

CHAPTER 2

LITERATURE REVIEW

Introduction

This chapter will begin with an extensive review of the literature. A conceptual definition of injury that will be used throughout this study is presented first. The epidemiology of injury among young adults will be discussed, followed by a review of the relevant literature on ACEs. What is known about ACEs and injury will then be presented, followed by an in-depth discussion of the theoretical and conceptual frameworks that are used to provide context for this study. The sources used for the literature review were EBSCO databases (UNLV Library); Google Scholar; Medline Plus; publications listed on the Add Health study website; publications listed on the CDC ACE Study website; and a review of selected journal article citations. An extensive array of search terms were used to find publications related to this topic and the research questions.

Injury: Intentional vs. Unintentional

CDC injury surveillance guidelines define injury as physical harm to the body as a result of being subjected to an external force, substance, or submersion (CDC Injury Center, 2007). In social and behavioral public health research, it is often not the actual injury that is the focus of study, but rather how those injuries were occurred. Injury prevention research classifies injuries according to whether or not they were deliberately inflicted. This classification forms the foundation for the *International Statistical*

Classification of Diseases and Related Health Problems (ICD-10). For the purposes of this study injuries are classified into two broad categories a) Unintentional injuries – injuries that occur without intent of harm and are often sudden and unexpected; b) Intentional injuries – injuries that are deliberately inflicted either through self-harm, such as a suicide attempt, or through interpersonal violence. Types of interpersonal violence include assault and attempted homicide; intimate partner violence; and sexual violence (World Health Organization, 2004)

Injuries are also classified according to the mechanism of injury which identifies the underlying cause, rather than the direct cause of injury (CDC Injury Center, 2007). Examples of injury mechanisms include motor vehicle crashes, poisoning, falls, fires/burns, drowning, firearms, etc. The intent and mechanism of injury classifications are often combined in research. Studies may also include some classifications to measure the *potential* for injury. For example, suicide attempts or motor vehicle crashes may be measured whether or not an actual injury was known to be inflicted. By analyzing the intent and mechanism of injury, researchers are able to understand the context in which injuries occur and identify risk factors that lead to injury (World Health Organization, 2004).

For the purposes of this study, injury intent is classified into two main categories with additional subcategories identifying the underlying mechanism of injury. Unintentional injury includes the subcategories of motor vehicle collisions as well as

serious injuries or "accidents." Intentional injuries are classified into three subcategories: self-harm, intimate partner violence, and interpersonal violence.

Prevalence of Injury among Young Adults

Great progress has been made in reducing injury mortality in areas such as motor vehicle collisions and occupational injuries (CDC, 2013). However, a 2012 study on the five leading external causes of injury mortality in the U.S. found that age-adjusted injury mortality rates had *increased* by 10% between 2000 and 2009. The authors found that suicide surpassed motor vehicle traffic crashes as the leading cause of injury deaths in 2009. Mortality from motor vehicle traffic crashes was 25% lower in 2009 compared to 2000, while suicide mortality had increased by 15% (Rockett, et al., 2012). **Figure 1** illustrates the age adjusted mortality rate per 100,000 for unintentional injury. The CDC reports that in 2010, the age adjusted mortality rate per 100,000 for unintentional injury was 39.0. The rate for motor vehicle collisions was 11.4. Suicide and homicide had rates of 12.2 and 5.3 respectively (CDC Analysis Fatality Reporting System, 2014).

Research has shown that significant disparities exist in injury mortality among young adults in different race/ethnicity groups. In 2009, non-Hispanic Whites had the highest overall rate of injury mortality, while non-Hispanic Blacks were more than 11 times more likely than Whites to become homicide victims. American Indian and Alaskan Native (AI/AN) young adults are three times more likely to die of suicide than Whites and also experience the highest mortality rates from motor vehicle crashes

compared to all other racial/ethnic groups (Herne, 2014, Hussey, 1997; Rocket, 2012; Rutman, et al., 2008).

The overall injury mortality rates are over two times higher for males than females (Courtenay, 2003; Rocket, et al., 2012; Sorenson, 2011). The greatest disparity between males and females is for intentional injury. The mortality rate for young adult males was six times higher than the female rate. Black (6.0) and Latino males (5.1) had the highest M-F mortality rates of intentional injury among racial/ethnic groups. Latinos had the highest M-F ratio for unintentional injury rate (3.2) compared to Whites (Sorenson, 2011).

The trends are similar for nonfatal injuries. **Table 1** provides the crude rate per 100,000 for young adults age 18-32 for all nonfatal injuries and by injury category in 2012 (CDC WISQARS, [online]). The rate for all non-fatal injuries in this age group was 12,435.38. Whites had the highest overall nonfatal injury rate and overall rate for unintentional injuries, 12,093.33 and 10,943.54, respectively. African Americans had the next highest rates at 11,117.26 and 8,964.27, following by Latinos at 7,342.5 and 5,945.36. However, for motor vehicle injuries, only, African Americans had the highest nonfatal injury rate at 1,802.87 per 100,000. The African-American rate for intentional injury was nearly double the rate for White and Latino young adults. Their rate was 2,152.97 compared to 1,149.79 and 1,397.14, respectively. African-Americans experienced physical assault related violence at twice the rate of Whites (1,800.12

compared to 764.29). Latinos also had higher injury rates from assault than Whites at 1,156.21.

Behavioral Risk Factors for Injury

A large body of research exists that examine behavioral risk factors that increase the likelihood of injury among young adults. Several scholars have researched how adolescent substance abuse, psychological functioning, juvenile delinquency and community violence might affect the likelihood of subsequent injury in young adulthood (Arnett, 2002; Begg, et al., 1999; Bingham & Shope, 2004; Caspi, et al., 1997; Feigelman & Gorman, 2010; Hingson, et al., 2009; Jokela, et al., 2009; Lawlor, et al., 2007; Mattila, et al., 2008; Osler, et al., 2007; Scarpa, 2003; Van Dulmen, et al, 2012).

The strongest behavioral risk factors associated with injury involvement for young adults are related to substance use and abuse. Smoking, alcohol and drug use are significant risk factors for injury from a variety of causes, including motor vehicle crashes, interpersonal violence, self-harm, and intimate partner violence (Begg, et al., 1999; Chipman, 1995; Hingson & Zha, 2009; Leistikow, et al., 2000; Neeleman, 2001; Reingle, et al., 2012; Sacks & Nelson, 1994; Schermer, et al., 2008; Stenbacka, et al, 2011).

Psychological functioning is also a significant risk factor for injury. Traits such as intelligence, impulsivity, or problem-solving ability, as well as psychological disorders such as depression, ADHD, anxiety disorders, conduct disorder, and post-traumatic stress

disorder (PTSD) have also been strongly associated with injury (Afifi, et al, 2011; Batty, et al., 2009; Caspi, et al., 1997; Dicker, et al., 2011; McAninch, et al., 2013; Ramos Olazagasti, et al., 2013; Osler, et al., 2007; Patil, et al., 2006; Tiesman, et al., 2006; Zatzick, et al., 2004).

It is not a coincidence that a large body of ACE research has found that the behavioral risk factors for injury are also associated with the behavioral outcomes resulting from exposures to ACEs. For example, data from the 2011-2012 Behavioral Risk Factor Surveillance System (BRFSS) from five states showed that individuals with 5-8 ACEs were significantly more likely to smoke cigarettes, have less seatbelt use, drink alcohol more heavily and binge drink (Stone, 2013). ACE research has consistently found that as individuals increase their number of ACE exposures, their odds also increase for depression, difficulty controlling anger, alcoholism, use of illicit drugs, and injected drug use (Anda, et al., 2006; Felitti, et al, 1998). It is possible that these behavioral risk factors mediate the relationship between ACEs and subsequent injury in young adulthood. A number of scholars have suggested that there is a "chain of risk" throughout the life course such that these behavioral risk factors serve as a pathway from earlier adverse childhood experiences to young adult health outcomes (Belsky, et al., 2012; Benson & Elder, 2011; Elder, 1998; Ellis, 2012; Halfon & Hochstein, 2002; Kuh, et al., 2003; Van der Kolk, 2005; Van der Kolk, 1996).

Adverse Childhood Experiences (ACEs)

ACEs are highly stressful and often traumatic events that occur during childhood and adolescence (Courtois, 2004; Felitti, et al., 1998; Van der Kolk, 2005). For scholars in the field of traumatic stress, ACEs are also termed developmental trauma or complex trauma which is defined as:

> "Stressors that are: (1) repetitive, prolonged, or cumulative (2) most often interpersonal, involving direct harm, exploitation, and maltreatment including neglect/abandonment/antipathy by primary caregivers or other ostensibly responsible adults, and (3) often occur at developmentally vulnerable times in the victim's life, especially in early childhood or adolescence (when critical brain development is rapidly occurring or being consolidated)…" (Courtois & Ford, 2009, p.13)

Types of ACEs include (a) child maltreatment (physical, emotional and sexual abuse; neglect); (b) exposure to substance abuse and/or domestic violence in the home; (c) parents and/or household members with physical and/or mental disabilities; (d) interpersonal loss such as the death of a parent or friend; or (e) the parental transitions such as divorce, entry into foster care or the incarceration of a parent. ACEs are often chronic in nature, although they can be sudden and dramatic such as the death of a parent or close friend.

These experiences may have lasting developmental and neurobiological effects on the individual (Brodsky & Biggs, 2012; Danese & McEwen, 2012; Heim, et al., 2001; Shonkoff, et al., 2009). Childhood and adolescence are crucial stages of life for cognitive, emotional and psychological development. Adverse or traumatic experiences during these critical stages can have lifelong effects on identity development, self-esteem, trust and intimacy, mental health, and physical health (Dolgin, 2011). Approximately 80% of ACEs are centered within the family (Van der Kolk, 2005). However, research has shown that children in nonparental care, e.g., foster care, were almost three times more likely to report ACEs compared to children living with their biological parents (Bramlett, et al., 2014).

There is no clear consensus of what variables constitute ACEs or "stressors." There are a number of childhood trauma checklists, most of which are based on the DSM-IV definition for Post-Traumatic Stress Disorder (PTSD) (for a review of assessments and their reliability and validity, see websites for The National Child Traumatic Stress Network, Trauma Institute and Child Trauma Institute and US Department of Veteran's Affairs National Center for PTSD). Much of the research in this field has traditionally used measures of child maltreatment (physical, emotional, sexual abuse and neglect).

A large number of studies have also examined other measures such as household dysfunction (Anda, 2002; Beautrais, 2003; Dube, et al., 2003; Felitti, et al., 1998; Fergusson, et al., 2000; Rothman, et al, 2008; Stone, 2013). Categories

of household function often include witnessing domestic violence (English, et al., 2009; La Noue, et al., 2013), residential transitions or divorce (Beautrais, et al., 1996; Reavis, et al., 2013; Springer, et al., 2007), parental substance abuse (Hussong, et al., 2008), and parental criminality (Sprinkle, 2007). Other studies have examined parental illness or disability; interpersonal loss such as the death of a parent or close friend, or experiencing street violence (Bruffaerts, et al., 2010; Fried, et al., 2013; Johnson, et al., 2002; Kaplow, et al., 2014; Pilowsky, et al., 2009; Ramstad, et al., 2004; Turner & Lloyd, 2003;). Some studies have also examined experiences with war or natural disasters (O'Donnell, et al., 2009).

Prevalence of ACEs

ACEs are common in the general population. The most studied type of ACE is child maltreatment. In 2012 in the United States, child protective services at state and local agencies responded to approximately 3.8 million reports of child maltreatment. In 2012, the rate of substantiated reports of child maltreatment was 9.2 per 1,000 children ages 0-17. Nationally, 78.3% of victims were neglected, 18.3% were physically abused, 9.3% were sexually abused and 8.5% were psychologically maltreated (Child Trends, 2014). Epidemiological surveys of adolescents have reported a lifetime prevalence rate of 8% for sexual abuse, 17% for physical abuse and 40% for witnessing violence (Costello, 2002). Among adults, the ACE Study found that over 30% of participants had reported physical abuse as a child, 24% reported being exposed to family alcohol abuse, 20% reported being sexually abused and 13% had witnessed domestic violence (Felitti, et al., 1998; Van der Kolk, 2005). Duke, et al., (2010) report that the most prevalent type of

ACE reported in her three year longitudinal study of adolescents was alcohol abuse by a household member at 14.5%.

Research suggests there are also significant racial/ethnic differences in exposure to ACEs, particularly child maltreatment (Elliott & Urquiza, 2006). In 2012, African-American and American Indian/Alaska Native children had the highest substantiated rates of reported maltreatment at 14.2 and 12.4 per 1,000 respectively. The rate for Hispanic children was 8.4, White children 8.0 and Asian children 1.7 (Child Trends, 2014). Being taken out of a home or placed in foster care can cause significant trauma for children and adolescents (Finkelhor, 2013; Bramlett, 2014; Whitfield, 1998). Some experts have argued that racism and institutional discrimination result in disproportionate referrals of children of color into the child welfare system (Bullock; 2003; Dixon, 2008; Dorch, 2010; Drake, et al., 2011; Morton, 1999). However, the National Incidence Study of Abuse and Neglect (NIS) data indicate that the actual rates of maltreatment have never been statistically different across racial groups (Dixon, 2008). Research of child maltreatment rates among Native American/Alaskan Native populations also indicate mixed results. Some studies show rates that are lower or similar to the general U.S. population among Navajo and San Carlos Apache children. Other studies indicate that rates are as high as 26 per 1,000 among Lakota children on the Cheyenne River reservation (DeBruyn, et al., 2001), which is three times higher than for White children.

ACEs and Negative Health Outcomes: The ACE Study

The effect of ACEs on physical health was not really considered until 1995 (Finkelhor, et al., 2013), when the CDC funded one of the largest investigations to

date on adverse childhood experiences and multiple adult health outcomes, entitled The ACE Study (CDC Injury Prevention and Control – ACE Study, 2014). The study examined the relationship between childhood abuse and household dysfunction to the leading causes of death among 9,508 adults (mean age 56.1 years) at a large HMO in San Diego. Household dysfunction measures were defined as parental substance abuse, parental mental illness, mother treated violently, and criminal behavior in the household. The authors found a significant dose response (frequency response) relationship between the *number* of adverse experiences in childhood and significantly greater risk of poor health outcomes in adulthood. Specifically, the ACE study found that participants with four or more ACEs had a significantly higher risk for a number of chronic diseases, health risk behaviors, and injury. For example, the adjusted odds ratio for heart disease was 2.2 (CI 1.3—3.7), any cancer 1.9 (CI 1.3-2.7), stroke 2.4 (CI 1.3-45), and diabetes 1.6 (CI 1.0-2.5) compared to those who reported no ACEs (Felitti, et al., 1998). This study and those that followed also found clear evidence that individual types of ACEs rarely occur in isolation and are often comorbid (Felitti, et al., 1998; Finkelhor, et al., 2013; Ramstad, et al., 2004; Van der Kolk, 2005).

"Chain of Risk" and the Neurobiological Pathway

As discussed earlier in this chapter, substance abuse and psychological functioning are strong behavioral risk factors for injury. Substance abuse and psychological functioning have also been shown to be outcomes from exposure to ACEs (Anda, et al., 1999; Murray & Farrington, 2010; Nelson, et al., 2002; Pilowsky, et al,

2009; Reavis, et al, 2013; Silverman, et al., 1996; Topitzes, et al, 2010; Turner & Lloyd, 2003; Yun, et al., 2011; Van der Kolk, et al., 2009; Watts & McNulty, 2013). Researchers have described these factors as pathways or mediators that cascade into a chain of risk between ACEs and poor health outcomes, including increased risk of injury in later life. A growing body of research has further associated these behavioral risk factors with neurobiological changes that result from exposure to childhood adversity.

Childhood and adolescence are a crucial time in the life course for the development of brain and physiological structures. The brain and regulatory systems such as the nervous system, the immune system and the endocrine system work to interpret and transfer information between the external and internal environments. The constant transfer of information prepares human beings to react and interact appropriately with their environment to ensure survival (Halfon & Hochstein, 2002). When the external environment is harsh and unpredictable as it is when a person experiences an adverse event, a stress response is triggered in the body. The stress response is processed through the nervous system and the hypothalamic pituitary adrenal (HPA) system in the brain to signal that the person is in danger and a behavioral response is necessary. The body releases a flood of chemicals, primarily adrenalin and cortisol which prepares the body for fight or flight (Danese & McEwen, 2012).

Chronic stress elevates the baseline level, or allostatic load, of these hormones circulating through the body, meaning that the person is constantly in a state of preparation for fight or flight. In children and adolescents, these elevated levels of stress

hormones have profound effects. Research has shown that brain structures such as the hippocampus, the amygdala, and the prefrontal cortex are affected by chronic stress. These brain structures are involved with memory, emotional regulation and executive decision-making. Further, there are epigenetic effects. Gene expression is affected as the body makes adaptations to its environment. In other words, traumatic experiences send molecular messages that adhere to the DNA signaling a need to calibrate developmental and behavioral strategies to match the environment resulting in changes to how genes are normally expressed (e.g., switched on and off). As the child/adolescent grows into young adulthood, these biological adaptations often result in lasting problems with dysregulation of emotion, reasoning capacity and language skills, hypervigilance, elevated fear response and maladaptive social behavior (Anda, et al, 2006; Brodsky & Biggs, 2012; Danese & McEwen, 2012; Daw & Guo, 2011; Heim, et al., 2001; Shonkoff, et al., 2009; Teicher, et al., 2003; Vaske, et al, 2012).

Post-traumatic Stress Disorder (PTSD) has been largely associated with the neurobiological changes resulting from exposure to ACEs and other traumatic events. However, research has shown that less than 25% of traumatized children meet the diagnostic criteria for PTSD, rather children may manifest a multitude of psychological disorders instead of PTSD as a result of trauma (Van der Kolk, et al., 2009). Van der Kolk et al., (2009) have provided an extensive description of the wide array of behaviors that are known to be associated with ACEs and complex trauma. Many of these behavioral manifestations may also be associated with the increased risk of injury. They include affective and physiological dysregulation such as sleep disturbances, diminished

awareness of surroundings, and an over- or under-reactivity to touch and sound. Attention and behavioral dysregulation such as an impaired capacity to perceive threat, impaired capacity for self-protection, and habitual or reactive self-harm. Other impairments include extreme distrust, reactive physical or verbal aggression towards others, and inappropriate attempts at intimate contact.

ACES and Injury among Young Adults

The effects of ACEs on the occurrence of injury among young adults deserve special consideration separate from studies of adolescents and older adults. Young adulthood is a distinct time in the life course when individuals are at highest risk of death and disability from injuries (WHO, 2004). Young adulthood is characterized by evolving identity development, shifting social roles and explorations of one's life directions (Dolgin, 2011; Arnett, 2000). For those who have experienced adverse events in their youth, young adulthood can be especially precarious. Youth raised in high stress environments may have interrupted development and exhibit behaviors that are destructive to themselves and others (Ellis, et al., 2012; Van der Kolk, 2005). This may put young adults who have experienced ACEs at even higher risk for intentional and unintentional injuries.

In researching ACE outcomes, it is important to recognize that there are significant developmental and social differences between adolescents and young adults and between young adults and older adults (Arnett, 2000; Dolgin, 2011, pg. 412). A number of ACE studies examine children or adolescent populations (Asbridge, et al.,

2014; Chino, et al., 2006; Duke, et al., 2010; Fried, et al, 2013; Sprinkle, 2007; Tyler, K., et al., 2011; Hammig, et al., 2001), which can inform us about what outcomes may carry over into young adulthood. However, some outcomes may be specific to adolescents or not occur with the same magnitude in young adulthood. For example, Reavis, et al., (2013) has shown that *adolescent* males who experience sexual abuse were 45 times more likely to engage in dating violence as those who were not sexually abused, yet were only 3.5 times more likely to engage in later violence with a romantic partner as a young adult.

The majority of ACE research participants are adults, with an average age typically between 45-55 years old (Easton, 2012; Felitti, et al., 1998; LaNoue, et al., 2013). These studies may not be able to detect any unique effects ACEs may have in the early years beyond adolescence when injury rates are the highest (Finkelhor, et al., 2013). An interesting indicator of this phenomenon is from an ACE study conducted by the Connecticut State Department of Public Health. This study used data from the CDC's Behavioral Risk Factor Surveillance System (BRFSS) and examined ACE associated outcomes in six states and for all age groups. The study finds that over 17% of 18-24 year olds and 25-34 years old groups reported 3-4 ACEs compared to 11% for 55+ years old. Similarly, the 25-34 years old group reported the highest prevalence rate of 14% for 5-8 ACEs compared to 11.1% for the 35-54 years old group and 4.44% for the 55+ years old group (Stone, 2013). The author of the study speculates that the lower prevalence of ACEs in the older population may be due to an increase in the prevalence of ACEs over the past few generations or that since mortality rates are higher among adults with ACEs,

there is a length bias in which those who remain alive at older ages are those who experienced less trauma in childhood. Changing definitions of abuse and recall bias were also provided as possible explanations.

ACEs and Unintentional Injury

An extensive literature review only produced a few studies that examined ACEs and unintentional injury. Most studies measured the number of ACEs, i.e., ACE score, as the independent variable. The ACE study found a significant association between 4+ ACEs and an odds ratio of 1.6 (CI 1.3-2.0) for skeletal fractures (Felitti, et al., 1998). In an Australian study on the prevalence of trauma exposure, O'Donnell, et al. (2009) found that of those respondents admitted to trauma services for unintentional injury, 86% had experienced at least one traumatic event prior to the current injury. The most frequent traumatic events were seeing a dead body excluding funerals and anatomy studies (39%), being threatened or harassed by someone without a weapon (38%) and witnessing domestic abuse (31%). In a representative sample of injured acute care inpatients in the U.S., Ramstad, et al. (2004) found that unintentionally injured patients were four times more likely to have been exposed to 4+ lifetime traumas before their admission to the hospital.

Exposure to different types of ACEs may also influence the kinds of injuries that occur among young adults. Thompson, et al. (2002) in a study of 1,000 women found that the risk of serious injury in adulthood (spinal cord, neck or head injury) was 1.44 (CI 1.18-1.75) for women who had been physically abused in childhood and 1.34 (CI 1.02-

1.78) for women who had been sexually abused in childhood. A 35 year cohort study among Swedish conscripts found that at ages 18-20, parents' divorce significantly increased the likelihood of premature death by 50% for all unintentional injuries (falls, transport, other). Illness of at least one parent increased the likelihood of death from all unintentional injuries by 38% (Stenbacka, et al., 2011). In contrast, a 25 year prospective study in the U.S. found no significant differences in rates of premature mortality among young adults in unintentional injury between respondents who were victims of substantiated child maltreatment and controls (White & Widom, 2003). Although the results are mixed, these studies suggest that certain adverse experiences within the categories of child maltreatment, interpersonal loss and household dysfunction may increase the risk of morbidity and mortality from unintentional injuries.

No studies have assessed the association of ACEs with motor vehicle collisions. Interestingly, however, in an overview of the literature of motor vehicle crashes, Pompili, et al., (2012) estimated that more than 2% of traffic collisions are the result of suicide behaviors. Further, a study in the review found that 50% of driver suicides were males between the ages of 15 and 34 years old. Another study in Pompili's review found that participants who were deemed suicidal averaged 2.7 motor vehicle collisions compared to 1.3 for those who were non-suicidal. Although none of the reviewed studies directly measured ACEs, many ACE associated outcomes were identified as risk factors associated with traffic collisions. The authors noted that several behavioral traits predicted involvement in motor vehicle collisions. Identified traits included lack of reflectiveness, poor control of hostility, low tolerance for tension and rigid cognitive

style. Other studies in the review found that life events and stress were major contributors to motor vehicle collisions (Pompili, et al, 2012).

ACEs and Intentional Injury

There is substantial evidence suggesting that ACEs are positively associated with the risk of intentional injury over the life course. This section will discuss research finding on three types of injury: Self-harm, Intimate Partner Violence and Interpersonal Violence (assault).

Self-Harm

In particular, there are a number of studies that have found a strong association between ACEs and self-harm behavior, such as attempted suicide (Afifi, et al., 2008; Beautrais, 2003; Beautrais, et al., 1996; Bruffaerts, et al., 2010; Dube, et al., 2001; Enns, et al., 2006; Fergusson, et al., 2000; Johnson, et al., 2002; Joiner, et al., 2007; Molnar, et al., 2001). Studies that have examined ACEs and suicide attempt over the life course have conflicting findings with regard to the risk of suicide attempts in young adulthood. One study that examined suicide risk among adults in 21 countries found that although the overall risk was increased, ACEs predicted increased risk for suicide attempts in childhood and later adulthood, but decreased risk in adolescence and young adulthood (Bruffaerts, et al., 2010). Another study in the U.S. that only examined the effects of childhood sexual abuse, found that participants had increased rates of first suicide attempts between mid-adolescence and young adulthood up to age 30 years (Molnar, et al., 2001). Most studies, however, found independent effects for ACEs on adult suicide

and suicide attempts, with mediating variables such as substance abuse and psychological functioning.

Intimate Partner Violence

A handful of studies examining intimate partner violence (IPV) in young adulthood have found that child maltreatment was a significant predictor for victimization by an intimate partner (Cui, et al., 2013; Fang & Corso, 2007; Gómez, 2010; Tyler, et al, 2011). One study found that childhood physical neglect had significant direct effects for females and significant indirect effects for males who were victims of IPV (Fang & Corso, 2007). Tyler, et al. (2007) found that childhood physical abuse had direct affects on IPV victimization as well as mediated effects through substance abuse and delinquency. Surprisingly, the authors did not find any significant effects for child sexual abuse or neglect. Gómez (2010) found a significant effect for child abuse (combined measure for child physical and sexual abuse) on IPV victimization among young adults. Cui, et al, (2013) found that the odds ratio for "parent-child violence" was 1.165 for IPV victimization in emerging adulthood (18-23 yrs old), but decreased to 1.081 for young adults (24-32 yrs old). Other than child maltreatment, no known IPV studies have examined other types of ACEs.

Studies have shown that women who experience childhood sexual abuse are more likely to experience rape as an adult (Chu, 1992; Noll, 2003; Walsh, et al., 2007). The majority of sexual violence victimization takes place within intimate partner relationships (Black, et al., 2011). However, most studies combine physical and sexual violence when

measuring IPV. This makes distinguishing prevalence difficult. This study uses separate variables for sexual IPV and physical IPV in order to assess any differences with regard to the relationship of ACEs between the two outcome variables.

Interpersonal Violence (Assault)

Most studies have examined ACEs as a variable related to the perpetration of violence. Duke at al., (2010) in a study of adolescents found that any ACE as well as the overall number of ACEs significantly increased the likelihood of the perpetration of interpersonal violence such as physical fighting. In this study, girls who experienced sexual abuse by a family member were 2.42 (CI 2.21 – 2.66) times more likely to hit or beat up another person. Boys who experienced sexual abuse by a family member were 4.46 (CI 3.86 – 5.16) times more likely to hit or beat up another person. Some studies show a positive association between ACEs and interpersonal violence victimization. Using Wave I and Wave II of the Add Health study, Barowsky & Ireland (2004) found that adolescents who reported ACEs such as not living with both biological parents, low perceived adult caring, feeling unsafe at school, household access to a gun, and witnessing violence were significantly more likely to sustain a fight related injury one year later. No known studies have examined the relationship between ACEs and injuries among young adults from interpersonal violence (e.g., being shot/stabbed or beaten up).

Theoretical Foundation and Conceptual Framework

The basis for this study and the associated literature review is founded on two interrelated theoretical frameworks for understanding how social determinants that take

place early in life, such as ACEs, might be associated with the type and frequency of injury years later in young adulthood. The Haddon Matrix and the Life Course Health Development Model are ideally suited for grounding the theoretical framework of this study. The historical development and constructs of each will be explained.

The Haddon Matrix

The Haddon Matrix uses the classic epidemiologic triad of host-agent-environment to understand injury occurrence, but also includes a time factor that is useful for studying pre-event injury factors and for conceptualizing how ACEs, a determinant in the social environment, are associated with injury (Li & Baker, 2012). The Haddon Matrix is the precursor to the social-ecological model, a paradigm for analyzing the interdependent, dynamic, and multilevel factors that contribute to health outcomes (Runyun, 2003).

As early as 1929, scholars recognized that social environments were a factor that contributed to injuries. The Heinrich Domino Theory posited that traits or characteristics that were inherited or present in the social environment, such as "recklessness, greed, and bad temper," were the initial factors that led to human faults (e.g., alcoholism) which in turn created unsafe acts or conditions leading to accidents and injuries. Heinrich's theory put the majority of the blame on the person and did not recognize multiple factors in the causation of injury (Sabet, et al., 2013). Research into the biomechanics of injury moved away from the idea of social environments and led to the current, more neutral, definition of injury as the result of a transfer of energy beyond what the body can tolerate. In 1949,

John Gordon was the first to hypothesize that the same biologic laws that govern modern epidemiology in the investigation of infectious and chronic disease also apply to injury. He was the first to put injury prevention in a public health framework by using the classic epidemiologic triad of host, agent and environment (Li & Baker, 2012).

Figure 2 illustrates the Haddon Matrix, introduced by William Haddon, Jr. in 1972. Haddon is widely considered to be the father of modern injury epidemiology (Runyan, 2003). The Haddon Matrix provided a model for analyzing etiologic factors of injury and how to prevent them (Lu, 2006; Runyan, 2003). The matrix is a table that uses columns to identify the triad of host-agent-environment. The rows include a time factor as a continuous variable divided into three phases of injury occurrence; pre-event, event, and post event (Haddon, 1972; Li & Baker, 2012). The Haddon Matrix deconstructs injury occurrence into stages in order to identify multiple intervention opportunities along a time variable to prevent injury.

Some critics have asserted that modern injury epidemiologists overly relied on the biomedical paradigm and were too mechanistic in their thinking about the causes of injury. Unlike the early days of the Domino Theory, many injury researchers considered host factors as unmodifiable (Lu, 2006). During the 1980s, there was a resurgence in the field of social epidemiology utilizing a biopsychosocial paradigm and a "web of causation" focus to explain how socio-structural factors affect population health (Honjo, 2004). Bronfenbrenner's Socio-ecological Model (1986) enhanced the host-agent-environment triad and became extensively used by scholars in social-behavioral public

health. It served as a theoretical framework in understanding the multi-level interaction between the social environment and nested intrapersonal factors, i.e., individual, family, and society. By the early 21st century, injury researchers began to recognize the value of including social environment factors in the Haddon Matrix (Runyan, 2003).

For this study, the Haddon matrix provides a useful foundation and justification for studying pre-event injury factors and for conceptualizing how ACEs, a determinant in the social environment, are associated with injury. However, it does not provide a satisfying explanation for understanding how events that take place earlier in the life course might be related to injuries that occur years later. The Life Course Health Development Model advances Life Course Theory to provide a new interdisciplinary paradigm describing pathways and mechanisms that connect health trajectories in long time horizons between exposures and outcomes (Halfon & Hochstein, 2002).

Life Course Health Development Model

Figure 3 illustrates the Life Course Health Development Model (LCHD). LCHD is built upon the core principles of Life Course Theory (LCT). LCT was formally advanced by Glen Elder in 1998, although a few researchers in the fields of psychology and sociology had been using the life course perspective in longitudinal research since the late 1920s (Elder, 1998). The central premise of LCT is that historical forces affect choices and opportunities, thus shaping individual social pathways and trajectories of family, education, and work across the life span. In other words, time, context, process, and meaning play a significant role in human development (Mitchell, 2003; Elder, 1998).

Mitchell (2003) outlines six tenets of LCT: 1) One's life path is embedded in and transformed by the events of the historical period and geographical location in which one lives. 2) Timing of lives, i.e., chronological age, generational cohort and historical time influences social pathways, positions, roles and rights of individuals and families. 3) Cohorts are not homogenous and the ability to adapt to life circumstances differ in terms of access to resources, social support, gender, social class, family structure, race/ethnicity, economic and cultural capital. 4) Lives are interdependent and reciprocally connected on several levels, particularly through the family. 5) Individuals are active agents and have autonomy to make decisions and set goals that shape their life pathways, but the ability to make specific choices depends on opportunities and constraints in one's environment. 6) The past shapes the future in a causal chain of cumulative advantage or disadvantage that can significantly alter the trajectories of individual lives, families, and generations.

Subsequently, researchers realized that the life course not only affected social trajectories, but health trajectories as well. LCT served as a paradigm for examining health disparities and how social determinants of health are distributed and function across populations (Halfon, 2012). Scholars also pondered the mechanisms by which early life experiences could result in poor health status much later in life. A large body of research in developmental psychology has shown that traumatic and stressful early life experiences are associated with attachment disorders, psychological impairment, and maladaptive social functioning that results in a number of adverse outcomes in later life

(Del Giudice, 2009; Van de Kolk, 2005;). Evolutionary biologists have hypothesized that when children experience harsh and unpredictable environments, it triggers "mortality cues," that the environment is dangerous and life will most likely be short. Mortality cues are evolved biological warning signs that direct and regulate development towards a "fast life" strategy such as earlier pubertal and physical development, increased impulsivity, risk-taking and temporal discounting which ultimately result in health disparities (Belsky, et al., 2012; Chisholm, et al., 2005; Ellis, et al., 2009; Griskevicius, et al., 2011). Similarly, Linda Burton (2007) used the term "Adultification" in her ethnographic research of economically disadvantaged families to describe how children prematurely and often inappropriately take on adult roles and responsibilities that have implications for poorer health status. Public health researcher Arline Geronimus (2006) proposed the Weathering Hypothesis which posits that early health deterioration and health disparities experienced by African-Americans in the U.S. are the consequences of chronic stress resulting from social, economic and political institutional discrimination and marginalization.

This explosion of interdisciplinary research in a wide array of developmental and health sciences gave rise to the emergence of life course epidemiology. According to Kuh, et al., (2003):

> "Life course epidemiology studies how socially patterned exposures during childhood, adolescence, and early adult life influence adult disease risk and socioeconomic position, and hence may account for social inequalities in adult

health and mortality. Socioeconomic factors at different life stages may operate either via social chains of risk or by influencing exposures to causal factors at earlier life stages that form part of long term biological or psychological chains of risk."

Recent advances in brain science, neuroscience, and epigenetics provide empirical evidence linking health development from birth through adulthood via biological mechanisms (Danese & McEwen, 2012; De Bellis, 2002; Shonkoff, et al., 2009; Heim, et al., 2001). The LCHD model proposed by Halfon & Hochstein (2002), attempts to synthesize these lines of research into a comprehensive framework. The LCHD framework is built upon four constructs: 1) Health is the result of multiple factors nested in genetic, biological, behavioral, social, and economic contexts that change over the life course as the individual develops; 2) Health is an adaptive process based on the interactions between environment and the biobehavioral systems that define human functions; 3) Different health trajectories are the product of cumulative risk and protective factors and other influences that are programmed into our bodies during critical and sensitive periods of development; 4) The timing and sequence of these biological, psychological, cultural, and historical events and experiences influence the health and development of both individuals and populations.

According to the LCHD model, toxic social environments or adverse childhood experiences that occur during critical periods of growth and development become physically embedded into the biological and physiological workings of the human body

through mechanisms and regulatory processes of latent gene expression, endocrine disruption, psychoneuro-immuno-regulation, and biological feedback loops. Some critics have charged that the LCHD "frontloads" interventions around pregnancy and early childhood. Another critique is that it is deterministic, in that people growing up in disadvantaged circumstances are predetermined to experience health disparities and lower life expectancy with little chance to obtain optimal health (Fine & Kotelchuck, 2010). However, research has also shown that there is malleability and plasticity in these biological systems that are amenable to positive intervention across the lifespan (Ellis, et al., 2012; Fine & Kotelchuck, 2010; Belsky, et al., 2009; Halfon & Hochstein, 2002).

In summary, the Haddon Matrix serves as a foundation and justification for analyzing pre-event factors in the study of injury prevention. The LCHD model defines the focus and goal of this study's research problem. It provides a strong conceptual and theoretical framework for understanding the relationships between the study variables, i.e., the relationship between ACEs and subsequent injury in young adulthood. The LCHD model will also provide a context for interpreting study results. The next section provides a conceptual model for how the constructs of the LCHD model will be adapted to generate the hypotheses for this study.

Adaptation of LCHD Framework for Current Study

Based on an extensive review of the literature for this study, the ACE variables as the independent variables were chosen based on the LCHD construct of the *Microcontext of Health Development* (See Box 1, **Figure 3)**. The injury variables as the outcome

variables were chosen based on the LCHD construct of *Developmental Health Outcomes* (See Box 3, **Figure 3**). Based on this model, my thesis is that there will be an independent association between participants who have experienced ACEs that occur in childhood and adolescence and the increased likelihood of subsequent injury later in young adulthood compared to participants who have not experienced ACEs. The design, process, mechanisms, and regulatory processes (see Boxes 2a and 2b, **Figure 3**) which serve as explanatory bio-physiological pathways between ACEs and subsequent injury in young adulthood cannot be measured in this study due to limitations of the data. For example, the data is self-report and does not indicate what critical or developmental period was affected by the exposure to ACEs and there is no clinical data to substantiate bio-physiological changes that may have occurred as a result of exposure to ACEs. Therefore, these pathways may only be assumed. In other words, boxes 2a and 2b are a kind of "black box" for this study. Future research will need to be conducted to examine these explanatory pathways between exposure to ACEs and subsequent injury in young adults. **Figure 4** illustrates how the LCHD model is adapted for the current study.

Summary

Injury prevention among young adults is an important public health objective. Unintentional injuries, suicide and homicide are the top three leading causes of death among young adults. Adverse childhood events are also prevalent. The body of literature on ACEs clearly shows that there is a dose-response relationship between the number of ACEs (ACE Score) and poor health outcomes, including the occurrence of some types of injury later in life, such as bone

fractures and suicide attempts. While not definitive, it also shows that different types of ACEs are associated with various types of injury. For example, sexual abuse is most strongly associated with suicidal behavior (Brodsky & Biggs, 2012). Physical abuse has been correlated with general injuries in females (Thompson, et al., 2002), and intimate partner violence in males (Tyler, et al., 2007).

The research is sparse on the association of ACEs with unintentional injury, particularly motor vehicle collisions. There is a large body of evidence that indicate a strong association of ACEs with intentional injury such as suicide attempt. Intimate partner violence has also been significantly associated with child maltreatment, but it is unknown if other forms of ACEs are also associated with IPV. Also, because most research combines measures for both physical and sexual violence, it is unknown if ACEs have a differential effect on these two aspects of IPV victimization. Some studies have shown that ACEs are associated with an increased risk of injury from interpersonal violence but these studies have mostly been conducted with adolescent populations. What is missing from the literature is an expanded view of how ACEs are associated with a range of unintentional and intentional injuries in the way that the ACE study demonstrated an association with a wide array of chronic disease and health risk behaviors. This study proposes to fill that gap in the literature. Chapter three will reintroduce the research questions and hypotheses for this study. I will describe the methods and variables selected to answer the research questions and will discuss the statistical aims that will be used to test the hypotheses.

CHAPTER 3

METHODS

Introduction

This chapter describes the methods used in this study. The study is a quantitative, cross-sectional study of secondary data using the National Longitudinal Study of Adolescent and Adult Health (Add Health). Using comprehensive measures of injury events in young adulthood, the purpose of the study is to examine the association between adverse childhood events (ACEs) endorsed by participants as adolescents with the subsequent types of unintentional and intentional injuries reported in young adulthood during Wave IV of the survey. First, the study design for the larger Add Health study and the current injury study will be discussed, followed by participant and sampling procedures of the Add Health study. Survey procedures and informed consent will then be discussed. Next, the measures selected for the dependent and independent variables, as well as for the control variables will be presented. The next section will present the analysis for the current study. It describes the statistical analysis for each research question and associated hypotheses as described in chapter one.

Study Design

The study uses quantitative methods to analyze secondary data from the National Longitudinal Study of Adolescent and Adult Health (Add Health). Add Health is a project directed by Kathleen Mullan Harris. The study was designed by Drs. Richard Udry, Peter Bearman, and Kathleen Mullan Harris at the University of North Carolina at

Chapel Hill. The study was funded by grant P01-HD31921 from the Eunice Kennedy Shriver National Institute of Child Health and Human Development, with cooperative funding from 23 other federal agencies and foundations. No direct support was received from grant P01-HD31921 for this research study.

The Add Health study is a school-based prospective cohort study. Study participants are comprised of a nationally representative probability-based sample of U.S. middle and high school students. (Chen & Chantala, 2014). Adolescents were initially interviewed when they were in grades 7 through 12 (ages 13-17) and then followed into young adulthood (ages 24-32). Four survey waves were conducted in 1994-1995 (baseline Wave I), 1996 (Wave II), 2001-2002 (Wave III), and 2007-2008 (Wave IV). The primary goal of the Add Health study was to "examine the developmental and health trajectories across the life course of adolescence into young adulthood using an integrative approach that combines social, behavioral, and biomedical sciences in its research objectives, design, data collection, and analysis" (Harris, 2013).

The Add Health Study was selected for several reasons: (1) it's the only nationally representative study in the U.S. that followed participants from adolescence into young adulthood, (2) it includes a diverse sample of participants, (2) it consists of a large stratified random sample of participants, (4) it provides a range of adverse childhood experiences, and (5) it consists of variables that measure multiple types of unintentional and intentional injury.

The full restricted dataset will be used for the proposed study. Through a set of linked identifiers, Wave I and Wave IV will be merged into one file. To answer the research questions, a subset of variables will be drawn from the full dataset. The subset of data includes questions on adverse childhood experiences and injury occurrence as well as covariates such as substance use/dependence, psychosocial function and demographic information. The data will be used for analysis and hypotheses testing. Extensive precautions will be taken to protect the data and to guard against deductive disclosure of the participants' identities. The restricted Add Health dataset was purchased for research use by the University of Nevada, Las Vegas, School of Community Health Sciences, Department of Environmental Health in May 2014. The human subjects' protocol for this study was approved by the University of Nevada, Las Vegas, Institutional Review Board (Protocol 1405–4810). Information on how to obtain the Add Health data files is available on the Add Health website (http://www.cpc.unc.edu/addhealth).

Participant and Sampling Procedures

The primary sampling frame for the Add Health study was derived from the Quality Education Database (QED) which consists of 26,666 high schools in the U.S. From this sampling frame, high schools were stratified by size (<125, 126-350, 351-775, >776 students), school type (public, private, parochial), region (Northeast, Midwest, South, West), location (urban, suburban, rural), and ethnic mix (percent of white students 0, 1-66, 67-93, 94-100 and percent of black students 0, 1-6, 7-33. 34-100). The principal investigators then selected a sample of 80 schools with probability proportional to the size of the school. Schools were defined as having more than 30 students and including

an 11th grade. For each high school that was selected, a feeder school (a middle school or junior high school) was also selected with probability proportional to the feeder school's contribution of students to the high school. This selection process resulted in one school pair in each of the 80 different communities. Of the schools that were contacted, 79% agreed to participate in the study. The total number of schools in the sample was 132 (Chen & Chantala, 2014; Harris, 2013).

Table 2 lists the sample sizes and weight components for each wave of the Add Health study. The baseline survey (Wave I) took place during the 1994-1995 academic year. First, in-school questionnaires were completed by over 90,000 students. From school rosters and the students who completed the in-school survey, a subset of adolescents were selected randomly to complete an in-home survey. The core sample consisted of a nationally representative sample of 12,105 students from grades 7 to 12, stratified in each school by grade and sex. Twins and other sibling pairs occur naturally in the core in-home sample proportional to the general population of adolescents in the United States among adolescents in 1995 (Harris, et al., 2006).

The researchers also used the in-school surveys to draw supplemental samples. These samples were drawn based on genetic relatedness, race/ethnicity, students with disabilities, a saturation sample for social networking purposes, and other factors. For the genetic-relatedness oversampling, full siblings occurred naturally in the core sample, so if an adolescent indicated that s/he was a twin, in the in-school survey, that individual was selected with 100% certainty. Adolescents with half-siblings, adopted siblings, and unrelated siblings (e.g., stepsiblings or foster children) who live in the same home were

oversampled. These genetic pairs data included over 3000 pairs of adolescents with varying degrees of genetic relatedness that were interviewed in the in-home survey and followed through all four waves of the Add Health study (Harris, et al., 2006). A second supplemental sample of included students with disabilities and students from diverse racial/ethnic backgrounds, including, Cuban, Puerto Rican, and Chinese students and African-American students with highly educated parents. Finally, a large supplemental sample included a saturated sampled of all students from two large schools and fourteen small schools who were all selected for the in-home interview. The total sample size for the Wave I in-home phase of the survey was 20,745 (Harris, 2013). 15,356 of the Wave I in-home respondents also have in-school data. The appropriate statistical weights will be applied to the in-home interview sample to adjust for the oversampling described above. The response rate for the Wave I in-home survey was 79% (UNC Carolina Population Center Project-Add Health Website; n.d.).

A parent survey was also conducted in Wave I. Over 85 percent of the parents of survey respondents, typically the resident mother, completed the parent survey (n=17,670). The parent survey gathered additional contextual data about the adolescents' lives. Survey questions asked about neighborhood characteristics, child and parent health conditions and health related behaviors, marriage and marriage-like relationships, parent involvement in volunteer, civic, or school activities, parent education and employment, household income and economic assistance, parent-adolescent communication and interaction, including the parent's familiarity with the adolescent's friends and friends' parents (Harris, 2013). The parent survey was not used in this study.

Wave II of the Add Health study was completed one year later, in 1996. Wave II participants consisted of 14,738 respondents in grades 8-11 from the Wave I in-home survey. 12th grade respondents were excluded from the Wave II survey as they exceeded the grade eligibility requirement. The response rate for Wave II was 88.6% (Harris, 2013; UNC Carolina Population Center Project-Add Health Website; n.d.). The Wave II survey was not used in this study.

Wave III of the Add Health study was completed in 2001-2002. The sample consisted of Wave I respondents who could be located and re-interviewed six years later. Participants were young adults age 18-26 (n=15,197). The response rate for Wave II was 77.4% (Harris, 2013; UNC Carolina Population Center Project-Add Health Website; n.d.). The Wave III survey was not used in this study.

Wave IV of the Add Health study was completed in 2007-2008. The sample consisted of 15,701 respondents from the Wave I in-home survey, regardless if they participated in Waves II or III. The weighted sample size to represent U.S. population n=14,800. The weighted sample size also represents respondents who participated in both Wave I and Wave IV of the study. Participants were young adults age 24-32. The response rate for Wave IV was 80.3%. (Harris, 2013; UNC Carolina Population Center Project-Add Health Website; n.d.).

Adjustment of Design Effects

In all analyses, the appropriate statistical weights will be used to ensure that the data are representative of the national population. Unless appropriate adjustments are made for sample selection and participation, the data can be biased on the outcome of interest (Chen & Chantala, 2014). In cross-sectional analysis, when the outcome variable is from one wave of the data, e.g, Wave IV, but the predictors and covariates are from previous waves, e.g., Wave I, the Add Health study design assigns a cross sectional weight for the wave from where the outcome variable comes (Chen & Chantala, 2014). Three design effects had to be considered when analyzing the Add Health data. First, stratification of the sample reduces the variance. The post stratification variable: REGION will be used to adjust for this design effect. The adjustment involved using the total number of schools in the sampling frame for each region of the country (northeast, Midwest, South, and West) and for each region adjusting the initial school weights so that the sum of the school weights was equal to the total number of schools in the sampling frame. Second, the clustering of students increases variance. The variable PRIMARY SAMPLING UNIT VARIABLE (PSUSCID): School Identification Variable will be used to adjust for the clustering of students. PSUSCID is the primary sampling unit for the In-School and Waves I through IV data. The sampling units in the Add Health study are middle schools and high schools in the U.S. The variable is constructed from the school identifier. Third, there is an unequal probability of selection that increases variance. Add Health researchers provide several variables for SAMPLING WEIGHTS that are intended to be used for cross-sectional and longitudinal analysis of the four survey waves. For this study the sampling weight variable GSWGT4_2 was used as the cross-sectional

weight for Wave I respondents who were interviewed at Wave IV. Unbiased estimates of population parameters and standard errors will be obtained by using the sampling weights and the variables to identify clustering and stratification of adolescents in the study. The Taylor Series linearization estimation in SPSS for complex samples will be used to compute standard errors to compensate for the complex, stratified sampling design of the Add Health study. It is the most commonly used method to estimate the covariance matrix of the regression coefficients for complex survey data (Chen & Chantala, 2014). Adjustments for the design effects will be included in every statistical procedure described below except for bivariate correlation analyses and diagnostic analyses since the adjustment of design effects does not support these statistical analyses.

Add Health Survey Procedures and Informed Consent

The Add Health survey instrument was designed to include measures covering a large spectrum of health. The survey instruments included several thousand variables spanning all four waves of the study. **Table 3** lists the topics covered by each survey wave (Harris, 2013). The construction of the surveys was based on an extensive review of the literature, although no intact scales were used. Survey items were also provided by the funding agencies. The survey instrument and its components were extensively pilot-tested and questions were revised as necessary in response to pilot-test results (Udry, 2001).

For the Wave I In-School Survey, participants were given a self-administered survey instrument (formatted for optical scanning) during a 45- to 60-minute class period.

Parents were informed in advance of the date of the survey and could opt out of their child's participation. For the In-home survey portion of the Wave I and Wave II surveys, written informed consent was obtained from the parent or legal guardian and assent was obtained from the adolescent. Each interview took 1 to 2 hours depending on the respondent's age and experience. Standardized questionnaires were administered by project interviewers using computer assisted self-interview (CASI) software. Sensitive questions were given on headphones and participants directly entered their responses into a laptop computer. This procedure reduced any potential for interviewer or parental influence on participant responses and has been shown to yield better self-reports of high-risk behaviors than regular interviews (Resnick, et al., 1997; Couper, 2005). To be eligible for a Wave III interview, original Add Health respondents were required to be 18 years of age or older. There were no minors interviewed at Waves III and IV of the study, eliminating the need for parental consent. All Wave III and IV respondents were asked to read and sign an informed consent form. Interviews were collected nationwide. Interviewers traveled to each respondent's home or to a suitable location identified by the participant. A 90-minute interview was conducted in an area that was as private as possible. The interviewers entered some responses directly into a computer. For potentially sensitive questions, the participants used a computer-assisted, self-interview (CASI) protocol to provide answers. An event history calendar was used as a memory aid to assist participants in recalling information asked in the survey (Harris, 2013; Udry, 2003).

Measures

The outcome variables on injury were obtained from the Wave IV survey. Independent ACE variables pertaining to household dysfunction, interpersonal loss and community violence were selected from the Wave I in-home survey. Retrospective questions about child maltreatment (child abuse), the death of parents and siblings and parental incarceration were obtained from the Wave IV survey.

Dependent Variables – Injury

Table 4 lists the injury variables used for this study. A total of seven (7) outcome variables are used for this study. The injury variables were obtained from the Add Health dataset Wave IV. Variables were selected based on injury definitions and classifications established by the Centers for Disease Control and Prevention for injury violence and injury intent, as well as the Web-based Injury Statistics Query and Reporting System (WISQARS) for nonfatal injury using type and cause (mechanism) of injury. Measures were sorted into each category based on the location of the question in the survey (context) and the content of the question.

Unintentional Injury

Serious Injury - Information on serious unintentional injury collected in Wave IV was measured by the question, "In the past 12 months have you ever suffered any serious injuries (broken bones, cuts or lacerations, burns, torn muscles or other injuries) that interfered with your ability to perform daily tasks."

Motor Vehicle Accident – Wave IV included one question about being involved in a motor vehicle accident in the past 12 months.

Intentional Injury

Suicide Attempt – One question in Wave IV of the Add Health survey asked respondents if they have ever made a suicide attempt in the past 12 months.

Physical Intimate Partner Violence – For the purpose of this study, intimate partner violence was divided into two categories. Physical Intimate Partner Violence was defined as any physical harm by a current romantic partner within the past 12 months. Three questions were asked in Wave IV, " In the past 12 months -- "How often has <partner> threatened you with violence, pushed, shoved or thrown something that could hurt?", "How often has <partner> slapped, hit, or kicked you?", "Have you had an injury, such as a sprain, bruise, or cut because of a fight with <partner>?" Responses to all three questions were combined into one variable for Physical IPV. Responses were recoded into a binary response so that any endorsement of physical violence between one time and more than 20 times was coded as '1' "yes." Responses of "This never happened" or "This happened, but not in the past 12 months" were coded "0" for "No."

Sexual Intimate Partner Violence – Sexual Intimate Partner Violence was measured by the question, "In the past 12 months, has your <partner> insisted on or made you have sexual relations with (him/her) when you didn't want to? Responses were recoded into a binary response so that any endorsement of sexual intimate partner

violence between one time and more than 20 times was coded as '1' "yes." Responses of "This never happened" or "This happened, but not in the past 12 months" were coded "0" for "No."

Interpersonal Violence – Interpersonal violence is defined as a physical injury by someone other than an intimate partner. Two variables were used from Wave IV: "In the past 12 months someone shot or stabbed you?" (Shot/Stabbed) and "In the past 12 months were you beaten up?" (Beaten Up).

To determine the likelihood of injury by ACE score, each injury type will be coded 1 "yes" if participants endorsed any of the questions within that injury type. If none of the items were endorsed, the injury type will be coded 0 "no."

Independent Variables: Adverse Childhood Experiences

Table 5 lists the independent ACE variables that will be used for this study. There are sixteen (16) types of ACEs used for this study, divided into four categories. ACE variables will be obtained from the Add Health Survey using Wave I (ages 13-17) and retrospective questions from Wave IV. ACE variables were selected based on an extensive literature review, from comparisons with the seminal ACE study (Felitti, et al., 1998) and the Traumatic Events Screening Inventory for Children (TESI-C). The TESI-C (Ribbe, 1996) is a 15 item scale designed to screen for a child's history of exposure to potentially traumatic experiences. Scale items are based on *DSM-IV* diagnostic criteria

for PTSD. Studies of reliability and validity of the instrument have been published by Daviss, et al., (2000) and Ford, et al. (2000).

Child Maltreatment

Three types of ACEs are included under the category of Child Maltreatment. These are Physical Abuse, Sexual Abuse, and Emotional Neglect. All of the childhood maltreatment variables were retrospectively reported from Wave IV.

Physical abuse – Measured retrospectively in Wave IV by the question, "Before your 18th birthday, how often did a parent or adult caregiver hit you with a fist, kick you, or throw you down on the floor, into a wall, or down stairs?" The variable was recoded as dichotomous, with respondents coded as "0" if they did not did not endorse any physical abuse and "1" if they responded affirmatively to any physical abuse between one and more than ten times before his/her 18th birthday.

Sexual Abuse – Measured retrospectively in Wave IV by the question, "Before your 18th birthday, how often did a parent or other adult caregiver touch you in a sexual way, force you to touch him or her in a sexual way, or force you to have sexual relations?" The variable was recoded as dichotomous, with respondents coded as "0" if they did not did not endorse any sexual abuse and "1" if they responded affirmatively to any sexual abuse between one and more than ten times before his/her 18th birthday.

Emotional Neglect – One item was measured retrospectively in Wave IV by the question, "Before your 18th birthday, how often did a parent or other adult caregiver say things that really hurt your feelings or made you feel like you were not wanted or loved?" The variable was recoded as dichotomous, with respondents coded as "0" if they did not did not endorse any emotional neglect and "1" if they responded affirmatively to any emotional neglect between one and more than ten times before his/her 18th birthday.

Household Dysfunction

Four types of ACEs were included in the category of Household Dysfunction. These are: parents' tobacco use, illegal drugs available in the home, household mental illness, not living with both biological parents. The variables that comprise the types of Household Dysfunction were obtained from Wave I in-home survey.

Substance Use or Abuse – This category measures adolescents' exposure to parents' use of tobacco and access to illegal drugs in the home. Two variables were used. First, four questions were asked about the tobacco use of the participant's biological mother and resident mother (if different) and the tobacco use of the participant's biological father and resident father (if different). These four questions were combined into one composite variable for Any Parent Smoking. Any affirmative response to any parent smoking was coded "1" otherwise it was coded "0". One question asked if illegal drugs were easily available in the home. This variable was coded "1" if the respondent endorsed the question, otherwise it was coded "0". Respondents were not asked about the alcohol use of their parents in the survey. The Parent survey included questions about

alcohol use by the parent completing the survey and her/his partner, but because it was a different survey tool, these questions were not included as variables in this study.

Family Mental Illness – One question asked if any family member had tried to kill themselves in the last 12 months. This question was used an indicator of mental illness since mental disorders are a major risk factor for suicide ideation and attempt (Afifi, T., Enns, Cox, et al., 2008).

Does Not Live With Both Biological Parents –Not living with both biological parents is an indication of some type of separation that in itself can be an adverse experience for children/adolescents. A series of questions asks respondents what their relationships are to their caretakers living in the household, e.g., biological mother, stepmother, foster mother, etc. A composite variable was constructed where living with two biological parents was coded as "0" and all other parental types of arrangements (e.g., single parent, living with one biological parent and one step-parent, adoptive parents, etc) were coded as "1."

Interpersonal Loss

Four types of ACEs were included in the category of Interpersonal Loss -- death of a parent, death of a sibling, suicide attempt of a friend and any parent incarcerated. These questions were obtained from Wave I and retrospectively from Wave IV.

Death of a Parent – The variables from the Wave I in-home survey and retrospective questions from Wave IV surveys ask about whether the biological mother, biological father are still alive (In Wave I) and whether the resident mother or father (if not the biological mother/father) had died before the respondent was 18 years of age. A composite variable was constructed to represent any parent died, coded as "1" and no parent died coded as "0."

Death of a Sibling - Another variable asks retrospectively (Wave IV) about how many and each biological siblings, adoptive or step siblings that had died before the respondent turned 18 years of age. A composite variable was constructed to represent any sibling died, coded as "1" and no sibling died coded as "0."

Suicide Attempt of a Friend - One question was asked in Wave I if any of the respondents' friends had attempted suicide. Respondents who endorsed the question were coded "1" otherwise they were coded "0".

Parent Incarceration - Four questions were obtained retrospectively from the Wave IV survey. These questions asked if the participants' biological mother (father) or mother figure/resident mother (father figure/resident father) if not the same as the biological parent ever spent time in jail or prison. A composite variable was constructed to represent any parent incarcerated coded as "1" and no parents incarcerated coded as "0."

Community Violence

Five items were used to represent exposure to community violence. All items were obtained from Wave I. Items include, "During the past 12 months, how often did each of the following things happen? You saw someone shoot or stab another person? You had a gun pulled on you? Someone shot, stabbed or jumped you?" One question asked if the adolescent felt safe in his/her school (Unsafe School) and another asked if the adolescent felt safe in his/her neighborhood (Unsafe Neighborhood). Respondents who endorsed each question were coded "1" otherwise they were coded "0".

ACE Score

As shown in **Table 5,** each type of childhood experience will be coded "yes" if participants endorsed any of the included items. If none of the items were endorsed, the adverse experience was coded "no". The ACE score constitutes the summed number of endorsed types of adverse childhood experiences to calculate each participant's ACE score (Anda, et al. 2009, Enns, et al., 2006; Dube, et al., 2001; Felitti, et al., 1998). Total ACE scores could range from 0 (participant experienced none of the types of adverse childhood experiences) to 16 (participant experienced all of the types of adverse childhood experiences). Because of small sample sizes at the upper end of the ACE distribution, it was necessary to determine a cut-off score. A natural ACE cut-off score is determined by the ACE score distribution across the sample. A natural cut point should have about 5-10% of the sample in the uppermost grouping (D.W. Brown, personal communication, February 17, 2015). ACE scores of six or more were combined into one category (≥ 6) for a distribution of 0 to 6+ ACEs. Logistic regression analyses were

conducted with this modified ACE score as a continuous variable to test the hypotheses of a frequency response relationship between ACE score and the odds of injury.

Covariates

In addition to the predictors variables discussed above, other factors possibly associated with injury in young adulthood were controlled. Two analyses were conducted testing the association between ACEs and injury. The first model controlled for demographic characteristics. These variables were sex, race, age at Wave IV and educational attainment at Wave IV.

The second analysis also controlled for psychosocial characteristics. These covariates are proximal risk factors that have been highly associated with injury in the literature. As discussed in chapter two, these covariates may also be outcomes of ACEs that may either partially or fully mediate the effect on injury. However, for this analysis, it was decided to control these variables to determine if the effect of ACE type and ACE score on injury was attenuated by these psychosocial characteristics. The psychosocial characteristics were constructed variables obtained from Wave IV. Four variables associated with injury were chosen.

Depression (C4VAR044) – Constructed from two variables, "Has a doctor or nurse ever told you that you have or had depression?" and "During the past 7 days have you felt depressed?" Dichotomous variable coded '1' for Depression and '0' for No Depression.

Angry Hostility Personality Scale (C4VAR011) – Constructed from four variables, "I get angry easily," I rarely get irritated," I lose my temper," and "I keep my cool." Responses to each question were given on a five point Likert type scale from "Strongly agree" to "Strongly Disagree." For the constructed variables, the scores were combined to represent a 20 point scale with higher scores representing more anger/hostility. For this study, the constructed variable was dichotomized at the mean with values higher than the mean coded '1' for anger/hostility. Values at the mean and lower coded '0' for no anger/hostility.

Nicotine Dependence from Fagerstrom Scale (C4VAR017) – Constructed from twelve variables on tobacco use, frequency of use and dependence. Dichotomous variable coded '1' for Nicotine Dependent and '0' for Not Nicotine Dependent.

DSM4 Lifetime Diagnosis of Alcohol Dependence or Abuse (C4VAR023) – Constructed from fourteen variables on alcohol use, frequency of use and dependence. The constructed variable was coded on a five point scale ranging from abuse to different forms of dependence. This variable was recoded to a dichotomous variable where '1' indicated any alcohol abuse/dependence and '0' indicated no alcohol abuse/dependence.

DSM4 Lifetime Diagnosis of Other Drug Dependence or Abuse (C4VAR033) (not cannabis) – Constructed from thirteen variables on illegal drug use, type, frequency and dependence. Types of illegal drugs included MDMA (Ectasy), inhalants, LSD,

heroin, PCP, cocaine, crystal meth, sedatives, tranquilizers, etc. The constructed variable was coded on a five point scale ranging from abuse to different forms of dependence. This variable was recoded to a dichotomous variable where '1' indicated any illegal drug abuse/dependence and '0 indicated no illegal drug abuse/dependence.

It is necessary to control for these confounders to ascertain if there is a significant, independent association between ACEs and the likelihood of injury in young adulthood. The final full model for each analysis controlled for significant demographic and psychosocial covariates. Tests to see if the data met the assumption of collinearity indicated that multicollinearity among the independent and control variables was not a concern.

Statistical Analysis

Sample Size Calculations

IBM SPSS Sample Power software was used for an *a priori* analysis of sample size and power for the Add Health data set used for this study. The goal was to estimate the percentage of people who would respond to endorsing ACEs in childhood/ adolescence. Specifically, to estimate the percentage of people who would respond to having an ACE score of ≥ 6 ACEs. The analysis examined the proportion of participants in the outcome category of injury. For this analysis, the sample size calculation uses the logistic regression model formula:

$$\log (P/(1 - P)) = \beta 0 + \beta_1 X_1 + \cdots + \beta_p X_p$$

The null hypothesis H_0 tests the effect of a specific predictor (e.g., X_1) in the presence of other predictors, such that:

$H_0 : [\beta 1, \beta 2, \ldots, \beta p] = [0, \beta 2, \ldots, \beta p]$

The alternative hypothesis is:

$H_1 : [\beta 1, \beta 2, \ldots, \beta p] = [\beta^*, \beta 2, \ldots, \beta p]$, where $\beta^* \neq 0$.

Conducting an analysis of sample size is to ensure that the secondary data set was large enough to obtain valid and accurate results. The power of a study is determined by the alpha level, the effect size and the sample size. The power of the study is calculated by: Power = 1- β, the probability that we will reject a false null hypothesis. A power of .80 or 80% indicates that one would see an effect or a difference between the conditions studied or that the null hypothesis would be rejected 80% of the time if the effect actually existed in the population. For a nationally representative study, a power of .80 ($\beta \leq .2$) or better with 95% confidence intervals is considered statistically powerful (Park, 2010). For the Add Health study, a power of .95 or better can be achieved.

The hypothesis for research question two is that there is a freqency response relationship between ACE score and injury. For this power analysis, I estimated the proportion of ACE score to injury proportionally, e.g., 0 ACEs (10%) to ≤6 ACEs (20%) with an allowable error margin as plus or minus one percentage point. The focus of the analysis was to estimate the percentage of the participants who would respond in the ≤6 category. For a power of .80, the study would have needed to enroll 8,196 participants for

logistic regression analysis. The total sample size for the Add Health study is 14,800 which is sufficient.

Statistical Aims

Table 6 describes in detail the statistical aims for this study. Descriptive statistics are presented on the prevalence of injury and ACEs by gender and by race and ethnicity. Logistic regression analyses with complex samples were conducted to answer both research questions. Statistical tests and analyses were performed for each of the fourteen hypotheses. Analyses were performed using SPSS v22. Findings that are statistically significant with an alpha of 0.05 are presented in the results section (Chapter 4). These analyses identified relationships of ACEs to injury occurrence and discerned odds ratios (with 95% confidence intervals) for the likelihood of each outcome by individual types of ACEs and by ACE score. **Figure 5** illustrates the conceptual model of the relationship between the independent variables and the outcome variables for each research question and hypotheses that were tested using the adapted LCHD framework.

Descriptive Analysis

The weighted prevalence of injury in young adulthood are presented for each type and subcategory of injury (e.g., intentional injury – Suicide Attempt). Prevalence rates are presented by gender and by race/ethnicity. Second, the mean number of all injuries experienced in young adulthood is presented by gender, and race/ethnicity. Results are presented separately by gender and race/ethnicity because combining them could bias results and mask important disparities.

The weighted prevalence of each type of ACE (e.g., physical abuse) are presented by gender, then by race/ethnicity. Second, the distribution of ACE scores (0-16) in the sample are presented by gender and by race/ethnicity. A comparison of mean ACE scores by gender and race/ethnicity are also given.

Data Analysis of Research Questions and Hypotheses

1. **What is the association between the types of ACEs and the occurrence of injury in young adulthood?**

   Hypothesis 1.1 – ACE type will be positively associated with significantly higher odds of Unintentional Injury – Serious Injury within the past twelve months in young adulthood.

   P1 – ACEs with the domain of Child Maltreatment will have the strongest positive association with the likelihood of unintentional injury within the past twelve months in young adulthood.

   Hypothesis 1.2 – ACE type will be positively associated with significantly higher odds of Motor Vehicle Accidents within the past twelve months in young adulthood.

   P1 – ACEs within the domain of Interpersonal Loss will have the strongest positive association with Motor Vehicle Accidents within the past twelve months in young adulthood.

   Hypothesis 1.3 – ACE type will be positively associated with significantly higher odds of Suicide Attempt within the past twelve months in young adulthood.

P1 – ACEs within the domain of Child Maltreatment will have the strongest positive association with Suicide Attempt within the past twelve months in young adulthood.

Hypothesis 1.4 – ACE type will be positively associated with higher odds of Physical Intimate Partner Violence within the past twelve months in young adulthood.

P1 – ACEs within the domain of Community Violence will have the strongest positive association with Physical IPV within the past twelve months in young adulthood.

Hypothesis 1.5 – ACE type will be positively associated with higher odds of Sexual Intimate Partner Violence within the past twelve months in young adulthood.

P1 – ACEs within the domain of Child Maltreatment will have the strongest positive association with the likelihood of Sexual IPV within the past twelve months in young adulthood.

Hypothesis 1.6 – ACE type will be positively associated with higher odds of being Shot/Stabbed within the past twelve months in young adulthood.

P1 – ACEs within the domain of Community Violence will have the strongest positive association with being Shot/Stabbed within the past twelve months in young adulthood.

Hypothesis 1.7 – ACE type will be positively associated with higher odds of being Beaten Up within the past twelve months in young adulthood.

P1 – ACEs within the domain of Household Dysfunction will have the strongest positive association with being Beaten Up within the past twelve months in young adulthood.

Three logistic regression analyses using complex samples were conducted to examine the association of each ACE type with the occurrence of each injury outcome. The first simple logistic analysis controlled for the significant demographic characteristics of sex, race, age at Wave IV, and educational attainment at Wave IV. The second logistic regression analysis included both demographic and significant psychosocial characteristics. A final model was analyzed with all of the significant ACE types from the second analysis, presented as follows:

log(p/1-p) = beta0 + beta1*ACE TYPE + beta2*SEX + beta3*RACE + beta4*AGE AT WIV + beta5*EDUCATION AT WIV + beta6*DEPRESSION + beta7* HOSTILITY+ beta8*NICOTINE DEPENDENCE + beta9*ALCOHOL ABUSE) + beta10*DRUG ABUSE

Where p is the probability of the outcome injury. Significance was defined by a $p<0.05$. All analyses were conducted using SPSS v.22.

2. **Is there a frequency response relationship between the number of ACEs (ACE Score) and injury in young adulthood?**

   Hypothesis 2.1 – Participants who experience more ACEs will have significantly higher odds of Unintentional Serious Injury within the past 12 months compared to participants with no ACEs.

Hypothesis 2.2 – Participants who experience more ACEs will have significantly higher odds of Motor Vehicle Accidents within the past 12 months compared to participants with no ACEs.

Hypothesis 2.3 – Participants who experience more ACEs will have significantly higher odds of Suicide Attempt within the past 12 months compared to participants with no ACEs.

Hypothesis 2.4 – Participants who experience more ACEs will have significantly higher odds of Physical Intimate Partner Violence within the past 12 months compared to participants with no ACEs.

Hypothesis 2.5 – Participants who experience more ACEs will have significantly higher odds of Sexual Intimate Partner Violence within the past 12 months compared to participants with no ACEs.

Hypothesis 2.6 – Participants who experience more ACEs will have significantly higher odds of being Shot/Stabbed within the past 12 months compared to participants with no ACEs.

Hypothesis 2.7 - Participants who experience more ACEs will have significantly higher odds of being Beaten Up within the past 12 months compared to participants with no ACEs.

Predictions for all Hypotheses for Research Question 2

P1 – For all injury outcomes, ACE score will have a significant independent effect in the logistic regression models when controlling for demographic and psychosocial characteristics.

P2 – For all injury outcomes, participants with ≥6 ACEs will have significantly greater odds of incurring an injury than participants with no ACEs.

Logistic regression analyses using complex samples were used to predict the probability of each outcome injury using a modified ACE score as the main variable of interest. The number of ACEs were summed for each respondent (ACE score range, 0 - ≥6. 8% of the sample had an ACE score of six or higher). Due to the distribution of the sample, ACE scores of six (6) and greater were combined into one category. The analyses were conducted with the summed score as a continuous variable. Odds ratios (ORs) were calculated controlling for the effect of 1) socio-demographic variables and 2) Psychosocial variables at Wave IV. Each covariate was tested in the model and removed if it did not significantly contribute to model fit. Two models are presented. Model 1 is adjust for demographic characteristics only. Model 2 is the full model controlling for both socio-demographic variables and Wave IV psychosocial characteristics. A final model is then presented as follows:

log(p/1-p) = beta0 + beta1*ACE SCORE + beta2*SEX + beta3*RACE + beta4*AGE AT WIV + beta5*EDUCATION AT WIV + beta6*DEPRESSION + beta7* HOSTILITY+ beta8*NICOTINE DEPENDENCE + beta9*ALCOHOL ABUSE) + beta10*DRUG ABUSE

Where p is the probability of the outcome injury. Significance was defined by a $p<0.05$. All analyses were conducted using SPSS v.22.

Summary

This chapter provided a discussion of the methodology for this. The Add Health dataset has been purchased by the UNLV School of Community Health Sciences. This study uses a quantitative correlational study design using secondary data from the Add Health Study. Details of the study design, survey and consent procedures were explained. The outcome variables and the independent variables for ACEs will be drawn from the larger Add Health data set. Logistic regression using complex samples will be used to test the study hypotheses and answer the two research questions posed for this study. There were several assumptions and limitations that were also discussed. Results from this study will be presented in Chapter Four.

CHAPTER 4

RESULTS

The objective of this study is to examine the association between adverse childhood experiences (ACEs) in the context of family and community and the likelihood of subsequent unintentional and intentional, nonfatal injury in young adulthood. The results presented in this chapter include a description of the study sample derived from the National Longitudinal Study of Adolescent and Adult Health, Wave I and Wave IV and the results of the two research questions and associated hypotheses and predictions. Results are presented in five sections. 1) Characteristics of the study population representative of the target U.S. population. 2) Prevalence of injury representative of the target U.S. population. The results of this analysis present the weighted prevalence of injury by demographic and psychosocial characteristics that were controlled as covariates in the analysis of the study's two research questions. 3) Prevalence of ACEs representative of the target U.S. population. The results from this analysis present the prevalence of ACE types and ACE score by sex (gender) and race/ethnicity. 4) Association between the types of ACEs and the occurrence of injury in young adulthood. Results are presented from the analysis of research question one and the seven associated hypotheses and predictions. 5) Association between ACE Score and the occurrence of injury in young adulthood. Results are presented from the analysis of research question two and the seven associated hypotheses and predictions.

Characteristics of the Study Population

The Add Health restricted use version of the data set of participants from Wave I and Wave IV was a nationally representative sample (N=14,800). The demographic and psychosocial characteristics of the sample are presented in **Table 7**. The sample consisted of 7,313 males (49%) and 7,485 females (51%). The participants' mean age at Wave IV was 28.5 years (SE, 0.30). The majority of the participants were White/Euro-American (67%), 15.8% were Black/African-American, 11.9% were Hispanic/Latino (any race), American Indian/Alaskan Natives (AI/AN) were 0.8% of the sample and Asian-American/Pacific Islanders were 3.1% of the sample. In terms of educational attainment in young adulthood at Wave IV, 8.2% had achieved less than a high school diploma or equivalent, 16.8% had a high school diploma or equivalent, 43.9% had some college or vocational training and 32.7% were college graduates or higher. The psychosocial characteristics endorsed in young adulthood (Wave IV) that are also risk factors for injury indicate a prevalence of 18.3% percent among this population for depression, 41.5% were characterized as having an angry/hostile personality trait, 11% had nicotine dependence, 25.2% had a DSM4 lifetime diagnosis of alcohol abuse or dependence and 7.1% had a DSM4 lifetime diagnosis of illegal drug abuse or dependence (not cannabis).

Prevalence of Injury

In this sample, 62.4% (n=7,019) of respondents did not endorse any of the injuries variables in Wave IV and 37.6% (n=4,141) of respondents endorsed at least one of the

seven injury outcomes (M=.51, SD=.788). Of those who did endorse an injury, 26.3% endorsed one injury, 8.2% endorsed two injury categories and 3.1% endorsed three or more injury categories. An overview of the prevalence of the seven injury outcomes is presented. **Figure 6** presents prevalence rates for all injuries by gender. **Figure 7** presents prevalence rates for all injuries by race/ethnicity. **Figure 8** presents prevalence rates for all injuries by age and educational attainment and **Figure 9** presents prevalence rates by psychosocial characteristics. These data are explained in more detail in the next sections for each injury outcome.

Unintentional Injury - Serious Injury

Overall, 13.3% (SE, 0.4%) of the sample sustained a serious injury in the past year in Wave IV. The prevalence rates of Serious Injury by demographic and psychosocial characteristics are presented in **Table 8**. Males were almost twice as likely to have had a serious injury in the past twelve months as females (17.3% vs. 9.3%). American Indian/Alaskan Native and White had the highest serious injury rates (23.2% and 15.5% respectively). Due to the small sample size, the standard error for the AI/AN population was large and may not be representative of the U.S. population. However, the prevalence rates are consistent with the injury statistics provided by the CDC (see **Figure 1**). Asian/Pacific Islanders had the lowest rates of serious injury (8.8%). There were no major differences in serious injury prevalence by age which averaged around 12%, although the age category 28-29 seemed to have a slightly higher percentage of serious injury (14.2%). Serious injuries decreased as educational attainment increased. The rate of serious injury for participants who were college graduates or higher was 10.7%

compared to those with less than a high school education which was 18.1%. Psychosocial characteristics had a significant impact on the prevalence rates of serious injury. Participants who had a DSM4 lifetime diagnosis of illegal drug abuse or dependence had the highest prevalence rate of serious injury and were more than twice as likely to report a serious injury (25.6%) compared to 12.3% for those who did not have a lifetime diagnosis of illegal drug abuse/dependence. Almost twice as many young adults who were nicotine dependent had a serious injury (23.1%) compared to those who weren't (12%). For those who had a DSM4 lifetime diagnosis of alcohol abuse or dependence, almost 19% also had a serious injury compared to 11.4% of participants who did not have an alcohol problem. Of those who were depressed, 19% also reported having a serious injury in the past twelve months compared to 12% of those who were not depressed. About 16% of those with an angry/hostile personality trait had a serious injury in the past twelve months compared to 11.4% of those who were not rated as angry/hostile.

Unintentional Injury - Motor Vehicle Accident

Overall, 10% (SE, 0.4%) of the sample reported a Motor Vehicle Accident (MVA) in the past year in Wave IV. The prevalence rates of MVA by demographic and psychosocial characteristics are presented in **Table 8**. Males were only slightly more likely to have had a MVA in the past twelve months as females (10.4% vs. 9.7%). American Indian/Alaskan Natives (13.7%) and African-Americans (11%) had the highest MVA rates. Asian/Pacific Islanders had the lowest rate of MVA (8.6%). MVAs decreased as age increased. The youngest participants had the highest rates of MVAs at

14.4% compared to participants in the category of ≥ 30 years of age who had the lowest rate of MVAs at 8.9%. Participants who had less than a high school education and those who had some college/vocational training had the highest rates of MVAs at about 11%. Participants with the most education had the lowest rates of MVAs at 9.4%. The effect of psychosocial characteristics on the prevalence rates of MVA were mixed and somewhat surprising, especially for alcohol abuse/dependence. The highest rates of MVA were among those with a DSM4 lifetime diagnosis of illegal drug abuse/dependence and those with depression. About 13% of participants who had a lifetime diagnosis of illegal drug abuse or dependence had a MVA compared to almost 10% for those who did not. The rate of MVAs for participants who endorsed depression was 12.6% compared to 9.5% for those who were not depressed. Slightly more young adults who were nicotine dependent had a MVA (12.4%) compared to those who weren't (9.4%). Interestingly, there was not much difference in the prevalence of MVAs based on angry/hostile personality trait. About 11% of those with an angry/hostile personality trait reported having an MVA in the past twelve months compared to 9.5% of those who were not angry/hostile. For those who had a DSM4 lifetime diagnosis of alcohol abuse or dependence, about 11% also had a MVA compared to 10% of participants who did not have an alcohol problem.

Intentional Injury - Suicide Attempt

The total prevalence rate of suicide attempt for the sample was 1.5% (SE, 0.2%). The prevalence rates of Suicide Attempt by demographic and psychosocial characteristics are presented in **Table 9**. Females were slightly more likely to attempt suicide in the past

twelve months compared to males (1.7% vs. 1.3%). American Indian/Alaskan Natives were two times more likely to attempt suicide (3.5%) than all other racial/ethnic groups. Whites had the second highest prevalence of suicide attempt (1.6%) while Asian/Pacific Islanders had the lowest rates at 1.0%. Suicide attempt did not vary by age, averaging around 1.5% for all of the age categories. Educational attainment had the largest demographic impact on the prevalence rate of suicide attempt. Participants with less than a high school education were almost three times more likely to have a suicide attempt in the past year compared to all other educational categories (3.7%). As education increased, the prevalence of suicide attempt decreased. The prevalence rate of suicide attempt for those who were college graduates or higher was 0.9%. The effect of psychosocial characteristics on the prevalence rates of suicide attempt were also significant. The rate of suicide attempt for participants who endorsed depression was four times higher (4.8%) than for those who were not depressed (0.8%). Respondents with a DSM4 lifetime diagnosis of abuse or dependence on illegal drugs had a prevalence rate of suicide attempt of 3.6% in the past twelve months as a young adult compared to those with no abuse/dependence on illegal drugs (1.3%). Those with an angry/hostile personality trait had a prevalence rate of suicide attempt that was almost two and a half times higher than those who did not (2.4% vs. 0.9%). Respondents who were nicotine dependent were also about twice as likely to have a suicide attempt (2.4%) as those who were not nicotine dependent (1.3%). Young adults with a lifetime diagnosis of alcohol abuse/dependence had a suicide attempt prevalence rate of 1.9% compared to those who did not (1.4%).

Intentional Injury - Physical Intimate Partner Violence

The total prevalence for Physical Intimate Partner Violence was 17% (SE, 0.5%) Prevalence rates of Physical Intimate Partner Violence by demographic and psychosocial characteristics are presented in **Table 9**. Surprisingly, in this sample, more males endorsed being victimized and/or injured by physical IPV (20.6%) than females (13.9%). However, the data also indicate that as physical IPV became increasingly chronic (i.e., 6-10 times, 11-10, 20+ times in the past year) female prevalence rates exceeded male rates (data not shown). Educational attainment had the largest demographic impact on the prevalence rate of physical IPV. As education increased, rates of physical IPV decreased. Participants with less than a high school diploma or equivalent had a rate of 25.6% compared to participants who were college graduates or higher (10.2%). African-American and Hispanic populations had the highest rates of physical IPV (24.4% and 17.1% respectively). Rates did not vary by age, averaging around 17% for all age categories. Prevalence rates also showed increases by psychosocial characteristics. Respondents with a lifetime diagnosis of DSM4 illegal drug abuse/dependence had the highest rates of victimization/injury from physical IPV. Their rate was 27.2% compared to young adults with no abuse/dependence on illegal drugs (16.2%). Respondents who were nicotine dependent had a prevalence rate of (26.1%) compared to those who were not nicotine dependent (15.8%). The prevalence rate for participants who endorsed depression was 24.0% compared to those who were not depressed (15.4%). Those with an angry/hostile personality trait had a prevalence rate of being victimized by physical IPV of 21.9% compared to those who did not (13.5%). Young adults with a DSM4

lifetime diagnosis of alcohol abuse/dependence had a physical IPV prevalence rate of 20.4% compared to those who did not (15.8%).

Intentional Injury - Sexual Intimate Partner Violence

The overall prevalence rate in this sample for Sexual Intimate Partner Violence was 4.9% (SE, 0.3%). Prevalence rates of Sexual Intimate Partner Violence by demographic and psychosocial characteristics are presented in **Table 9**. Again, in this sample, slightly more males endorsed sexual IPV (5.3%) than females (4.8%). However, with sexual IPV there was no change in prevalence with increasing chronicity in this sample (i.e., 6-10 times, 11-10, 20+ times in the past year). The prevalence rates remained relatively equal between males and females at each level (data not shown). African-American and Hispanic populations had the highest rates of sexual IPV at 6.1% each. As education increased, rates of sexual IPV decreased. Participants with less than a high school diploma or equivalent had a rate that was almost twice as high as college graduates for sexual IPV (6.2% vs. 3.6%). Rates did not vary by age, averaging around 5%, but did decrease to 4.4% for participants aged ≥ 30 years. Psychosocial characteristics also increased prevalence rates of sexual IPV. Respondents who endorsed depression had the highest rates of sexual IPV (8.8%) compared to those who were not depressed (4.1%). Respondents who were nicotine dependent had a prevalence rate of (7.9%) compared to those who were not nicotine dependent (4.7%). Respondents with a DSM4 lifetime diagnosis of illegal drug abuse/dependence had a prevalence rate of sexual IPV of 7.7% compared to young adults with no abuse/dependence on illegal drugs (4.8%). Young adults with a lifetime diagnosis of alcohol abuse/dependence had a sexual

IPV prevalence rate of 6.6% compared to those who did not (4.4%). Those with an angry/hostile personality trait had a prevalence rate of sexual IPV of 6.1% compared to those who did not (4.2%).

Intentional Injury - Shot/Stabbed

The overall prevalence rate for individuals who were Shot/Stabbed in the past year in Wave IV was 3.9% (SE, 0.3%). Prevalence rates for being Shot/Stabbed by demographic and psychosocial characteristics are presented in **Table 10**. Males had higher prevalence of being shot/stabbed than females (4.4% vs 3.5%). American Indian/ Alaskan Natives had the highest prevalence rate which was four times higher than Asian/Pacific Islanders, the group with the lowest rate (8.7% vs 2.8% respectively). There was an inverse correlation between the prevalence rate of being shot/stabbed and both age and education. Educational attainment had the strongest overall impact on prevalence rates. Participants with less than a high school education had a prevalence rate of 9.6% compared to college graduates or higher (2.4%). The youngest age range, 24-25 year olds, had the highest rates compared to ≥ 30 year olds (5.3% vs. 3.8%). Psychosocial characteristics also increased prevalence rates for being shot/stabbed. Respondents with a DSMIV lifetime diagnosis of illegal drug abuse/dependence had the highest prevalence rate at 6.6% compared to young adults with no abuse/dependence on illegal drugs (3.7%). Respondents who were nicotine dependent had a prevalence rate of 6.4% compared to those who were not nicotine dependent (3.6%). The prevalence rate for participants who endorsed depression was 5.7% compared to those who were not depressed (3.5%). Those with an angry/hostile personality trait had a prevalence rate of being shot/stabbed of 4.9%

compared to those who did not (3.2%). Participants with a lifetime diagnosis of alcohol abuse/dependence had a *lower* prevalence rate of 3.0% compared to those who did not (4.2%).

Intentional Injury - Beaten Up

The overall prevalence rate for respondents who were Beaten Up in the past year in Wave IV was 3.6% (SE, 0.3%). Prevalence rates for being Beaten Up by demographic and psychosocial characteristics are presented in **Table 10**. Males had higher prevalence of being beaten up than females (4.0% vs 3.1%). American Indian/Alaskan Natives had the highest prevalence rate at 7.6%. Asian/Pacific Islanders had the lowest prevalence rate of 2.6%. There was an inverse correlation between the prevalence rate of being beaten up and both age and education. Educational attainment had the strongest overall impact on prevalence rates. Participants with less than a high school education had a prevalence rate of 9.3% compared to college graduates or higher (1.5%). 24-25 year olds had the highest rates compared to ≥ 30 year olds (4.5% vs. 3.9%). Psychosocial characteristics also increased prevalence rates for being beaten up. Respondents with a lifetime diagnosis of DSM4 illegal drug abuse/dependence had the highest rates and were over three times more likely to be beaten up than those who did not have a drug problem (10.9% vs 3.0%). Respondents who were nicotine dependent were almost four times more likely to be beaten up than those who were not nicotine dependent (9.5% vs. 2.9%). The prevalence rate for participants who endorsed depression was 7.5% compared to those who were not depressed (2.7%). Those with an angry/hostile personality trait had a prevalence rate of being beaten up of 5.2% compared to those who did not (2.3%).

Participants with a lifetime diagnosis of alcohol abuse/dependence had a prevalence rate of 5.0% compared to those who did not (3.0%).

Prevalence of ACEs – ACE Type

The prevalence of positive responses for the sixteen ACE types in the four categories of childhood exposures ranged from 2.0% for 'Any sibling died' to 72.3% for 'Any parent who smoked.' 93.4% of all participants endorsed at least one ACE type. **Figures 10 and 11** compare prevalence rates of each ACE type by gender and race/ethnicity. The prevalence rates illustrated by these graphs are presented in greater detail in **Tables 11 and 12** and are described below by ACE category.

Childhood Maltreatment

The ACE Types in this category were: Physical Abuse, Sexual Abuse, and Emotional Neglect. Emotional neglect had the highest prevalence in this category with an overall prevalence of 48.2%. Females had a higher prevalence rate than males (53.1% vs. 42.5%). American Indian/Alaskan Natives had the highest prevalence rate (55.9%) and Hispanics had the lowest rate of emotional neglect at 45.3%. The weighted percentage of physical abuse was 18.9%. Males and females had similar rates at about 19%. American Indian/Alaskan Natives had the highest prevalence rate of physical abuse (32.7%) and Whites reporting the lowest rates at 17.9%. The overall weighted prevalence for sexual abuse was 5.5%. Females were almost four times more likely to endorse childhood sexual abuse than males (8.0% vs. 2.6%). Almost one out of five American Indian/Alaskan

Natives experienced childhood sexual abuse (19.8%). Asian/Pacific Islanders had the lowest prevalence rate of childhood sexual abuse at 3.3%.

Household Dysfunction

Ace Types in this category were: Any parent smoked cigarettes, Easy access to illegal drugs in the home, Family member attempted suicide, and Respondent does not live with both biological parents. Nearly three out of four participants (72.3%) had at least one parent who smoked cigarettes (biological parent or resident-parent). Females were slightly more likely to have a parent who smoked than males (73% vs 71.6%). White participants had the highest prevalence rate of any parent that smoked (76.5%). Asian/Pacific Islanders had the lowest prevalence rate of having any parent who smoked at 63.5%. Half of this population (50%) did not live with both of their biological parents. Females were slightly more likely not to live with both biological parents (51.6%) compared to males (48.5%). Over two-thirds of African-Americans (68.8%) did not live with both biological parents. Asian/Pacific Islanders had the lowest prevalence rate of not living with both biological parents (30.4%). The overall prevalence for having a family member attempt suicide in the past year (Wave I) was 4.4%. Females were more likely to experience a family member suicide attempt than males (5.6% vs. 3.1%). American Indian/Alaskan Natives had the highest prevalence for having a family member attempt suicide in the past year (5.1%), followed by White at 4.6%. Asian/Pacific Islanders had the lowest rate at 3.1%. Overall, only 3.3% of respondents reported having easy access to illegal drugs in the home. Males had a slightly higher prevalence than females (3.6% vs. 3.0%). American Indian/Alaskan Native had the highest prevalence of easy access to

illegal drugs in the home (5.2%) followed by White (3.6%). Asian/Pacific Islanders had the lowest prevalence rate at 1.8%.

Interpersonal Loss

ACE Types in this category were: Any parent died, Any sibling died, Friend attempted suicide, and Any parent incarcerated. The highest prevalence rates in the category of interpersonal loss related to the experience of having a friend attempt suicide in the past twelve months (Wave I). The prevalence rate for this ACE type was 17.8%. Females were almost twice as likely to have experienced a friend attempt suicide as males (22.2% vs. 13.2%). American-Indian/Alaskan Natives had the highest prevalence rates at 37.4%, followed by White participants at 20.1%. African-American participants had the lowest prevalence rate at 12.2%. Almost 11% of participants had experienced having at least one parent incarcerated (biological parent or resident parent). Prevalence rates were about the same for males and females. American Indian/Alaskan Natives had the highest prevalence rates of having any parent incarcerated at 16.7%, followed by African-Americans at 14.4%. Asian-Pacific Islanders had the lowest prevalence rate of having any parent incarcerated at 3.5%. The total weighted prevalence rate for having any parent die (biological parent or resident parent) in childhood/adolescence was 4.5%. Females had a higher prevalence rate of having any parent die than males (5.3% vs. 3.7%). African-Americans had the highest prevalence of having any parent die (7.0%). Hispanics had the lowest prevalence at 3.6%. As expected, experiencing the death of a sibling in childhood/adolescence had the lowest overall prevalence in the category of interpersonal loss. Females had a higher prevalence rate than males (2.6% vs. 1.6%).

African-Americans also had the highest prevalence rate of having a sibling die when the respondent was <18 years old (3.1%), while Hispanics had the lowest prevalence rate at 1.3%.

Community Violence

The ACE Types in this category were: Saw someone get shot, Respondent had a knife or gun pulled on them, Physical Assault (shot/stabbed/jumped), Responded does not feel safe at School, and Respondent does not feel safe in the neighborhood. The highest prevalence rate in this category was physical assault (being shot/stabbed/jumped) in the past year (Wave I) when the respondent was <18 years old. The total weighted prevalence of this ACE type was 14.8%. Males were more than twice as likely to experience this type of physical assault as females (20.7% vs. 9.1%). Hispanics had the highest prevalence rate at 19.8%, while Asian/Pacific Islanders had the lowest prevalence at 11.8%. 14% of respondents did not feel safe at school, with slightly more females not feeling safe as males (14.4% vs. 13.6%). About one in five American Indian/Alaskan Native respondents did not feel safe at school (20.2%), followed by African-Americans with a prevalence rate of 17.8%. White respondents had the lowest rate of not feeling safe at school with a prevalence rate of 11.5%. Overall, 13% of respondents had witnessed violence with 13.4% indicating they saw someone get shot and 13.2% indicating they had a gun or knife pulled on them. Males were more likely to witness violence than females. 15.7% of males saw someone get shot vs 11.3% of females. Males were more than twice as likely to have a knife or gun pulled on them (19.3%) compared to females (7.4%). African-Americans had the highest prevalence rates of having witnessed someone get

shot (21.6%), while Whites had the lowest prevalence rate at 7.6%. Hispanics and American Indian/Alaskan Natives had the highest prevalence rates of having a knife or gun pulled on them (17.9% respectively). Asian/Pacific Islanders had the lowest prevalence rate of 8.4%. Finally, about 12% of respondents did not feel safe in their neighborhood. More females did not feel safe in their neighborhood than males (13.3% vs 10.5%). Hispanics had the highest prevalence rate of not feeling safe in their neighborhood (18.5%). Whites had the lowest prevalence rate of not feeling safe in their neighborhood (7.1%).

Prevalence of ACEs – ACE Score

Each ACE type that the respondent endorsed was summed into an overall score. Possible scores could range from 0 to 16. Among the total sample, ACE Scores ranged from 0 to 13. **Figure 12** and **Figure 13** show prevalence rates of ACE Score by gender and race/ethnicity. **Figure 14** compares the modified mean ACE Score (0-≥6 ACEs) by race/ethnicity and gender. Only 6.6% of respondents had an ACE Score of 0. 10.8% of had an ACE score of ≥6 (i.e., exposure to six or more types of ACEs). The prevalence rates are described in greater detail in **Tables 13, 14** and **15.** The mean ACE score among the total sample was 2.98 (SE, 0.26). There were no significant differences between the mean scores of males and females (Males, M=2.91, SE, .039; Females, M=3.04, SE, 0.36). American-Indian/Alaskan Natives had the highest mean score (M= 3.67, SE, 0.30), followed by African-Americans (M= 3.42, SE, 0.06). Asian/Pacific Islanders had the lowest mean ACE Score (M=2.59, SE, 0.09).

Research Question One: Is there an Association between the Types of ACEs and the Occurrence of Injury in Young Adulthood?

Hypothesis 1.1 – ACE type will be positively associated with significantly higher odds of Unintentional Injury - Serious Injury within the past twelve months in young adulthood.

H_0 – There is no association between ACE type and higher odds of Unintentional Injury – Serious Injury within the past twelve months in young adulthood.

Table 16 presents the adjusted odds ratios for the simple logistic regression analyses for each of the sixteen (16) ACE types with Unintentional Injury – Serious Injury as the outcome variable. Odds ratios were first adjusted for significant demographic covariates only. The second model adjusts for both significant demographic and psychosocial covariates. Only eight of the sixteen ACE types were significantly associated with higher odds of subsequent serious injury in young adulthood. These eight ACE types were put into a final full multiple logistic regression model. **Table 16a** presents the final model. Three ACE types were significantly associated with higher odds of subsequent serious injury in young adulthood. Respondents who reported being physically assaulted (shot/stabbed/jumped) in Wave I of the survey were significantly more likely than those who were not physically assaulted to report a serious injury within the past twelve months in young adulthood (Wave IV) (OR=1.35, 95% CI=1.072, 1.697). The odds having a serious injury in young adulthood for respondents who experienced physical abuse before the age of 18 years were also higher than for their non-abused counterparts (OR=1.33, 95% CI=1.068, 1.654). Emotional neglect in

childhood/adolescence increased respondents' odds of serious injury fourteen years later in young adulthood compared to respondents who were not emotionally neglected (OR=1.27, 95% CI = 1.059, 1.530). Finally, the experience of having a friend attempt suicide when the respondent was an adolescent in Wave I was significantly associated with higher odds of having a serious injury later in young adulthood even after controlling for demographic and psychosocial characteristics, compared to respondents who did not have a friend attempt suicide when they were adolescents (OR=1.24, 95% CI=1.018, 1.504). All four variables were significant in this model (p <.05). Due to the significance, the null hypothesis was rejected and the alternate hypothesis, "ACE type will be positively associated with significantly higher odds of Unintentional Injury - Serious Injury within the past twelve months in young adulthood" was accepted.

P1 – ACEs with the domain of Child Maltreatment will have the strongest positive association with the likelihood of unintentional injury within the past twelve months in young adulthood.

In the simple logistic regression analyses, Child Maltreatment - Sexual abuse had the strongest significant association (OR=1.52, 95% CI=1.064, 2.166). Child Maltreatment - Physical Abuse had a strong association in both the simple logistic regression analysis controlling for demographic and psychosocial characteristics (OR=1.48, 95% CI=1.212, 1.805) and in the final model (see above). However, it was not the strongest association. This prediction is partially supported.

Hypothesis 1.2 – ACE type will be positively associated with significantly higher odds of Motor Vehicle Accidents within the past twelve months in young adulthood.

H_0 – There is no association between ACE type and higher odds of Motor Vehicle Accidents within the past twelve months in young adulthood.

Table 16 presents the adjusted odds ratios for the simple logistic regression analyses for each of the sixteen (16) ACE types with Motor Vehicle Accident as the outcome variable. Odds ratios were first adjusted for significant demographic covariates only. The second model adjusts for both significant demographic and psychosocial covariates. Only four of the sixteen ACE types were significantly associated with higher odds of subsequent MVA in young adulthood. These four ACE types were put into a final full multiple logistic regression model. **Table 16b** presents the final model. Three ACE types were significantly associated with higher odds of subsequent MVA in young adulthood. The probability of being in a motor vehicle accident increased by 53% for respondents who were physically abused compared to those were not abused (OR=1.53, 95% CI= 1.192, 1.961). Respondents who had a family member attempt suicide in Wave I were more likely to be involved in a motor vehicle accident as a young adult (OR=1.49, 95% CI= 1.035, 2.132). Finally, respondents who were emotionally neglected as children/adolescents had higher odds of motor vehicle accidents as young adults (OR=1.24, 95% CI=1.041, 1.483). All three variables were significant in this model (p <.05). Due to the significance, the null hypothesis was rejected and the alternate hypothesis, "ACE type will be positively associated with significantly higher odds of

Motor Vehicle Accidents within the past twelve months in young adulthood" was accepted.

P1 – ACEs within the domain of Interpersonal Loss will have the strongest positive association with Motor Vehicle Accidents within the past twelve months in young adulthood.

One ACE type within the domain of Interpersonal Loss, having a family member who attempted suicide, had a strong association in both the simple logistic regression analysis controlling for demographic and psychosocial characteristics (OR=1.46, 95% CI=1.029, 2.072) and in the final model (see above). However, it was not the strongest association. In the simple logistic regression analyses, Child Maltreatment - Physical abuse had the strongest significant association (OR=1.62, 95% CI=1.284, 2.049). In the final model, physical abuse also had the strongest association. This prediction is not supported.

Hypothesis 1.3 – ACE type will be positively associated with significantly higher odds of Suicide Attempt within the past twelve months in young adulthood.
H_0 – There is no association between ACE type and higher odds of Suicide Attempt within the past twelve months in young adulthood.

Table 17a presents the adjusted odds ratios for the simple logistic regression analyses for each of the sixteen (16) ACE types with Suicide Attempt as the outcome variable. Odds ratios were first adjusted for significant demographic covariates only. The second

model adjusts for both significant demographic and psychosocial covariates. Only two of the sixteen ACE types were significantly associated with higher odds of subsequent suicide attempt in young adulthood. These two ACE types were put into a final full multiple logistic regression model. **Table 17a.1** presents the final model. One ACE type was significantly associated with higher odds of subsequent suicide attempt in young adulthood. Respondents who were emotionally neglected as children/adolescents had higher odds of suicide attempt as young adults than their counterparts who were not emotionally neglected (OR=1.63, 95% CI=1.043, 2.551). One ACE type was significant in this model (p <.05). Due to the significance, the null hypothesis was rejected and the alternate hypothesis, "ACE type will be positively associated with significantly higher odds of Suicide Attempt within the past twelve months in young adulthood" was accepted.

P1 – ACEs within the domain of Child Maltreatment will have the strongest positive association with Suicide Attempt within the past twelve months in young adulthood.

In the simple logistic regression analysis, Interpersonal Loss – Having a family member attempt suicide had the strongest association with the probability of a respondent later attempting suicide themselves as a young adult. Respondents were almost twice as likely to attempt suicide as those who did not have a family member who had attempted suicide (OR = 1.96, 95% CI = 1.008, 3.809). However, Child Maltreatment - Emotional neglect maintained its strength of association both the simple analysis controlling for

demographic and psychosocial characteristics and in the full model. This prediction is supported.

Hypothesis 1.4 – ACE type will be positively associated with higher odds of Physical Intimate Partner Violence within the past twelve months in young adulthood.
H_0 – There is no association between ACE type and higher odds of Physical Intimate Partner Violence within the past twelve months in young adulthood.

Table 17a presents the adjusted odds ratios for the simple logistic regression analyses for each of the sixteen (16) ACE types with Physical IPV as the outcome variable. Odds ratios were first adjusted for significant demographic covariates only. The second model adjusts for both significant demographic and psychosocial covariates. Nine (9) of the sixteen ACE types were significantly associated with higher odds of subsequent Physical IPV in young adulthood. These ACE types were put into a final full multiple logistic regression model. **Table 17a.2** presents the final model. Four ACE types were significantly associated with higher odds of subsequent Physical IPV in young adulthood. Having a family member attempt suicide when the respondent was an adolescent increased their odds by 67% of being victimized by physical IPV as a young adult (OR=1.67, 95% CI=1.164, 2.394). Child maltreatment also played a strong role. Respondents who were physically abused were 50% more likely to be victimized by physical IPV compared to their counterparts that were not physically abused (OR=1.50, 95% CI=1.262, 1.788). Respondents who were emotionally neglected were also more likely to be injured by physical intimate partner violence (OR=1.35, 95% CI=1.122,

1.626). Witnessing community violence also had a significant association. Respondents who saw someone get shot had increased odds of later being injured by physical IPV compared to those who did not witness such community violence (OR=1.32, 95% CI=1.091, 1.590). All four variables were significant in this model (p <.01). Due to the significance, the null hypothesis was rejected and the alternate hypothesis, "ACE type will be positively associated with significantly higher odds of Physical Intimate Partner Violence within the past twelve months in young adulthood" was accepted.

P1 – ACEs within the domain of Community Violence will have the strongest association with Physical IPV within the past twelve months in young adulthood.

In the simple logistic regression analyses, four of the nine ACEs that were significant after adjusting for demographic and psychosocial covariates where in the domain of Community Violence. They were: Saw someone get shot or stabbed (OR=1.69, 95% CI=1.420, 2.20), Someone pulled a knife/gun on you (OR=1.38, 95% CI=1.136, 1.676), You were shot/stabbed/jumped (OR=1.37, 95% CI= 1.126, 1.667), and Do not feel safe in neighborhood (OR=1.37, 95% CI=1.083, 1.722). In the final full model, Community Violence – Saw someone get shot retained significance, but it was not the strongest association. Interpersonal Loss – Family member attempted suicide (OR=1.80, 95% CI=1.275, 2.536) and Child Maltreatment (OR=1.74, 95% CI=1.74, 95% CI=1.475, 2.053) remained the strongest associations in the simple logistic regressions and in the final model multiple logistic regression. This prediction is not supported.

Hypothesis 1.5 – ACE type will be positively associated with higher odds of Sexual Intimate Partner Violence within the past twelve months in young adulthood.

H_0 – There is no association between ACE type and higher odds of Sexual Intimate Partner Violence within the past twelve months in young adulthood.

Table 17a presents the adjusted odds ratios for the simple logistic regression analyses for each of the sixteen (16) ACE types with Sexual IPV as the outcome variable. Odds ratios were first adjusted for significant demographic covariates only. The second model adjusts for both significant demographic and psychosocial covariates. Seven (7) of the sixteen ACE types were significantly associated with higher odds of subsequent Sexual IPV in young adulthood. These ACE types were put into a final full multiple logistic regression model. **Table 17a.3** presents the final model. Two ACE types were significantly associated with higher odds of subsequent Sexual IPV in young adulthood. Respondents who endorsed emotional neglect in childhood/adolescence had higher odds of sexual IPV (OR=1.77, 95% CI=1.369, 2.293). Respondents who did not live with both of their biological parents in Wave I of the survey were also more likely to have higher odds of sexual IPV as young adults (OR=1.29, 95% CI=1.006=1.643). Both variables were significant in this model (p <.05). Due to the significance, the null hypothesis was rejected and the alternate hypothesis, "ACE type will be positively associated with significantly higher odds of Sexual Intimate Partner Violence within the past twelve months in young adulthood" was accepted.

P1 – ACEs within the domain of Child Maltreatment will have the strongest positive association with the likelihood of Sexual IPV within the past twelve months in young adulthood.

In the simple logistic regression analysis, all three child maltreatment ACE types had the strongest association with Sexual IPV: Emotional neglect (OR=1.85, 95% CI=1.413, 2.413), Physical abuse (OR=1.65, 95% CI=1.258, 2.163), and Sexual abuse (OR=1.62, 95% CI=1.054, 2.497). Emotional neglect remained significant in the final model and had the strongest association (see Hypothesis 1.5 above). This prediction is supported.

Hypothesis 1.6 – ACE type will be positively associated with higher odds of being Shot/Stabbed within the past twelve months in young adulthood.
H_0 – There is no association between ACE type and higher odds of being Shot/Stabbed within the past twelve months in young adulthood.

Table 17b presents the adjusted odds ratios for the simple logistic regression analyses for each of the sixteen (16) ACE types with Physical Assault - Shot/Stabbed as the outcome variable. Odds ratios were first adjusted for significant demographic covariates only. The second model adjusts for both significant demographic and psychosocial covariates. Seven (7) of the sixteen ACE types were significantly associated with higher odds of subsequent Physical Assault – Shot/Stabbed in young adulthood. These ACE types were put into a final full multiple logistic regression model. **Table 17b.1** presents the final model. Respondents who had a family member attempt suicide in adolescence

had *lower* odds of being shot/stabbed as a young adult compared to their counterparts who did not have a family member attempt suicide (OR=0.381, 95% CI=.179, .811). Respondents who were sexually abused as children or adolescents were over two times more likely to be subsequently shot/stabbed as a young adult compared to those who did not endorse childhood sexual abuse (OR 2.02, 95% CI=1.198, 3.390). Respondents who had a parent die when they were children or adolescents were 87% more likely to be shot/stabbed compared to respondents who did not have a parent die (OR=1.87, 95% CI=1.086, 3.205). Community violence also played a role. Respondents who were shot, stabbed or jumped as adolescents were more likely to be shot or stabbed as young adults compared to their counterparts who were not physically assaulted when they were adolescents (OR=1.78, 95% CI=1.290, 2.446). All four variables were significant in this model (p <.05). Due to the significance, the null hypothesis was rejected and the alternate hypothesis, "ACE type will be positively associated with significantly higher odds of being Shot/Stabbed within the past twelve months in young adulthood" was accepted.

P1 – ACEs within the domain of Community Violence will have the strongest positive association with being Shot/Stabbed within the past twelve months in young adulthood.

In the simple logistic regression analyses, three of the seven ACE types that were significant when controlling for demographic and psychosocial characteristics were in the domain of Community Violence. These were: Saw someone get shot or stabbed (OR=1.75, 95% CI=1.223, 2.517), respondent was Shot/Stabbed/Jumped as an adolescent (OR=1.72, 95% 95% CI=1.219, 2.428), and respondent had a knife or gun pulled on them

(OR=1.43, 95% CI=1.016, 2.008). The strongest ACE type associations with being Shot/Stabbed in young adulthood in the bivariate logistic analyses were Sexual abuse (OR=2.19, 95% CI=1.324, 3.606) and having a parent who died (OR=2.01, 95% CI=1.219, 3.328). In the full model, only Community Violence – being shot/stabbed/jumped in adolescence retained significance, but Child Maltreatment – Sexual abuse and Interpersonal Loss – having a parent die, were the stronger associations. This prediction is not supported.

Hypothesis 1.7 – ACE type will be positively associated with higher odds of being Beaten Up within the past twelve months in young adulthood.

H_0 – There is no association between ACE type and higher odds of being Beaten Up within the past twelve months in young adulthood.

Table 17b presents the adjusted odds ratios for the simple logistic regression analyses for each of the sixteen (16) ACE types with Physical Assault – Beaten Up as the outcome variable. Odds ratios were first adjusted for significant demographic covariates only. The second model adjusts for both significant demographic and psychosocial covariates. Six (6) of the sixteen ACE types were significantly associated with higher odds of subsequent Physical Assault – Beaten Up in young adulthood. These ACE types were put into a final full multiple logistic regression model. **Table 17b.2** presents the final model. Respondents who had easy access to illegal drugs in the home as children or adolescents were over two times more likely to be subsequently beaten up as a young adult compared to those who did not have easy access to illegal drugs in the home (OR 2.18, 95% CI=1.219, 3.893). Child Maltreatment was also strongly associated with

subsequent physical assault in young adulthood. Respondents who were sexually abused as children or adolescences were over twice as likely to be beaten up as young adults as those who were not sexually abused (OR=2.09, 95% CI=1.291, 3.384). Those who were physically abused in childhood or adolescence also had higher odds of being beaten up (OR=1.64, 95% CI=1.030, 2.077). In the domain of Community Violence, respondents who were shot, stabbed or jumped were also more likely to be beaten up as young adults compared to their counterparts who were not physically assaulted as adolescents (OR1.46, 95% CI=1.030, 2.077). All four variables were significant in this model (p <.05). Due to the significance, the null hypothesis was rejected and the alternate hypothesis, "ACE type will be positively associated with significantly higher odds of being Beaten Up within the past twelve months in young adulthood" was accepted.

P1 – ACEs within the domain of Household Dysfunction will have a significant positive association with being Beaten Up within the past twelve months in young adulthood.

In the simple logistic regression analyses, only one of the six ACE types that were significant when controlling for demographic and psychosocial characteristics were in the domain of household dysfunction. This ACE type was Easy Access to Illegal Drugs in the Home (OR=2.11, 95% CI=1.193-3.757). The strongest association in the bivariate logistic analysis was Sexual abuse (OR=2.47, 95% CI=1.514, 4.031). However, in the final full model, Household Dysfunction – Easy access to illegal drugs in the home did have the strongest association with being beaten up in young adulthood. This prediction is supported.

Figure 15 illustrates the prevalence of significant ACE types for all seven injury outcomes in both the simple logistic regression analyses and in the full model multiple logistic regression analyses. For example, in the full model analyses, Child Maltreatment – Emotional Neglect was significant in five out of the seven injury outcomes (all except Shot/Stabbed and Beaten Up) and Physical Abuse was significant in four of the seven injury outcomes (Serious Injury, Motor Vehicle Accident, Physical IPV, Beaten Up). In response to Research Question One, these analyses, the associated tables and graphs have demonstrated that there is a statistically significant positive association between certain types of Adverse Childhood Experiences (ACE type) and increased odds in the occurrence of injury years later in young adulthood.

Research Question Two: Is there a frequency response relationship between the number of ACEs (ACE score) and injury in young adulthood?

Hypothesis 2.1 – Participants who experience more ACEs will have significantly higher odds of Unintentional Injury - Serious Injury within the past 12 months compared to participants with no ACEs.

H_0 – There is no association between ACE Score and higher odds of Unintentional Injury – Serious Injury within the past twelve months in young adulthood.

Table 18 presents the results of the logistic regression analyses. ACE Score (0 ACEs - ≥ 6 ACEs) was entered into the model as a continuous variable. Serious Injury was the outcome variable. The first analysis controlled for significant demographic

characteristics only. The second analysis controlled for significant demographic and psychosocial characteristics. With all covariates controlled, respondents were more likely to experience a serious injury as their number of ACEs or ACE Score increased (OR per additional ACE=1.16, 95% CI=1.098, 1.230). **Figure 16** illustrates the frequency response relationship between ACE Score and Serious Injury. Respondents with ≥ 6 ACEs had an adjusted odds ratio of 2.44 compared to respondents with one ACEs, who had an adjusted odds ratio of 1.16 ($p \leq .001$). Due to the significance, the null hypothesis was rejected and the alternate hypothesis, "Participants who experience more ACEs will have significantly higher odds of Unintentional Injury - Serious Injury within the past 12 months compared to participants with no ACEs" was accepted.

Hypothesis 2.2 – Participants who experience more ACEs will have significantly higher odds of Motor Vehicle Accidents within the past 12 months compared to participants with no ACEs.

H_0 – There is no association between ACE Score and higher odds of Motor Vehicle Accident within the past twelve months in young adulthood.

Table 18 presents the results of the logistic regression analyses. ACE Score (0 ACEs - ≥ 6 ACEs) was entered into the model as a continuous variable. Motor Vehicle Accident was the outcome variable. The first analysis controlled for significant demographic characteristics only. The second analysis controlled for significant demographic and psychosocial characteristics. With all covariates controlled, respondents were slightly more likely to experience a motor vehicle accident as their number of ACEs or ACE

Score increased (OR per additional ACE=1.09, 95% CI=1.030, 1.161). **Figure 17** illustrates the frequency response relationship between ACE Score and Motor Vehicle Accident. Respondents with ≥ 6 ACEs had an adjusted odds ratio of 1.68 compared to respondents with one ACE, who had an adjusted odds ratio of 1.09 ($p \leq .01$). Due to the significance, the null hypothesis was rejected and the alternate hypothesis, "Participants who experience more ACEs will have significantly higher odds of Motor Vehicle Accidents within the past 12 months compared to participants with no ACEs" was accepted.

Hypothesis 2.3 – Participants who experience more ACEs will have significantly higher odds of Suicide Attempt within the past 12 months compared to participants with no ACEs.

H_0 – There is no association between ACE Score and higher odds of Suicide Attempt within the past twelve months in young adulthood.

Table 18 presents the results of the logistic regression analyses. ACE Score (0 ACEs - ≥ 6 ACEs) was entered into the model as a continuous variable. Suicide Attempt was the outcome variable. The first analysis controlled for significant demographic characteristics only. In this analysis, ACE Score was associated with increased odds for Suicide Attempt (OR=1.19, 95% CI=1.036, 1.370) However, in the second analysis controlling for significant demographic and psychosocial characteristics, there was no significant association between ACE Score and Suicide attempt. Due to the lack of significance, the null hypothesis was "*There is no association between ACE Score and*

higher odds of Suicide Attempt within the past twelve months in young adulthood." was accepted.

Hypothesis 2.4 – Participants who experience more ACEs will have significantly higher odds of Physical Intimate Partner Violence within the past 12 months compared to participants with no ACEs.

H_0 – There is no association between ACE Score and higher odds of Physical Intimate Partner Violence within the past twelve months in young adulthood.

Table 18 presents the results of the logistic regression analyses. ACE Score (0 ACEs - ≥ 6 ACEs) was entered into the model as a continuous variable. Physical Intimate Partner Violence was the outcome variable. The first analysis controlled for significant demographic characteristics only. The second analysis controlled for significant demographic and psychosocial characteristics. With all covariates controlled, respondents were more likely to experience injury from physical intimate partner violence as their ACE Score increased (OR per additional ACE=1.13, 95% CI=1.030, 1.161). **Figure 18** illustrates the frequency response relationship between ACE Score and Physical Intimate Partner Violence. Respondents with ≥ 6 ACEs had an adjusted odds ratio of 2.08 compared to respondents with one ACE who had an adjusted odds ratio of 1.13 ($p \leq .001$). Due to the significance, the null hypothesis was rejected and the alternate hypothesis, "Participants who experience more ACEs will have significantly higher odds of Physical Intimate Partner Violence within the past 12 months compared to participants with no ACEs" was accepted.

Hypothesis 2.5 – Participants who experience more ACEs will have significantly higher odds of Sexual Intimate Partner Violence within the past 12 months compared to participants with no ACEs.

H_0 – There is no association between ACE Score and higher odds of Sexual Intimate Partner Violence within the past twelve months in young adulthood.

Table 18 presents the results of the logistic regression analyses. ACE Score (0 ACEs - ≥ 6 ACEs) was entered into the model as a continuous variable. Sexual Intimate Partner Violence was the outcome variable. The first analysis controlled for significant demographic characteristics only. The second analysis controlled for significant demographic and psychosocial characteristics. With all covariates controlled, respondents were more likely to experience sexual IPV as their ACE Score increased (OR per additional ACE=1.22, 95% CI=1.142, 1.297). **Figure 19** illustrates the frequency response relationship between ACE Score and Sexual IPV. Respondents with ≥ 6 ACEs were over three times more likely to be involved in sexual IPV compared with respondents who only had one ACE (Adjusted OR= 3.30 vs. Adjusted OR=1.22, $p \leq .001$). Due to the significance, the null hypothesis was rejected and the alternate hypothesis, "Participants who experience more ACEs will have significantly higher odds of Sexual Intimate Partner Violence within the past 12 months compared to participants with no ACEs" was accepted.

Hypothesis 2.6 – Participants who experience more ACEs will have significantly higher odds of being Shot/Stabbed within the past 12 months compared to participants with no ACEs.

H_0 – There is no association between ACE Score and higher odds of being Shot/Stabbed within the past twelve months in young adulthood.

Table 18 presents the results of the logistic regression analyses. ACE Score (0 ACEs - ≥ 6 ACEs) was entered into the model as a continuous variable. Physical Assault – Shot/Stabbed was the outcome variable. The first analysis controlled for significant demographic characteristics only. The second analysis controlled for significant demographic and psychosocial characteristics. With all covariates controlled, respondents were more likely to experience being Shot/Stabbed as their ACE Score increased (OR per additional ACE=1.16, 95% CI=1.079, 1.256). **Figure 20** illustrates the frequency response relationship between ACE Score and being Shot/Stabbed. Respondents with ≥ 6 ACEs had an adjusted OR of 2.44 compared to respondents with an ACE score of one (OR=1.22). Due to the significance ($p \leq .001$), the null hypothesis was rejected and the alternate hypothesis, "Participants who experience more ACEs will have significantly higher odds of being Shot/Stabbed within the past 12 months compared to participants with no ACEs" was accepted.

Hypothesis 2.7 - Participants who experience more ACEs will have significantly higher odds of being Beaten Up within the past 12 months compared to participants with no ACEs.

H_0 – There is no association between ACE Score and higher odds of being Beaten Up within the past twelve months in young adulthood.

Table 18 presents the results of the logistic regression analyses. ACE Score (0 ACEs - ≥ 6 ACEs) was entered into the model as a continuous variable. Physical Assault – Beaten Up was the outcome variable. The first analysis controlled for significant demographic characteristics only. The second analysis controlled for significant demographic and psychosocial characteristics. With all covariates controlled, respondents were more likely to experience being Beaten Up as their ACE Score increased (OR per additional ACE=1.25, 95% CI=1.136, 1.377). **Figure 21** illustrates the frequency response relationship between ACE Score and being Beaten Up. Respondents with ≥ 6 ACEs were over three times more likely to be beaten up than respondents with only one ACE (adjusted OR=3.81 vs. adjusted OR=1.25). Due to the significance ($p \leq .001$), the null hypothesis was rejected and the alternate hypothesis, "Participants who experience more ACEs will have significantly higher odds of being Beaten Up within the past 12 months compared to participants with no ACEs" was accepted.

Predictions for all Hypotheses for Research Question 2

P1 – For all injury outcomes, ACE score will have a significant independent effect in the logistic regression models after controlling for demographic and psychosocial characteristics. This prediction was supported in the analyses for all injury outcomes with the exception of the injury outcome - Suicide Attempt.

P2 – For all injury outcomes, participants with ≥6 ACEs will have significantly greater odds of incurring an injury than participants with no ACEs. This prediction was supported in the analyses for all injury outcomes with the exception of the injury outcome – Suicide Attempt.

In response to Research Question Two, these analyses, the associated tables and graphs have demonstrated that there is a statistically significant frequency response relationship between the number of ACEs (ACE score) and injury in young adulthood for six of the seven injury outcomes tested (Serious Injury, Motor Vehicle Accident, Physical Intimate Partner Violence, Sexual Intimate Partner Violence, being Shot/Stabbed, and being Beaten Up). There was no statistically significant frequency response relationship between ACE score and Suicide Attempt after controlling for demographic and psychosocial characteristics. This means that for each additional ACE experienced by a respondent in childhood/adolescence, her/his odds of having one of these injuries also increases as a young adult.

Summary

The results of the data analyses using a nationally representative study sample demonstrate that Adverse Childhood Experiences (ACEs) are associated with subsequent injury in young adulthood. The two study questions and 13 of the 14 of the hypotheses that were tested demonstrated significance and supported the research questions concerning the association between ACE type and the occurrence of injury and the

frequency response relationship between ACE score and injury. Logistic regression analyses using complex samples demonstrated that the statistically significant differences found were beyond the chance of using a large sample size. A further discussion of the findings, comparison with other ACE-related studies, and recommendations for future research will be discussed in chapter 5.

CHAPTER 5

DISCUSSION

Introduction

Injuries are the leading cause of death and disability among young adults in the United States. A large body of research on adverse childhood experiences suggests that there is a strong relationship between early childhood experiences and poor health outcomes later in life. The objective of this study was to examine the association between adverse childhood experiences (ACEs) in the context of family and community and the likelihood of increased odds of subsequent unintentional and intentional, nonfatal injury in young adulthood. This study contributes to the literature in several ways. First, to our knowledge, this is the first study to examine the relationship between a wide range of ACEs and unintentional and intentional injuries. Second, there are no known studies that have examined the relationship between ACEs and unintentional serious injuries, motor vehicle accidents, physical assault (beaten up) or aggravated assault (shot/stabbed). This research is also the first known study to examine the effects of ACEs separately for physical intimate partner violence and sexual intimate partner violence. Third, it uses a nationally representative sample of respondents that was longitudinally followed from adolescence to young adulthood. Finally, it consists of a large, diverse sample of young adults that provided an opportunity to examine any unique associations of ACEs and injury within this age group that may be masked in other studies. In addition to ACEs, several important demographic and psychosocial factors were also examined to control for the sources of confounding and to ensure the internal validity of the associations between ACEs and injury in young adulthood. In this chapter, I will discuss key

findings, directions for future research, and implications for public policy and interventions.

Key Findings

Adverse Childhood Experiences (ACEs)

Over one third (37.6%) of young adults sustained at least one of the seven injury outcomes in the past 12 months of the study period (Wave IV). Further, this study found an association between adverse childhood experiences and unintentional and intentional injury in young adulthood. These results lend support to the Life Course Health Development Model which posits that stressful experiences that occur during critical times of growth and development can change the health trajectories of individuals and populations over time. The mechanisms for how ACEs are associated with injuries much later in young adulthood were not measured in this study and remain unclear. Many scholars hypothesize that early life events alter brain functioning resulting in "stress-induced remodeling of neuronal structure and connectivity [that] alters behavioral and physiological responses, including anxiety, aggression, mental flexibility, memory, and other cognitive processes." (Shonkoff, J., et al., 2009). Children and adolescents who are chronically exposed to fear, particularly from their own caregivers, may develop states of hyper-arousal, dissociation, or even a sense of victimization that may make them vulnerable to injury (Van der Kolk, 2005).

ACE Type and Injury

In this study, 93.4% of all respondents had been exposed to at least one ACE with a mean score of almost three ACEs per respondent. This indicates that exposure to adverse childhood experiences are the norm rather than the exception for young adults in the United States. The overall prevalence of ACEs in this study is higher than that found in most of the ACE literature. This may be due to the inclusion of two ACE types, 'Any parent smoked' and 'Does not live with both biological parents.'

Over 72% of respondents had a parent who smoked. Initially, we did not anticipate that respondents would be exposed to such high rates of parental smoking (biological and/or residential parents). In the logistic regression analyses parental smoking was not a significant factor for any of the injury outcomes when adjusting for both demographic and psychosocial characteristics. Parental smoking is either not a significant adverse childhood experience or it was not an adequate proxy variable for measuring unobservable variables for household dysfunction (e.g., parental stress, parental mental health, domestic conflict, etc.). Half of the respondents (50%) did not live with both of their biological parents. Several epidemiological studies have shown small but significant differences in adjustment and well-being between children who live with both biological parents compared with those who do not. This includes measures of conduct problems, poor psychological adjustment, self-concept and social relations that carry into adulthood (Amato, 2001; Storksen, et al., 2006). Consistent with this literature, respondents who did not live with both biological parents had higher odds of physical and sexual IPV.

Nearly half (48.2%) of respondents endorsed emotional neglect. This study took a broad perspective of emotional neglect by including even one instance since it was not possible to determine the severity of the neglect or the impact of the adversity on the respondent. Therefore, the prevalence of this variable is much higher than in most ACE studies. For example, the CDC reports a prevalence rate for emotional neglect from the ACE Study of 14.8% (CDC Injury Prevention and Control: Division of Violence Prevention, 2014). Emotional neglect was a significant ACE type in five of the seven injury outcomes after controlling for demographic and psychosocial characteristics. It retained its significance when other ACE types were added into the regression model. Only being shot/stabbed and beaten up were not associated with emotional neglect.

The prevalence of physical abuse (18.9%) and sexual abuse (5.5%) was lower among the participants in this study than has been reported in other ACE studies. For example, the CDC ACE study reports a prevalence for physical abuse of 28.3% and a prevalence for sexual abuse of 20.7% (CDC Injury Prevention and Control, 2014). A review of the literature indicated that while the sexual abuse rates were quite low in this study, they are more in line with other community-based studies that have been conducted. Townsend (2013) reviewed U.S. studies that collected sexual abuse prevalence rates since 1992. Of the 16 studies identified, the author concluded that the overall childhood sexual abuse prevalence rate for both males and females was between 7.5% and 11.7%. This may be another indication that the ACE study, although large in terms of participants, is not representative since those participants derive from one health

maintenance organization in San Diego. Another possibility for the lower rates in this study is that young adults are not a willing to disclose physical and sexual abuse as older adults.

When all significant ACE types were included in the multiple regression model for each injury outcome, the relationships between the ACE types and injury were attenuated and some ACE types became non-significant in the model. This result suggests some overlap or perhaps a synergistic effect that cannot be identified through logistic regression analysis. The fact that individual ACE types were attenuated does not mean that they are not important. As discussed earlier, all of the psychosocial characteristics that were controlled in the model have also been shown to be outcomes of ACEs. It is possible that these variables partially or fully mediate the effects of ACEs on the injury outcomes. This finding will need to be explored in future research.

In examining the odds ratios in the simple logistic regression models, the category of child maltreatment tended to have stronger influences than other types of adverse childhood experiences for unintentional injuries. For intentional injuries, ACE types in the category of Interpersonal Loss tended to have a stronger influence. Particularly, respondents who had a family member who attempted suicide were almost twice as likely to attempt suicide themselves as a young adult, to be victimized by physical IPV, and were over twice as likely to be shot/stabbed. ACE types in the categories of Child Maltreatment and Community Violence also had odds ratios of comparable magnitudes. Overall, in the bivariate logistic regression analyses, 14 of the 16 ACE types were

significant in at least one of the injury outcomes. Physical abuse was significant in six of the seven injury outcomes. Sexual abuse and being shot/stabbed/jumped as an adolescent was significant in five of the seven injury outcomes. In the multiple logistic regression analyses where all of the significant ACE types were entered into the model together for each injury outcome, seven of the ACE types retained their significance. Emotional neglect remained significant for five of the seven injury outcomes. Physical abuse remained significant for four of the seven injury outcomes. The only ACE type not associated with any injury outcome was 'any sibling died.' This was surprising since the death of a sibling can cause feelings of grief, anxiety and vulnerability, survivor's guilt, and fear of intimacy (Fletcher, et al., 2013). Only 2% of the sample reported a sibling death, we may have been unable to capture any associations due to a small sample size.

ACE Score and Injury

An increased risk of injury was observed with each adverse childhood experience reported (ACE Score). This finding suggests that it is the accumulation of adverse childhood experiences that may be most harmful to young adult health. These results are also consistent with findings from the ACE study literature which has found a graded relationship between ACEs and the leading causes of death in adults (Anda, et al., 2009; Brown, et al., 2009; Felitti, et al., 1998).

The only injury outcome that was not found to be significant for ACE Score was Suicide Attempt. This was a highly unusual finding since much of the ACE literature had found a significant association between ACE score and suicide attempt. There may be a

couple of explanations for this. First, many of the ACE studies in the literature only controlled for demographic characteristics such as age, gender, race, and educational attainment (see Bruffaerts, et al., 2010; Dube, et al, 2001), whereas this study controlled for several psychosocial characteristics. We took the more conservative approach to control for these factors in this study. It is possible that the psychosocial characteristics used in this study suppressed the relationship between ACEs and injury. Second, most ACE studies measure *ever* attempted suicide or lifetime number of suicide attempts. This study measured suicide attempt in the past twelve months. It is possible that the sample size of suicides in a 12 month period was too small to detect a positive association with ACE score compared to lifetime suicide attempts.

ACE Score had the strongest influence on being Beaten Up. Respondents with ≥ 6 ACEs had an OR=3.81 compared to respondents with zero ACEs. ACE score had the weakest influence on Motor Vehicle Accidents. Respondents with ≥ 6 ACEs were 68% more likely to be involved in a MVA in the past year compared to respondents with zero ACEs. This outcome is another where the results may be attenuated by the limitation on the timeframe of the past twelve months instead of lifetime MVAs which may have increased the odds.

Populations of Interest – Gender and Racial/Ethnic Disparities

Gender

Young adult males had higher prevalence rates for all injury categories than females with the exception of Suicide Attempt. Males were more than two times more likely to have had a serious injury in the past twelve months than females. A surprising finding in this study was that more males endorsed being victimized by physical intimate partner violence than females. A number of studies using population-based surveys have shown that young adult males are, in fact, more likely to be victimized by certain types of physical intimate partner violence (e.g, slapped, kicked, bit, punched, hit with an object) (Archer, 2002; Fergusson, et al., 2005; Dutton, D., 2012) and that overall rates of domestic violence perpetration and victimization are similar between males and females (Fegusson, et al., 2005). Men are more likely to engage in more severe and chronic forms of physical intimate partner violence (Archer, 2002). There does not appear to be any clear pattern in the relationship between males, the prevalence of ACEs, and IPV victimization. This may indicate interactions between ACEs and IPV perpetration and victimization based on gender. More research needs to be conducted to determine this. The results of this study, however, clearly indicate that injury from physical intimate partner violence is a problem for both males and females.

Race/Ethnicity

Many ACE studies are not large enough to include American Indian/Alaskan Native populations. The Add Health study does allow for the inclusion of AI/ANs in the study. Although, the standard errors are large, which indicates that the results may not be representative of the population, most of the findings from this study are consistent with the literature for AI/AN populations and other national data such as the Youth Risk Behavior Surveillance System (YRBSS) (Urban Indian Health Institute, 2009, Chino & Fullerton-Gleason, 2006; Park, et al., 2006). American-Indian/Alaskan Natives reported some of the highest prevalence rates for the majority of the ACE types. American Indian/Alaskan Native participants reported the highest prevalence rates in all categories for child maltreatment. In the category of Household Dysfunction, they reported the highest prevalence of access to illegal drugs in the home and having a family member attempt suicide. AI/ANs had the highest prevalence for having a friend attempt suicide and any parent incarcerated. The mean ACE Score for AI/AN males was 3.80 compared to 2.68 for White males. The mean ACE score for AI/AN females was 3.55 compared to 2.85 for White females. American Indian/Alaskan Natives also reported the highest injury rates for five of the seven injury categories: Serious Injury, Motor Vehicle Accident, Suicide Attempt, being Shot/Stabbed, and Beaten Up. The results of this study provide further evidence of a population in crisis from a public health perspective. Tribal leaders and Native public health scholars have urged that more and better public health violence prevention models are needed. These interventions must be culturally appropriate and account for the historical and political context in which American Indians/Alaskan Natives live (DeBruyn, et al., 2001).

African-Americans had the lowest rates of suicide attempt and the second lowest rate of unintentional serious injury. However, African-American participants had the highest rates of not living with both biological parents, experiencing the death of a parent or a sibling, and having witnessed community violence (seeing someone get shot). Almost 25% of African-Americans in the sample endorsed being victimized by physical IPV. This group also had the second highest rate of MVAs, being shot/stabbed and being beaten up. These results are consistent with national data. During the time that this survey was taken in 1995 violent victimization was very high in African-American communities. According a recent CDC health disparities and inequality report, although the rates have been steadily decreasing, in 2009 the homicide rate for non-Hispanic African-Americans was still 650% higher than the rate for non-Hispanic Whites (Meyer, et al., 2013). During this study, high profile cases of homicides against unarmed, young African-American males by police sparked nationwide protests and the moniker #blacklivesmatter. As this study and other ACE research has shown, community violence and witnessing community violence are adverse childhood experiences for children and adolescents that have long term health consequences.

The results of this study demonstrate a significant disparity for American-Indian and African-American children and adolescents in their exposures to adverse childhood experiences. These exposures are associated with higher rates of preventable unintentional and intentional injuries. Contextual factors that may be related to exposure to ACEs among these populations include experiences of historical trauma, oppression,

institutional discrimination, underemployment, and disparate rates of poverty and educational opportunities (DeBruyn, et al., 2001).

Directions for Future Research

Examine the relative impact of ACEs on subsequent injury outcomes

More research needs to be conducted on the how the acuity/severity or the chronicity of ACEs effect injury outcomes rather than if they just occurred or not. More work is needed to understand the mechanisms and regulatory processes (e.g., neuropathways, immuno-regulation, epigenetic) for how ACEs impact subsequent injuries. Studies should also examine the effect of age at which the ACE exposure occurred to determine the differential effect between childhood and adolescent exposures. Researchers also need to weigh ACE types from the perspective of the participant. For example, some participants who experienced being shot/stabbed may weigh that ACE as more traumatic than being physically abused by a caregiver.

Research ACEs and Injury outcomes in indigenous and minority populations to reduce health disparities

In 2013, young adult American Indian/Alaskan Natives had the highest mortality rates from unintentional injuries at 52.42 per 100,000 and African-Americans have the highest mortality rates for intentional injury 52.33 per 100,000 (CDC WISQARS, 2013) More empirical research is needed to gain a better understanding of the prevalence and

associations of ACEs and injuries among Native American/Alaskan Native populations. Research needs to be conducted with minority and immigrant populations in the U.S. to determine if there are unique types of ACEs such as systemic discrimination, interpersonal racism, historical trauma, experiences with war, conscription, or other forms of severe trauma (Anda, et al., 2010; Sotero, 2006), or if there are response variations dependent on resource availability, resiliency, protective, or cultural factors that have bearing on the relationship between ACEs and injury.

Examine other injuries and psychosocial characteristics in association with ACEs

More injuries need to be studied, such as occupational injuries, sport injuries, and combat injuries. Future research on ACEs should also examine if psychosocial characteristics partially or fully mediate the effect on health outcomes using longitudinal data and structured equation modeling which may also suggest causality between ACEs and injury (Pearl, 2012). Finally, more research needs to be done on resiliency and protective factors that may mitigate the effects of ACEs on poor health outcomes. Some studies suggest a U-shaped relationship between lifetime adversity exposure and mental health and well-being such that individuals who experience high exposures to ACEs develop a "toughness" that results in psychological and physiological resilience to manage stressful situations throughout life (Seery, 2011). Other studies have concluded that genetics, higher IQ, guidance and supervision by parents, higher functioning families, other adults in the household and higher educational aspirations contributed resiliency from the negative effects of ACEs (Beaver, et al, 2010; Tiet, et al., 1998).

Prospective research to determine if reducing ACEs affect health outcomes

There has been no prospective, longitudinal research to determine if reducing exposure to specific types of adverse childhood experiences or the cumulative effects (ACE Score) improves health outcomes. Studies can also examine how the timing of interventions in the life course effect health outcomes. Empirical studies can also be conducted in adult populations to determine how screening for ACEs in medical settings might impact health status compared to individuals who are not screened.

Implications for Public Health Policy and Interventions

Integrate trauma informed screening into health assessments

Although the original ACE study was published in 1998, there has been very little integration of this research into clinical and public health practice in the last seventeen years. This may be due to under-recognition of trauma by providers, a feeling that there is nothing that can be done once the trauma has occurred or that the provider is unprepared to deal with any potential emotional consequences of talking about ACEs with patients/clients. Inquiring about ACEs with children and adolescents is even more complicated due to mandatory reporting requirements. This is particularly true when providers are working with cultural and language barriers. The original study authors have developed a ten item checklist that can be used by practitioners to determine an individual's ACE Score, available at http://www.acestudy.org/ace_score. Routine screening for ACEs can be done in primary care settings, mental health settings, Indian

Health Services, social service settings, juvenile justice intake settings, correctional facilities, or anywhere where health and human services are provided. Awareness of ACEs by both patients and providers may be a positive step towards improving health status. Screening also provides better public health surveillance of the prevalence of ACEs in relation to adult health outcomes.

Evidence-based, culturally competent interventions to reduce the prevalence of ACEs among children and adolescents

Primary prevention of ACEs is the ideal solution to prevent child maltreatment, family dysfunction and community violence. Child maltreatment rates have continued to decrease since the 1998 (ChildStats.gov, 2013). Interventions aimed at violence prevention for child maltreatment and community violence need to be based on the best research available and require the integration of deep structure culture competency to be effective for specific cultural groups. Community-based, participatory and non-punitive solutions that help parents build skills and keep families together need to be explored. For example, more funding and support needs to go towards expansion of the Nurse Family Partnership. This is a two year program where public health nurses are matched with first-time low-income mothers for two years beginning at the birth of their child. Results from a randomized controlled trial showed that child maltreatment among by 48% at a 15 year follow-up (CDC Injury Prevention and Control, 2015).

Conclusions

To date, injury prevention efforts have been primarily focused on proximal causes of injury, i.e., those risk factors immediately preceding the injury. This study provides results that suggest that adverse childhood experiences have long term effects on subsequent nonfatal injuries in young adulthood. The recognition that early childhood/adolescent experiences are associated with injury in young adulthood provides new opportunities for intervention over the life course. The importance of this work should not be underestimated. Every missed opportunity may result in a nonfatal injury becoming an injury mortality. In this study alone, there were 107 participants who died between Wave I and Wave IV as a result of accidents, intentional self-harm, and assault. These individuals were lost forever. More young adult participants from the Add Health study may have lost their lives to preventable injuries since Wave IV ended in 2008. The Life Course Health Development Model is well suited as an interdisciplinary paradigm describing pathways and mechanisms that connect health trajectories in long time horizons between exposures and outcomes that provide the constructs to assist public health researchers and practitioners find ways to reduce injury mortality and morbidity among young adults.

Assumptions and Limitations

The Add Health Study uses a self-report questionnaire. Child maltreatment questions were asked retrospectively. It is assumed that respondents will understand and recall the answers accurately. The survey instrument and its components were extensively

pilot tested by the Add Health research team. An event history calendar was used to assist recall and audio computer-assisted self-interview (CASI) was used for more sensitive questions (Udry, 2001). Another assumption is that exposure to an adverse event resulted in some level of stress, distress or trauma, although the Add Health survey does not measure this directly. However, a large body of research has shown that ACEs are a latent variable that represents some level of traumatic stress with a profound and varied effect on health outcomes (Felitti, et al., 1998; Finkelhor, et al, 2013; Van der Kolk, 2005).

Questions in the Add Health survey did not provide a way to measure actual injury. Some of the measures only report the *potential* for injury, e.g., involvement in a motor vehicle accident or suicide attempt. However, it is common in social/behavioral health research to examine categories of injury intent rather than the actual injury incurred.

There are no standardized self-report measures of ACEs in the literature. For example, the National Child Traumatic Stress Network (NCTSN, n.d.) website has a database that lists forty (40) assessments designed to measure exposure to childhood trauma and adverse experiences. The self-report measures used in the Add Health study may not be comparable across studies. Several measures required subjective judgments and respondents may have had varying perceptions about what constitutes child maltreatment and whether or not they were victims of it. Studies have shown that approximately one-third of adult with substantiated cases of severe child maltreatment

denied being abused (Goldsmith, et al., 2009). This phenomenon is likely to bias results towards the null.

The Add Health study only surveyed adolescents who were in school at the time of Wave I. Although the results of the present study can be generalized to all 7th through 12th graders in the United States, the results of this study cannot be generalized to out-of-school adolescents who may have been more likely to experience adverse events in their lives and/or are more likely to engage in risk behaviors than in-school adolescents.

A clear advantage of longitudinal studies is the ability to use repeated measures to examine within subject variability as well as between subject variability. In other words, longitudinal studies can examine systematic change over time. Several statistical methods have been developed to analyze longitudinal data, the most popular being survival analysis and individual growth models. An important feature of longitudinal research is that the outcome of interest be measured at least three times to detect any trends or patterns in the data. Two measures would only indicate a straight line and not a trend (Singer & Willett, 2003). For this study, the outcome of interest, injuries, was only measured twice in young adulthood. Further, some questions were only measured in Wave III and some only in Wave IV. Many of the predictor variables were also measured retrospectively in Wave III or Wave IV. Due to these limitations of the Add Health data set, it is difficult to justify that the data used in this study is truly longitudinal. The main focus of this study is to examine if predictors that occur at one point in time are associated with outcomes at another point in time. Another focus of the study was to

understand gender and racial/ethnic disparities that exist in the prevalence of ACEs. Examining participant level changes in injury over time was not the main focus. Therefore, a delimitation of this study is that only injury variables from Wave IV were used. Statistical analyses were chosen that are not predicated on the use of repeated measures data.

APPENDIX A
LIST OF TABLES

Table 1. 2012 Nonfatal Injury Rates per 100,000 – Young Adults 24-32 Years

Cause of Injury	All Races	White (Non-Hispanic	Black (Non-Hispanic)	Hispanic	Males	Females
All Causes	12,435	12,093	11,117	7,343	13,756	11,060
Unintentional (All)	10,854	10,944	8,964	5,945	11,939	9,731
Motor Vehicle Collisions	1,506	1,246	1,803	955	1,310	1,710
Violence Related (All)	1,581	1,150	2,153	1,397	1,817	1,338
Physical Assault	1,186	764	1,800	1,156	1,451	911
Self Harm	276	303	150	151	235	318
Sexual Assault	45.8	43.61	57.49	16.47	5.0	88.0

Source: CDC - Web-based Injury Statistics Query and Reporting System (WISQARS) [Online]. (2003). National Center for Injury Prevention and Control, Centers for Disease Control and Prevention (producer). Available from: URL: www.cdc.gov/ncipc/wisqars Accessed 8/20/14

Table 2. Add Health Survey Sample Sizes and Sample Weights

Interview Year	Sample Size	Weighted Sample Size	Sample Description	Target Population	Weighting Description
Wave I (1994)	90,118	83,135	In-School Survey. Adolescents chosen with a known probability of being selected from 1994-1995 enrollment rosters of US schools	Grade 7-12 in 1994-1995	Cross-sectional weights
Wave I (1995)	20,745	18,924	In-home survey. Core sample derived by stratifying students in each school by grade and sex and then randomly choosing 17 students from each stratum to yield about 200 from each pair of schools. The core in-home sample is self-weighting and provides a nationally representative sample of 12,105 adolescents in grades 7-12. However, the rest of the sample were based on ethnicity, genetic relatedness to siblings, oversample of Black adolescents with highly educated parents, students with a disability and other factors.	Grade 7-12 in 1994-1995	Cross-sectional weights
Wave I (1995)	17,670	N/A	The mother (or other female head of the household) of the originally sampled adolescent was surveyed in a 40-minute, interviewer-administered, paper-and-pencil survey regarding health status and behaviors	Parent (mother) of Wave I In-Home survey participants	N/A

Interview Year	Sample Size	Weighted Sample Size	Sample Description	Target Population	Weighting Description
			of the adolescent, home environment, and interpersonal relationships.		
Wave II (1996)	14,738	13,568	Adolescents interviewed at Wave II. 13,568 of these adolescents were also interviewed at Wave I	Grade 7-11 in 1994-1995	Cross-sectional weights
Wave III (2001)	15,197	14,322	Wave I respondents who were interviewed at Wave III	Grade 7-12 in 1994-1995	Cross-sectional weights
Wave III (2001)	15,197	10,828	Eligible Wave I respondents interviewed at both Wave II and Wave III	Grade 7-11 in 1994-1995	Longitudinal weights
Wave IV (2008)	15,701	14,800	Wave I respondents who were interviewed at Wave IV	Grade 7-12 in 1994-1995	Cross-sectional weights
Wave IV (2008)	15,701	9,421	Eligible Wave I respondents interviewed at Wave II, III and IV	Grade 7-11 in 1994-1995	Longitudinal weight

Table 3. Add Health Survey Content

WAVES I, II	WAVE III	WAVE IV
Demographic	Demographic	Demographic
Family, siblings, friends	Family, siblings, friends	Family, siblings, friends
Education, work	Education, work	Education, work
Physical and mental health	Physical and mental health	Physical and mental health
Daily activities and sleep	Daily activities and sleep	Daily activities and sleep
Relationships	Relationships	Relationships
Sexual and fertility	Sexual and fertility	Sexual and fertility
Substance use	Substance use	Substance use
Delinquency and violence	Involvement with the criminal justice system	Involvement with the criminal justice system
Attitudes, religion	Attitudes, religion	Work attitudes and characteristics, religion
Economics, expectations	Economics, expectations	Economics, expectations
Psychological, personality	Psychological, personality	Personality, stressors
	Children and parenting	Children and parenting
	Civic participation	Civic participation
	Gambling	Cognitive function
	Mentoring	Psychosocial factors

Source: Harris, K. (2013). *The Add Health Study: Design and Accomplishments.* Accessed 8/7/14 at http://www.cpc.unc.edu/projects/addhealth/data/guides/index.html

Table 4. Outcome Variable – Injury (WAVE IV)		
Outcome Variable	**Survey Question**	**Variable Definition**
Unintentional Injury		
Unintentional Serious Injury	During the past 12 months, have you suffered any serious injuries? For example, broken bones, cuts or lacerations, burns, torn muscles, tendons or ligaments, or other injuries that interfered with your ability to perform daily tasks?	Coded 0 for "no" Coded 1 for "yes"
Motor Vehicle Collision	During the past 12 months, were you involved in a motor vehicle accident?	Coded 0 for "no" Coded 1 for "yes"
Intentional Injury		
Suicide Attempt	During the past 12 months, how many times have you actually attempted suicide?	Coded 0 for "no" Coded 1 for "yes"
Physical Intimate Partner Violence	In the past 12 months -- "How often has <partner> threatened you with violence, pushed, shoved or thrown something that could hurt?", "How often has <partner> slapped, hit, or kicked you?", "Have you had an injury, such as a sprain, bruise, or cut because of a fight with <partner>?"	Coded 0 for "no" Coded 1 for "yes"
Sexual Intimate Partner Violence	During the past 12 months, {initials} (insisted/insist) on or (made/make) you have sexual relations with (him/her) when you didn't want to?	Code 0 if "no" Code 1 if "yes"
Shot or Stabbed	Past 12 months, has any of the following things happened: Someone shot or stabbed you?	Code 0 if "no" Code 1 if "yes"
Beaten Up	Past 12 months, has any of the following things happened: You were beaten up?	Code 0 if "no" Code 1 if "yes"

Table 5. Independent Variables - ACEs			
ACE Category	**Type of ACE (Wave Question was asked)**	**Type of Variable**	**Outcome**
ACE SCORE	Number of Adverse Childhood Experiences	Count Modified	0-16 0 - ≥ 6
Child Maltreatment	1. Physical Abuse (WIV)	Binary	0 (no), 1 (yes)
	2. Sexual Abuse (WIV)	Binary	0 (no), 1 (yes)
	3. Emotional Neglect (WIV)	Binary	0 (no), 1 (yes)
Household Dysfunction	4. Any Parent Smoke Cigarettes (WI)	Binary	0 (no), 1 (yes)
	5. Illegal drugs Easily Available in Home (WI)	Binary	0 (no), 1 (yes)
	6. Does Not Live with Both Biological Parents (WI)	Binary	0 (no), 1 (yes)
	7. Household Member Attempted Suicide in the Past 12 Months (WI)	Binary	0 (no), 1 (yes)
Interpersonal Loss	8. Any parent died (WIV)	Binary	0 (no), 1 (yes)
	9. Death of a Sibling (WIV)	Binary	0 (no), 1 (yes)
	10. Friend attempted Suicide in past 12 months (WI)	Binary	0 (no), 1 (yes)
	11. Any parent Incarcerated (WIV)	Binary	0 (no), 1 (yes)
Community Violence	12. Saw Someone Get Shot (WI)	Binary	0 (no), 1 (yes)
	13. Had a Gun Pulled on You (WI)	Binary	0 (no), 1 (yes)
	14. Got Shot/Stabbed (WI)	Binary	0 (no), 1 (yes)
	15. Feel Unsafe at School (WI)	Binary	0 (no), 1 (yes)
	16. Feel Unsafe in Neighborhood (WI)	Binary	0 (no), 1 (yes)

Table 6. Proposed Data Analysis by Aim

DESCRIPTIVE STATISTICS

1. What is the prevalence of ACEs among this sample of adolescents?

Dependent Variable	Independent Variable	Covariates	Steps in Statistical Analysis
ACEs 1. Type 2. Score	1. Gender 2. Race/ethnicity		Step 1: Present prevalence rates for each type of ACE in overall sample. Step 2: Present these rates of each type of ACE by gender and race/ethnicity. Step 3: Present prevalence rates by ACE score (0-16) in overall sample. Step 4: Present summary of the distribution ACE Scores. Step 5: Present prevalence rates by mean ACE score by gender and race/ ethnicity.

2. What is the prevalence of Injury among this sample of young adults?

Dependent Variable	Independent Variable	Covariates	Steps in Statistical Analysis
Unintentional Injury 1. Serious Injury 2. Motor Vehicle Intentional Injury 1. Suicide Attempt 2. Physical IPV 3. Sexual IPV 4. Shot/Stabbed 5. Beaten up	1. Gender 2. Race/ethnicity		Step 1: Present prevalence rates for each type of injury in overall sample. Step 2: Present the rates of each type of injury by gender and race/ethnicity. Step 3: Present summary of the distribution of Injury Step 4: Present prevalence rates by mean injury score by gender and race/ethnicity.

Research Question 1. What is the association between the types of ACEs and the occurrence of injury in young adulthood?

Hypothesis 1.1 – ACE type will be associated with significantly higher odds of unintentional general within the past twelve months in young adulthood.

Dependent Variable	Independent Variable	Covariates	Steps in Statistical Analysis
Unintentional Injury Unintentional Serious Injury	Physical Abuse Sexual Abuse Emotional Neglect Any Parent Smokes Illegal drugs in Home Does Not Live with 2 biological parents Household Member suicide attempt Any parent incarcerated	Sex Race/ethnicity Age at WIV Education at WIV Depression WIV Anger/Hostility WIV Nicotine Dep. WIV Alcohol abuse/Dep. WIV Drug abuse/Dep. WIV	Use logistic regression complex samples analysis to test for significant associations between each ACE type and Serious injury while adjusting for covariates. Present adjusted odds ratios and 95% confidence intervals. Present final model.

Table 6. Proposed Data Analysis by Aim			
	Death of a Parent Death of a Sibling Death of a Friend Saw someone get shot Someone Pulled a gun on you Got shot/stabbed Feel Unsafe at School Feel Unsafe in Neighborhood		
Hypothesis 1.2 – ACE type will be associated with significantly higher odds of motor vehicle accidents within the past twelve months in young adulthood.			
Dependent Variable	**Independent Variable**	**Covariates**	**Steps in Statistical Analysis**
Unintentional Injury Motor Vehicle Accident (MVA)	Physical Abuse Sexual Abuse Emotional Neglect Any Parent Smokes Illegal drugs in Home Does Not Live with 2 biological parents Household Member suicide attempt Any parent incarcerated Death of a Parent Death of a Sibling Death of a Friend Saw someone get shot Someone Pulled a gun on you Got shot/stabbed Feel Unsafe at School Feel Unsafe in Neighborhood	Sex Race/ethnicity Age at WIV Education at WIV Depression WIV Anger/Hostility WIV Nicotine Dep. WIV Alcohol abuse/Dep. WIV Drug abuse/Dep. WIV	Use logistic regression complex samples analysis to test for significant associations between each ACE type and MVA while adjusting for covariates. Present adjusted odds ratios and 95% confidence intervals. Present final model.
Hypothesis 1.3 – ACE type will be associated with significantly higher odds of suicide attempt within the past twelve months in young adulthood.			
Dependent Variable	**Independent Variable**	**Covariates**	**Steps in Statistical Analysis**
Intentional Injury Suicide Attempt	Physical Abuse Sexual Abuse Emotional Neglect Any Parent Smokes Illegal drugs in Home Does Not Live with 2 biological parents Household Member suicide attempt Any parent incarcerated Death of a Parent	Sex Race/ethnicity Age at WIV Education at WIV Depression WIV Anger/Hostility WIV Nicotine Dep. WIV Alcohol abuse/Dep. WIV Drug abuse/Dep. WIV	Use logistic regression complex samples analysis to test for significant associations between each ACE type and suicide attempt while adjusting for covariates. Present adjusted odds ratios and 95% confidence intervals. Present final model.

Table 6. Proposed Data Analysis by Aim			
	Death of a Sibling Death of a Friend Saw someone get shot Someone Pulled a gun on you Got shot/stabbed Feel Unsafe at School Feel Unsafe in Neighborhood		
Hypothesis 1.4 – ACE type will be associated with significantly higher odds of physical intimate partner violence within the past twelve months in young adulthood.			
Dependent Variable	**Independent Variable**	**Covariates**	**Steps in Statistical Analysis**
Intentional Injury Physical IPV	Physical Abuse Sexual Abuse Emotional Neglect Any Parent Smokes Illegal drugs in Home Does Not Live with 2 biological parents Household Member suicide attempt Any parent incarcerated Death of a Parent Death of a Sibling Death of a Friend Saw someone get shot Someone Pulled a gun on you Got shot/stabbed Feel Unsafe at School Feel Unsafe in Neighborhood	Sex Race/ethnicity Age at WIV Education at WIV Depression WIV Anger/Hostility WIV Nicotine Dep. WIV Alcohol abuse/Dep. WIV Drug abuse/Dep. WIV	Use logistic regression complex samples analysis to test for significant associations between each ACE type and physical IPV while adjusting for covariates. Present adjusted odds ratios and 95% confidence intervals. Present final model.
Hypothesis 1.5 – ACE type will be associated with significantly higher odds of sexual intimate partner violence within the past twelve months in young adulthood.			
Dependent Variable	**Independent Variable**	**Covariates**	**Steps in Statistical Analysis**
Intentional Injury Sexual IPV	Physical Abuse Sexual Abuse Emotional Neglect Any Parent Smokes Illegal drugs in Home Does Not Live with 2 biological parents Household Member suicide attempt Any parent incarcerated Death of a Parent Death of a Sibling	Sex Race/ethnicity Age at WIV Education at WIV Depression WIV Anger/Hostility WIV Nicotine Dep. WIV Alcohol abuse/Dep. WIV Drug abuse/Dep. WIV	Use logistic regression complex samples analysis to test for significant associations between each ACE type and sexual IPV while adjusting for covariates. Present adjusted odds ratios and 95% confidence intervals. Present final model.

Table 6. Proposed Data Analysis by Aim			
	Death of a Friend Saw someone get shot Someone Pulled a gun on you Got shot/stabbed Feel Unsafe at School Feel Unsafe in Neighborhood		
Hypothesis 1.6 – ACE type will be associated with significantly higher odds of being shot/stabbed within the past twelve months in young adulthood.			
Dependent Variable	**Independent Variable**	**Covariates**	**Steps in Statistical Analysis**
Intentional Injury Shot/Stabbed	Physical Abuse Sexual Abuse Emotional Neglect Any Parent Smokes Illegal drugs in Home Does Not Live with 2 biological parents Household Member suicide attempt Any parent incarcerated Death of a Parent Death of a Sibling Death of a Friend Saw someone get shot Someone Pulled a gun on you Got shot/stabbed Feel Unsafe at School Feel Unsafe in Neighborhood	Sex Race/ethnicity Age at WIV Education at WIV Depression WIV Anger/Hostility WIV Nicotine Dep. WIV Alcohol abuse/Dep. WIV Drug abuse/Dep. WIV	Use logistic regression complex samples analysis to test for significant associations between each ACE type and getting shot/stabbed while adjusting for covariates. Present adjusted odds ratios and 95% confidence intervals. Present final model.
Hypothesis 1.7 – ACE type will be associated with significantly higher odds of being beaten up within the past twelve months in young adulthood.			
Dependent Variable	**Independent Variable**	**Covariates**	**Steps in Statistical Analysis**
Intentional Injury Beaten up	Physical Abuse Sexual Abuse Emotional Neglect Any Parent Smokes Illegal drugs in Home Does Not Live with 2 biological parents Household Member suicide attempt Any parent incarcerated Death of a Parent Death of a Sibling Death of a Friend	Sex Race/ethnicity Age at WIV Education at WIV Depression WIV Anger/Hostility WIV Nicotine Dep. WIV Alcohol abuse/Dep. WIV Drug abuse/Dep. WIV	Use logistic regression complex samples analysis to test for significant associations between each ACE type and being beaten up while adjusting for covariates. Present adjusted odds ratios and 95% confidence intervals. Present final model.

Table 6. Proposed Data Analysis by Aim			
	Saw someone get shot Someone Pulled a gun on you Got shot/stabbed Feel Unsafe at School Feel Unsafe in Neighborhood		
Research Question 2. Is there a frequency response relationship between the number of ACEs (ACE score) and injury in young adulthood?			
Hypothesis 2.1 – Participants who experience more ACEs will have significantly higher odds of unintentional Injury – Serious Injury within the past 12 months compared to participants with no ACEs.			
Dependent Variable	**Independent Variable**	**Covariates**	**Steps in Statistical Analysis**
Unintentional Injury Serious Injury	ACE Score	Sex Race/ethnicity Age at WIV Education at WIV Depression WIV Anger/Hostility WIV Nicotine Dep. WIV Alcohol abuse/Dep. WIV Drug abuse/Dep. WIV	Step 1: Use logistic regression analysis for complex samples to test for significant associations between ACE Score and unintentional serious injury. Present odds ratios and 95% confidence intervals adjusting for demographic characteristics. Step 2: Use logistic regression analysis for complex samples to test for significant associations between ACE Score and unintentional serious injury while adjusting for significant demographic and psychosocial covariates. Present adjusted odds ratios and 95% confidence intervals.
Hypothesis 2.2 – Participants who experience more ACEs will have significantly higher odds of motor vehicle accidents within the past 12 months compared to participants with no ACEs.			
Dependent Variable	**Independent Variable**	**Covariates**	**Steps in Statistical Analysis**
Unintentional Injury Motor Vehicle Accident (MVA)	ACE Score	Sex Race/ethnicity Age at WIV Education at WIV Depression WIV Anger/Hostility WIV Nicotine Dep. WIV Alcohol abuse/Dep. WIV Drug abuse/Dep. WIV	Step 1: Use logistic regression analysis for complex samples to test for significant associations between ACE Score and unintentional injury – MVA. Present odds ratios and 95% confidence intervals adjusting for

Table 6. Proposed Data Analysis by Aim			
			demographic characteristics. <u>Step 2</u>: Use logistic regression analysis for complex samples to test for significant associations between ACE Score and unintentional injury – MVA while adjusting for significant demographic and psychosocial covariates. Present adjusted odds ratios and 95% confidence intervals.
<u>Hypothesis 2.3</u> – Participants who experience more ACEs will have significantly higher odds of suicide attempt within the past 12 months compared to participants with no ACEs.			
Dependent Variable	**Independent Variable**	**Covariates**	**Steps in Statistical Analysis**
<u>Intentional Injury</u> Suicide Attempt	ACE Score	Sex Race/ethnicity Age at WIV Education at WIV Depression WIV Anger/Hostility WIV Nicotine Dep. WIV Alcohol abuse/Dep. WIV Drug abuse/Dep. WIV	<u>Step 1:</u> Use logistic regression analysis for complex samples to test for significant associations between ACE Score and intentional injury – Suicide Attempt. Present odds ratios and 95% confidence intervals adjusting for demographic characteristics. <u>Step 2</u>: Use logistic regression analysis for complex samples to test for significant associations between ACE Score and intentional injury – Suicide Attempt while adjusting for significant demographic and psychosocial covariates. Present adjusted odds ratios and 95% confidence intervals.
<u>Hypothesis 2.4</u> – Participants who experience more ACEs will have significantly higher odds of Physical IPV within the past 12 months compared to participants with no ACEs.			
Dependent Variable	**Independent Variable**	**Covariates**	**Steps in Statistical Analysis**
<u>Intentional Injury</u> Physical IPV	ACE Score	Sex Race/ethnicity Age at WIV Education at WIV Depression WIV	<u>Step 1:</u> Use logistic regression analysis for complex samples to test for significant associations between ACE Score and

Table 6. Proposed Data Analysis by Aim			
		Anger/Hostility WIV Nicotine Dep. WIV Alcohol abuse/Dep. WIV Drug abuse/Dep. WIV	intentional injury – Physical IPV. Present odds ratios and 95% confidence intervals adjusting for demographic characteristics. Step 2: Use logistic regression analysis for complex samples to test for significant associations between ACE Score and intentional injury – Physical IPV while adjusting for significant demographic and psychosocial covariates. Present adjusted odds ratios and 95% confidence intervals.
Hypothesis 2.5 – Participants who experience more ACEs will have significantly higher odds of sexual IPV within the past 12 months compared to participants with no ACEs.			
Dependent Variable	**Independent Variable**	**Covariates**	**Steps in Statistical Analysis**
Intentional Injury Sexual IPV	ACE Score	Sex Race/ethnicity Age at WIV Education at WIV Depression WIV Anger/Hostility WIV Nicotine Dep. WIV Alcohol abuse/Dep. WIV Drug abuse/Dep. WIV	Step 1: Use logistic regression analysis for complex samples to test for significant associations between ACE Score and intentional injury – Sexual IPV. Present odds ratios and 95% confidence intervals adjusting for demographic characteristics. Step 2: Use logistic regression analysis for complex samples to test for significant associations between ACE Score and intentional injury – Sexual IPV while adjusting for significant demographic and psychosocial covariates. Present adjusted odds ratios and 95% confidence intervals.
Hypothesis 2.6 – Participants who experience more ACEs will have significantly higher odds of being shot/stabbed within the past 12 months compared to participants with no ACEs.			
Dependent Variable	**Independent Variable**	**Covariates**	**Steps in Statistical Analysis**

Table 6. Proposed Data Analysis by Aim			
Intentional Injury Shot/Stabbed	ACE Score	Sex Race/ethnicity Age at WIV Education at WIV Depression WIV Anger/Hostility WIV Nicotine Dep. WIV Alcohol abuse/Dep. WIV Drug abuse/Dep. WIV	Step 1: Use logistic regression analysis for complex samples to test for significant associations between ACE Score and intentional injury – Shot/Stabbed. Present odds ratios and 95% confidence intervals adjusting for demographic characteristics. Step 2: Use logistic regression analysis for complex samples to test for significant associations between ACE Score and intentional injury – Shot/Stabbed while adjusting for significant demographic and psychosocial covariates. Present adjusted odds ratios and 95% confidence intervals.
Hypothesis 2.7 – Participants who experience more ACEs will have significantly higher odds of being beaten up within the past 12 months compared to participants with no ACEs.			
Dependent Variable	**Independent Variable**	**Covariates**	**Steps in Statistical Analysis**
Intentional Injury Beaten Up	ACE Score	Sex Race/ethnicity Age at WIV Education at WIV Depression WIV Anger/Hostility WIV Nicotine Dep. WIV Alcohol abuse/Dep. WIV Drug abuse/Dep. WIV	Step 1: Use logistic regression analysis for complex samples to test for significant associations between ACE Score and intentional injury – Beaten Up. Present odds ratios and 95% confidence intervals adjusting for demographic characteristics. Step 2: Use logistic regression analysis for complex samples to test for significant associations between ACE Score and intentional injury – Beaten Up while adjusting for significant demographic and psychosocial covariates. Present adjusted odds ratios and 95% confidence intervals.

Table 7. Demographic and Psychosocial Characteristics of Add Health Participants (N=14,800)				
		No.[a]	Unweighted %[b]	Weighted %[c]
Demographic Characteristics				
Sex				
	Male	7313	49.4	49
	Female	7485	50.6	51
Race/ethnicity[d]				
	Euro-American/White	7607	51.4	67
	African-American/Black	3289	22.2	15.8
	Hispanic/Latino (any race)	2573	17.4	11.9
	Native American/Alaskan Native (AI/AN)	123	0.8	0.8
	Asian-American/Pacific Islander (PI)	1009	6.8	3.1
Age at WIV				
	24-25	493	3.3	4.5
	26-27	2926	19.8	25.6
	28-29	4096	27.7	37.2
	≥30e	3637	24.6	32.7
	Mean (SE)[f] - 28.5 (0.30)			
Education at WIV				
	Less than high school	923	6.2	8.2
	High school diploma or equiv.	1846	12.5	16.8
	Some college/vocational training	4878	33.0	43.9
	College graduate or higher	3509	23.7	31.2
Psychosocial Characteristics at Wave IV				
Depression				
	Yes	2074	14.0	18.3
	No	9086	61.4	81.7
Angry/Hostility Personality Scale				
	Yes	4586	31.0	41.5
	No	6553	44.3	58.5
Nicotine Dependence from Fagerstrom Scale				
	Yes	1194	8.1	11.0
	No	9781	66.1	89.0
DSM4 Lifetime Diagnosis of Alcohol Abuse or Dependence				
	Yes	2765	18.7	25.2
	No	8390	56.7	74.8
DSM4 Lifetime Diagnosis of Illegal Drug Abuse or Dependence (not Cannabis)				
	Yes	811	5.5	7.1
	No	10349	69.9	92.9

[a] This number may not sum to the total of number of participants (n=14,800) due to missing data

[b] Reflects the percentage of respondents in the study sample

[c] Reflects the representative proportion in the target U.S. population.

[d] Percentages do not total 100% because 'Other' category not shown.

[e] 34 participants were 33-34 years old.

[f] Age is an interval level continous variable, summarized here.

Table 8. Prevalence Rates of Unintentional Injury[a] by Demographic and Psychosocial Characteristics at Wave IV

		Serious Injury			MVA	
		No. of Participants[b]	Weighted %[c]		No. of Participants[b]	Weighted %[c]
Sex						
	Male	881	17.3		548	10.4
	Female	560	9.8		559	9.7
Race/Ethnicity						
	White	880	15.5		594	9.8
	Black	242	10.4		259	11.0
	Hispanic	224	11.3		177	9.5
	AI/AN	*[d]	23.2		*[d]	13.7
	Asian/PI	66	8.8		51	8.6
Age						
	24-25	66	12.5		72	14.4
	26-27	380	12.6		322	11.6
	28-29	554	14.2		393	9.4
	≥30[e]	441	12.9		320	8.9
Education						
	Less than high school	158	18.1		98	11.1
	HS diploma or equiv.	245	13.8		149	7.3
	Some college/voc. training	685	14		516	11.4
	College graduate or higher	353	10.7		344	9.4
Depression						
	Yes	372	19.1		241	12.6
	No	1069	12.0		866	9.5
Anger/Hostility						
	Yes	683	15.9		489	10.9
	No	756	11.4		618	9.5
Nicotine Dep.						
	Yes	251	23.1		142	12.4
	No	1156	12.0		942	9.7
Alcohol Dep/Abuse						
	Yes	507	18.8		314	10.9
	No	934	11.4		793	9.8
Illegal Drug Dep/ Abuse						
	Yes	186	25.6		105	13.1
	No	1255	12.3		1002	9.8

[a] Injury was defined as occuring in the past 12 months in Wave IV of the Add Health Study when participants were 24-32 years of age.

[b] Represents the number of participants who endorsed the injury as having occurred vs not occurred.

[c] Reflects the representative proportion of the target U.S. population.

[d] Due to small sample sizes, the number of participants are not reported to protect participants from deductive disclosures. Weighted prevalence should be interpreted with caution.

[e] 34 participants were 33-34 years old

Table 9. Prevalence rates of Intentional Injury[a] (Self Harm, IPV) by Demographic and Psychosocial Characteristics at Wave IV								
		Suicide Attempt		Physical IPV		Sexual IPV		
		No. of Participants[b]	Weighted %[c]	No. of Participants[b]	Weighted %[c]	No. of Participants[b]	Weighted %[c]	
Sex								
	Male	71	1.3	1010	20.6	277	5.3	
	Female	97	1.7	776	13.9	280	4.8	
Race/Ethnicity								
	White	92	1.6	860	14.6	244	4.0	
	Black	40	1.4	541	24.4	165	6.1	
	Hispanic	28	1.5	272	17.1	100	6.1	
	AI/AN	*[d]	3.5	*[d]	7.5	*[d]	3.3	
	Asian/PI	*[d]	1.0	85	12.1	34	5.5	
Age at WIV								
	24-25	*[d]	1.3	89	16.7	23	5.4	
	26-27	53	1.6	476	16.6	153	5.0	
	28-29	57	1.6	667	17.9	209	5.4	
	≥30[e]	52	1.4	554	16.3	172	4.4	
Education								
	Less than high school	39	3.7	232	25.6	56	6.2	
	HS diploma or equiv.	42	2.0	349	20.5	107	5.4	
	Some college/voc. training	66	1.3	844	18.9	268	5.5	
	College graduate or higher	21	0.9	361	10.2	126	3.6	
Depression								
	Yes	100	4.8	465	24.0	174	8.8	
	No	68	0.8	1321	15.4	383	4.1	
Anger/Hostility								
	Yes	113	2.4	922	21.9	264	6.1	
	No	54	0.9	863	13.5	293	4.2	
Nicotine Dep.								
	Yes	42	3.4	313	26.1	104	7.9	
	No	122	1.3	1446	15.8	444	4.7	
Alcohol Dep/Abuse								
	Yes	47	1.9	561	20.4	189	6.6	
	No	121	1.4	1225	15.8	368	4.4	
Illegal Drug Dep/ Abuse								
	Yes	31	3.6	224	27.2	69	7.7	
	No	137	1.3	1562	16.2	488	4.8	

[a] Injury was defined as occuring in the past 12 months in Wave IV of the Add Health Study when participants were 24-32 years of age.

[b] Represents the number of participants who endorsed the injury as having occurred vs not occurred.

[c] Reflects the representative proportion of the target U.S. population.

[d] Due to small sample sizes, the number of participants are not reported to protect participants from deductive disclosures. Weighted prevalence should be interpreted with caution.

[e] 34 participants were 33-34 years old

Table 10. Prevalence Rates of Intentional Injury[a] (Assault) by Demographic and Psychosocial Characteristics at Wave IV

		Shot/Stabbed		Beaten Up	
		No. of Participants[b]	Weighted %[c]	No. of Participants[b]	Weighted %[c]
Sex					
	Male	189	4.4	177	4.0
	Female	167	3.5	155	3.1
Race/Ethnicity					
	White	142	2.8	155	3.1
	Black	127	5.8	96	4.5
	Hispanic	61	5.2	61	4.0
	AI/AN	*[d]	8.7	*[d]	7.6
	Asian/PI	17	2.8	14	2.6
Age					
	24-25	19	5.3	20	4.5
	26-27	105	4.2	94	4.0
	28-29	114	3.7	107	2.8
	≥30[e]	118	3.8	111	3.9
Education					
	Less than high school	76	9.6	74	9.3
	HS diploma or equiv.	74	4.9	65	4.5
	Some college/voc. training	142	3.5	148	3.5
	College graduate or higher	64	2.4	45	1.5
Depression					
	Yes	86	5.7	120	7.5
	No	270	3.5	212	2.7
Anger/Hostility					
	Yes	188	4.9	195	5.2
	No	165	3.2	135	2.3
Nicotine Dep.					
	Yes	60	6.4	82	8.5
	No	294	3.6	244	2.9
Alcohol Dep/Abuse					
	Yes	72	3.0	115	5.0
	No	284	4.2	217	3.0
Illegal Drug Dep/ Abuse					
	Yes	38	6.6	68	10.9
	No	318	3.7	264	3.0

[a] Injury was defined as occuring in the past 12 months in Wave IV of the Add Health Study when participants were 24-32 years of age.

[b] Represents the number of participants who endorsed the injury as having occurred vs not occurred.

[c] Reflects the representative proportion of the target U.S. population.

[d] Due to small sample sizes, the number of participants are not reported to protect participants from deductive disclosures. Weighted prevalence should be interpreted with caution.

[e] 34 participants were 33-34 years old

Table 11. Prevalence Rates of ACE Types by Gender								
		Male			Female		Total	
	ACE TYPE[a]	No.[b]	Wtd %[c]		No.[b]	Wtd %[c]	No.[b]	Wtd %[c]
	CHILDHOOD MALTREATMENT							
1	Physical abuse	990	19.0		1067	18.9	2057	18.9
2	Sexual abuse	134	2.6		450	8.0	584	5.5
3	Emotional neglect	2132	42.5		3116	53.1	5248	48.2
	HOUSEHOLD DYSFUNCTION							
4	Any parent smoked cigarettes	5223	71.6		5416	73.0	10639	72.3
5	Easy access to illegal drugs in the home	252	3.6		217	3.0	469	3.3
6	Family member attempted suicide	257	3.1		422	5.6	679	4.4
7	Does not live with both bio-parents	3604	48.5		3878	51.6	7482	50.1
	INTERPERSONAL LOSS							
8	Any parent died	281	3.7		435	5.3	716	4.5
9	Any sibling died	125	1.6		191	2.6	316	2.1
10	Friend attempted suicide	935	13.2		1606	22.2	2541	17.8
11	Any parent incarcerated	554	10.6		658	10.8	1212	10.7
	COMMUNITY VIOLENCE							
12	Saw someone get shot	1130	15.7		790	11.3	1920	13.4
13	Knife or gun pulled on you	1424	19.3		550	7.4	1974	13.2
14	Physical Assault (shot/stabbed/jumped)	1574	20.7		648	9.1	2222	14.8
15	Not safe at school	1028	13.6		1026	14.4	2054	14.0
16	Not safe in neighborhood	778	10.5		949	13.3	1727	11.9

[a] ACE Type is defined as adverse childhood experiencess that occurred when the respondent was < 18 years of age.

[b] Weighted percent represents the number of participants who endorsed the ACE as having occurred vs not occurred.

[c] Reflects the representative proportion of the target U.S. population.

Table 12. Prevalence rates of ACE Types by Race/Ethnicity

	WHITE		BLACK		HISPANIC		AI/AN		ASIAN/PI		Total	
ACE TYPE[a]	No.[b]	Wtd %[c]	No.[b]	Wtd %[c]	No.[b]	Wtd %[c]	No.[b]	Wtd %[c]	No.[b]	Wtd %[c]	No.[b]	Wtd %[c]
CHILDHOOD MALTREAMENT												
Physical abuse	1065	17.9	446	18.9	359	21.2	22	32.7	141	20.7	2033	18.9
Sexual abuse	285	4.9	152	6.2	98	5.9	11	19.8	26	3.3	572	5.4
Emotional neglect	2829	48.2	1149	49.0	824	45.3	39	55.9	338	51.6	5179	48.2
HOUSEHOLD DYSFUNCTION												
Any parent smoked cigarettes	5816	76.5	2238	68.4	1730	68.7	89	71.2	627	63.5	10500	72.3
Easy access to illegal drugs in the home	255	3.6	104	3.0	66	3.0	*[d]	5.2	28	1.8	457	3.2
Family member attempted suicide	344	4.6	155	4.1	134	4.4	*[d]	5.1	30	3.1	671	4.4
Does not live with both bio-parents	3410	44.4	2312	68.8	1269	48.8	78	65.0	309	30.4	7378	50.0
INTERPERSONAL LOSS												
Any parent died	291	3.7	250	7.0	109	3.6	*[d]	5.0	50	4.8	707	4.5
Any sibling died	133	1.8	106	3.1	41	1.3	*[d]	3.0	22	2.2	306	2.0
Friend attempted suicide	1472	20.1	399	12.2	448	18.2	43	37.4	138	13.9	2500	17.7
Any parent incarcerated	570	9.4	378	14.4	211	12.1	14	16.7	23	3.5	1196	10.7
COMMUNITY VIOLENCE												
Saw someone get shot	556	7.6	686	21.6	515	20.3	24	19.0	112	10.4	1893	13.4
Knife or gun pulled on you	818	10.7	558	16.4	452	17.9	23	17.9	99	8.4	1950	13.2
Physical Assault (shot/stabbed/jumped)	948	12.4	570	16.3	520	19.8	30	19.7	122	11.8	2190	14.7
Not safe at school	861	11.5	576	17.8	430	16.3	22	20.2	135	13.7	2024	14.0
Not safe in neighborhood	520	7.1	547	16.1	470	18.5	18	13.4	148	16.1	1703	11.9

[a] ACE Type is defined as adverse childhood experiences that occurred when the respondend was < 18 years of age.

[b] Weighted percent represents the number of participants who endorsed the ACE as having occurred vs not occurred.

[c] Reflects the representative proportion of the target U.S. population.

[d] Due to small sample sizes, the number of participants are not reported to protect participants from deductive disclosures. Weighted prevalence should be interpreted with caution.

Table 13. Prevalence rates of ACE Score by Gender									
	Male (n=4858)			Female (n=5612)			Total		
ACE Score[a]	No.[b]	Wtd %[c]		No.[b]	Wtd %[c]		No.[b]	Wtd %[c]	
0	354	7.5		355	5.9		709	6.6	
1	903	18.1		940	17.0		1843	17.5	
2	1029	21.9		1214	21.8		2243	21.8	
3	927	19.0		1119	19.5		2046	19.2	
4	687	14.5		835	14.8		1522	14.7	
5	420	8.6		525	10.0		945	9.4	
6	252	5.0		309	5.2		561	5.1	
7	151	3.0		185	3.4		336	3.2	
8	81	1.4		74	1.5		155	1.5	
9	31	0.5		30	0.6		61	0.6	
10	21	0.4		16	0.4		37	0.4	
11	*[d]	0.0		*[d]	0.0		*[d]	0.0	
12	0	0.0		*[d]	0.0		*[d]	0.0	
13	0	0.0		*[d]	0.0		*[d]	0.0	
14	0	0.0		0	0.0		0	0.0	
15	0	0.0		0	0.0		0	0.0	
16	0	0.0		0	0.0		0	0.0	
Mean ACE Score			**2.91**			**3.04**			**2.99**

[a] ACE Score is defined as the total number of adverse childhood experiences endorsed by the participant.

[b] This number may not sum to the the total number of participants (N=14,800) due to missing data.

[c] Weighted percent reflects the representative proportion of the target U.S. population.

[d] Due to small sample sizes, the number of participants are not reported to protect participants from deductive disclosures. Weighted prevalence should be interpreted with caution.

Table 14. Prevalence rates of ACE Score by Race/Ethnicity															
	WHITE (n=5704)			BLACK (n=2251)			HISPANIC (N=1684)			AI/AN (n=66)			ASIAN/ PI (n=639)		
ACE Score[a]	No.[b]	Wtd %[c]		No.[b]	Wtd %[c]		No.[b]	Wtd %[c]		No.[b]	Wtd %[c]		No.[b]	Wtd %[c]	
0	446	7.4		96	4.7		114	7.2		*[d]	1.5		48	7.4	
1	1157	19.9		248	11.1		270	16.3		*[d]	17.2		136	22.2	
2	1283	23.3		425	19.5		336	19.2		*[d]	11.2		157	24.6	
3	1090	19.2		476	20.3		315	18.7		*[d]	21.7		133	18.9	
4	763	13.4		406	17.9		249	15.3		*[d]	16.5		77	12.4	
5	443	7.9		258	12.6		168	9.6		*[d]	13.4		52	9.5	
6	270	4.5		160	6.5		102	5.7		*[d]	9.1		17	2.0	
7	140	2.5		111	4.5		62	4.1		*[d]	5.5		15	2.3	
8	73	1.3		36	1.4		41	2.3		*[d]	2.0		*[d]	0.4	
9	22	0.4		19	0.7		15	0.8		0	1.8		*[d]	0.2	
10	14	0.2		13	0.8		*[d]	0.6		0	0		0	0.1	
11	*[d]	0.0		*[d]	0.0		*[d]	0.1		0	0		0	0	
12	0	0.0		*[d]	0.0		*[d]	0.1		0	0		0	0	
13	0	0.0		0	0.0		*[d]	0.0		0	0		0	0	
14	0	0.0		0	0.0		0	0.0		0	0		0	0	
15	0	0.0		0	0.0		0	0.0		0	0		0	0	
16	0	0.0		0	0.0		0	0.0		0	0		0	0	
Mean Ace Score			**2.78**			**3.42**			**3.17**			**3.67**			**2.59**
[a] ACE Score is defined as the total number of adverse childhood experiences endorsed by the participant.															
[b] Total number of participants may not sum to (N=14,800) due to missing data.															
[c] Weighted percent reflects the representative proportion of the target U.S. population.															
[d] Due to small sample sizes, the number of participants are not reported to protect participants from deductive disclosures. Weighted prevalence should be interpreted with caution.															
AI/AN = American Indian/Alaskan Native; PI = Pacific Islander															

Table 15. Mean ACE Scores by Sex and Race/Ethnicity				
		Mean ACE Score	**SE**	
Sex				
	Males	2.91	0.04	
	Females	3.04	0.036	
Mean for Sex		**2.99**	**0.026**	
Race/Ethnicity				
	White	2.78	0.036	
	Black	3.42	0.061	
	Hispanic	3.17	0.079	
	AI/AN	3.67	0.305	
	Asian/PI	2.59	0.092	
Mean for Race/Ethnicity		**2.98**	**0.026**	
Males				
	White	2.68	0.047	
	Black	3.44	0.104	
	Hispanic	3.19	0.100	
	AI/AN	3.80	0.611	
	Asian/PI	2.47	0.127	
Mean for males by race/ethnicity		**2.91**	**0.039**	
Females				
	White	2.86	0.052	
	Black	3.40	0.072	
	Hispanic	3.14	0.115	
	AI/AN	3.55	0.261	
	Asian/PI	2.72	0.138	
Mean for females by race/ethnicity		**3.04**	**0.035**	
Reflects the representative proportion of the target U.S. population.				
SE = Standard Error				

Table 16. Bivariate Association between exposure to Adverse Childhood Experiences (ACE Type) and the Adjusted Odds of Unintentional Injury in Young Adulthood at Wave IV

		UNINTENTIONAL INJURY					
ACEs (<18 YRS)		**SERIOUS INJURY**			**MVA**		
CHILD MALTREATMENT	**No. Participants[a]**	**Weighted %[b]**	**(A)OR[1] (95% CI)[c]**		**No. Participants[a]**	**Weighted %[b]**	**(A)OR[1] (95% CI)[c]**	
Physical abuse	352	18.5	1.72	(1.410-2.094)***	264	14.3	1.66	(1.327-2.086)***
--- Psychosocial covariates[2]			1.48	(1.212--1.805)***			1.62	(1.284-2.049)***
Sexual Abuse	99	18.0	1.84	(1.311-2.569)***	81	13.6	1.45	(1.053-2.000)***
--- Psychosocial covariates[2]			1.52	(1.064-2.166)*			ns	
Emotional neglect	778	15.6	1.62	(1.392-1.899)***	598	11.8	1.44	(1.232-1.683)***
--- Psychosocial covariates[2]			1.40	(1.183-1.664)***			1.44	(1.232-1.683)***
HOUSEHOLD DYSFUNCTION								
Any parent(s) smoke cigarettes	1088	14.1	1.28	(1.058-1.537)**	795	9.8	ns	
--- Psychosocial covariates[2]			ns					
Illegal drugs easily available in home	58	16.9	ns		31	7.1	ns	
--- Psychosocial covariates[2]								
Family member attempted suicide	86	15.6	ns		61	14.3	1.53	(1.081-2.173)*
--- Psychosocial covariates[2]							1.46	(1.029-2.072)*
Does not live with both biological parents	745	14.2	ns		540	10.3	ns	
--- Psychosocial covariates[2]								
INTERPERSONAL LOSS								
Any parent(s) died	77	12.3	ns		58	8.2	ns	
--- Psychosocial covariates[2]								
Sibling(s) died	33	10.6	ns		28	8.5	ns	
--- Psychosocial covariates[2]								
Friend(s) tried to commit suicide	305	16.5	1.52	(1.270-1.837)***	211	10.2	ns	
--- Psychosocial covariates[2]			1.34	(1.098-1.623)**				
Any parent(s) incarcerated	214	18.0	1.43	(1.170-1.738)***	137	11.9	ns	
--- Psychosocial covariates[2]			1.30	(1.031-1.619)*				
COMMUNITY VIOLENCE								
Saw someone get shot or stabbed	214	15.9	1.27	(.997-1.606)*	142	10.5	ns	
--- Psychosocial covariates[2]			ns					
Had a knife or gun pulled on you	256	18.2	1.34	(1.058-1.703)*	141	9.7	ns	
--- Psychosocial covariates[2]			ns					
Shot/stabbed/jumped	307	20.4	1.61	(1.287-2.023)***	170	10.9	1.30	(1.050-1.596)*
--- Psychosocial covariates[2]			1.46	(1.155-1.85)**			1.28	(1.041-1.582)*
Do not feel safe at school	234	16.0	1.32	(1.081-1.623)**	144	10.2	ns	
--- Psychosocial covariates[2]			1.27	(1.032-1.572)*				
Do not feel safe in neighborhood	170	15.4	1.31	(1.017-1.691)*	117	11.8	ns	
--- Psychosocial covariates[2]			1.31	(1.021-1.699)*				

[a] Unweighted number of participants who endorsed the ACE type in Wave I and also endorsed the Injury in Wave IV.

[b] Reflects the representative proportion of the target U.S. population who reported the ACE prior to 18 years of age and also reported the injury in Wave IV

[c] (A)OR = (Adjusted) Odds Ratio; CI = Confidence Interval

[1] Model 1 adjusted for significant demographic characteristics Sex, Race, Age at Wave IV, and Educational Attainment at Wave IV

[2] Model 2 adjusted for significant demographic characteristics Sex, Race, Age at Wave IV, Educational Attainment at Wave IV and Psychosocial Characteristics at Wave IV of Depression, Anger/Hostility Personality Trait, Nicotine Dependence, Alcohol Dependence/Abuse; Illegal Drug

* p ≤ .05; ** p ≤ .01; ***p ≤ .001; ns indicates nonsignificant in the model.

Table 16a. Final Model - Association between exposure to Adverse Childhood Experiences (ACE Type) and the Adjusted Odds of Unintentional Injury - Serious Injury in Young Adulthood at Wave IV Analyzed by Multiple Logistic Regression

SERIOUS INJURY			
Independent variable[1]	**(A)OR[a]**	**95% CI**	**p value**
ACE Type			
Community Violence - Shot/Stabbed/Jumped	1.35	(1.072-1.697)	0.01
Child Maltreatment - Physical Abuse	1.33	(1.068-1.654)	0.01
Child Maltreatment - Emotional Neglect	1.27	(1.059-1.530)	0.01
Interpersonal Loss - Past year friend attempted Suicide (WI)	1.24	(1.018-1.504)	0.03
Covariates			
Sex (Male)	2.06	(1.737-2.439)	<.001
Depression (WIV)	1.50	(1.23-1.819)	<.001
DSM4 Lifetime Diagnosis of Drug Abuse/Dependence (WIV)	1.49	(1.135-1.957)	0.003
Nicotine Dependence (WIV)	1.44	(1.162-1.775)	<.001
DSM4 Lifetime Diagnosis of Alcohol Abuse/Dependence (WIV)	1.30	(1.101-1.538)	0.001
Angry/Hostile Personality Trait	1.26	(1.083-1.474)	0.004
Race			0.007
White	Referent		
African-American	0.74	(0.601-0.917)	
Hispanic	0.79	(0.627-1.002)	
American Indian/Alaskan Native	1.78	(0.851-3.737)	
Asian/Pacific Islander	0.62	(0.426-0.91)	

[1]Final Model tests significant ACE Types from Model 2 and significant demographic and psychosocial covariates (See Table 16)

[a] (A)OR = (Adjusted) Odds Ratio; CI = Confidence Interval

Table 16b. Final Model - Association between exposure to Adverse Childhood Experiences (ACE Type) and the Adjusted Odds of Unintentional Injury - Motor Vehicle Accident in Young Adulthood at Wave IV Analyzed by Multiple Logistic Regression

MOTOR VEHICLE ACCIDENT			
Independent variable[1]	**(A)OR[a]**	**95% CI**	**p value**
ACE Type			
Child Maltreatment - Physical abuse	1.53	(1.192-1.961)	0.001
Interpersonal Loss - Past year family member attempted suicide (WI)	1.49	(1.035-2.132)	0.032
Child Maltreatment - Emotional neglect	1.24	(1.041-1.483)	0.017
Covariates			
Age at WIV	0.918	(.870-.967)	0.002

[1]Final Model tests significant ACE Types from Model 2 and significant demographic and psychosocial covariates (See Table 16)

[a] (A)OR = (Adjusted) Odds Ratio; CI = Confidence Interval

Table 17a. Bivariate Association between exposure to Adverse Childhood Experiences (ACE Type) and the Adjusted Odds of Intentional Injury (Self Harm, IPV) in Young Adulthood at Wave IV

	INTENTIONAL INJURY											
ACEs (<18 YRS)	**SUICIDE ATTEMPT**				**PHYSICAL IPV**				**SEXUAL IPV**			
CHILD MALTREATMENT	**No. Participants[a]**	**Weighted %[b]**	**(A)OR[1] (95% CI)[c]**		**No. Participants[a]**	**Weighted %[b]**	**(A)OR[1] (95% CI)[c]**		**No. Participants[a]**	**Weighted %[b]**	**(A)OR[1] (95% CI)[c]**	
Physical abuse	47	2.6	1.97	(1.248-3.103)**	508	26.0	1.97	(1.663-2.320)***	174	7.8	1.87	(1.427-2.453)***
--- Psychosocial covariates[2]			ns				1.74	(1.475-2.053)***			1.65	(1.258-2.163)***
Sexual abuse	21	3.7	2.59	(1.351-4.967)**	129	23.5	1.65	(1.223-2.230)***	52	9.8	1.99	(1.287-3.076)**
--- Psychosocial covariates[2]			ns				1.38	(1.020-1.866)*			1.62	(1.054-2.497)*
Emotional neglect	106	2.1	2.28	(1.50-3.477)***	1032	20.9	1.80	(1.534-2.124)***	368	6.8	2.11	(1.617-2.748)***
--- Psychosocial covariates[2]			1.63	(1.043-2.551)*			1.60	(1.354-1.890)***			1.85	(1.413-2.413)***
HOUSEHOLD DYSFUNCTION												
Any parent(s) smoke cigarettes	137	1.8	ns		457	15.4	ns		408	5.1	ns	
--- Psychosocial covariates[2]												
Illegal drugs easily available in home	*[d]	2.2	ns		71	25.4	1.58	(1.096-2.271)*	24	6.5	ns	
--- Psychosocial covariates[2]							ns					
Family member attempted suicide	18	4.2	2.85	(1.455-5.592) **	119	28.5	2.04	(1.440-2.890)***	43	8.6	1.75	(1.062-2.868)*
--- Psychosocial covariates[2]			1.96	(1.008-3.809)*			1.80	(1.273-2.536)***			ns	
Does not live with both biological parents	96	1.4	ns		1004	19.0	1.21	(1.047-1.393)**	317	6.0	1.42	(1.106-1.825)**
--- Psychosocial covariates[2]							1.17	(1.015-1.360)*			1.40	(1.095-1.808) **
INTERPERSONAL LOSS												
Any parent(s) died	15	1.5	ns		125	17.7	ns		37	4.8	ns	
--- Psychosocial covariates[2]												
Sibling(s) died	*[d]	1.3	ns		43	15.1	ns		11	4.4	ns	
--- Psychosocial covariates[2]												
Friend(s) tried to commit suicide	41	2.1	ns		349	18.5	ns		124	5.3	ns	
--- Psychosocial covariates[2]												
Any parent(s) incarcerated	31	2.7	ns		273	22.3	1.32	(1.64-1.649)*	96	8.0	1.64	(1.214-2.221)***
--- Psychosocial covariates[2]												
COMMUNITY VIOLENCE												
Saw someone get shot or stabbed	27	1.7	ns		339	26.3	1.72	(1.457-2.047)***	103	7.9	1.63	(1.168-2.287)**
--- Psychosocial covariates[2]							1.69	(1.420-2.20)***			1.59	(1.131-2.225)**
Had a knife or gun pulled on you	27	1.4	ns		339	25.1	1.46	(1.206-1.775)***	104	6.5	1.33	(.996-1.773)*
--- Psychosocial covariates[2]							1.38	(1.136-1.676)***			ns	
Shot/stabbed/jumped	36	1.9	ns		366	25.0	1.46	(1.204-1.771)***	112	6.8	ns	
--- Psychosocial covariates[2]							1.37	(1.126-1.667)**				
Do not feel safe at school	30	1.9	ns		259	17.8	ns		96	5.9	ns	
--- Psychosocial covariates[2]												
Do not feel safe in neighborhood	23	2.6	ns		243	22.4	1.42	(1.124-1.792)**	84	7.6	1.53	(1.081-2.166)*
--- Psychosocial covariates[2]							1.37	(1.083-1.722)**			1.48	(1.052-2.101)*

[a] Unweighted number of participants who endorsed the ACE type in Wave I and also endorsed the Injury in Wave IV.

[b] Reflects the representative proportion of the target U.S. population who reported the ACE prior to 18 years of age and also reported the select injury in Wave IV

[c] (A)OR = (Adjusted) Odds Ratio; CI = Confidence Interval

[d] Due to small sample sizes, the number of participants are not reported to protect participants from deductive disclosures. Weighted prevalence should be interpreted with caution.

[1] Model 1 adjusted for significant demographic characteristics Sex, Race, Age at Wave IV, and Educational Attainment at Wave IV

[2] Model 2 adjusted for significant demographic characteristics Sex, Race, Age at Wave IV, Educational Attainment at Wave IV and Psychosocial Characteristics at Wave IV of Depression, Anger/Hostility Personality Trait, Nicotine Dependence, Alcohol Dependence/Abuse; Illegal Drug Dependence/Abuse

* p ≤ .05; ** p ≤ .01; *** p ≤ .001; ns indicates nonsignificant in the model.

Table 17a.1 Final Model - Association between exposure to Adverse Childhood Experiences (ACE Type) and the Adjusted Odds of Intentional Injury - Suicide Attempt in Young Adulthood at Wave IV Analyzed by Multiple Logistic Regression

SUICIDE ATTEMPT			
Independent variable[1]	**(A)OR[a]**	**95% CI**	**p value**
ACE Type			
Child Maltreatment - Emotional Neglect	1.63	(1.043-2.551)	0.032
Covariates			
Educational Attainment WIV	0.69	(.531-.897)	0.006
Depression (WIV)	4.88	(3.147-7.555)	<.001
Angry/Hostile Personality Trait	1.80	(1.106-2.948)	0.018

[1]Final Model tests significant ACE Types from Model 2 and significant demographic and psychosocial covariates (See Table 17a)

[a] (A)OR = (Adjusted) Odds Ratio; CI = Confidence Interval

Table 17a.2 Final Model - Association between exposure to Adverse Childhood Experiences (ACE Type) and the Adjusted Odds of Intentional Injury - Physical Intimate Partner Violence in Young Adulthood at Wave IV Analyzed by Multiple Logistic Regression

PHYSICAL IPV			
Independent variable[1]	**(A)OR[a]**	**95% CI**	**p value**
ACE Type			
Interpersonal Loss - Past year family member attempted Suicide (WI)	1.67	(1.164-2.394.)	0.006
Child Maltreatment - Physical Abuse	1.50	(1.262-1.788)	<.001
Child Maltreatment - Emotional Neglect	1.35	(1.122-1.626)	0.002
Community Violence - Saw someone get shot	1.32	(1.091-1.590)	0.004
Covariates			
Educational Attainment (WIV)	0.79	(.725-.849)	<.001
Sex (Male)	1.59	(1.428-1.774)	<.001
Angry/Hostile Personality Trait	1.57	(1.355-1.807)	<.001
Depression (WIV)	1.50	(1.193-1.887)	0.001
DSM4 Lifetime Diagnosis of Drug Abuse/Dependence (WIV)	1.47	(1.157-1.873)	0.002
DSM4 Lifetime Diagnosis of Alcohol Abuse/Dependence (WIV)	1.29	(1.105-1.503)	0.001
Race			<.001
White	Referent		
African-American	2.08	(1.750-2.493)	
Hispanic	1.24	(0.985-1.558)	
American Indian/Alaskan Native	0.43	(0.167-1.110)	
Asian/Pacific Islander	0.96	(0.710-1.299)	

[1]Final Model tests significant ACE Types from Model 2 and significant demographic and psychosocial covariates (See Table 17a)

[a] (A)OR = (Adjusted) Odds Ratio; CI = Confidence Interval

Table 17a.3 Final Model - Association between exposure to Adverse Childhood Experiences (ACE Type) and the Adjusted Odds of Intentional Injury - Sexual Intimate Partner Violence in Young Adulthood at Wave IV Analyzed by Multiple Logistic Regression

SEXUAL IPV			
Independent variable[1]	**(A)OR[a]**	**95% CI**	**p value**
ACE Type			
Child Maltreatment - Emotional neglect	1.77	(1.369-2.293)	<.001
Household Dysfunction - Does not live with both biological parents	1.29	(1.006-1.643)	0.045
Covariates			
Depression (WIV)	2.06	(1.591-2.658)	<.001
DSM4 Lifetime Diagnosis of Alcohol Abuse/Dependence (WIV)	1.62	(1.253-2.084)	<.001
Nicotine Dependence	1.57	(1.124-2.202)	0.009
Race			<.001
White	Referent		
African-American	1.93	(1.443-2.584)	
Hispanic	2.04	(1.386-2.992)	
American Indian/Alaskan Native	0.84	(0.189-3.686)	
Asian/Pacific Islander	1.94	(1.116-3.368)	

[1]Final Model tests significant ACE Types from Model 2 and significant demographic and psychosocial covariates (See Table 17a)

[a] (A)OR = (Adjusted) Odds Ratio; CI = Confidence Interval

Table 17b. Association between exposure to Adverse Childhood Experiences (ACE Type) at Wave I and the Adjusted Odds of Intentional Injury (Assault) in Young Adulthood at Wave IV

			INTENTIONAL INJURY					
ACEs (<18 YRS)	**PHYSICAL ASSAULT - SHOT/STABBED**				**PHYSICAL ASSAULT- BEATEN UP**			
CHILD MALTREATMENT	**No. Participants[a]**	**Weighted %[b]**	**(A)OR[1] (95% CI)[c]**		**No. Participants[a]**	**Weighted %[b]**	**(A)OR[1] (95% CI)[c]**	
Physical abuse	95	5.9	1.64	(1.159-2.316)**	107	6.7	2.34	(1.646-3.315)***
--- Psychosocial covariates[2]			1.59	(1.117-2.258)**			1.87	(1.322-2.650)***
Sexual abuse	34	8.4	2.25	(1.380-3.680)***	49	10.8	3.47	(2.232-5.367)***
--- Psychosocial covariates[2]			2.19	(1.324-3.606)**			2.47	(1.514-4.031)***
Emotional neglect	168	4.0	ns		191	4.5	1.66	(1.245-2.222)***
--- Psychosocial covariates[2]							ns	
HOUSEHOLD DYSFUNCTION								
Any parent(s) smoke cigarettes	270	4.1	ns		261	3.9	ns	
--- Psychosocial covariates[2]								
Illegal drugs easily available in home	24	7.0	1.83	(1.047-3.202)*	25	9.4	2.69	(1.524-4.730)***
--- Psychosocial covariates[2]			ns				2.11	(1.193-3.757) **
Family member attempted suicide	14	2.0	2.22	(1.044-4.734)*	23	3.8	ns	
--- Psychosocial covariates[2]			2.26	(1.061-4.800)*				
Does not live with both biological parents	217	4.8	1.34	(1.008-1.789)*	209	4.4	1.36	(1.029-1.790)*
--- Psychosocial covariates[2]			ns				ns	
INTERPERSONAL LOSS								
Any parent(s) died	37	7.4	2.00	(1.204-3.348)**	33	5.8	ns	
--- Psychosocial covariates[2]			2.01	(1.219-3.328) **				
Sibling(s) died	15	7.1	ns		11	5.8	ns	
--- Psychosocial covariates[2]								
Friend(s) tried to commit suicide	64	3.5	ns		76	4.3	ns	
--- Psychosocial covariates[2]								
Any parent(s) incarcerated	56	5.6	ns		63	6.9	1.85	(1.287-2.673)***
--- Psychosocial covariates[2]							1.59	(1.095-2.303)*
COMMUNITY VIOLENCE								
Saw someone get shot or stabbed	65	6.9	1.78	(1.234-2.553)**	69	5.6	1.52	(1.046-2.197)*
--- Psychosocial covariates[2]			1.75	(1.223-2.517)**			1.50	(1.025-2.197)*
Had a knife or gun pulled on you	65	6.1	1.48	(1.047-2.079)*	62	5.6	1.45	(1.019-2.073)*
--- Psychosocial covariates[2]			1.43	(1.016-2.008)*			ns	
Shot/stabbed/jumped	76	7.0	1.75	(1.243-2.468) **	74	6.4	1.68	(1.199-2.365)*
--- Psychosocial covariates[2]			1.72	(1.219-2.428) **			1.55	(1.087-2.197)*
Do not feel safe at school	63	5.4	ns		64	5.7	1.60	(1.110-2.306)*
--- Psychosocial covariates[2]							ns	
Do not feel safe in neighborhood	54	5.5	ns		48	4.8	ns	
--- Psychosocial covariates[2]								

[a] Unweighted number of participants who endorsed the ACE type in Wave I and also endorsed the Injury in Wave IV.

[u] Reflects the representative proportion of the target U.S. population who reported the ACE prior to 18 years of age and also reported the select injury in Wave IV

[c] (A)OR = (Adjusted) Odds Ratio; CI = Confidence Interval

[1] Model adjusted for significant demographic characteristics Sex, Race, Age at Wave IV, and Educational Attainment at Wave IV

[2] Model adjusted for significant demographic characteristics Sex, Race, Age at Wave IV, Educational Attainment at Wave IV and Psychosocial Characteristics at Wave IV of Depression, Hostility, Nicotine Dependence, Alcohol Dependence/Abuse; Illegal Drug Dependence/Abuse

* p ≤ .05; **p ≤ .01; *** p ≤ .001; ns indicates nonsignificant in the model.

Table 17b.1 Final Model - Association between exposure to Adverse Childhood Experiences (ACE Type) and the Adjusted Odds of Intentional Injury - Shot/Stabbed in Young Adulthood at Wave IV Analyzed by Multiple Logistic Regression

Shot/Stabbed			
Independent variable[1]	**(A)OR[a]**	**95% CI**	**p value**
ACE Type			
Interpersonal Loss - Past year family member attempted suicide (WI)	0.381	(.179-.811)	0.013
Child Maltreatment - Sexual abuse	2.02	(1.198-3.390)	0.009
Interpersonal Loss - any parent died when respondent was <18 years	1.87	(1.086-3.205)	0.024
Community Violence - Shot/Stabbed/Jumped at WI	1.78	(1.290-2.446)	0.001
Covariates			
Educational Attainment (WIV)	0.71	(.608-.834)	<.001
DSM4 Lifetime Diagnosis of Drug Abuse/Dependence (WIV)	1.77	(1.118-2.809)	0.015
Depression (WIV)	1.46	(1.061-2.016)	0.021
Race			<.001
White	Referent		
African-American	2.04	(1.461-2.854)	
Hispanic	1.73	(1.168-2.559)	
American Indian/Alaskan Native	2.66	(0.996-7.113)	
Asian/Pacific Islander	1.21	(0.650-2.237)	

[1]Final Model tests significant ACE Types from Model 2 and significant demographic and psychosocial covariates (See Table 17b)

[a] (A)OR = (Adjusted) Odds Ratio; CI = Confidence Interval

Table 17b.2 Final Model - Association between exposure to Adverse Childhood Experiences (ACE Type) and the Adjusted Odds of Intentional Injury - Beaten Up in Young Adulthood at Wave IV Analyzed by Multiple Logistic Regression

BEATEN UP			
Independent variable[1]	**(A)OR[a]**	**95% CI**	**p value**
ACE Type			
Household Dysfunction - Easy access to drugs in the home	2.18	(1.219-3.893)	0.009
Child Maltreatment - Sexual abuse	2.09	(1.291-3.384)	0.003
Child Maltreatment - Physical abuse	1.64	(1.138-2.348)	0.008
Community Violence - Shot/Stabbed/Jumped (WI)	1.46	(1.030-2.077)	0.034
Covariates			
Educational Attainment (WIV)	0.68	(.565-.824)	<.001
DSM4 Lifetime diagnosis of Drug Abuse/Dependence (WIV)	2.71	(1.862-3.943)	<.001
Depression (WIV)	1.85	(1.330-2.582)	<.001
Nicotine dependence (WIV)	1.69	(1.035-2.772)	0.36
Angry/hostile personality trait (WIV)	1.59	(1.140-2.205)	0.006
Race			0.006
White	Referent		
African-American	1.93	(1.295-2.863)	
Hispanic	1.52	(.964-2.397)	
American Indian/Alaskan Native	1.99	(0.864-4.566)	
Asian/Pacific Islander	1.25	(0.603-2.570)	

[1]Final Model tests significant ACE Types from Model 2 and significant demographic and psychosocial covariates (See Table 17b)

[a] (A)OR = (Adjusted) Odds Ratio; CI = Confidence Interval

Table 18. Association between ACE Score and the Adjusted Odds of Injury in Young Adulthood at Wave IV

INJURY	(A)OR[c] (95% CI)[d]	
Serious Injury in the past 12 months[a]	1.23	(1.167-1.295)***
+ Psychosocial Characteristics[b]	1.16	(1.098-1.230)***
Motor Vehicle Accident past 12 months	1.10	(1.042-1.169)***
+ Psychosocial Characteristics	1.09	(1.030-1.161)**
Suicide attempt past 12 months	1.19	(1.036-1.370)*
+ Psychosocial Characteristics	ns	
Physical IPV past 12 months	1.19	(1.128-1.245)***
+ Psychosocial Characteristics	1.13	(1.070-1.184)***
Sexual IPV past 12 months	1.26	(1.182-1.342)***
+ Psychosocial Characteristics	1.22	(1.142-1.297)***
Shot/Stabbed past 12 months (n=9531)	1.19	(1.103-1.293)***
+ Psychosocial Characteristics	1.16	(1.079-1.256)***
Beaten Up past 12 months (n=9531)	1.34	(1.221-1.478)***
+ Psychosocial Characteristics	1.25	(1.136-1.377)***

[a] Model adjusted for significant demographic characteristics Sex, Race, Age at Wave IV, and Educational Attainment at Wave IV

[b] Model adjusted for significant demographic characteristics Sex, Race, Age at Wave IV, Educational Attainment at Wave IV and Psychosocial Characteristics at Wave IV - Depression, Anger/Hostility, Nicotine Dependence, Alcohol Dependence/Abuse; Illegal Drug Dependence/Abuse

[c] (A)OR=Adjusted Odds Ratio. Odds ratio (Exp(B)) is calculated at the mean value for each unit of change.

[d]CI = Confidence Interval.

***Adjusted odds ratios are significantly different from 1.00 with $p \leq .001$

**Adjusted odds ratios are significantly different from 1.00 with $p \leq .01$

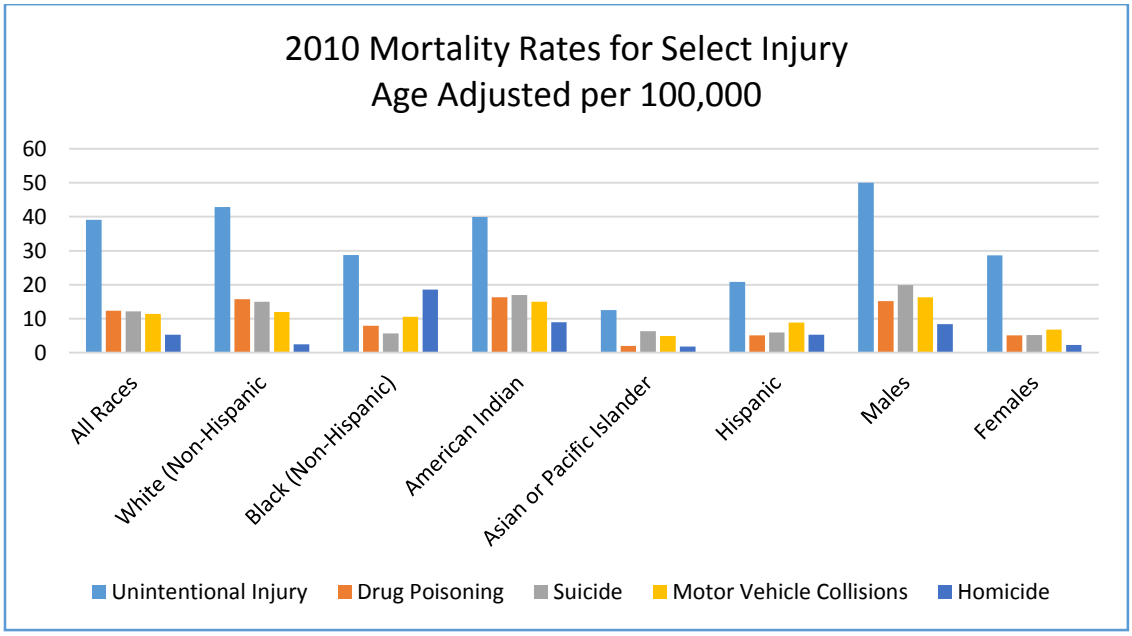
*Adjusted odds ratios are significantly different from 1.00 with $p \leq .05$

ns = ACE Score was not significant in the model after controlling for demographic and psychosocial covarviates

Analyses using weighted data and taking into account clustered sampling design to provide national estimates.

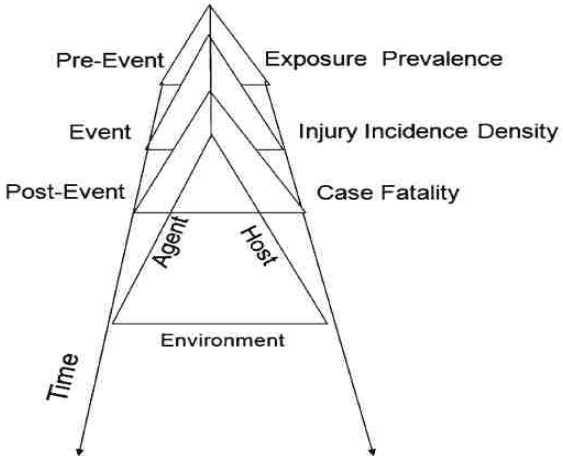
APPENDIX B
LIST OF FIGURES

Figure 1. 2010 Mortality Rates for Select Injury by Race and Ethnicity



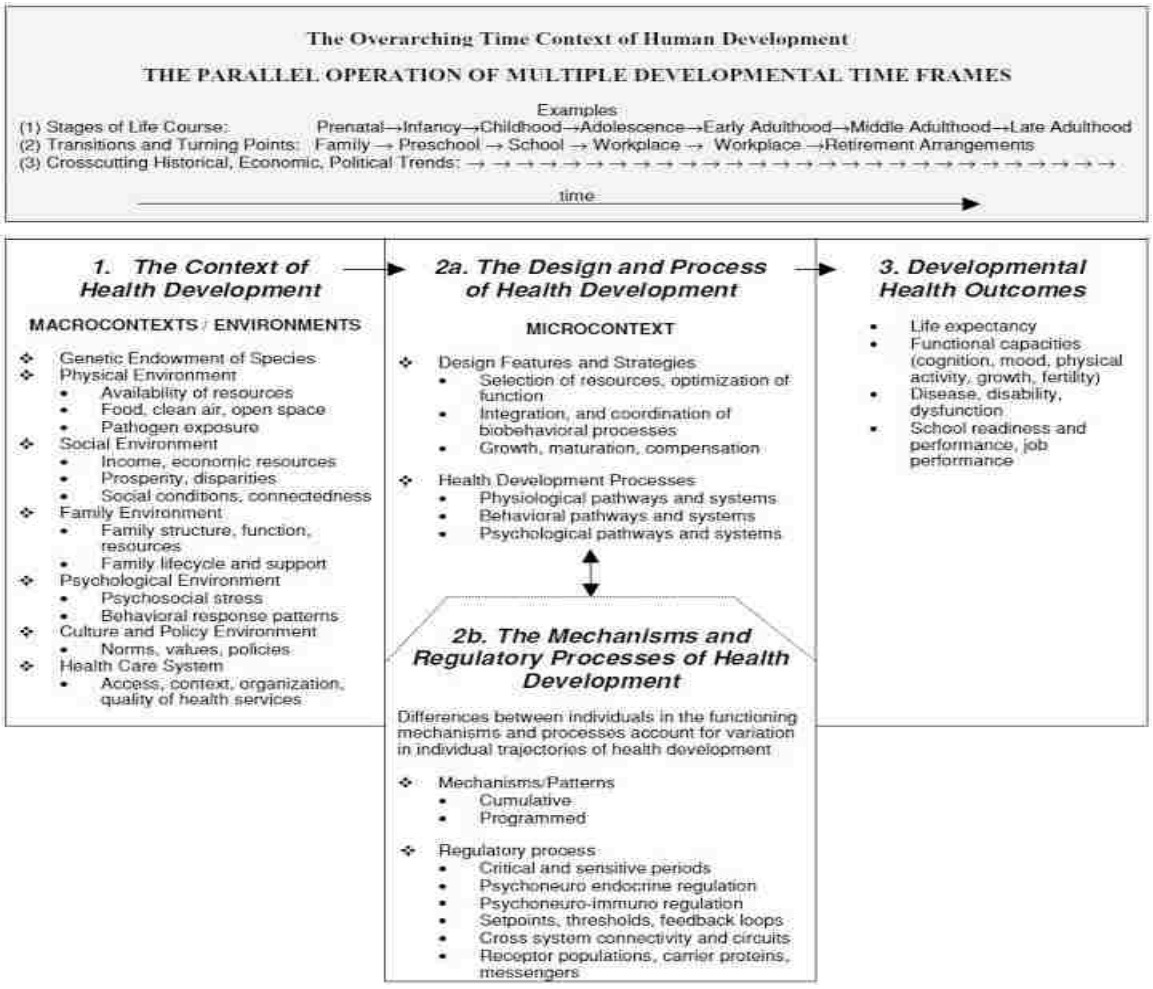
Source: Centers for Disease Control and Prevention, Fatality Analysis Reporting System (FARS)/ NHTSA. Sortable Risk Factors and Health Indicators Website, last updated (January, 2014). Site accessed at http://wwwn.cdc.gov/sortablestats.

Figure 2. Haddon Matrix



Source: Li, G. & Baker, S.P. (2012). Epidemiologic Methods, p. 208. In G. Li & S.P. Baker (Eds.), *Injury Research: Theories, Methods, and approaches* (pp. 203-220). New York, NY: Springer. Reprinted with permission

Figure 3. Life Course Health Development Model



Source: Halfon, N. & Hochstein, M. (2002). Life Course Health Development: An Integrated Framework for Development Health Policy, and Research. *The Milbank Quarterly* 80(3):433-479. Reprinted with permission.

Figure 4. Adapted LCHD Model

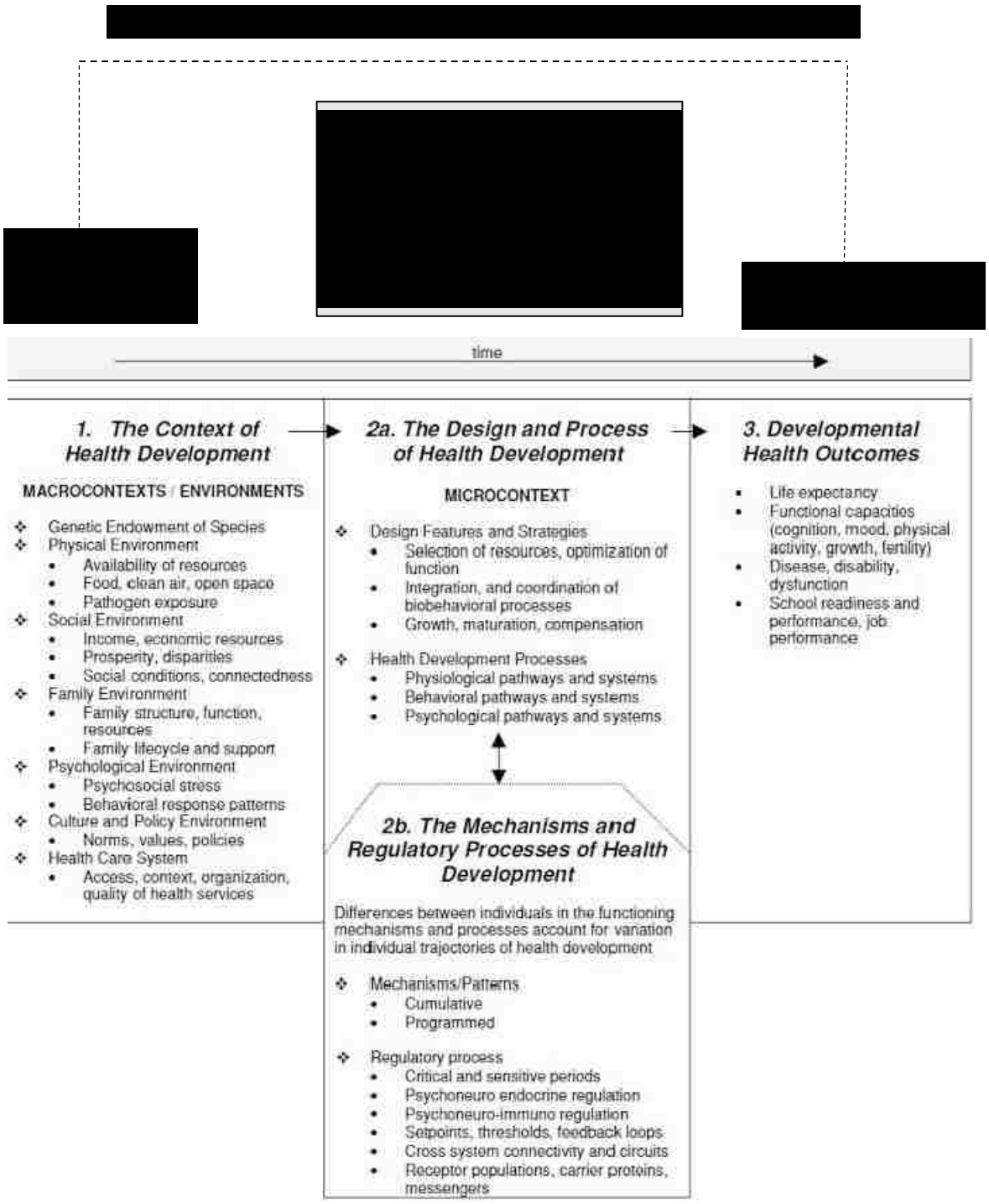


Figure 5. ACEs and Injury in Young Adulthood Conceptual Model

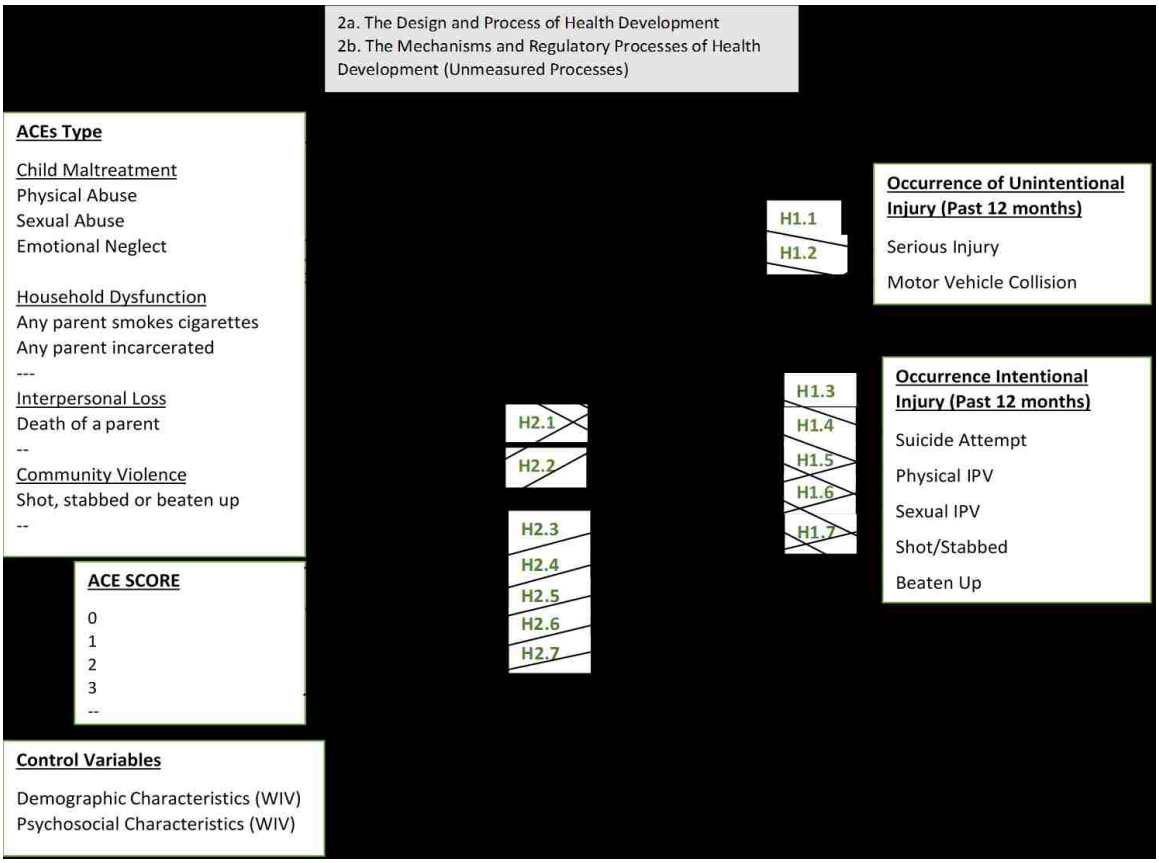


Figure 6. Prevalence Rates of Injury by Gender

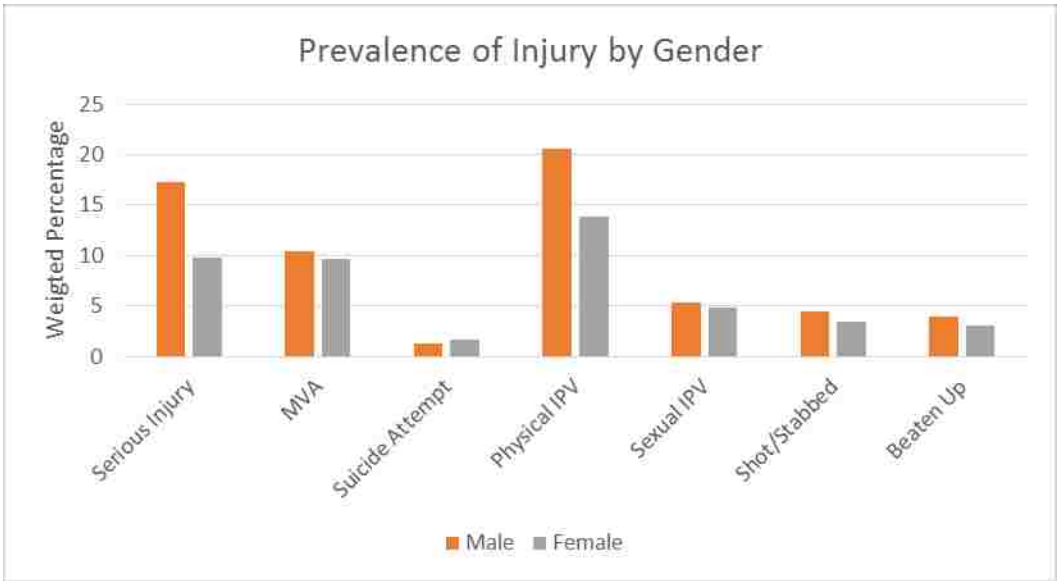


Figure 7. Prevalence Rates of Injury by Race/Ethnicity

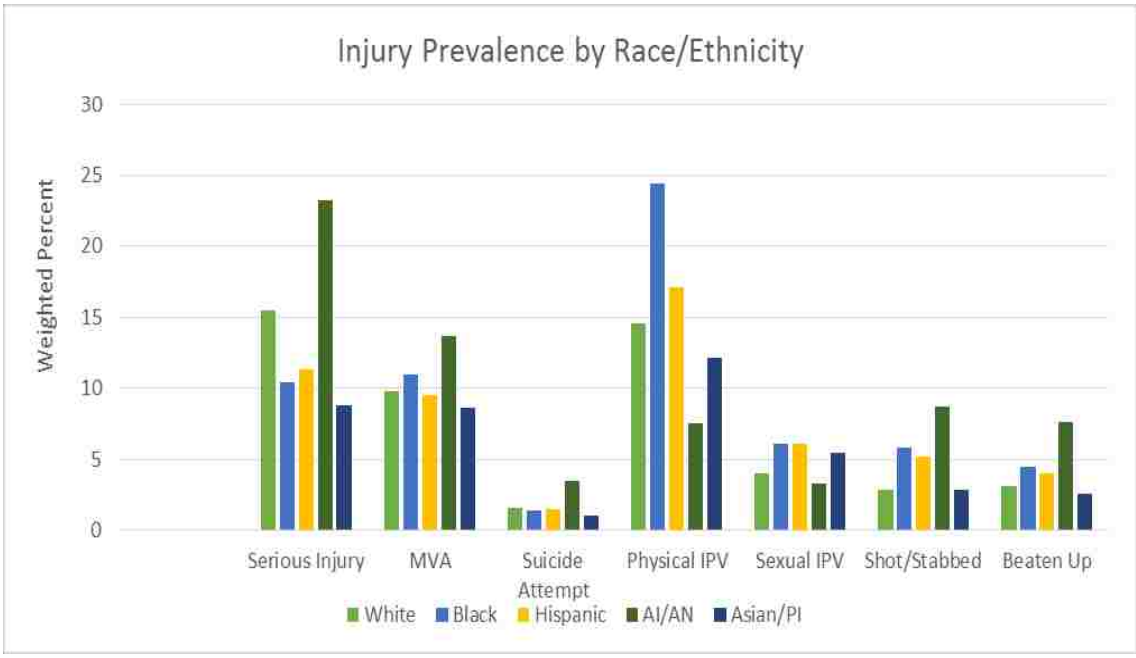


Figure 8. Prevalence Rates of Injury by Age and Educational Attainment

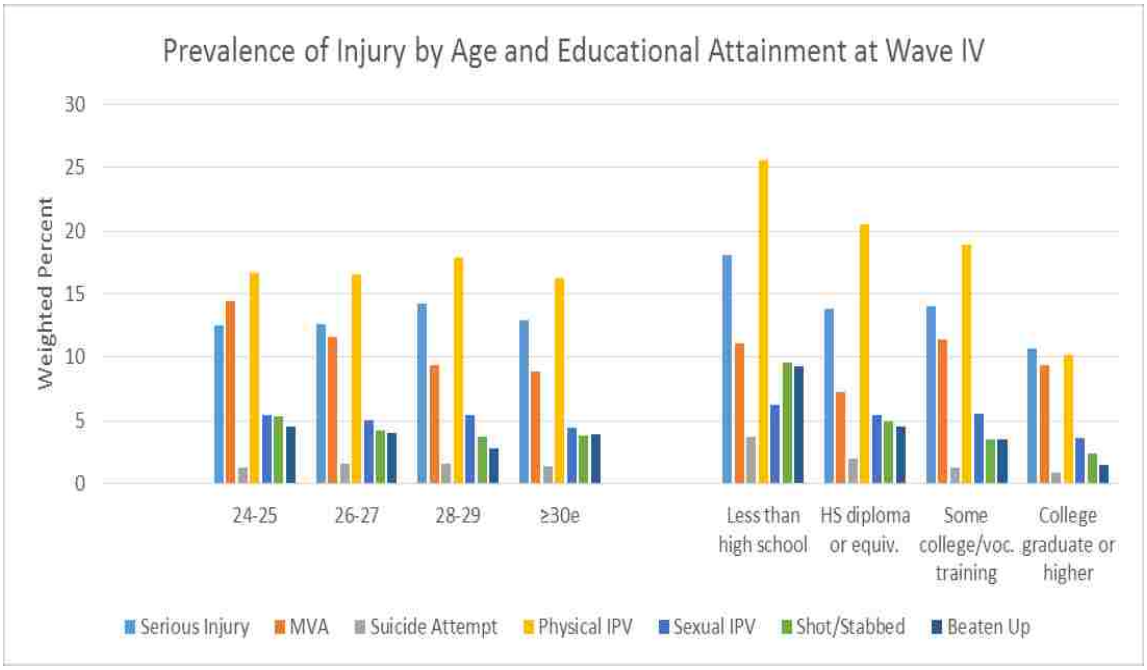


Figure 9. Prevalence Rates of Injury by Psychosocial Characteristics

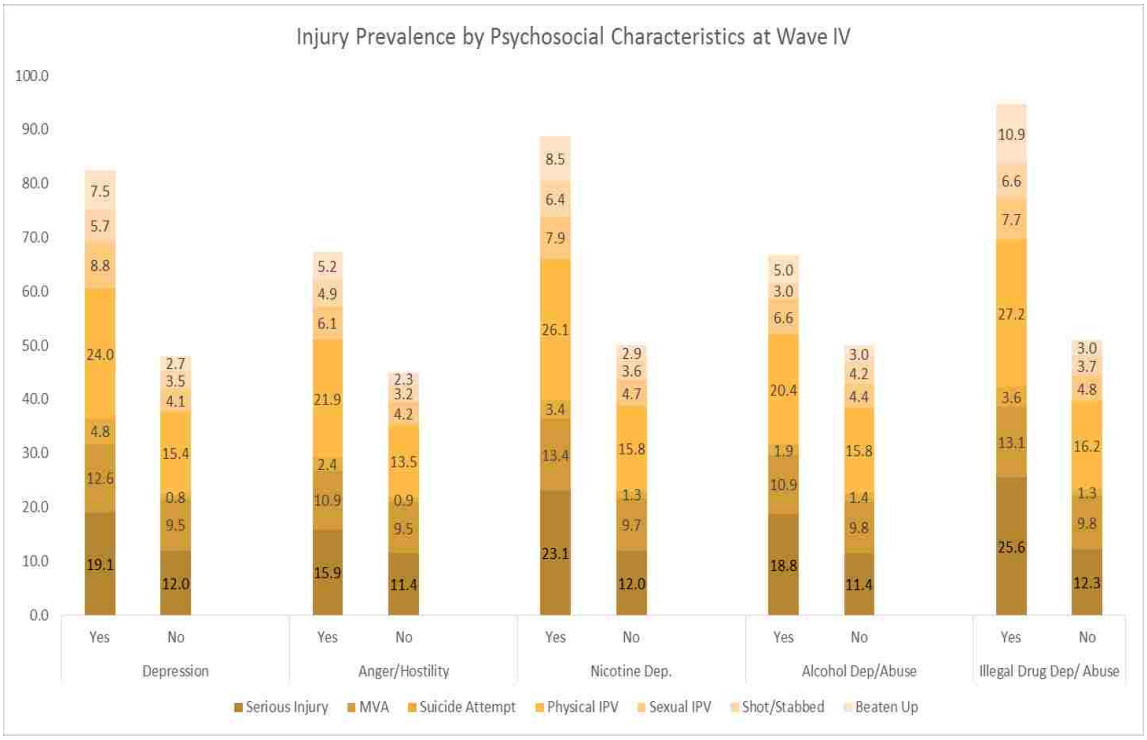


Figure 10. Prevalence Rates of ACE Types by Gender

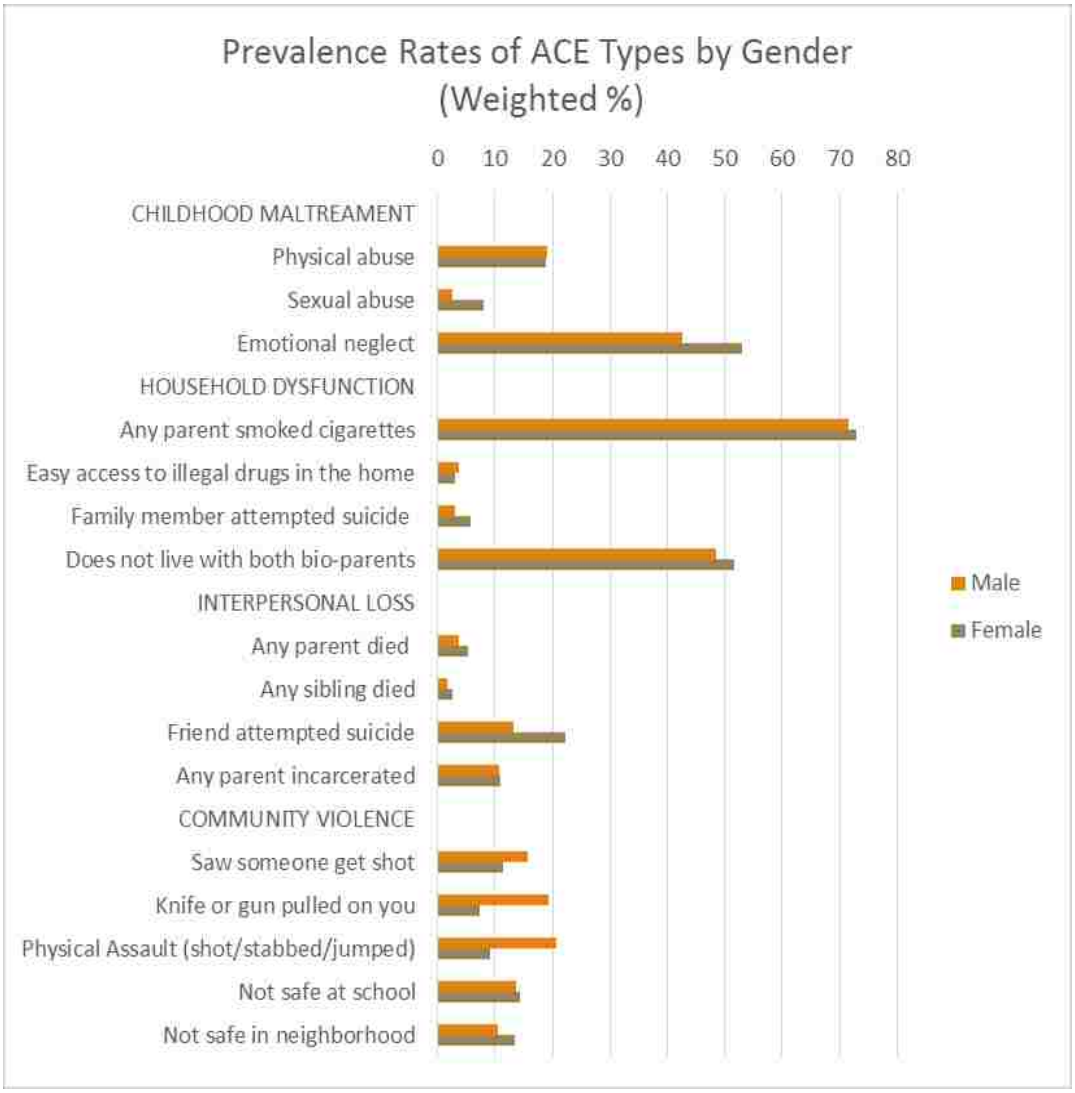


Figure 11. Prevalence Rates of ACE Types by Race/Ethnicity

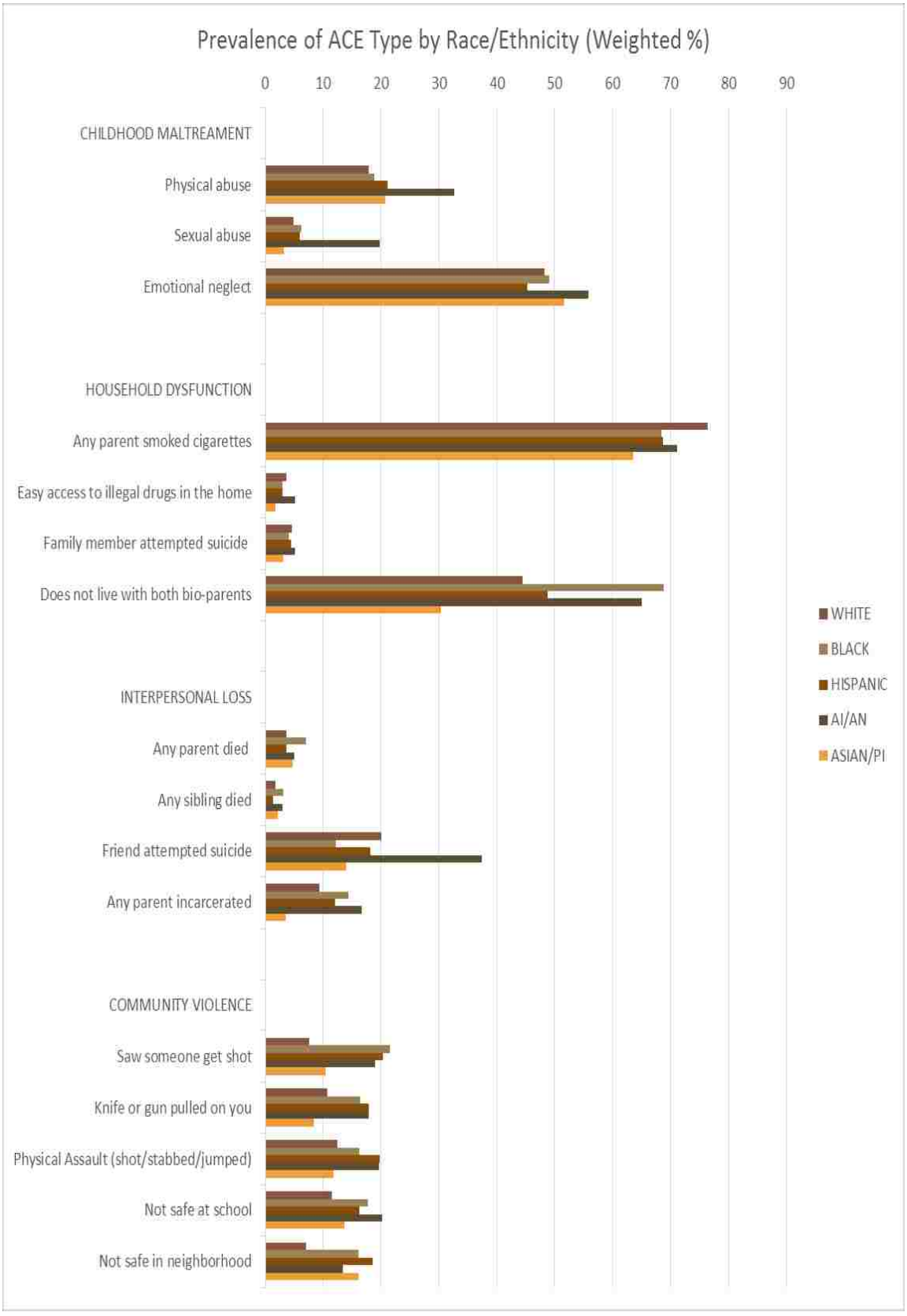


Figure 12. Prevalence Rates of ACE Score by Gender

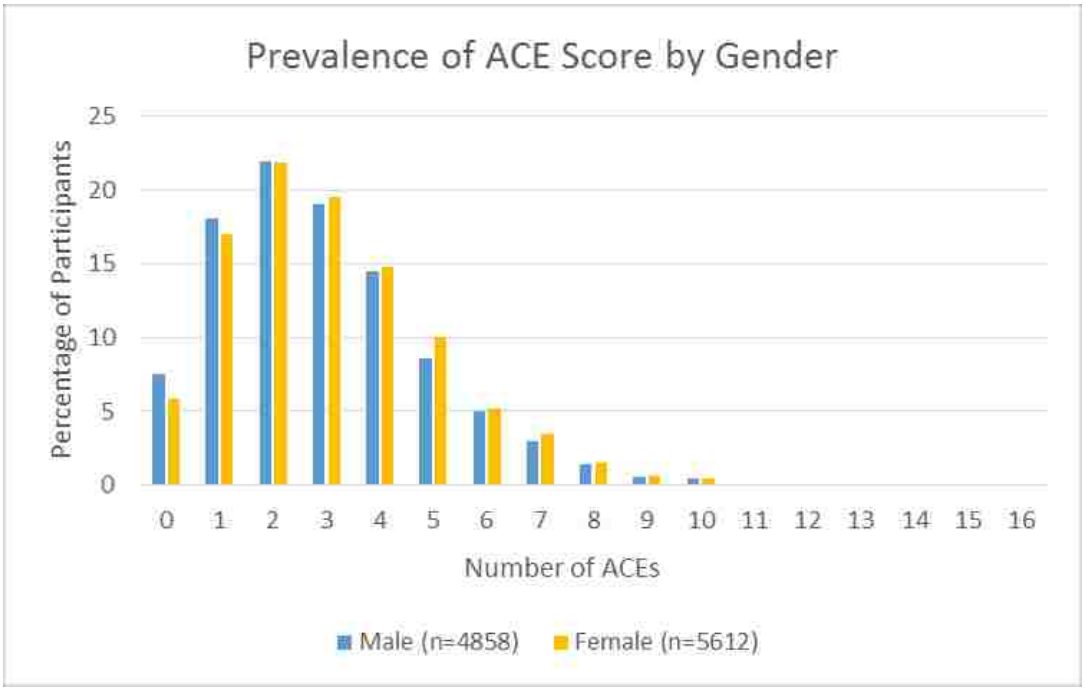


Figure 13. Prevalence Rates of ACE Score by Race/Ethnicity

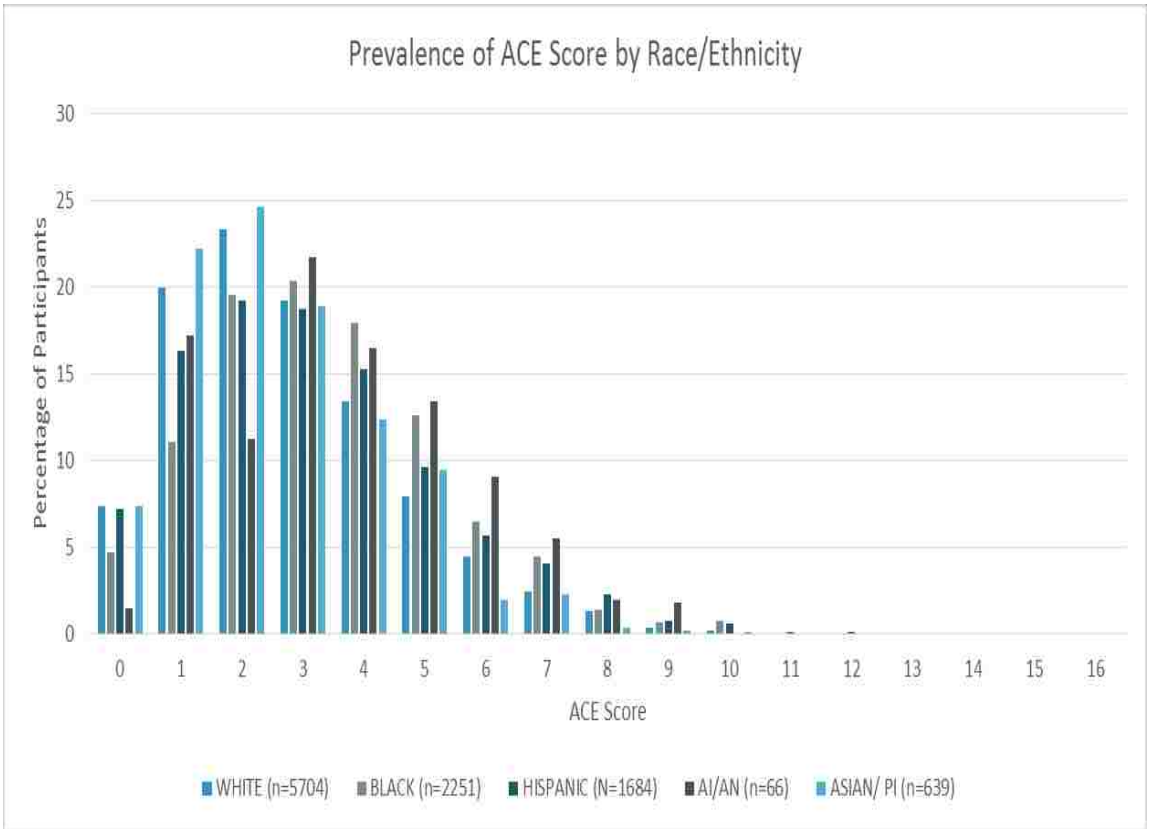


Figure 14. Mean Ace Score by Race/Ethnicity and Gender

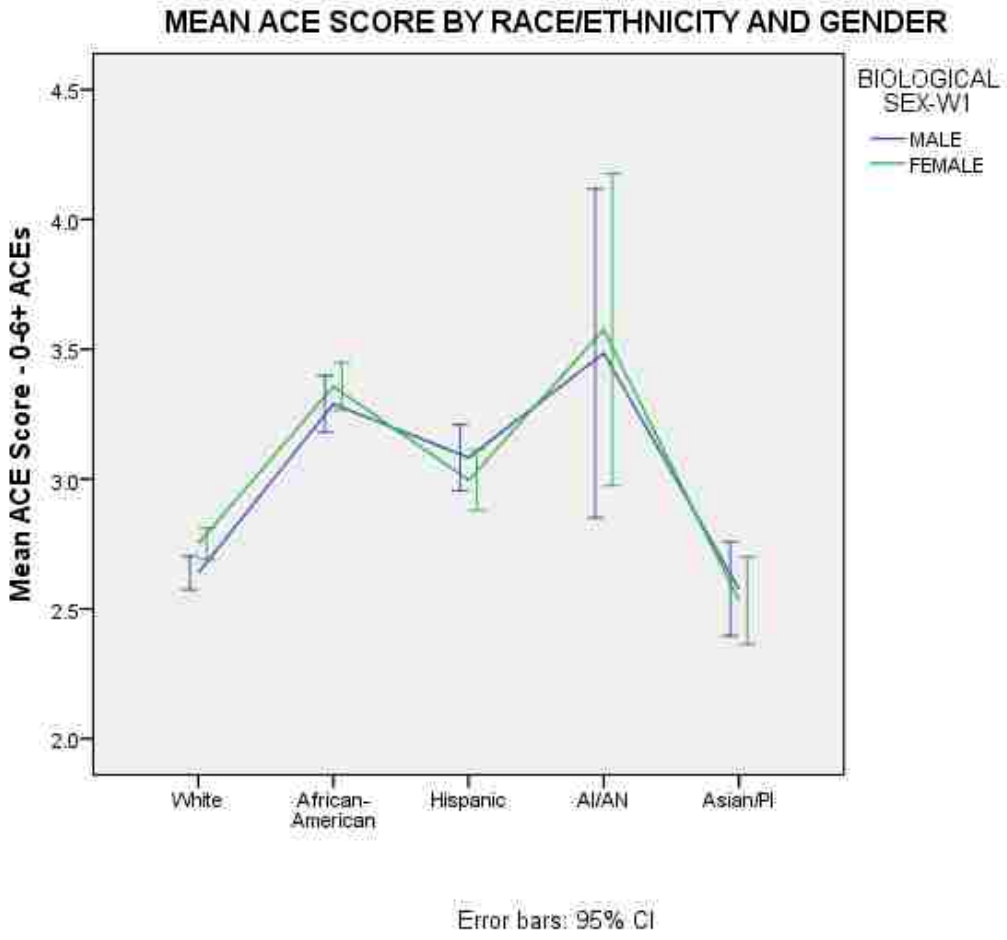
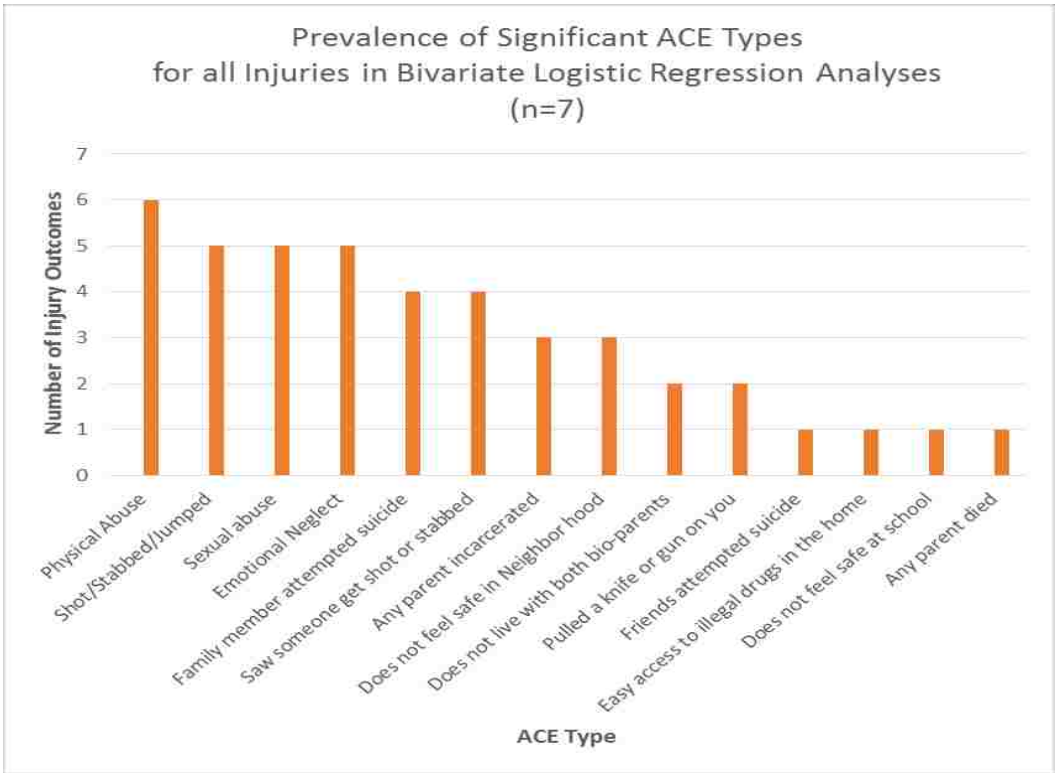


Figure 15. Prevalence of Significant ACE Types for All Injuries in Bivariate and Multiple Regression Models



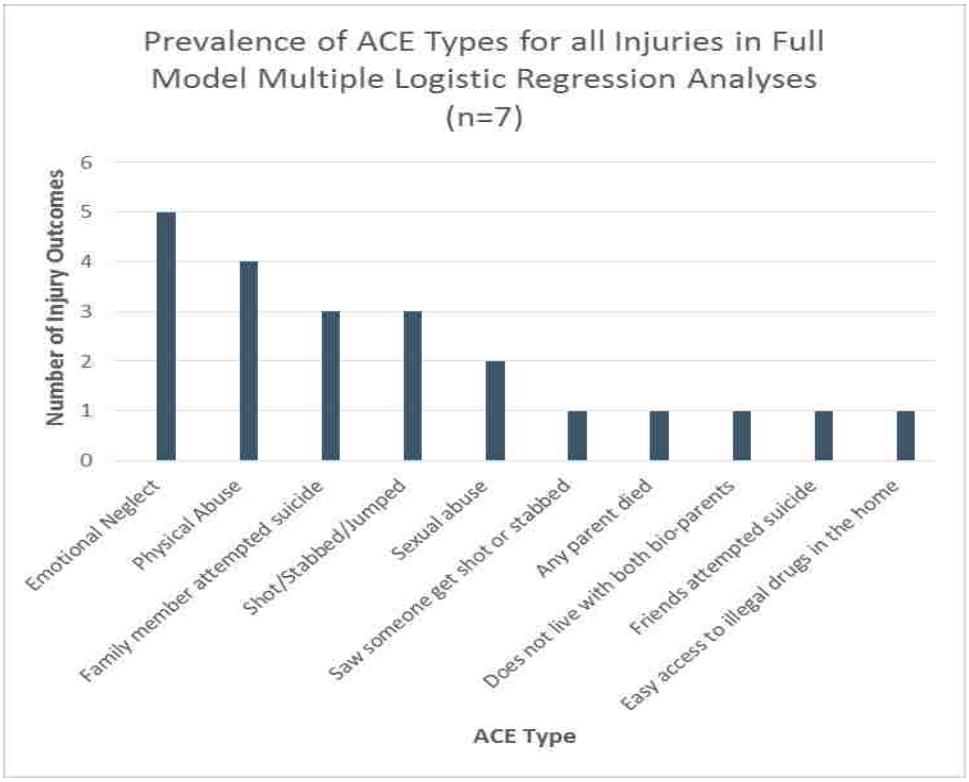


Figure 16. Relationship of ACE Score to Serious Injury in Young Adulthood

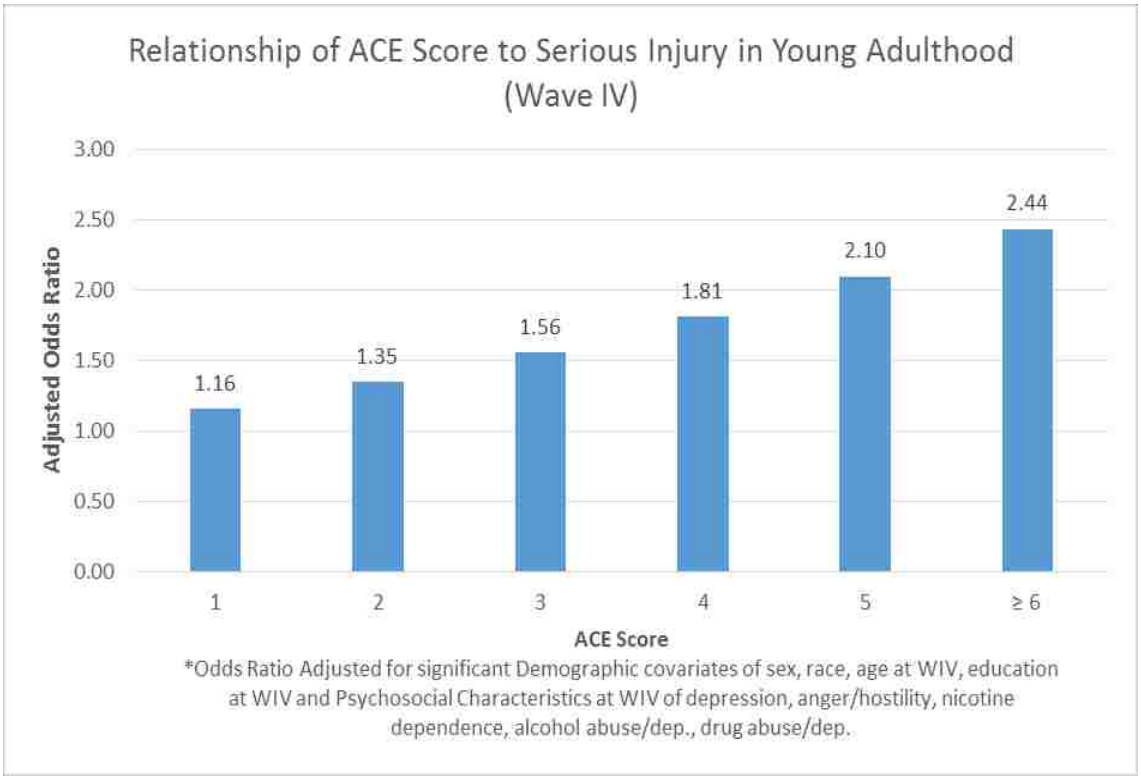


Figure 17. Relationship of ACE Score to MVA in Young Adulthood

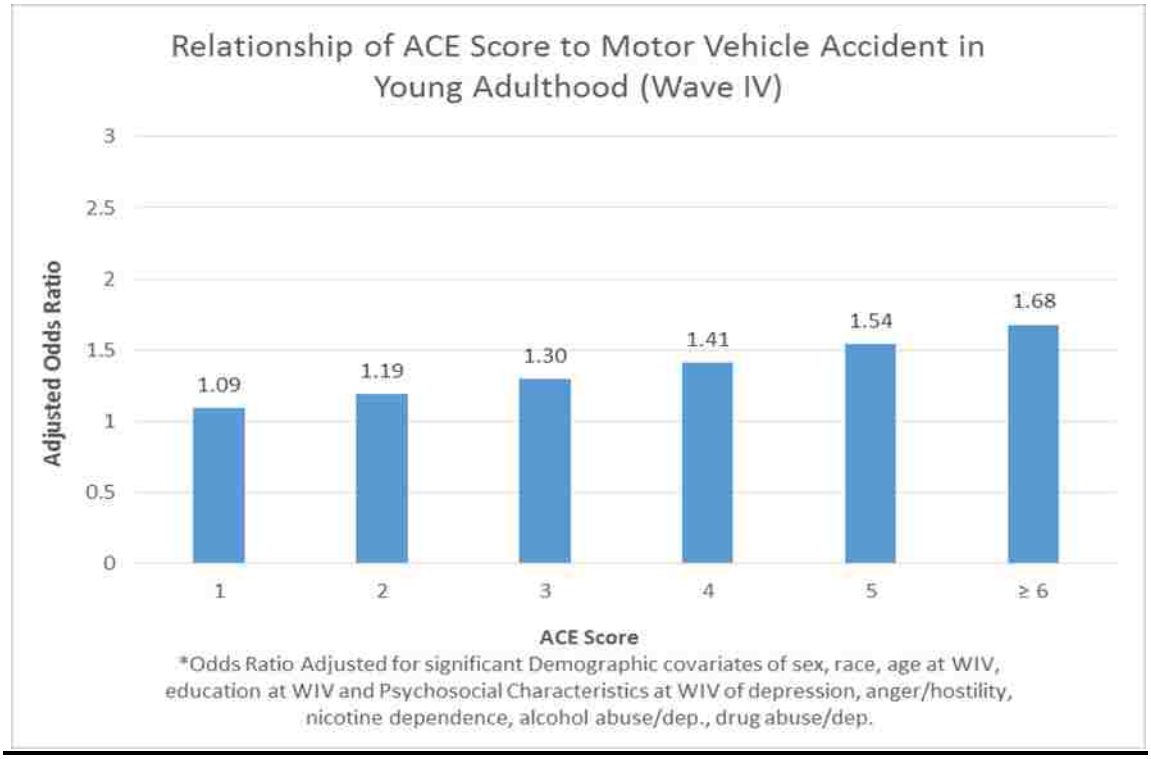


Figure 18. Relationship of ACE Score to Physical IPV in Young Adulthood

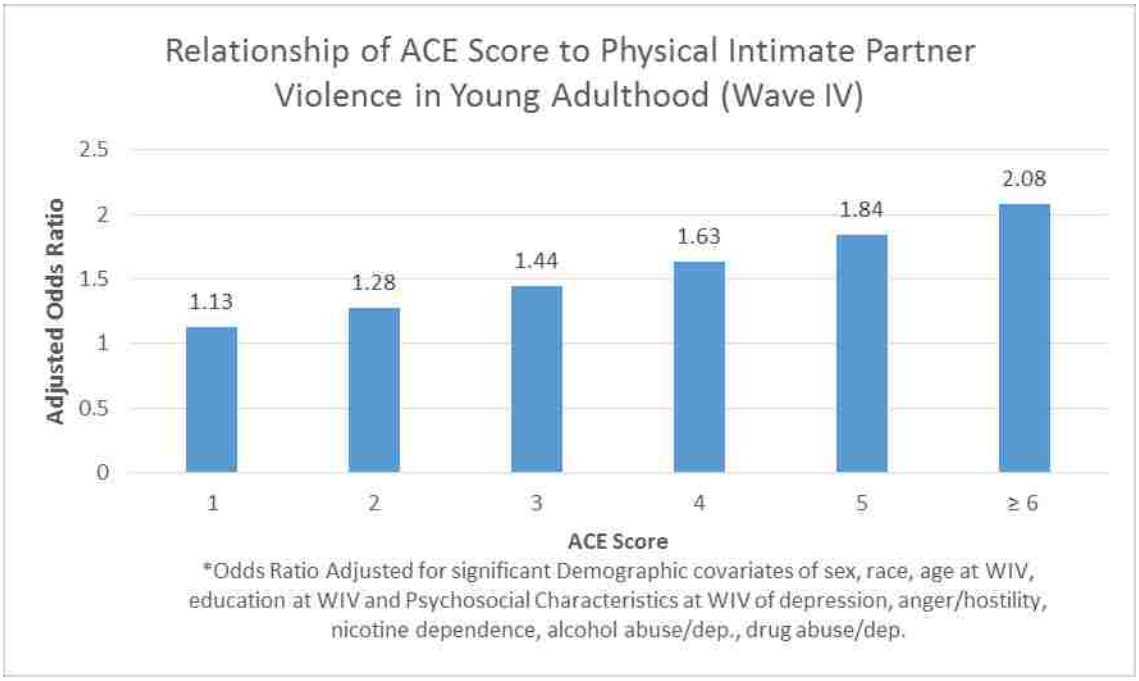


Figure 19. Relationship of ACE Score to Sexual IPV in Young Adulthood

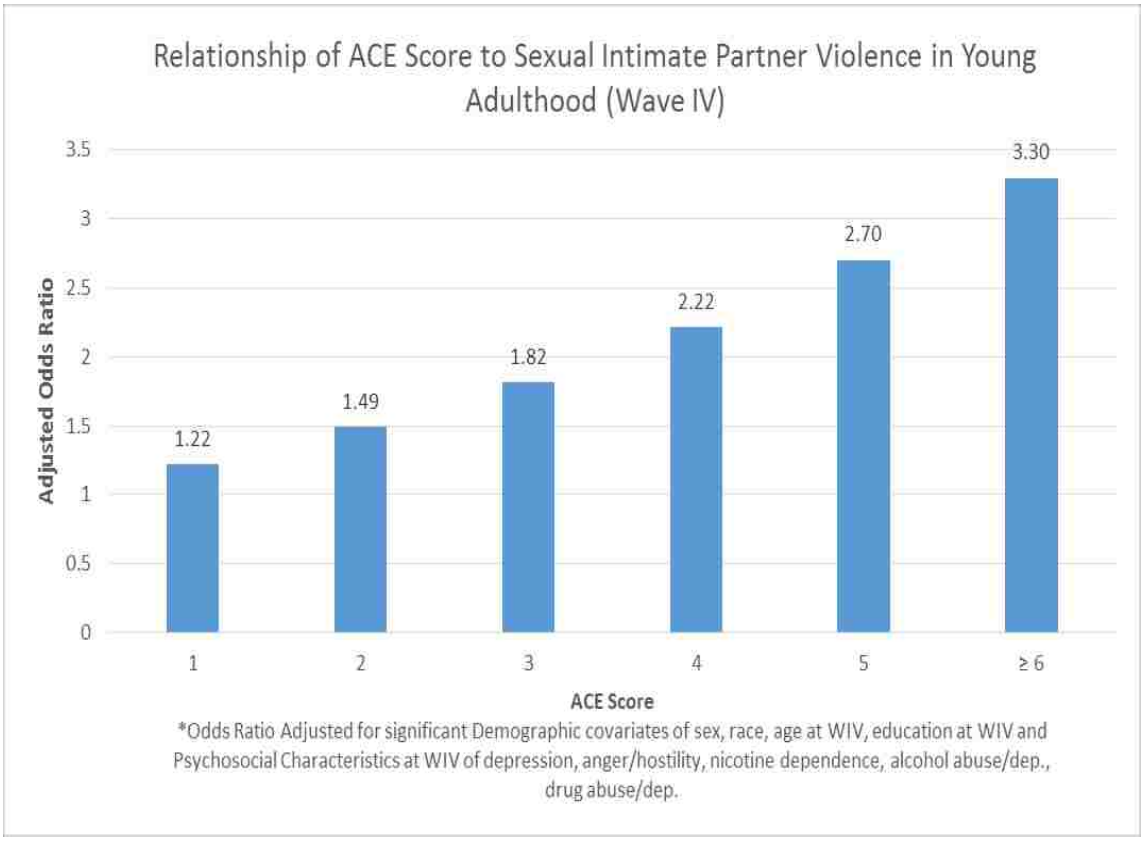


Figure 20. Relationship of ACE Score to Being Shot/Stabbed in Young Adulthood

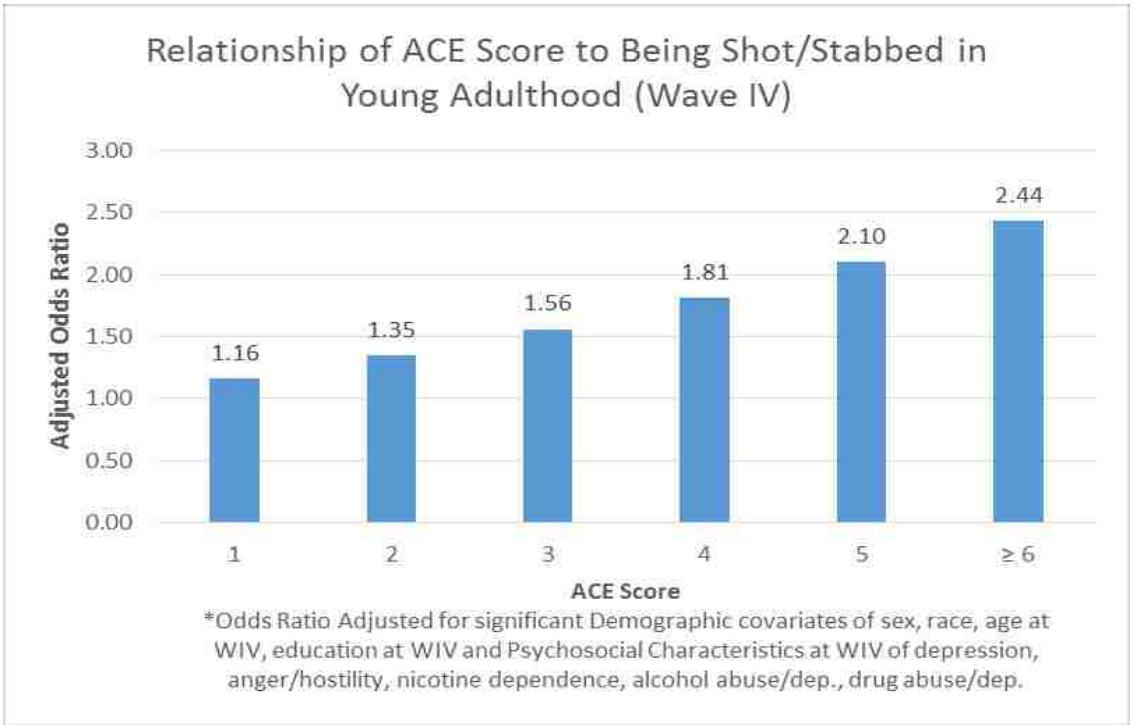
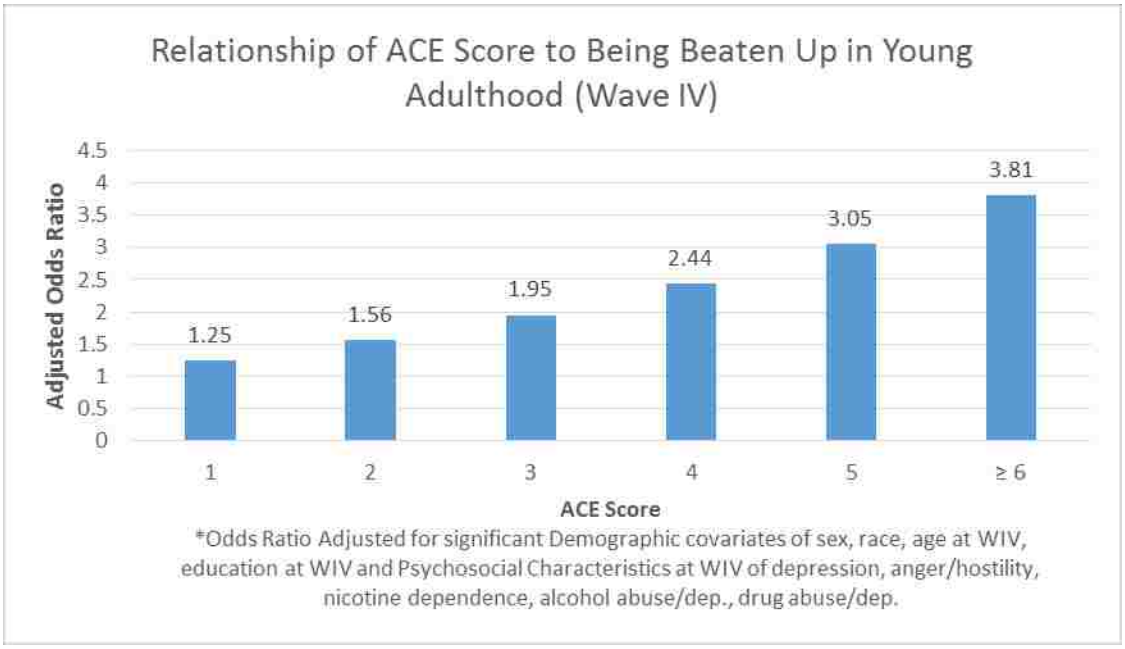


Figure 21. Relationship of ACE Score to Being Beaten Up in Young Adulthood



APPENDIX C
IRB APPROVAL

UNLV
UNIVERSITY OF NEVADA LAS VEGAS

Biomedical IRB
Notice of Excluded Activity

DATE: May 13, 2014

TO: **Dr. Michelle Chino,** Environmental and Occupational Health

FROM: Office of Research Integrity – Human Subjects

RE: Notification of IRB Action
Protocol Title: **Determinants of Injury Morbidity and Mortality Over the Life Course**
Protocol# 1405-4810

This memorandum is notification that the project referenced above has been reviewed as indicated in Federal regulatory statutes 45CFR46.

The protocol has been reviewed and deemed excluded from IRB review. It is not in need of further review or approval by the IRB.

Any changes to the excluded activity may cause this project to require a different level of IRB review. Should any changes need to be made, please submit a Modification Form.

If you have questions or require any assistance, please contact the Office of Research Integrity – Human Subjects at IRB@unlv.edu or call 895-2794.

Office of Research Integrity – Human Subjects
4505 Maryland Parkway • Box 451047 • Las Vegas, Nevada 89154-1047
(702) 895-2794 • FAX: (702) 895-0805

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- Teach undergraduate and graduate level courses assigned by the Chair of the Department of Health Care Administration, UNLV School of Public Health; develop and plan curriculum; conduct student assessments and evaluation of modules and programs; utilize technology based instructional tools such as Blackboard Learning System and on-line distance education.

1/2004 – 8/2014 **Adjunct Faculty** ♦ *University of Nevada, Las Vegas* ♦ *LV, NV*

- Teach undergraduate and graduate level courses assigned by the Chair of the Department of Health Care Administration, UNLV School of Public Health; develop and plan curriculum; conduct student assessments and evaluation of modules and programs; utilize technology based instructional tools such as Blackboard Learning System and on-line distance education.

12/2010 – 8/2013 – **Senior Health Educator/Program Coordinator** ♦ *Southern Nevada Health District* ♦ *LV, NV*

- Oversee one million dollar OAH teen pregnancy prevention grant. Ensure the implementation of evidence based, culturally sensitive curricula to program partners, including fidelity to the model. Develop strategy and workplans to achieve stated program goals and measurable objectives. Design and implement sustainability projects including community coalition; Teen Advocates for Pregnancy Prevention (TAPP); Social media/marketing/branding campaigns. Oversee grant subrecipients to ensure scope of work/budget compliance. Provide analysis of process and outcome evaluation data. Ensure project timelines are met. Supervise seven health educators and support staff; ensure staff has the training, competencies and resources necessary to meet program requirements.

11/2007 to 12/2010 –**Human Resources Analyst** ♦ *Southern Nevada Health District* ♦ *LV, NV*

- Conduct position classification studies, audit and prepare new or modified job analysis documents and class specifications point factor job evaluation methodology; Plan, implement and evaluate employee recruitment and selection activities; design and implement recruitment programs to obtain qualified candidates; Conduct adverse impact analysis of test results and ensure that all phases of recruitment and selection comply with applicable federal, state and local laws. Interpret collective bargaining agreements and personnel code; conduct grievance and disciplinary investigations; make recommendations and provide related professional support; conduct investigations into complaints filed with the State or Federal Equal Opportunity Commissions; make recommendations regarding resolution.

1/2/2007 to 11/2007 **Special Projects Research Analyst** ♦ *University of Nevada, Las Vegas* ♦ *LV, NV*

- Reporting to the Dean of the School of Public Health - perform complex, sensitive and specialized professional level administrative, organizational, systems, budgetary and related analysis for programs and activities related to the administration of the School of Public Health; develop goals, objectives, program requirements and procedures; provide technical information regarding specialized projects; and participate and provide support to various committees, advisory boards and other work groups.

1/2005 to 12/2006 **Research/Graduate Assistant** ♦ *University of Nevada, Las Vegas* ♦ Las Vegas, NV

- Nevada Institute for Children's Research and Policy – Compiled, transcribed, cleaned and analyzed data for a number of NICRP projects, including Clark County Child Death Review; Health, Safety, and Welfare of Children in Residential Facilities in Nevada; Smaller Learning Communities (SLC) in the Clark County School District.
- Center for Health Disparities Research - Planned, organized and conducted research on a variety of public health issues among underserved populations in Clark County. Developed and implemented surveys; performed program evaluations; assisted in writing research articles for peer-reviewed publications; conducted literature reviews; participated in various research projects including identifying risk factors for youth suicide, access to care for low in-come women and children, disparate rates of breast-feeding among low-income and African American women; historical trauma as a risk factor in health disparities.
- Department of Health Care Administration and Policy – Conducted research and statistical analysis on the following projects: Nevadans without Health Insurance, including an analysis of the demography and health care access trends of uninsured children; Public Health Workforce Assessment, cost/benefit analysis of practicum and internship programs in health care organizations.

6/1993 - 10/2004 **Human Resources Analyst** - ***Diversity/Interpreter Services Program Coordinator*** ♦ *University Medical Center of Southern Nevada* ♦ Las Vegas, NV

- Managed hospital-wide Diversity/Interpreter Services Program since 1993. Supervised four on-site interpreters and coordinated the training and interpreting activities of twenty-one Designated Employee Interpreters, ensuring coverage throughout the organization and off site facilities. Determined assignments, workload and priorities. Responsible for the screening, selection and evaluation of staff and contracted interpreters.
- Conducted program evaluations and developed strategies and cost/benefit analysis for the Interpreter Services Program. Provided reports and analysis to administration and department heads with recommended cost saving and/or utilization opportunities. Conducted organization-wide diversity profile analyses and completed EEO-4 reports.
- Developed and conducted cultural competency, diversity, and interpreter training for management, hospital staff, physicians and interpreters; established interpreter evaluation standards; establish criteria for proficiency testing; established and managed interpreter services budget of approximately $500,000.
- Liaison with leaders, organizations and individuals from various ethnic communities in Clark County to determine the healthcare, linguistic and cultural needs of their communities.

- Developed hospital-wide diversity programs and initiatives which include the following: UMC Diversity Committee; UMC Mentoring Program; Interfaith Sanctuary; UMC Philosophy on Culture and Diversity; New Hire Diversity Training; Study Circles – Dialogue on Race; Diversity Newsletter; Diversity Awareness Recognition Program; Department focused intercultural conflict resolution/mediation.

PUBLICATIONS:

Refereed Journal Publications

Sotero, M. (2006). A Conceptual Model of Historical Trauma: Implications for Public Health Research and Practice. *Journal of Health Disparities Research and Practice*. Vol. 1(1):93-107. http://chdr.unlv.edu/journal.htm

Moseley, C. & **Sotero, M.** (2006). Nevadans Without Health Insurance. *Nevada Journal of Public Health.* Vol. 3 (1):1-7 http://www.nphaonline.org/current_issue_v3.htm

Cochran, C. & **Sotero, M.** (2006). Evaluation of the Impact of a Health Care Administration Student Practicum. *Nevada Journal of Public Health.* Vol. 3 (1):14-18 http://www.nphaonline.org/current_issue_v3.htm

Invited Publications

Moseley, C. & **Sotero, M.** (2005) *Health Care Access and Insurance Availability;* In, The Social Health of Nevada: Leading Indicators and Quality of Life in the Silver State. *UNLV Center for Democratic Culture.* Accessed at *http://www.unlv.edu/centers/cdclv/mission/index2.html*

La Rue, B., **Sotero M**. (1991) *Creating a Global Neighborhood through Language.* Peoplelink:Petaluma, CA

Professional Publications

Sotero, M. (2004) *10 Easy Steps to Developing a Culturally Competent Treatment Plan.* (Consultant Training publication)

Sotero, M. (2000) *Introduction to Cultural Competency*. (Hospital Employee Training Manual)

Sotero, M. (2000) *Multi-Cultural Communication in the Workplace*. (Hospital Employee Training Manual)

Sotero, M. (1999) *The Manager's Guide to Personnel Administration* (Hospital Training Manual)

Unpublished Thesis

Sotero, M (2006). Perceived Skill Gaps and Training Preferences among Employees in a State Public Health Agency. University of Nevada, Las Vegas.

PRESENTATIONS:

Jackson, S., **Sotero, M.** (2013). Designing Community Sustainability in Teen Pregnancy Prevention using an Ecological Framework: Lessons Learned from an OAH Demonstration Project. Oral presentation: CityMatch Annual Conference, September 24, 2013.

Olguin, R. & **Sotero, M.** (2013). *Got Swag? Countermeasure Marketing, Urban African-American Youth and Teen Pregnancy Prevention: A Pilot Project*. Oral presentation to the Healthy Teen Network 2013 Annual Conference, October 23-25, 2013.

Sotero, M. (2012). SNHD Teen Pregnancy Prevention Program. Oral presentation to the Nevada State Summit on Teen Pregnancy Prevention.

Sotero, M. & Harvey A. (2012). Reaching At Risk Males in Teen Pregnancy Prevention. Poster Presentation: National Reproductive Health Conference, August 5-7, 2012.

Sotero, M. (2006). A Conceptual Model of Historical Trauma and Health Disparities: Implications for Research and Practice. Oral presentation to the 18th Annual Indian Health Services Research Conference, April 24-26, 2006.

MEMBERSHIPS AND AWARDS:

Member – Nevada Public Health Association

2008-2011 – Society of Human Resources Management - Certified Professional in Human Resources (PHR)

2011 – Adjunct Faculty Recognition Award UNLV School of Community Health Sciences

2010 Scholar - Great Basin Public Health Leadership Institute

2009-2010 - Faculty Excellence Award – CSUN Student Government, University of Nevada, Las Vegas